SUMMARY

Carlsbad Caverns National Park proposes modification of the developed area above Carlsbad Cavern. As directed by the park's general management plan (NPS, 1996), an infiltration study was performed to determine the impacts of the developed area on Carlsbad Cavern and groundwater. This study found contamination of cave pools from parking lot runoff and leaking or overflowing sewage lines and identified potential catastrophic contamination that could be caused by vehicle accidents or fires, structural fires, or fuel leaks. The general management plan also states, that based on the study the park will "complete a development concept plan to decide the future of surface facilities over Carlsbad Cavern." This plan and EA fulfills this directive.

The goal of this plan is to protect the cave from existing sources of contamination, to prevent future damage to the cave and the groundwater system, and to provide a safe, quality visitor experience. To accomplish these goals, the park considered three alternatives that would 1) eliminate pollution sources above the cave (fuel storage tanks, paved areas, maintenance operations, and park residences), 2) restore natural infiltration above the cave, 3) reduce catastrophic threats (spills, vehicle accidents, fires), and 4) implement mitigation measures to protect natural resources and the public where threats remain.

ALTERNATIVES

No Action Alternative would provide a basis for comparing the management direction and environmental consequences of the proposed action. The current buildings, facilities, and land-use policies would remain intact.

Alternative A would not significantly alter the development "footprint" above the cave. The actions in this alternative primarily involve installation of engineered devices that protect areas from accidental spills, and collect, filter, and/or redirect storm water run-off. The sewer collection system would be replaced and the outfall system relocated. Although many sources of contamination would not be removed, a higher level of resource protection would be provided.

Alternative B (Park Preferred Action and Environmentally Preferred Alternative) would remove the most threatening sources of contamination from above Carlsbad Cavern and follow the same proposals as Alternative A to alleviate contamination from remaining facilities. This alternative also involves modification of land-use policies, including pavement removal and reconfiguration of the Bat Cave Draw parking lot, relocation of some maintenance functions, and removal of the Mission 66 housing area and the tennis court. The actions in this alternative also restore natural drainage and infiltration to areas where pavement is removed. The sewer collection system would be replaced and the outfall system relocated.

Alternative B would offer the best resource protection for the cost and with the fewest resource impacts. Contamination from parking lot runoff would be reduced by 268,200 gallons per year or 19% of the total contaminated runoff (versus 7% under Alternative A). This alternative would restore infiltration and drainage to 149,500 square feet of formerly- paved areas (versus 31,200 square feet under Alternative A). Cultural resources would be impacted more under Alternative B, but would be mitigated through careful photo documentation and consultation with the New Mexico State Historic Preservation Office (SHPO) and park cultural resource staff.

Alternative Considered but Rejected: Facility Reduction and Land Use Modification
This alternative would have removed most of the non-historic structures from above the cave as well as the east parking lot near the visitor center. The west parking lot would be used as a turnaround and staging facility for shuttle buses carrying visitors from an off-escarpment parking facility. This alternative was rejected because of the adverse impacts of new construction and because an engineering analysis indicated that a transit system was not practical for the park at this time.

PLANNING PROCESS

This environmental assessment (EA) has been prepared as part of the process described under the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA), Section 106. All major actions by the National Park Service (NPS) that are not categorically excluded from NEPA have to be evaluated by an EA or an environmental impact statement (EIS). The process involves developing alternatives to accomplish well-defined goals and then evaluating the potential impacts of those alternatives.

Internal scoping by NPS staff was done in the park in March 1999 to develop goals and objectives for the resource protection plan. The goals developed during this meeting were 1) protect natural and cultural resources, 2) provide visitor enjoyment, 3) improve effectiveness of park operations, and 4) provide cost-effective and environmentally responsible facilities for the park. Preliminary alternatives were developed using these objectives, and in June 1999, public scoping was conducted in the city of Carlsbad, New Mexico, to present the alternatives and gather public comments.

A meeting was held in September 1999 to perform a Choosing By Advantages (CBA) analysis of the alternatives and select a park-preferred alternative. In the CBA analysis, factors such as resource protection, visitor experience, and visitor and staff safety were used to evaluate and rate each of the alternatives. These ratings were then factored against the costs of each alternative to select a preferred alternative.

The public is invited to review the draft plan (this document) and make comments on the alternatives and the EA of those alternatives. Once the comment period is completed, the park will screen the comments to determine whether any important new issues or reasonable alternatives have been suggested. If major substantive issues not covered adequately by the EA are raised or if the park wishes to consider new suggested alternatives, the EA would be rewritten to incorporate them and reissued for a second 30-day review. If commentors correct or add factual information that has no bearing on the determination of significant impact, the information would be added to the EA when

possible. If any of the issues point to the potential for significant impacts, the park will publish a notice of intent to prepare an EIS. Otherwise, a Finding of No Significant Impact (FONSI) will be issued and the revised plan will be published and implemented.

Public Comment

If you wish to comment on the EA, you may mail comments to the name and address below. This EA will be available for public review for 30 days. Please note that names and addresses of people who comment become part of the public record. **If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment**. We will make all submissions from organizations, businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses available for public inspection in their entirety.

> Cave Resources Protection Plan, Carlsbad Caverns National Park, 3225 National Parks Highway, Carlsbad, NM 88220 [or email: cave_planning@nps.gov]

Further Compliance

The specific actions under any selected alternative would require additional description and discussion to satisfy the compliance requirements of NEPA and NHPA, Section 106. Detailed descriptions and work scopes would be developed for each phase of the project. Consultation with the SHPO, Affiliated Native American Tribes, and the U.S. Fish and Wildlife Service would be done prior to each project phase. Site-specific detailed surveys for state or federally-listed plant and animal species would be conducted prior to any activity under the selected alternative.

CONTENTS

MAPS

TABLES

APPENDICES

PURPOSE AND NEED FOR ACTION

Carlsbad Caverns National Park proposes modification of the developed area above Carlsbad Cavern. The purpose of this plan is to: 1) protect the groundwater and cave resources from continuing chronic exposure to contamination; 2) protect the cave resources from potential catastrophic contamination; and 3) protect visitors to Carlsbad Cavern from potential hazardous conditions due to contamination. The goals of this plan may be reached through prevention measures as outlined in "The Alternatives" section.

The National Park Service (NPS) is mandated by the Federal Cave Resources Protection Act of 1988 to protect Carlsbad Cavern. Section 2c states, "It is the policy of the United States that Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves." The *Cave and Karst Management Plan* for the park (NPS, 1995) outlines several objectives, including to "protect and perpetuate natural cave systems from internal and external threats" and to "establish regulations, guidelines, and permit stipulations that ensure maximum safety for the cave visitor, park employees, and preservation of park resources."

A study was conducted in the developed area of the park to evaluate the effects of development on cave resources and natural groundwater infiltration in accordance with the 1996 *General Management Plan* (NPS, 1996) that states:

> *Facts on water infiltration patterns, and how development has affected water migration into Carlsbad Cavern, are needed to better understand and mitigate human-induced changes in the cave ecosystem. A study has been initiated to determine the rates, amounts and routes of water infiltration into the cavern. It will also identify and characterize potential contamination sources in the vicinity of the cavern and assess possible hazards and cave resource impacts from such contaminants.*

The infiltration study was performed as part of a Colorado School of Mines master's thesis (Brooke, 1996) in conjunction with an investigation by the International Ground Water Modeling Center (van der Heijde et. al., 1997). This study identified areas in the cave threatened or already affected by contamination due to surface facilities, as well as probable pollution sources. The most affected areas of Carlsbad Cavern are 1) Quintessential Right, 2) Left Hand Tunnel, 3) New Section, 4) Main Corridor between Devil's Spring and Iceberg Rock, and 5) locations in Chocolate High, the New Mexico Room, the Scenic Rooms, and the Big Room Area (see the Potential Contamination Sources map, page 12). The study reported:

> *Most of the unnaturally high concentrations of aluminum, zinc, total organic carbon, and nitrate... can be related to rather chronic, relatively low-level, releases at specific locations at the surface…A variety of accident, spill and leakage scenarios can threaten the water quality in the cavern, and even public health. Major potential sources identified in this study are: 1) leaks in the sewer lines; 2) spills and vehicle fires with subsequent contaminated runoff from the public parking lots and road segments in the western part of the [developed] area; and 3) spills, leaking tanks, fires and other accidental releases from the maintenance yard.*

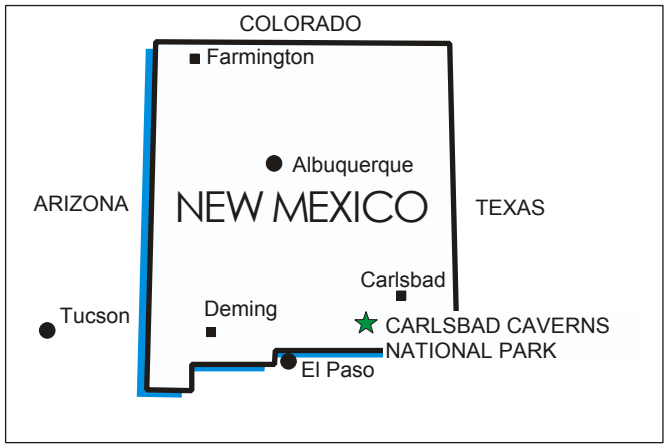
Spills of hazardous materials, including oil and gasoline, into the subsurface could pose a potential threat to visitors. Such a danger could cause the cave to be closed until the danger was eliminated. It could also severely damage or destroy cave biota and the cave ecosystem.

BACKGROUND

Carlsbad Caverns National Park encompasses approximately 47,000 acres of wilderness and nonwilderness lands in the Guadalupe Mountains of southern New Mexico (see the Vicinity map, page 3). The park preserves and provides opportunities for visitors to view a large portion of the Capitan Reef, the best exposed Permian-age fossil reef in the world. The park also contains one of few protected northern Chihuahuan Desert ecosystems and contains species of plants and animals that are at the northernmost limits of their geographic distribution. Cultural resources in the park represent a long and varied history of human uses from prehistoric times to the present.

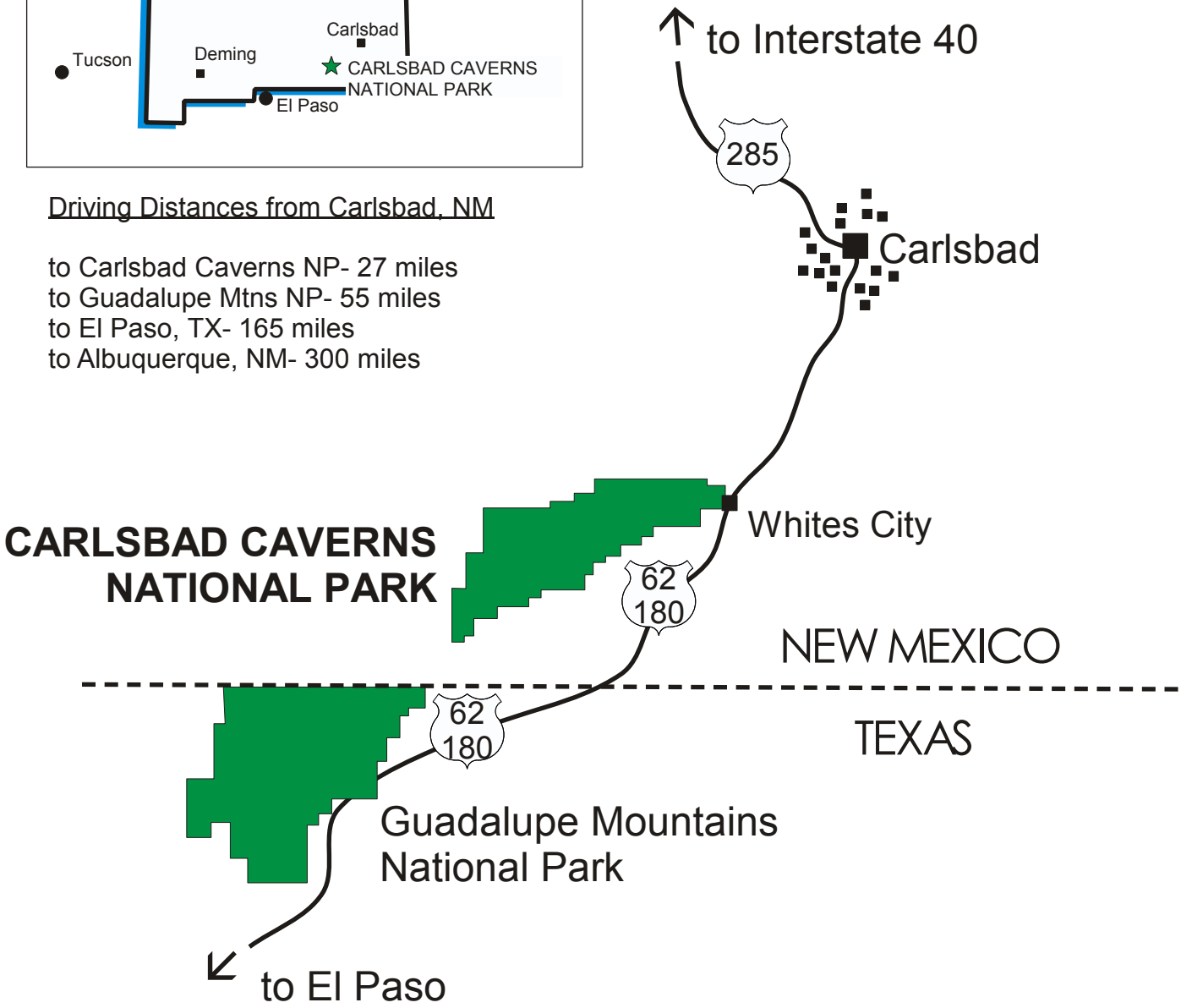
The park is a designated World Heritage Site that contains many world-class caves including Carlsbad Cavern. The Big Room of Carlsbad Cavern is the largest, most easily accessible chamber in North America. Carlsbad Cavern is also home to a world-famous colony of migratory Mexican free-tailed bats and one of the largest colonies of migratory cave swallows in the United States.

About 250 acres of surface area around Carlsbad Cavern have been developed to provide access and support for the 500,000-600,000 annual visitors to Carlsbad Caverns National Park. Cave tours began in the early 1900s and continue to the present. To satisfy housing and park operational needs of a new and increasingly popular national park, offices, residences, and parking areas were constructed above Carlsbad Cavern near the natural entrance to the cave beginning in 1926. The first elevator shaft was built in 1931, and a second shaft was excavated in 1954. Beginning in 1961-62, a period of major facility expansion in the NPS known as Mission 66, left its mark on Carlsbad Caverns. During the Mission 66 era, the visitor center and maintenance areas were expanded and additional buildings were constructed to provide housing for park personnel.



Driving Distances from Carlsbad, NM

to Carlsbad Caverns NP- 27 miles
to Guadalupe Mtns NP- 55 miles
to El Paso, TX- 165 miles
to Albuquerque, NM- 300 miles



Vicinity Map
Carlsbad Cavern Resource Protection Plan

Carlsbad Caverns National Park

US Department of the Interior

National Park Service

130/20040 DSC March 2000

SITE DESCRIPTION AND EXISTING CONDITIONS

FACILITIES

Currently, nearly all development related to park operations, employee housing and visitor services is located on the surface directly above Carlsbad Cavern. The development consists of nineteen primary buildings, a road system and parking for over 900 vehicles (see the Existing Development map, page 5).

The development is separated by an arroyo known as Bat Cave Draw. Current developed areas on the south side of Bat Cave Draw include a visitor center with large parking lots on the east and west sides of the building. The visitor center houses museum exhibits on the resources of Carlsbad Cavern and includes elevators for easy access into the cave and areas for ticket sales and interpretive programs. The visitor center also contains a restaurant, cooperating association bookstore, souvenir shop, park offices, kennels, a theater, exhibit areas and storage space.

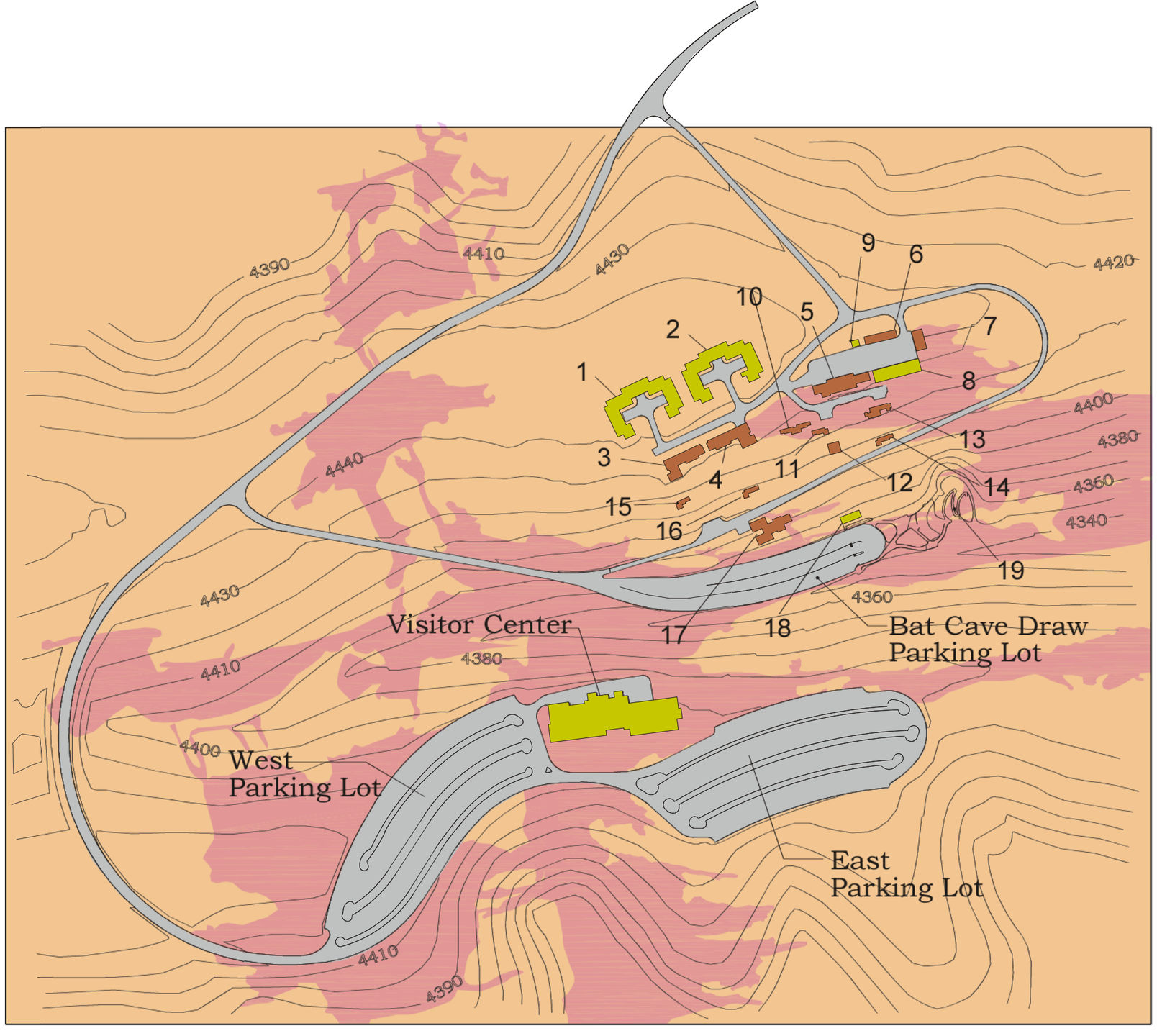
The development within Bat Cave Draw is primarily used for overflow parking and to support the summer bat flight interpretive program at the natural entrance of the cave. The development includes an access road, paved parking lot, a comfort station, and an amphitheater overlooking the natural entrance to Carlsbad Cavern. Portions of the development within the draw and most of the structures north of Bat Cave Draw comprise the Caverns Historic District which is listed on the National Register of Historic Places.

The buildings to the north of Bat Cave Draw are used for logistical support of park functions, research, administrative offices, maintenance, and staff and researcher quarters. In addition to the buildings, there is a concrete tennis court for park personnel use, a maintenance storage area, several employee parking areas, and a helipad.

SEWAGE SYSTEM

The sewage collection system includes the smaller diameter (4- to 6-inch) collection pipes that collect wastewater from individual office, residential, and maintenance buildings. The collection system includes every sewer pipe on the north side of Bat Cave Draw and west of the “Begin Outfall Pipe” manhole (see Sewage System map, page 6).

The outfall system includes the larger diameter (6- to 8-inch) transmission pipes that convey the wastewater to the treatment location without additional collection from individual buildings or subsystems. The main outfall pipeline runs parallel to the ridgeline of the escarpment and cavern system below for 1,939 feet before heading south off the ridge to a series of evaporation ponds where sewage is disposed and treated. These evaporation ponds, commonly referred to as sewage lagoons, are located at the base of the escarpment on NPS property.



KEY:

1 Mission 66 Era Residence
2 Mission 66 Era Residence
3 Employee Quarters
4 Employee Quarters
5 Maintenance Structure
6 Maintenance Structure
7 Maintenance Structure
8 Maintenance Structure
9 Maintenance Structure
10 Employee Quarters
11 Employee Quarters
12 Research Hut
13 Employee Quarters
14 Research Hut
15 Employee Quarters
16 Law Enforcement Office
17 Superintendent's Office Complex
18 Bat Flight Restroom/ Lift Station
19 Natural Cave Entrance and Amphitheater

Historic Structure

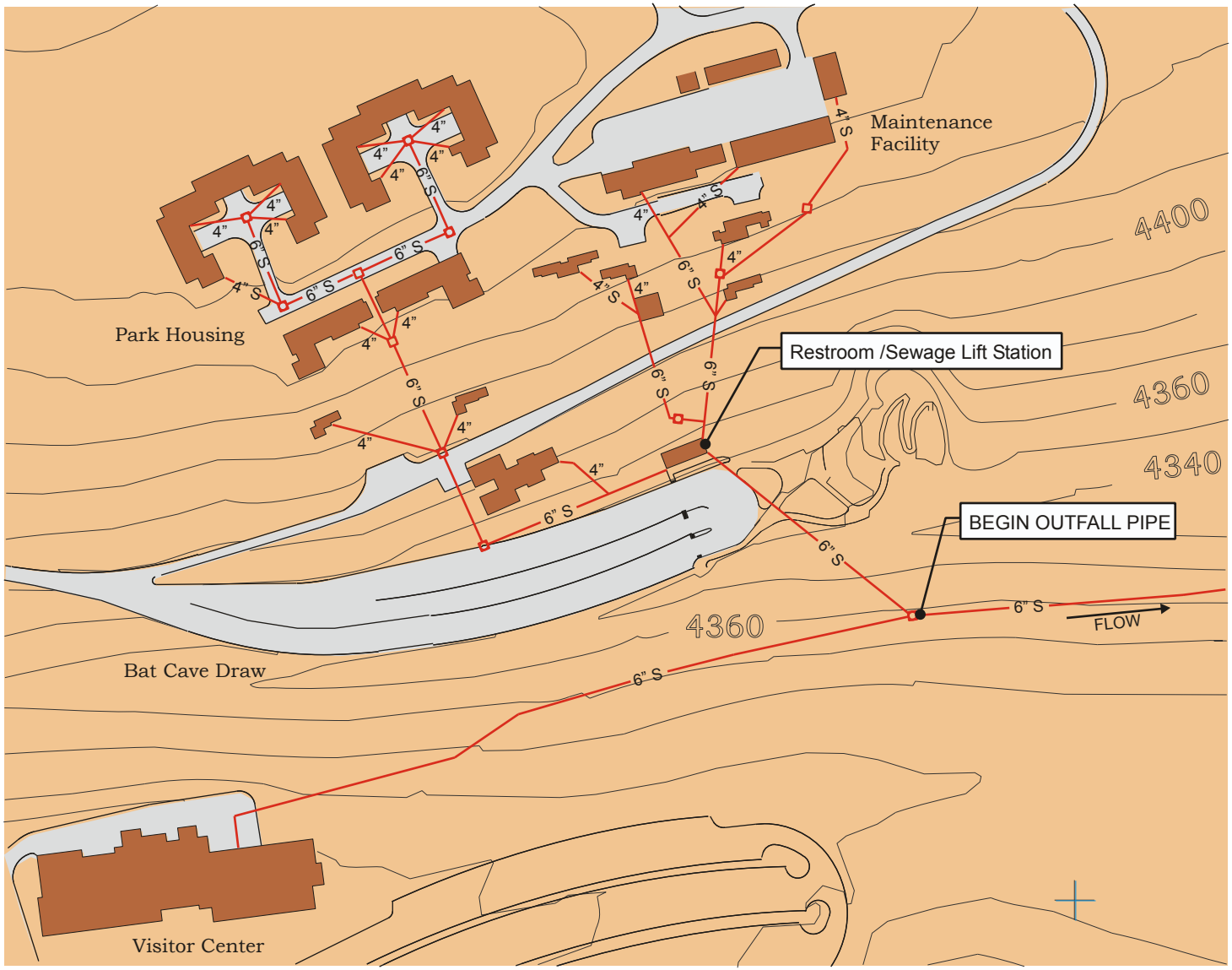
Non-historic Structure

CAVERN SYSTEM (subsurface)

Existing Development
Carlsbad Cavern
Resource Protection Plan

Carlsbad Caverns National Park
US Department of the Interior
National Park Service
130/20041 DSC March 2000

north
0 100 300 *FEET*



KEY:

Existing Building

6" S — Existing Sewer Collection Pipe with Size

Sewage System Existing Conditions (collection)

Carlsbad Cavern Resource Protection Plan

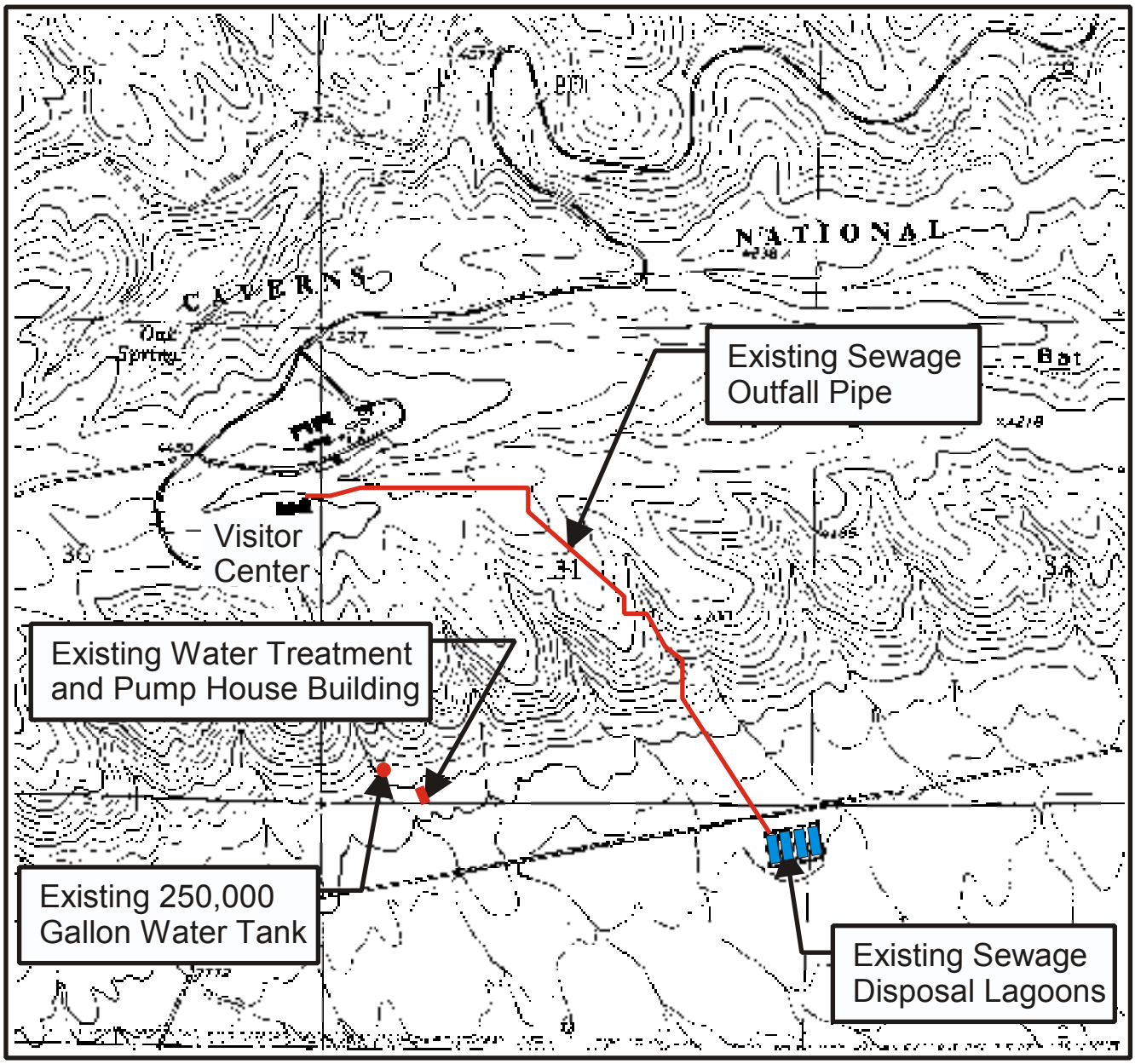
Carlsbad Caverns National Park

US Department of the Interior

National Park Service

130/20048 DSC March 2000

north 0 50 150 *FEET*



Sewage System Existing Conditions (outfall)

Carlsbad Cavern Resource Protection Plan

Carlsbad Caverns National Park

US Department of the Interior

National Park Service

130/20049 DSC March 2000

NATURAL RESOURCES

Carlsbad Caverns National Park contains one of the best preserved northern Chihuahuan Desert ecosystems. The escarpment is a mountainous ridge of limestone that has been lifted above the plains to the south and east. Below the escarpment, visitors can observe the transition from high desert scrubland into the sparse grassland characteristic of the low Chihuahuan Desert. The developed area contains a mixture of cacti, agave, and other plants characteristic of a high desert scrubland. In Bat Cave Draw, there is a mixture of trees and scrub including juniper, hackberry, soapberry, and Mexican buckeye.

Surface Rare, Threatened or Endangered Species

A rare plant survey was conducted by the New Mexico Natural Heritage Program in December 1999 (Chauvin, 1999). There were no rare plants found in either the developed area or in the proposed off-escarpment maintenance area. No survey was conducted along the route of the proposed sewage line realignment. Once final design decisions are made, all affected areas will need to be re-surveyed in the proper season for all current state and federally-listed species.

The project area also contains several state-listed noxious weeds. The park would develop plans to prevent the spread of these noxious plants prior to any activities associated with the proposed alternatives.

There are several species of mammals, birds, and reptiles whose habitat may be affected by activities under the proposed alternatives. Once final design decisions are made and prior to any construction activity, site-specific surveys for these species and their habitats would be conducted.

Subsurface Rare, Threatened or Endangered Species

No threatened or endangered species listed by the federal or state government have been identified in the park's subsurface environment. The cave does have colonies of several bat species and the entrance area is occupied by a colony of Cave swallows.

Some invertebrates such as flatworms have been found in the pools of Carlsbad Cavern (Ek, 1991). Changes in pool chemistry and water level could adversely impact these organisms. Researchers have also identified several species of bacteria unique to cave environments in Lechuguilla Cave and Spider Cave in the park (Northup et al., 1999; Northup et al., 1997, Northup et al., 1994; and Cunningham et al., 1995). No studies have been done to identify these microbes in Carlsbad Cavern, but similar environmental conditions exist, and could be favorable for bacteria growth. These bacteria are sensitive to changes in moisture conditions and changes in water chemistry.

Cave and Groundwater Resources

Infiltration. The natural drainage and infiltration patterns above Carlsbad Cavern have been disrupted by park development. Under undisturbed conditions, most rainfall would be absorbed into the soil and taken up by plants or evaporated. Water would flow into Bat Cave Draw only during intense thunderstorms. Now, the buildings and paved areas, which are impervious to water, focus drainage into culverts, drains, and eventually Bat Cave Draw. Any water that does not evaporate or is not used by plants becomes part of the groundwater system.

Water moves downward primarily through fractures in the limestone that underlie the developed area and Bat Cave Draw. Eventually, the groundwater moving through the fractures appears in the cave as seeps or drips. These drips have created the numerous speleothems (cave formations) and pools found in Carlsbad Cavern. Over time, this water continues downward from the cave passages through fractures to the water table, approximately 200 feet below the deepest known point in the cave.

Contamination Sources. Any contaminants generated at the surface and carried by groundwater will reach the cave and eventually the water table. These contaminants pose a threat to human health and the cave ecosystem. The sewage system and the parking lots are the most significant chronic problems, and the fuel storage tanks pose the highest potential risk.

The sewer lines in the park vary in size, construction material, and condition. Some pipes are more than 50 years old and backup frequently due to blockages (NPS, 2001). Some blockages are caused by accumulation of grease and other materials in system low points and some are caused by the intrusion of roots into the clay-tile pipes. The oil and grit separator in the maintenance area wash bay functions poorly and permits a discharge of toxic pollutants pressure washed from vehicles and their components into the normally domestic waste stream. The collection and conveyance system starts in the residential and maintenance areas and runs by gravity to a small lift station located in the Bat Cave Draw restrooms near the natural entrance to Carlsbad Cavern (see the Existing Development map, page 5). The lift station forces the sewage up to the ridge of the escarpment. There is also a sewage lift station near the underground lunchroom that forces sewage up 750 feet to the surface. Sewage flows by gravity from the visitor center along the escarpment ridge and drops off the ridge to sewage lagoons at the base of the escarpment. Total wastewater generated by visitors and staff in the park is approximately 10 million gallons per year. When the system backs up or has root intrusions, sewage flows out of manholes and onto the ground. These releases expose the groundwater system to raw sewage and pose a threat to human health and surface water quality.

The two main parking lots have the capacity for over 900 cars, 63 recreational vehicles, and approximately 500 feet of unmarked space that can be used for either recreational vehicles or cars. There is also an average of 25 cars parked in the residential area on the north side of Bat Cave Draw. These cars are generally parked all day, not for just four hours a day as the average visitor is parked. However, these 25 cars produce an effective visitation of 72 cars per day or 26,026 cars per year (Bremer, 1998). This means that resident parking accounts for almost 14% of the park's yearly vehicle use.

The parking lots not only alter natural infiltration patterns, they act to collect and store hazardous materials generated by automobiles, maintenance operations, and residential activities. Kitchen floor mats and other items from the concessionaire restaurant kitchen are washed daily behind the visitor center. This contaminated water attracts animals but drains into the sewage system. The maintenance facility makes wide use of solvents and other materials required for vehicle maintenance. Although staff tries to avoid spills, some may still occur.

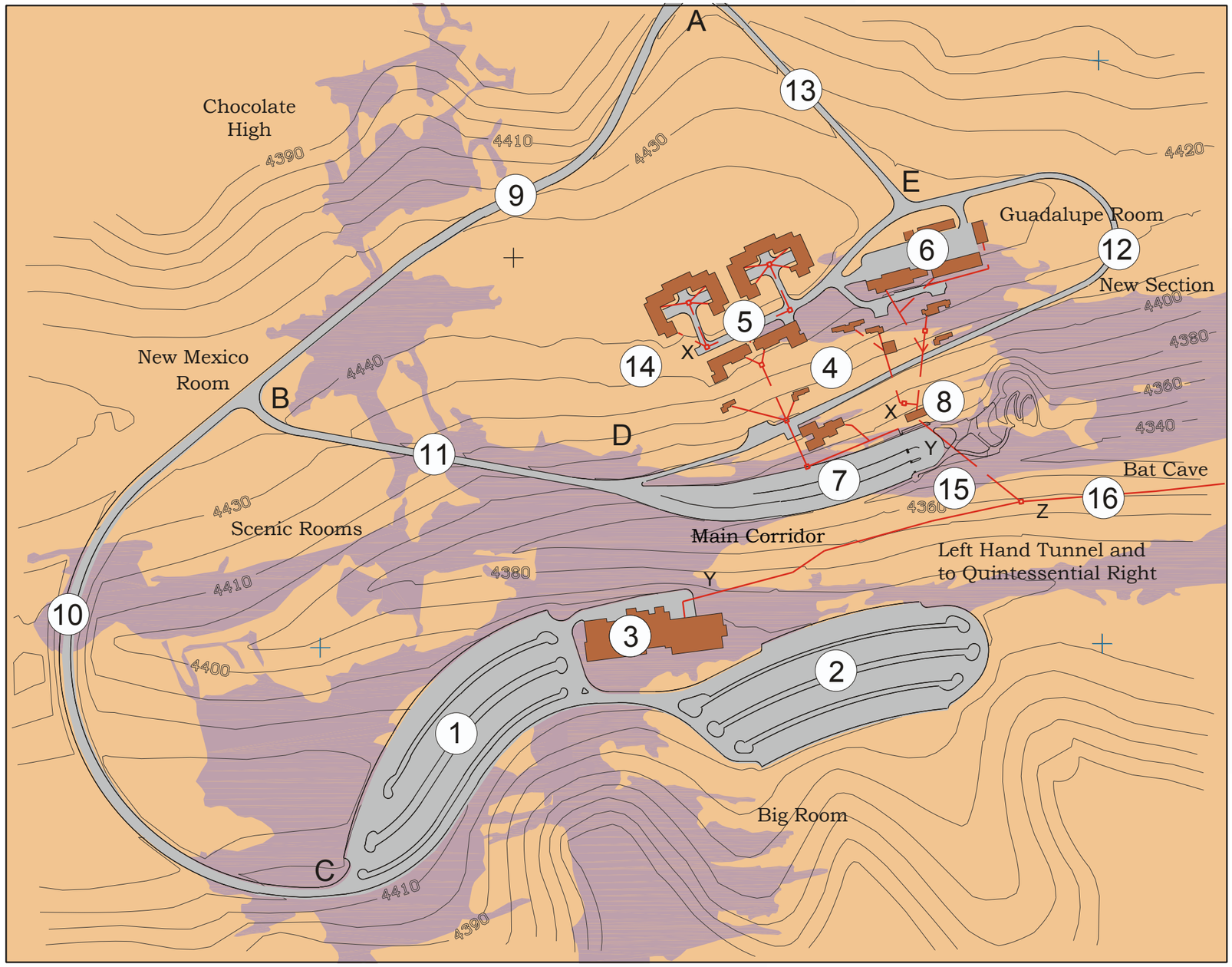
Between rainstorms, oil, fuel, antifreeze, and other contaminants accumulate on the pavement. When it rains, contaminants are carried off the pavement and into the fractured limestone above the cave. Most of the contaminants are carried by the first half-inch of rainfall. The parking lots collect rainwater from a total of 458,000 square feet (10.5 acres). This results in 143,000 gallons of potentially contaminated water entering the groundwater system in every half-inch storm. Between 1978 and 1998 there was an average of 10 storms per year that produce more than a half inch of rain (Bremer, 1998), totalling 1.4 million gallons of potentially contaminated water entering the groundwater system every year. Some of the contaminants are absorbed by the thin soil and the rock, but unmitigated exposure to these materials would lead to contamination of the groundwater and the cave (Bremer, 1998). Organisms in the soil and rock could also be damaged by this contamination.

The park is conducting a dye-trace study in Bat Cave Draw. This study involves injecting approximately 25,000 gallons of water containing a non-toxic, biodegradable dye into Bat Cave Draw. Water samples and charcoal dye traps were collected prior to the dye injection. Analysis of these samples showed detectable amounts of the dye already in the groundwater system. This dye is also used to give antifreeze its distinctive green color and is the likely source of dye found in cave pools and drips. This means that there is contamination from parking lot runoff still moving through the groundwater system into the cave even though the park has restricted parking in the Bat Cave Draw parking lot for four years. While the amounts of dye, and probably antifreeze, are below levels that would pose a threat to human health, these data do indicate that chronic contamination of groundwater has happened in the past and will continue unless preventative measures are taken.

Chronic contamination from automobiles is not as hazardous as a fuel spill or fire in the developed area. There is a 3,000-gallon propane tank located in the Mission 66 housing area and two 1,000-gallon propane tanks in the maintenance area. Propane is a heavy gas and any leaks from these tanks or associated lines would flow downward into Bat Cave Draw and potentially into the cave entrance. There are also three large liquid fuel tanks in the park: a diesel tank for the generator behind the visitor center, and one gasoline and one diesel tank at the maintenance yard. Fuel leaked during refueling, or if a truck overturned and ruptured, would rapidly enter the groundwater system. The thin soil cover and thick, fractured unsaturated zone (the portion of the groundwater system above the water table) would limit the effectiveness of standard remediation methods. In the case of a structural or vehicle fire, water or chemicals used to put out the fire would also rapidly enter the groundwater system, carrying contaminants into the subsurface.

The storage tanks pose a threat to the cave and groundwater, not only from spills during refueling, but from leaks in the tanks and associated lines. Though the tanks meet Environmental Protection Agency guidelines and are double-walled and monitored, there is still some potential for leakage. The source, contamination type, affected areas, and level of risk are summarized in Table 2 (page 13). Mitigation and prevention measures suggested by the infiltration study (Brooke, 1996) are described in the proposed alternatives. The locations of potential contamination sources are shown on the Potential Contamination Sources map (page 12).

Wetlands and Floodplains. There are no wetlands or 100-year floodplains within the project area.



KEY:

1 Parking West of Visitor Center
2 Parking East of Visitor Center
3 Visitor Center
4 Park Offices
5 Employee Housing
6 Maintenance Yard
7 Bat Cave Draw Parking Lot
8 Bat Flight Comfort Station and Lift Station
9 Main Road between points A and B
10 Main Road between points B and C
11 Access Road between points B and D
12 Service Road between points D and E
13 Service Road between points A and E
14 Sewer Line (X)
15 Sewer Line (Y)
16 Sewer Line (Z)

CAVERN SYSTEM (subsurface)

SEWER SYSTEM (subsurface)

Potential Contamination Sources

Carlsbad Cavern Resource Protection Plan

Carlsbad Caverns National Park

US Department of the Interior

National Park Service

130/20042 DSC March 2000

north

0 100 300 *FEET*

Table 1. Summary of Contamination Risks; See location map on page 12 (modified from van der Heijde, et. al., 1997)

Item #	Source	Potential Problems	Risk and Affected Cavern Area
1	RV/Bus parking lot west of visitor center	1. chronic release of metals, oil and other contaminants from cars, carried by runoff 2. car fire/crash with spill and subsequent infiltration	Moderate risk to Quintessential Right. High risk to Quintessential Right, moderate risk to Big Room
2	Car parking lot east of visitor center	1. chronic release of metals, oil and other contaminants from cars, transported by runoff 2. car fire/crash with spill and subsequent infiltration	Moderate risk to Quintessential Right High risk to Quintessential Right
3	Visitor center	1. utility line breaks 2. storage tank leak (chronic) or spill 3. sewage	Some risk to Quintessential Right Moderate risk to Quintessential Right Moderate risk to Quintessential Right
4	Park offices	1. sewage	High risk to the Main Corridor
5	Employee housing	1. sewage 2. propane tank leaks (chronic) or spill (while filling)	Both problems pose a Moderate risk to Main Corridor, Left-Hand Tunnel and New Section/Guadalupe Room
6	Maintenance yard	1. chronic releases of metals, oil and other contaminants from vehicle washing and maintenance 2. car fire/crash with spill 3. sewage 4. buried tank leaks (chronic) or spill (while filling) 5. leaks from stored materials	All problems pose a high risk to the New Section, Left-Hand Tunnel, Quintessential Right, and the Natural Entrance area
7	Bat Cave Draw	1. chronic release of metals, oils and other contaminants from cars 2. car fire/crash with spill	High risk to Main Corridor and moderate risk to Left-Hand Tunnel and Quintessential Right Extreme risk to Main Corridor, high risk to Left-Hand Tunnel and Quintessential Right

Table 1. Summary of Contamination Risks (continued)

8	Pumphouse	1. sewage overflow, line leaks	High risk to Main Corridor, moderate risk to Left-Hand Tunnel and Quintessential Right
9	Main road between service road to maintenance yard and road to Bat Cave Draw	1. chronic release of metals, oils and other contaminants from cars 2. car fire/crash with spill	Both problems pose a moderate risk to the Chocolate High and Scenic Rooms areas
10	Main road between road to Bat Cave Draw and visitor center parking lots	1. chronic release of metals, oils and other contaminants from cars 2. car fire/crash with spill	Both problems pose a moderate risk to the Scenic Rooms, Boneyard, and part of the Big Room
11	Paved road down Bat Cave Draw to Amphitheater	1. chronic release of metals, oils and other contaminants from cars 2. car fire/crash with spill	Both problems pose a high risk to New Mexico Room and Scenic Rooms
12	Service road through office area	1. chronic release of metals, oils and other contaminants from cars 2. car fire/crash with spill	Both problems pose a high risk to Main Corridor
13	Road north of maintenance yard and service road to maintenance yard	1. chronic release of metals, oils and other contaminants from cars 2. car fire/crash with spill	Both problems pose some risk to seeps along seep line in Walnut Canyon
14	Sewer line from north side of Bat Cave Draw to pumphouse in Bat Cave Draw	1. sewage overflow and line leaks	High risk to Main Corridor
15	Sewer line from visitor center along Bat Cave Draw	1. sewage overflow and line leaks	Extreme risk to Left-Hand Tunnel and Quintessential Right
16	Sewer line from Bat Cave	1. sewage overflow and line leaks	Moderate risk to Quintessential Right and Lake of the Clouds

CULTURAL RESOURCES

Caverns Historic District

The Caverns Historic District, listed on the National Register of Historic Places, consists of an assemblage of NPS buildings and landscaped features surrounding the natural entrance of Carlsbad Cavern, dating from the mid-1920s through the early 1940s. These buildings and landscaped features are on the slopes and ridges above Bat Cave Draw and at the bottom of the draw where the terrain was leveled and terraced for visitor access to the cave. The earliest buildings and the terracing are constructed of limestone from the surrounding hillside. The architectural style of the buildings is of both the Pueblo Revival style and the New Mexican Territorial style.

The Caverns Historic District contains 13 administrative, residential, and maintenance buildings and their surrounding landscaping (Colby, 1988). Originally, 19 rock buildings were constructed on the north slope of the draw between 1926 and 1932. Six of these original structures have since been removed. Construction on the earliest park facilities, including the three-tiered parking area in Bat Cave Draw, began in 1926. In 1927-1928, construction was begun on several of the rough-cut stone buildings that remain today. These facilities were designed by the first park superintendent and built by park rangers. A second construction phase was undertaken during 1931-1932, which added several more stone buildings, including the elevator tower. Between 1938 and 1942, additional residential and maintenance buildings were designed and built above the cave entrance. The construction was done by Civilian Conservation Corps (CCC) crews stationed at the nearby Rattlesnake Springs camp.

The visitor center was completed in 1957, encasing the original 1932 elevator tower. In 1961-1962, two additional multiple dwelling units, a maintenance building, and the tennis court area were constructed on the top of the hill on the north side of the draw. These projects were part of the NPS's Mission 66 design and construction program intended to revitalize the national parks through a massive 10-year program of capital investment to improve the deteriorating conditions of NPS facilities following World War II (Carr and Allabeck, 1998).

The Mission 66 residences are not considered eligible for the National Register of Historic Places. They do not meet the individual significance criteria under the National Historic Preservation Act for the following reasons:

> A. *Association with events that have made significant contributions to the broad patterns of our history*: While the Mission 66 program marked a change in construction and design philosophies of the NPS, the hallmark of the program was the development of the central visitor centers, not necessarily individual housing units within parks. While the park Mission 66 housing was part of that broader national program, the housing complex at Carlsbad Caverns is typical of Mission 66 housing in many other national parks, including other parks in New Mexico.

B. *Associated with the lives of significant persons*: The park's Mission 66 housing was designed by staff of the NPS Western Office, Division of Design and Construction. The plans for the park's housing were one of many similar designs incorporated around many NPS units.

C. *Works of architecture that embody distinctive characteristics of a type, period or method of construction or that represent the work of a master, or that possess high artistic value*: The blocky, modernistic design of the park's Mission 66 housing does not represent any distinctive style or significant method of construction. In fact, the design of the Mission 66 residences departs from the previous NPS architectural style of rustic architecture designed to blend in with the local landscape. Again, several other highly similar examples of Mission 66 housing exist in other NPS sites within the state.

D. *Likely to yield information important in history*: The park holds complete design drawings of all of the Mission 66 residences, as well as project completion reports and photographs of the construction. The likelihood of any additional significant information coming from the buildings themselves is minimal.

This historic setting is managed as a "cultural landscape," which, in NPS terms, is defined as a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built (NPS, DO-28). The character of a natural landscape is defined both by physical materials such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions. The buildings and designed landscape features represent the rustic theme for facility development used during the early years of NPS construction in parks. This philosophy emphasized the use of local materials and building techniques used in harmony with the natural setting of the landscape. The current Cultural Landscape Inventory for the Caverns Historic District defines the landscape as encompassing all of the designed buildings and landscaping from the tops of the ridges adjacent to Bat Cave Draw.

The period of significance for which both the Caverns Historic District and the cultural landscape of the Cavern entrance area are managed is 1926-1942. Several more buildings were added to the developed area after 1942. The Bat Flight Amphitheater was completed in 1963. The Mission 66 residences lie outside the boundaries of the Caverns Historic District but are within the managed boundaries of the cultural landscape. However, since their construction does not fall within the historic district's and cultural landscape's period of significance, they detract from the cultural landscape the park is attempting to preserve.

Caves in general, and Carlsbad Cavern in particular, play a significant role in the oral history and cultural traditions of many Native American tribes. The park is actively involved in consultations with 13 Native American tribes concerning their historic and cultural ties to park lands. The Caverns area should be considered as an ethnographic landscape because of archaeological and ethnographic resources within the project area.

Archeological Resources

In October 1999, a Class III archeological survey of approximately 115 acres within the developed area surrounding the natural entrance of Carlsbad Cavern was conducted by Pecos Archeological Consultants of Carlsbad, New Mexico (Hunt, 1999). Twenty-four isolated manifestations and 19 archeological sites were encountered during the survey. The survey examined all areas within the 115-acre tract that were not paved or contained in currently standing buildings. Park staff identified one additional site for a total of 20 sites in the project area.

Archeological sites within the developed area fall into two distinct types: prehistoric and historic Native American occupations and historic Anglo-American habitation of the area. The former consists of food processing sites, such as ring middens or hearth features, and lithic scatters. Ring middens, constructed and used to bake vegetal materials for human consumption, are large features and are the result of multiple usage, sometimes over centuries. Hearth features consist of circular or amorphous scatters of burned rock and represent heating fires kindled by individuals or small groups, perhaps only for a single event. The lithic scatters are sparsely deposited, small-scale sites with few artifacts. They most likely represent a single event where toolmaking or tool maintenance work occurred.

The historic occupation of the area resulted in many sites, including campsites, temporary housing sites, quarries, guano mining-related sites, and trash dumps. Material in the survey area
reflects the area's continued use from the late 19th century into present times. The Caverns Historic District is virtually a continuous scatter of cultural material reflecting activities related to ranching, guano mining, CCC construction, tourism, and NPS family life.

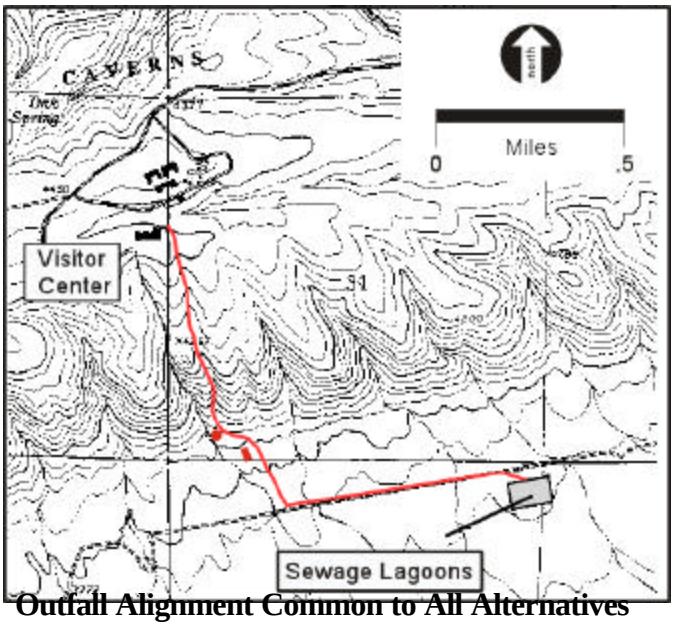
ALTERNATIVES

The goal of each of the alternatives is to protect the cave environment, cultural resources, surface resources, groundwater resources, and human health while providing a quality visitor experience. Some facilities and services are necessary to provide for visitor enjoyment and to preserve the character of the Caverns Historic District, but resource impacts of these facilities could be reduced. These alternatives offer a range of solutions to reduce the impacts of contamination on the cave environment.

The park evaluated eight options for rehabilitating the portion of the sewage system that conveys waste from the developed area off the escarpment. The options ranged from replacing or relining the existing outfall system along its current alignment to replacing the outfall system with a biological wastewater treatment facility near the visitor center. All of the options included replacing the collection system with new plastic pipe. Each option was evaluated based on six primary factors: cave protection, impact to surface resources, water re-use and conservation, education and new technology, sustainability, and park operations (ease of use). The rejected outfall options and reasons for rejection are summarized in the "Alternatives Considered but Rejected" section (page 33).

SEWER SYSTEM REHABILITATION COMMON TO ALL ALTERNATIVES

Under Alternatives A and B, the park proposes to reroute the sewage outfall line so that it runs south from the visitor center, and then along a maintenance access road to the existing evaporative sewage lagoons (see outfall alignment figure below). The sewage lagoons would be rehabilitated and relined to prevent any leaks into the groundwater system. This route minimizes the risk of contamination from sewage to Carlsbad Cavern by shortening the amount of outfall line that lies directly above the cave. This alternative also minimizes new impacts to undisturbed surface resources by utilizing existing utility corridors and the existing lagoons. A plan to mitigate sewage overflows has also been developed (Appendix 2, page 56).



Outfall Alignment Common to All Alternatives

Once final location and design are completed on the sewage line realignment are completed, surveys of all state and federally-listed plant and animal species will be conducted. A revegetation plan that addresses mitigation of noxious weeds would also be developed and approved by park resource management staff.

NO ACTION ALTERNATIVE

Under the No Action Alternative, the current buildings and facilities would remain. All of the current land-use policies would remain intact. The character of the Caverns Historic District and surrounding cultural landscape would remain unaltered. The No Action Alternative provides a basis for comparing the management direction and environmental consequences of the proposed action. Should the No Action Alternative be selected, the NPS would respond to future needs and conditions associated with the Carlsbad Caverns Resource Protection Plan without major actions or changes in course.

Visitor Center Area

The visitor center building would be left intact. The parking lots on the east and west of the visitor center would remain unaltered. Paved areas and structures would continue to act as impervious barriers to infiltration. Parking areas would act to collect and focus contaminants into Bat Cave Draw.

Chronic contamination from parking lot runoff would continue. Potential groundwater contamination from leaks or spills from the visitor center storage tanks and chronic contamination from parking lots would continue to be a threat. Threats from damaged, leaking, or overflowing sewage lines to groundwater and the cave ecosystem would continue.

Bat Cave Draw

The entrance road and parking lot would be left in Bat Cave Draw. The historic stone walls would be retained. Current runoff and infiltration patterns would remain as they are. Chronic groundwater contamination from parking lot runoff would continue and potential contamination from automobile accidents or fires would continue to be a threat. Threats from damaged or leaking sewage lines to groundwater and the cave ecosystem would continue.

Maintenance Facility

All maintenance facility underground storage tanks would be left intact. Runoff patterns would continue as they are. Chronic releases of hazardous materials from parking lot runoff would continue. Threats to groundwater from underground storage tanks and other hazardous stored materials would continue. Threats from damaged or leaking sewage lines to groundwater and the cave ecosystem would continue.

Historic Office and Residence Area

All buildings would be left intact and used for their current purposes. All land-use and parking policies would remain intact. Current runoff and infiltration patterns would remain as they are. Potential threats to groundwater from resident automobile repair and other hazardous material would be unmitigated. Threats from damaged or leaking sewage lines to groundwater and the cave ecosystem would continue.

Mission 66 Housing Area

All buildings would be left intact and used for their current purposes. All propane storage tanks would be left in place, and all land-use and parking policies would remain intact. Current runoff and infiltration patterns would remain as they are. Potential threats to groundwater from resident automobile maintenance and other hazardous material would continue. Threats from damaged or leaking sewage lines to groundwater and the cave ecosystem would continue.

Tennis Court And Helipad Area

The tennis court and helipad area would be left intact. Current runoff and infiltration patterns would remain as they are.

Sewage System

All existing pipes in the sewage collection system would remain and continue to deteriorate and leak contaminants into the groundwater. The outfall system would remain over Bat Cave, Left-Hand Tunnel, and Quintessential Right (see the Existing Sewage Outfall System map, page 7) and would continue to leak sewage into the cave. Collection and outfall pipes would be repaired as leaks and overflows were found, but could still release large amounts of sewage before detection.

ALTERNATIVE A: IMPLEMENT TECHNOLOGICAL MEASURES

Alternative A (see Alternative A map, page 23) does not significantly alter the developed area above the cave. Pavement would be removed from about 0.25 acres and revegetated with native plants. Under this alternative, contaminated runoff would be reduced by approximately 97,200 gallons per year (7% of the total). Oil/grit separators and containment areas would be installed to treat and contain spills, and to collect and filter or redirect storm water runoff. This alternative would remove some sources of contamination, and would provide a higher level of resource protection than is currently present. For all activities under this alternative, construction would take place in the winter to reduce the effects of these activities on visitors and wildlife, particularly bats.

Visitor Center Area

Alternative A would eliminate parking of vehicles adjacent to the north side of the visitor center and institutes a policy to restrict parking of the concessionaire trash truck at the visitor center except to pick up trash. Stormwater would be redirected to the south away from Bat Cave Draw by regrading the parking lots. Oil and grit filters would be installed to collect parking lot runoff and the filtered water directed into the drainages south of the visitor center. The parking lots would be sealed to prevent infiltration of volatiles into the groundwater.

Spill containment measures would be constructed at the filling area for the 6,000-gallon underground diesel fuel storage tank. An enclosed wash area with grease traps would be constructed for the concessionaire restaurant kitchen.

Bat Cave Draw

The historic stone walls would be retained. Parking would be provided for disabled visitors only. A passenger drop-off zone for disabled visitors in passenger cars and tour buses would be defined. Pavement would be removed from the center tier of the parking area and would be revegetated with native plants. The revegetated area would be used for bioretention and runoff treatment. Bioretention is stormwater management where plants and soil are used to efficiently and naturally filter runoff from developed areas before the water enters the groundwater system. Catch basins and filters would be installed to treat runoff from the remaining paved areas.

Maintenance Facility

Underground storage tanks would be removed and an alternative heating system used in the buildings to allow removal of the propane tanks. The oil and grit separator in the auto shop would be rehabilitated and a containment system constructed for hazardous material use areas. Staff would be trained in spill accident prevention and response. Stormwater runoff would be contained and filtered, and park garbage trucks would be required to park off the escarpment.

Historic Office and Residence Area

Automobile repair and maintenance by residents would be restricted in the residential area. The effects of runoff from paved areas would be mitigated by containing and treating the water. Propane tanks would be removed and an alternative heating system used.

Mission 66 Housing Area

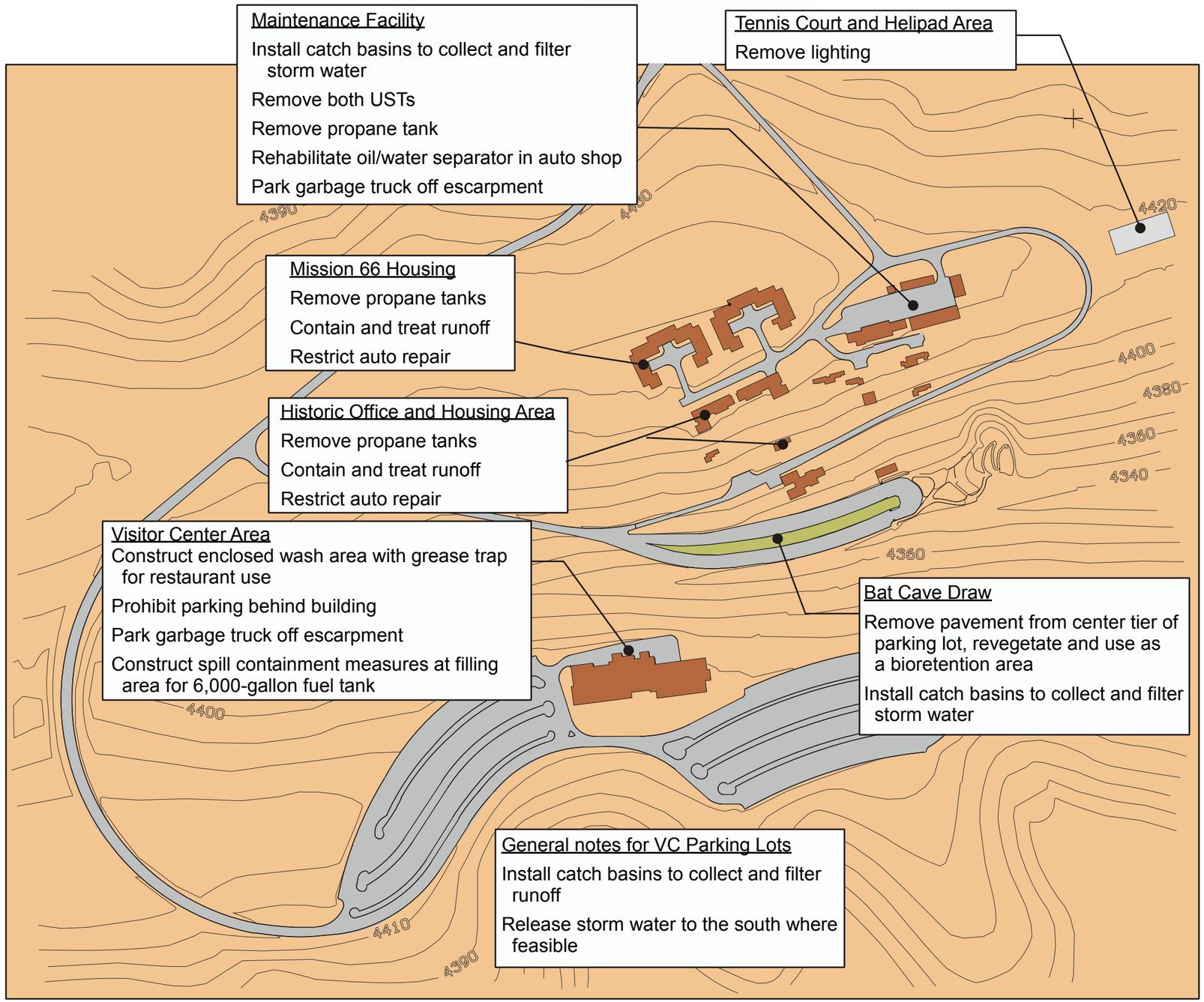
Automobile repair and maintenance would be restricted in the residential area. The effects of runoff from paved areas would be mitigated by containing and treating the water. Propane tanks would be removed and an alternative heating system used. The number of vehicles per residence would be restricted.

Tennis Court and Helipad Area

The tennis court would remain at the current site.

Sewage System

The collection system would be rehabilitated and the outfall system would be rerouted so that it runs south from the visitor center, and then along a maintenance access road to the existing evaporative sewage lagoons. The sewage lagoons would be rehabilitated and relined to prevent any leaks into the groundwater system.



GENERAL NOTES:

All structures north of Bat Cave Draw would be converted to alternative HVAC system once propane tanks have been removed.

Building to Remain

UST- Underground Storage Tank (fuel)

Alternative A
Carlsbad Cavern Resource Protection Plan

Carlsbad Caverns National Park

US Department of the Interior

National Park Service

130/20043 DSC March 2000

north 0 100 300 *FEET*

ALTERNATIVE B: PARTIAL RELOCATION OF FACILITIES (Park Preferred Action and Environmentally Preferred Alternative)

The Park Service has been mandated to identify an environmentally preferred alternative that protects the environment for succeeding generations, assures safe and pleasing surroundings for all generations, attains beneficial use of the environments without degradation, preserves important historic, cultural and natural aspects of our heritage, achieves a balance between population and resource use, and enhances the quality of renewable resources and maximizes recycling of depletable resources. In the context of this project, the environmentally preferred alternative would be the one that would reduce the impacts of existing surface development on natural resources while preserving cultural resources and would have minimal adverse effect on other natural resources and visitor experience.

Alternative B (see Alternative B map, page 27) removes the most threatening sources of contamination from above Carlsbad Cavern. This alternative would remove 4.2 acres of pavement and reconfigure the roadway in the Bat Cave Draw parking lot. Contaminated runoff would be reduced by approximately 268,200 gallons per year (19% of the total). This alternative would also remove the Mission 66 housing area and the tennis court, and would relocate the hazardous functions from the maintenance area. Where facilities and pavement remain, specialized stormwater systems would be installed to contain spills, and to redirect, collect, and filter stormwater runoff. For all activities under this alternative, construction would take place during the winter to reduce the effects of these activities on visitors and wildlife, particularly bats. The estimated costs of this alternative are summarized in Appendix 1 (page 55).

Visitor Center Area

Use of park-provided shuttle transportation by park employees would be encouraged. Laws would be enforced to prevent the use of park roads by unauthorized commercial vehicles to reduce the magnitude of potential spills from vehicle accidents. Both policies encourage reduced vehicle use in the existing parking areas adjacent to the visitor center.

The east and west parking lots would be redesigned to direct stormwater to the south into a collection and filtration system. Parking lots would be sealed to prevent infiltration of volatiles into the groundwater. The redesign would also better utilize space and improve vehicle circulation and pedestrian access to the views off the escarpment.

Spill containment areas would be constructed at the filling point for the 6,000-gallon underground diesel fuel storage tank. The filling point for the storage tank would be relocated further west to reduce the potential for the refueling truck to back off the pavement into Bat Cave Draw and spill fuel. An enclosed wash area with grease traps would be constructed for the concessionaire restaurant kitchen.

Bat Cave Draw

Pavement would be removed from the current parking area, retaining the majority of the historic stone walls (see the Bat Cave Draw Concept Plan map, page 28). A turnaround and drop-off area would be relocated to the far west end of the existing parking lot. Ten accessible parking spaces would be provided. A new stone retaining wall would be required to connect the lower road to the upper road at

the turnaround. Portions of the middle wall would be removed or buried to accommodate the new roadwork. Salvaged stone from removed portions of the original stone wall would be incorporated into the new retaining walls for the turnaround. The new walls would match the character and construction techniques of the original structures.

An eight-foot-wide concrete walk would be constructed along the upper tier from the new turnaround location to the Natural Entrance to accommodate disabled access, maintenance work, and rescue operations.

A natural bioretention area would be established to treat runoff from the remaining paved road and turnaround. Native vegetation and natural drainage patterns would be restored in areas where pavement has been removed. Vegetation would be selected that would not damage the historic walls over time. A detailed design plan of changes to the historic walls would be provided to the New Mexico SHPO for their concurrence.

The park would locate off-site parking to accommodate the overflow parking removed from Bat Cave Draw under this alternative. The NPS anticipates needing overflow parking only for Memorial Day, Independence Day, and Labor Day weekends (approximately nine days per year). A private commercial service would be contracted at the expense of the government to provide shuttle service to the visitor center.

Maintenance Facility

Non-historic maintenance facility buildings and underground storage tanks would be removed. Chemical/hazardous material storage, excess material storage, auto shop, paint storage building, heavy equipment storage, trash collection and recycling facilities would be relocated onto park land off the escarpment (see Off Escarpment Maintenance Facility map, page 29). The final off-escarpment maintenance facility design would be developed, including the exact location of buildings, access roads, and utility lines. Further NEPA compliance would have to be completed prior to any construction to evaluate all the impacts of the facility relocation. This compliance would include cultural resource surveys and SHPO concurrence and surveys for rare, threatened, and endangered plant and animal species.

The square footage requirements of an off-escarpment facility are summarized below. Carpentry, plumbing and electrical shops would move into remaining historic buildings. Remaining space in historic buildings would be adapted for limited small equipment and non-hazardous material storage. A restroom and breakroom would be provided for maintenance employees. Propane tanks would be removed and an alternative heating system for remaining buildings would be installed.

Emergency vehicles would continue to be housed in existing parking bays. The paved area would be reduced to allow for only limited employee parking. Chronic contamination from remaining paved areas would be mitigated by redirecting runoff to collection filtration systems. Natural drainage conditions would be restored where possible and revegetated with native plants.

Table 2. Program Requirements for Off Site Maintenance Facility

Function	Square Footage
General Office Space	2,000
Shop Space/Storage	5,000
Covered Vehicle Storage	2,200
Paint Storage	1,000
2000-gallon above ground fuel storage and pump area	2,000
Parking/maintenance yard	20,000
Total	32,200 SF (0.74 acres)

Historic Office and Residence Area

A park policy for required residency and housing priorities would be established, and the sewage lines would be upgraded. An alternative heating system would be installed for each of the residential and office buildings. Historic buildings that are not used for housing or office space would be converted to be used by researchers or other park partners, for curatorial storage, and storage space for nonhazardous materials.

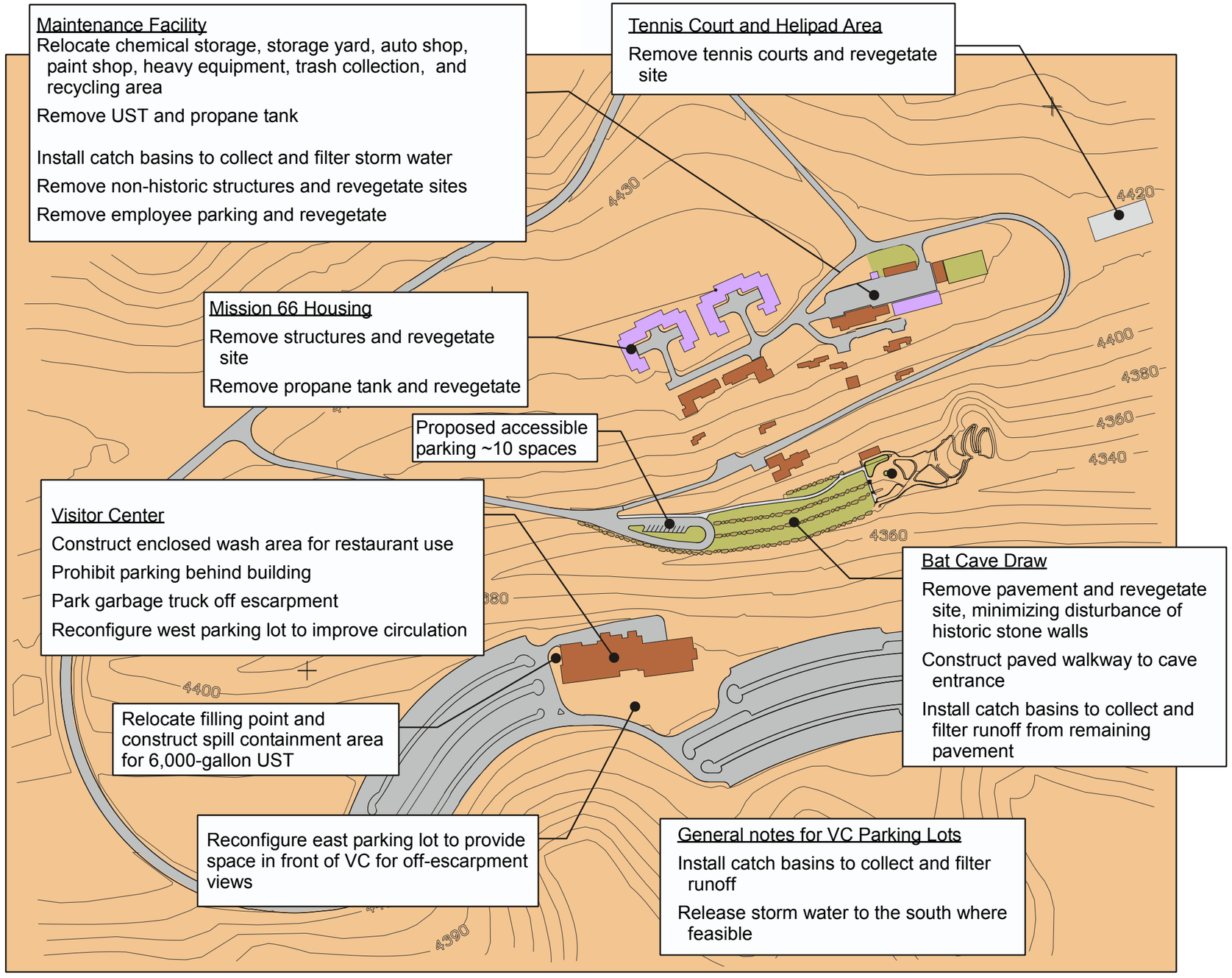
Defined parking areas would be provided and a park policy established that would restrict automobile maintenance by residents. The use of park-provided shuttle service by employees would be encouraged. The effects of runoff from paved areas would be mitigated by containing and treating the water or by redirecting the flow to existing treatment facilities. Bare areas would be repaired and revegetated with native plants.

Mission 66 Housing Area

All Mission 66 residences and the 3,000-gallon propane tank would be removed. Natural drainage conditions would be restored where possible and revegetated with native plants. Offices currently located in this area would be relocated off the escarpment.

Tennis Court and Helipad Area

The tennis court would be removed, natural drainage conditions would be restored, and the area would be revegetated with native plants. New Mexico SHPO and park cultural resources staff would develop a detailed plan for removing the tennis court without adversely impacting cultural resources.



GENERAL NOTES:

For Bat Cave Draw improvements see Alternative B: Bat Cave Draw Concept (page 26)

For relocated facilities see Alternative B: Off-Escarpment Maintenance Facility and Alternative B: Off-Escarpment Parking (pages 27 and 28)

All structures north of Bat Cave Draw would be converted to alternative HVAC system once propane tanks have been removed.

KEY:

Building to be Removed

Building to Remain

UST- Underground Storage Tank (fuel)

Alternative B (Preferred) Carlsbad Cavern Resource Protection Plan

Carlsbad Caverns National Park

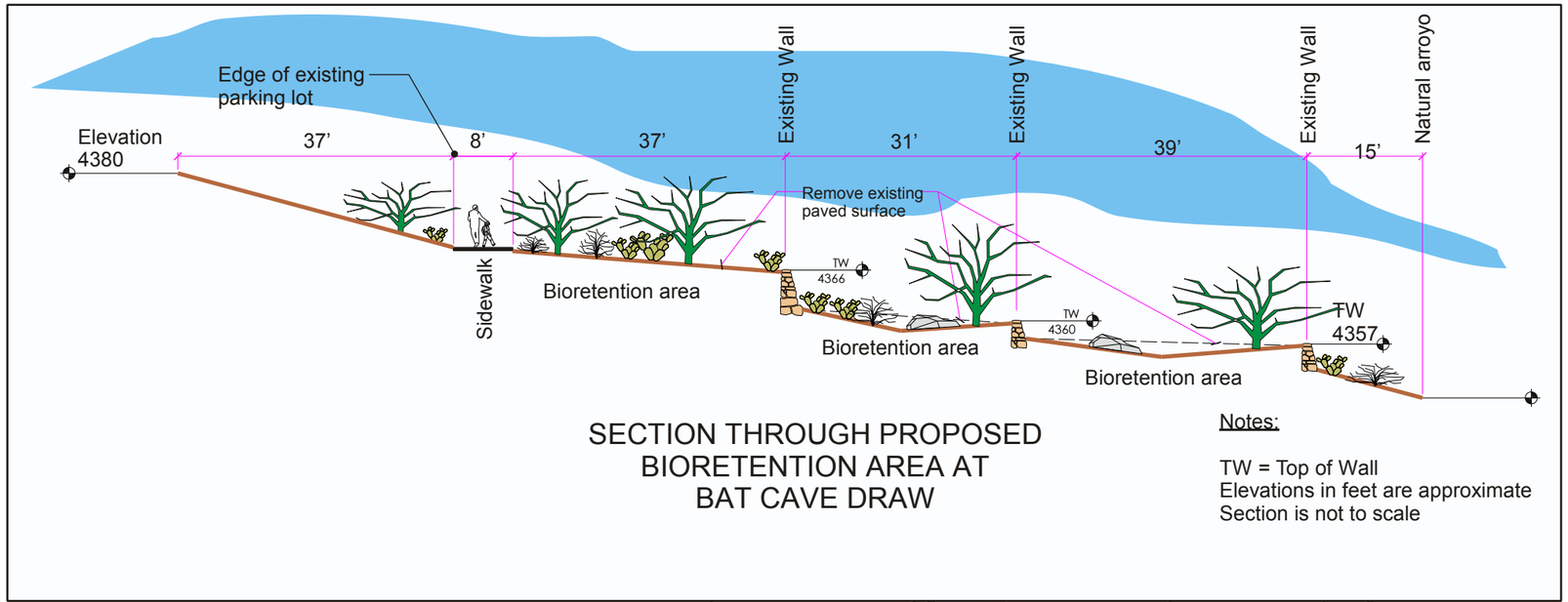
US Department of the Interior

National Park Service

130/20044 DSC March 2000

north

0 100 300 *FEET*



SECTION THROUGH PROPOSED
BIORETENTION AREA AT
BAT CAVE DRAW

Notes:

TW = Top of Wall
Elevations in feet are approximate
Section is not to scale

BAT CAVE DRAW PROPOSAL

GENERAL NOTES:

The turn-around would be designed to fit within the current boundaries of the parking lot and would not expand beyond the current historic walls to the south or into the hillside to the north.

The proposed bioretention area will serve as a natural filter for storm water run-off from the hill north of the draw

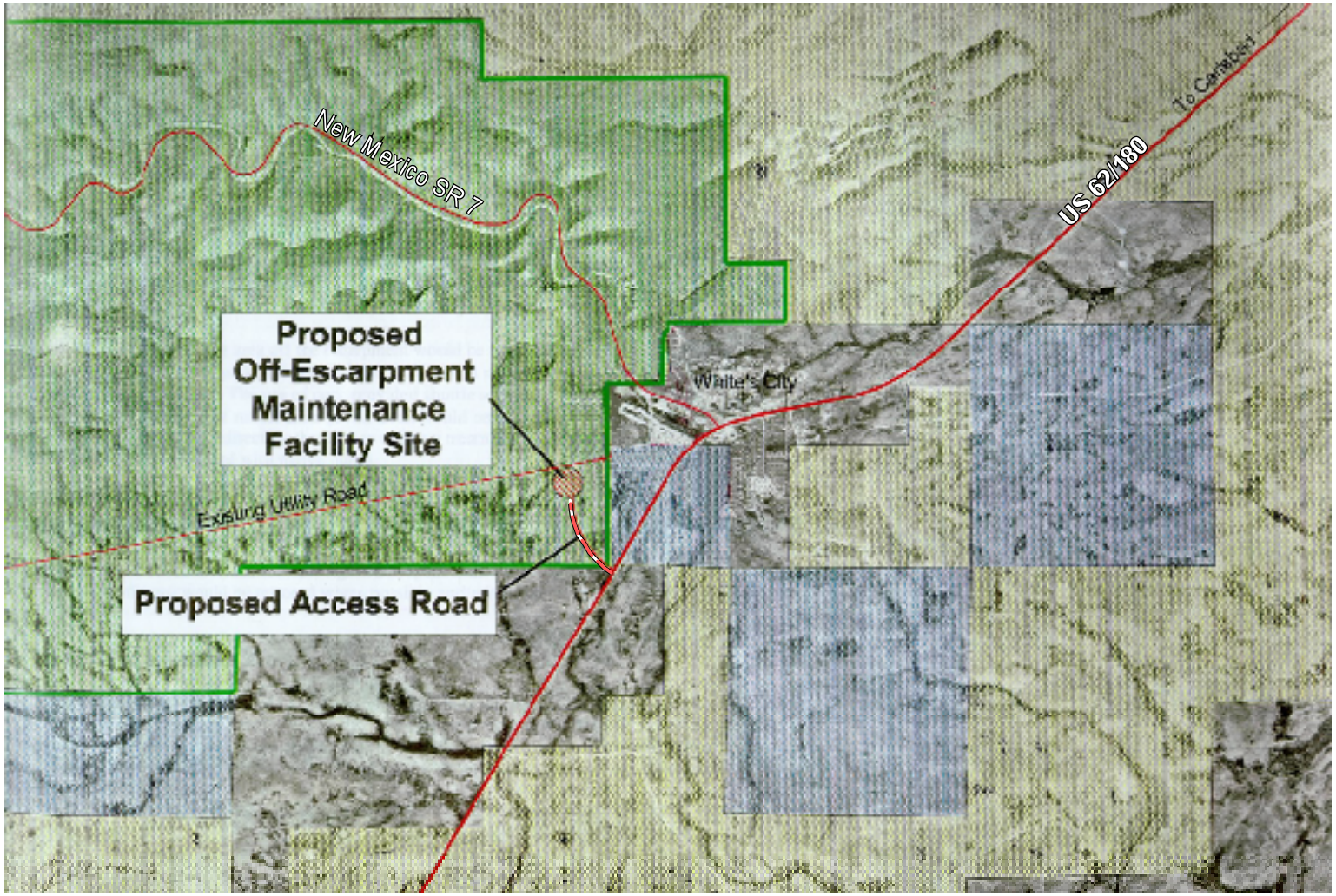
A system of catch basins to collect and filter storm water is proposed for the new accessible parking area

Alternative B:
Bat Cave Draw Concept
Carlsbad Cavern Resource Protection Plan

Carlsbad Caverns National Park

US Department of the Interior

National Park Service



Key

Proposed Features

Maintenance Area

Access Road

Land Ownership

Carlsbad Caverns N.P.

State Land

BLM Land

Private Land

Alternative B:

Off-Escarpment Maintenance Facility

Carlsbad Caverns National Park
US Department of the Interior
National Park Service

130/20055 Intermountain GIS Program - Denver February 2000

N

Feet

0 4000

Sewage System

The collection system would be rehabilitated and the outfall system would be rerouted so that it runs south from the visitor center, down the escarpment, and then along a maintenance access road to the existing evaporative sewage lagoons. The sewage lagoons would be rehabilitated and relined to prevent any leaks into the groundwater system.

No Action Alternative	A-Technological Measures	B- Partial Relocation of Facilities (Park and Environmentally Preferred Alternative)
There would be no changes to current land-use practices or to non-historic buildings. The underground storage tanks would remain.	The paved area would be reduced in Bat Cave Draw and runoff from remaining paved areas and buildings would be contained, filtered, or redirected. The underground storage tanks would be removed from the maintenance and housing areas. The parking lots would be sealed and policies on parking lot use would be changed. The sewage outfall line would be rerouted to minimize exposure to cave and groundwater resources.	The paved area would be reduced in Bat Cave Draw and runoff from remaining paved areas and buildings would be contained, filtered, or redirected. The underground storage tanks would be removed from the maintenance and housing areas. The parking lots would be sealed and policies on parking lot use would be changed. Some of the hazardous maintenance and other activities would be relocated from above the cave. Policies would be established to restrict auto repair and fertilizer use. The sewage outfall line would be rerouted to minimize exposure to cave and groundwater resources.
Meets project objectives. No, contamination sources would remain above the cave and continue to degrade cave and groundwater resources.	**Meets project objectives.** Partially, but significant runoff from Bat Cave Draw would still threaten cave and groundwater resources. Activities and facilities that are hazardous to these resources would remain above the cave.	**Meets project objectives.** Yes, the primary sources of contamination to cave and groundwater resources would be eliminated or mitigated. More natural infiltration conditions would be restored around Bat Cave Draw.

Table 4. Summary Comparison of Impacts

Impact Topic	No Action Alternative	A- Technological Measures	B- Partial Relocation of Facilities (Preferred Alternative)
Air Quality	Continuing chronic air quality degradation around open sewage lagoons	Short-term and non-cumulative impacts during construction and demolition Continuing chronic air quality degradation around open sewage lagoons	Short-term and non-cumulative impacts during construction and demolition Continuing chronic air quality degradation around open sewage lagoons
Soils & Vegetation	None	Minor and local changes from erosion and runoff 0.25 acres of vegetation restored in Bat Cave Draw	Minor and local changes from erosion and runoff 4.2 acres of vegetation restored in Bat Cave Draw 1.3 acres of vegetation lost in new maintenance area and access road
Cave Resources	Continued degradation of groundwater and cave formations Potential contamination from spills/ accidents unmitigated	Potential effects from sewage leaks reduced Contaminated parking lot runoff reduced by 97,200 gallons per year (7%) Infiltration and drainage restored to 0.65 acres.	Potential effects from sewage leaks reduced Contaminated parking lot runoff reduced by 268,200 gallons per year (19%) Infiltration and drainage restored to 4.2 acres.
Threatened or Endangered Species	Potential poaching of plant and animal species along park roads and parking lots	Potential poaching of plant and animal species along park roads and parking lots Possible adverse impacts to plant and animal habitat	Potential poaching of plant and animal species along park roads and parking lots Possible adverse impacts to plant and animal habitat
Cultural Resources	No short-term impacts	Some adverse effect on historic integrity of the Bat Cave Draw parking area – mitigated by photo-documentation of the parking area prior to construction Character and integrity of the overall Caverns Historic District and cultural landscape would be retained.	Permanent impacts on Caverns Historic District Impacts on cultural landscape are permanent but beneficial Archaeological and historic sites would be protected and avoided Removal of Mission 66 residences, the non-historic maintenance structures, and the tennis courts would enhance the character of the Caverns Historic District
Visitor Use and Experience	No short-term impacts Threats from spills and accidents which could pose a health hazard to visitors remains unmitigated	Minor reduction of some potential health threats to visitors Temporary visual and audible impacts	Minor reduction of some potential health threats to visitors Temporary visual and audible impacts

ALTERNATIVES CONSIDERED BUT REJECTED

FACILITY REDUCTION AND LAND-USE MODIFICATION

This alternative would have removed most non-historic structures from above the cave and eliminated most of the threats to the groundwater system from the developed area. The east parking lot would have been removed from the visitor center. The west parking lot would have been redesigned as a turnaround and staging facility for shuttle buses. A visitor parking facility would have been constructed off the escarpment and shuttle service would have been provided to the visitor center.

The pavement in the parking lot in Bat Cave Draw would have been removed and a turnaround constructed similar to Alternative B. The non-historic buildings in the maintenance area would have been removed and a new maintenance facility would have been constructed off the escarpment. All of the Mission 66 buildings would have been removed, and the number of residents reduced in the historic residence area. The non-occupied historic buildings in the housing and maintenance area would have been converted to curatorial and storage space.

Reasons for Rejection

This alternative was rejected because a transportation engineering analysis indicated that a transit system was not practical for the park at this time. A shuttle system could also negatively impact visitor experience, by forcing visitors to stage their cars and visit the park on the shuttle's schedule. The costs of developing a transit system and constructing new facilities off the escarpment would be substantial and would offer only slightly more resource protection than the preferred alternative, B.

SEWAGE SYSTEM IMPROVEMENT OPTIONS

The sewage collection system includes the smaller diameter (4- to 6-inch) collection pipes that collect wastewater from individual office, residential, and maintenance buildings. The collection system includes every sewer pipe on the north side of Bat Cave Draw and the sewer forcemain between the comfort station and the gravity outfall manhole on the visitor center side of the arroyo.

The outfall system includes the larger diameter (6- to 8-inch) transmission pipes that convey the wastewater to the treatment location without additional collection from individual buildings or subsystems. The main outfall pipeline runs parallel to the ridgeline of the escarpment and cavern system below for 1,939 feet before heading south off the ridge to the sewage lagoons. Sewage is disposed and treated in a series of evaporation ponds commonly referred to as sewage lagoons. The lagoons are located at the base of the escarpment on NPS property.

The collection system pipes the sewage from the residence and office area on the north side of Bat Cave Draw to the comfort station. The outfall system pipes the sewage from the visitor center and then off the escarpment.

REHABILITATION OF COLLECTION SYSTEM

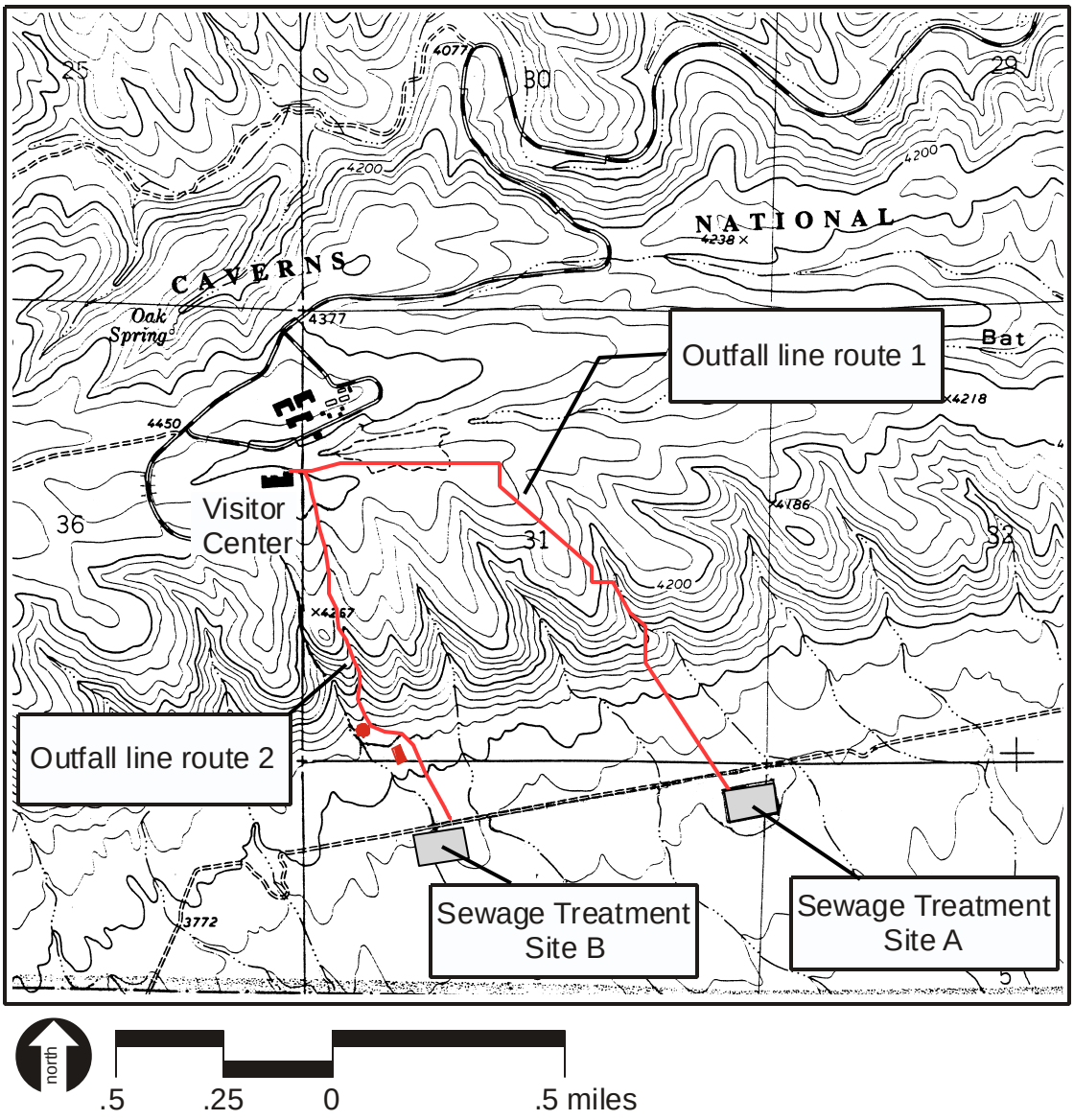
One proposed option for the sewer system was to rehabilitate the system that collects sewage from the maintenance and historic office and residence area and carry it to the station in Bat Cave Draw. Rehabilitation would be accomplished by first conducting a television inspection on the entire sewer system to locate wall failures, tree root intrusions, and other blockages. A survey would have to be conducted to locate low points in any of the pipe runs that could cause sewage buildup. Low points and blocked sections of pipe would have to be excavated and replaced. The entire system would then be slip-lined.

Reasons for Rejection: The repair history of the collection system indicates that a large number of the sewage lines have significant intrusions. Minor collapse areas in the system would also make it impractical to use proposed slip-line technology. An analysis of the costs indicates that it would be more expensive to survey and inspect the lines and then replace the damaged pipe than to replace the whole system with better pipes.

SEWAGE OUTFALL OPTIONS CONSIDERED BUT REJECTED

One objective of the outfall redesign was to minimize the total amount of cave exposed to sewage by making the outfall route as short as possible. The current route maximizes exposure of the sewage line by running over a significant amount of cave. All of the options would require some ground disturbance, but each option was evaluated on the basis of how much new area would be disturbed. In order to ensure that the system is dependable and serves the needs of the public, each option was evaluated on the basis of ease of operation and maintenance.

The park considered a wide range of options to protect the cave and groundwater resources from exposure to sewage. Each alternative was evaluated based on six primary factors: cave protection, impact to surface resources, water re-use and conservation, education and new technology, sustainability, and park operations (ease of use). These options ranged from rehabilitating the current line to using a Living Machine® to treat the waste and reusing the treated water at the visitor center. A Living Machine® is a biological waste treatment system that removes contaminants using plants, bacteria, and other non-chemical treatments in a series of tanks enclosed in a building similar to a greenhouse. The water from this system could be used for toilet flushing and other non-potable uses. The Living Machine® would provide an educational opportunity to teach the public about sustainable technology and water re-use.



Sewage Outfall Options
Carlsbad Cavern
Cave Resource Protection Plan

Carlsbad Caverns National Park

US Department of the Interior

National Park Service

Rehabilitate Existing Outfall
Slip line the existing outfall sewage line (Route 1) and rehabilitate the existing lagoons (Site A).

Reason for Rejection: The sewage outflow would still flow over significant portions of the cave and future releases could threaten cave resources. Vehicle access to portions of the sewage line would cause a great deal of surface disturbance. With time, the system would deteriorate and we would return to the conditions we have now.

REPLACE EXISTING OUTFALL
Replace the outfall sewage line (Route 1) with double-walled HDPE pipe and rehabilitate the existing lagoons.

Reason for Rejection: The sewage outflow would still flow over significant portions of the cave and future releases could threaten cave resources. Vehicle access to portions of the sewage line would cause a great deal of surface disturbance. With time, the system would deteriorate and we would return to the conditions we have now.

REROUTE OUTFALL AND CONSTRUCT NEW LAGOONS
This option is similar to the proposed alternative, except that new sewage lagoons would be constructed near the existing water evaporation pond at the base of the escarpment (Site B) and there would be no sewage line along the access road. The sewage from the comfort station in Bat Cave Draw would be pumped up to the visitor center and then piped down the escarpment to the south. The sewage line from the edge of the escarpment to the base of the escarpment would be kept aboveground (Route 2) to monitor and prevent releases. The existing sewage disposal ponds would be removed and revegetated.

Reasons for Rejection: This option would increase the amount of surface impact outside the developed area at a higher cost. The new sewage lagoons would require major excavation of new areas along the base of the escarpment.

LIVING MACHINE â WITH WATER REUSE SYSTEM
This option eliminates the need for an outfall sewage line by placing the primary treatment system (Living Machine®) adjacent to the visitor center. This option would require construction of a small-diameter effluent sewer to be constructed down the escarpment (Route 2) to a newly-constructed leach field (Site B). The existing sewage lagoons would be demolished and the area revegetated. This option would require plumbing the existing buildings with a gray-water system for toilet flushing.

Reason for Rejection: Because of additional plumbing costs and higher maintenance needs, this option would cost significantly more than the traditional sewage treatment options with only a slight increase in resource protection. This option treats the sewage above the cave and would still expose portions of the cave to future sewage releases. The construction of a leach field would disturb new surface areas below the escarpment.

LIVING MACHINE â BELOW ESCARPMENT, REPLACE OUTFALL SEWER
The outfall sewage line would be relocated (Route 2) and a Living Machine® and leach field would be constructed near the existing sewage lagoons (Site A). The existing sewage lagoons would be demolished and the area revegetated.

Reason for Rejection: Because of higher maintenance needs, this option would cost significantly more than the traditional sewage treatment options with only a slight increase in resource protection. This option would require a significant amount of improvement along the access road to provide an educational benefit.

LIVING MACHINE â BELOW ESCARPMENT, SLIPLINE EXISTING OUTFALL
The outfall sewage line would be slip-lined (Route 1) and a Living Machine® and leach field would be constructed near the existing sewage lagoons (Site A). The existing sewage lagoons would be demolished and the area revegetated.

Reason for Rejection: This option would require higher maintenance costs than the selected alternative. The sewage outflow would still flow over significant portions of the cave and future releases could threaten cave resources. This option would require a significant amount of improvement along the access road to provide an educational benefit.

COMPOSTING TOILETS
The use of composting toilets for each building in the historic residence and office area would change the wastewater conveyed over the cave from raw sewage to water that has had solid waste and some contaminants removed from it.

Reasons for Rejection: The use of composting toilets would add to the life cycle cost of each of the alternatives and was considered an objectionable substitute for traditional indoor plumbing.

Table 5. Summary of Sewage Outfall Options (see map on page 33)

Option	Outfall Route	Treatment Location	Cost	Primary Reason for Rejection
Selected Alternative- Reroute Outfall to existing lagoons	2	A	2,507,000	Selected alternative presented for comparison
1-Rehabilitate Existing Outfall	1	A	1,038,000	The sewage outflow would still flow over significant portions of the cave and future leaks could threaten cave resources.
2-Replace Existing Outfall	1	A	2,188,000	The sewage outflow would still flow over significant portions of the cave and future leaks could threaten cave resources.
3-Reroute Outfall and Construct New Lagoons	2	B	2,821,000	This option costs more and would cause more damage to surface resources than the selected option.
5-Living Machine® with Water Reuse System	2	Visitor Center	2,905,000	This option would still expose large portions of the cave to potential sewage leaks.
6-Living Machine® below Escarpment, Replace Outfall Sewer	2	B	3,600,000	This option costs significantly more than the selected option with only slightly more protection to resources.
7-Living Machine® below Escarpment, Slip-line Existing Outfall	2	A	2,567,000	This option would require a significant amount of improvement along the access road to provide a benefit beyond the selected alternative.

ENVIRONMENTAL CONSEQUENCES

Impacts, both adverse and beneficial, were evaluated in terms of context (are the effects site-specific, local, or even regional?), duration (are the effects short-term, lasting less than one year, or long-term, lasting more than one year?), and intensity (are the effects negligible, minor, moderate, or major?).

In addition to determining the environmental consequences of the preferred and other alternatives, the NPS's *Management Policies 2001* (2000) requires analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system is to conserve park resources and values. National Park Service managers must always seek ways to avoid, or minimize adverse impacts on park resources and values. However, the NPS has the discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

To analyze potential impacts in this EA, the thresholds of change for the intensity of an impact are defined as follows:

Negligible-the impact is at the lowest levels of detection
Minor-the impact is slight, but detectable
Moderate-the impact is readily apparent
Major-the impact is a severe or adverse impact or of exceptional benefit
Impairment- a major, adverse impact to a key resource or value

The park was required to assess cumulative impacts in the decision-making process. Cumulative impacts are the environmental impacts that result from the alternative when added to other past, present, and reasonable foreseeable future actions regardless of what agency or person undertakes such other actions.

AIR QUALITY

No Action Alternative. There are no activities that would affect air quality under the No Action Alternative.

Alternatives A and B. Under Alternatives A and B, some minor disturbance to air quality would result from dust particles being blown into the air during destruction of buildings and removal of underground storage tanks and paved surfaces. There would be slight increases in air pollutant

emissions from heavy machinery during these activities as well. These effects on air quality would be localized and temporary. No state or federal air quality standards would be exceeded.

Cumulative Impacts: Reasonable foreseeable future actions such as rehabilitation of the visitor center, rehabilitation of the sewage collection system, and resurfacing of parking lots have the potential to adversely impact air quality. Since there are no activities under the No Action Alternative, this alternative would not be a component of the cumulative impacts. Minor disturbances to air quality under Alternatives A and B would contribute to cumulative impacts on air quality.

Conclusion: There would be site-specific, short-term, minor adverse impacts to air quality during activities under Alternatives A and B. Because there would be no major, adverse impacts to a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment to park resources or values.

SOILS AND VEGETATION

No Action Alternative. There are no activities that would affect soils or vegetation under the No Action Alternative.

Alternative A. Areas where sewage lines would be replaced, buildings demolished, and tanks and pavement removed would undergo accelerated erosion until native vegetation was reestablished. Interim water runoff in disturbed areas might change soil nutrient transport.

Vegetation would be restored to 0.65 acres in Bat Cave Draw, resulting in a long-term positive impact on natural resources in this area. Water infiltration and groundwater flow patterns would be restored above this area after 75 years of imperviousness.

Alternative B. Areas where the sewage lines would be replaced, buildings demolished, and tanks and pavement removed would undergo accelerated erosion until native vegetation was reestablished. Interim water runoff in disturbed areas might change soil nutrient transport.

Vegetation would be restored to 1.2 acres in Bat Cave Draw, two acres in the Mission 66 residence area, and one acre in the maintenance and tennis court areas. Revegetation would result in a long-term positive impact on natural resources in these areas. Water infiltration and groundwater flow patterns would be restored above this area after 75 years of imperviousness. The off-escarpment maintenance facility would result in a loss of 0.75 acres of vegetation and the access road would result in a loss of 0.6 acres of vegetation.

Cumulative Impacts: Reasonable foreseeable future actions such as rehabilitation of the visitor center, rehabilitation of the sewage collection system, and resurfacing of parking lots have the potential to adversely impact soils and vegetation. Since there are no activities under the No Action Alternative, this alternative would not be a component of the cumulative impacts.

Activities under Alternative A would result in site-specific, short-term, minor adverse impacts to soils and would contribute to the overall cumulative impacts on soils. Restoration of vegetation to 0.25 acres would result in site-specific, long-term, moderate beneficial impacts to vegetation and would contribute to the cumulative impacts on vegetation.

Activities under Alternative B would result in site-specific, short-term, minor adverse impacts to soils and would contribute to the overall cumulative impacts on soils. Restoration of vegetation to a net 2.9 acres would result in site-specific, long-term, moderate beneficial impacts to vegetation and would contribute to the cumulative impacts on vegetation.

Conclusion: There would be site-specific, short-term, minor adverse impacts to soils and site-specific, short- to long-term beneficial impacts to vegetation during activities under Alternatives A and B. Because there would be no major, adverse impacts to a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment to park resources or values.

CAVE AND GROUNDWATER RESOURCES

No Action Alternative. Sewage spills from pipes and manholes would continue to threaten cave resources. Contamination of cave formations would continue, leading to their long-term degradation. An average of 1.4 million gallons of contaminated water per year (100% of the total) would still run off the parking lots and into the groundwater system every year. Potential contamination from automobile accidents as well as fuel tank leaks and spills would pose a continuing threat to cave resources as well as human health. Natural drainage and infiltration patterns above the cave would remain altered.

No wetlands or 100-year floodplains exist within the project area or would be affected by actions under this alternative.

Alternative A. The adverse effects on cavern water quality from sewage releases would be reduced by replacing the sewage collection system and rerouting the sewage outfall system to remove sewage from the escarpment as quickly as possible.

Pavement would be removed from 0.65 acres in Bat Cave Draw. This could eliminate a minimum of 97,200 gallons of contaminated water per year (7% of the total). The removal of pavement in Bat Cave Draw would help restore natural drainage and infiltration to this area.

No wetlands or 100-year floodplains exist within the project area or would be affected by actions under this alternative.

Alternative B. The adverse effects on cavern water quality from sewage releases would be reduced by replacing the sewage collection system and rerouting the sewage outfall system to remove sewage from the escarpment as quickly as possible.

Vegetation would be restored to 1.2 acres in Bat Cave Draw, two acres in the Mission 66 residence area, and one acre in the maintenance and tennis court area. This could eliminate a minimum of 268,000 gallons of contaminated water per year (19% of the total). The removal of pavement and buildings would help restore natural drainage and infiltration to these areas.

No wetlands or 100-year floodplains exist within the project area or would be affected by actions under this alternative.

Cumulative Impacts: Reasonable foreseeable future actions such as rehabilitation of the visitor center, rehabilitation of the sewage collection system, and resurfacing of parking lots have the potential to beneficially impact cave and groundwater resources. The No Action Alternative leaves all the sewage lines and paved areas as they are and would contribute to the continuing degradation of cave and groundwater resources.

Under Alternative A, removal of paved surfaces, treatment of runoff, replacement and reconfiguration of sewage lines, and changes in some land-use polices would slow, but not stop most degradation of cave and groundwater resources. The long-term effects would still be steady, gradual reduction of groundwater quality and degradation of cave formations. Local, long-term, moderate impacts to cave and groundwater resources from Alternative A would contribute to cumulative adverse impacts on cave and groundwater resources.

Under Alternative B, removal of paved surfaces, treatment of runoff, and changes in some land-use policies would stop most of the degradation. The local, long-term, major beneficial impacts to cave and groundwater resources from Alternative B would contribute to cumulative beneficial impacts on cave and groundwater resources.

Conclusion: There would be site-specific, long-term, major adverse impacts to cave and groundwater resources under the No Action Alternative. There would be local, long-term, moderate negative impacts to cave and groundwater resources under Alternative A. There would be local, long-term, major beneficial impacts to cave and groundwater resources under Alternative B.

Because under the No Action Alternative there would be major, adverse impacts to a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents, the No Action Alternative would result in impairment to park resources or values.

RARE, THREATENED OR ENDANGERED SPECIES

Surface Species

There would be no adverse impacts on known rare, threatened or endangered plant species from any of the alternatives. A plant survey conducted by the New Mexico Natural Heritage Program (Chauvin, 1999) did not identify rare, threatened or endangered plants in either the developed area or in the proposed off-escarpment maintenance area.

No Action Alternative. There would be no adverse impacts on threatened or endangered plant or animal species.

Alternative A. The developed area is within the habitat of some state and federally-listed plant and animal species. Sewage line replacement and realignment under this alternative may adversely affect these habitats.

Alternative B. The developed area and the off-escarpment maintenance facility are within the habitat of some state and federally-listed plant and animal species. Sewage line replacement and realignment under this alternative may negatively affect these habitats. Construction of an off-escarpment maintenance facility and access road may adversely impact habitats. Detailed surveys for these species and habitats would be conducted prior to any activity and plans would be developed to mitigate potential negative impacts.

Subsurface Species

No threatened or endangered species listed by the federal or state government have been identified in the park's subsurface environment. The cave does have several colonies of bats and a colony of Cave swallows. While little microbial research has been done in Carlsbad Cavern, the conditions are favorable for microbial growth and it is likely unique microbes exist. These microbes are sensitive to changes in moisture conditions and changes in water chemistry.

No Action Alternative. There would be no adverse impacts on threatened or endangered subsurface species. This alternative would allow chronic contamination of the groundwater to continue that could adversely impact the cave's natural ecosystem.

Alternative A. There would be no adverse impacts on threatened or endangered subsurface species. The bats and Cave swallows occupy the cave from March through October, so any construction activities would take place preferably between November and February.

This alternative would reduce the amount of contaminants entering the groundwater and would reduce the adverse impacts of surface activities on the cave's natural ecosystem.

Alternative B. There would be no adverse impacts on threatened or endangered subsurface species. The bats and Cave swallows occupy the cave from March through October, so any construction activities would have to take place preferably between November and February.

This alternative would reduce the amount of contaminants more than Alternative A. It would restore more natural infiltration and moisture to the cave that is beneficial to the cave's natural ecosystem.

Cumulative Impacts: Reasonable foreseeable future actions such as rehabilitation of the visitor center, rehabilitation of the sewage collection system, and resurfacing of parking lots have the potential to adversely impact rare, threatened, or endangered plant and animal species. Since there are no activities under the No Action Alternative, this alternative would not be a component of the cumulative impacts. If further studies find rare, threatened, or endangered species in the project area, site-specific, long-term, minor adverse impacts to species under Alternatives A and B would contribute to the cumulative impacts on these species.

Conclusion: Current surveys indicate that there are no known rare, threatened, or endangered plant or animal species within the project area, although the area contains suitable habitat for some threatened or endangered species. If these species do occur within the area, there would be site-specific, long-term, minor adverse impacts to these species under Alternatives A and B. Because there would be no major, adverse impacts to a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment to park resources or values.

CULTURAL RESOURCES

The period of significance for the Caverns Historic District is 1926 to 1942. A building, structure, or element of a structure is significant if it retains enough of its original craftsmanship, style, or construction to reflect its original appearance or function during its period of significance. If a structure or element was constructed during the period of significance and supports the overall historic context of that period, then it would be contributing to the Caverns Historic District.

More recent construction that matches the character and appearance of those originating during the development of the Caverns Historic District are considered supporting. These are generally buildings less than 50-years old, so they are not eligible for the National Register, but do reflect the character of the Caverns Historic District.

Buildings like the paint storage building would be supporting to the overall district because its construction style and materials reflect the period of significance (it matches the appearance of the other structures), but non-contributing to the Historic District because it was added after the period of significance and is not individually eligible for the National Register of Historic Places.

No Action Alternative. This alternative would have no new effect on cultural resources within the Cavern Historic District and cultural landscape. The non-contributing and non-supporting elements within the Cavern Historic District would remain.

Alternative A. Most of the proposed actions would have no adverse effect on historic or archeological resources. Construction of a water collection and filtration system, repair or replacement of the sewer lines, or construction of new sewer lines, if necessary, would be planned to avoid known archeological and historical sites. Changes in the heating and cooling systems of the historic structures would be designed to have no adverse effect on those structures. Revegetation projects would be designed to avoid all archeological and historic sites. The proposed change to the Bat Cave Draw parking area would have no adverse effect on the structure since the original walls, terraces, and appearance would remain. Construction activities would temporarily introduce non-historic visual, audible, and atmospheric elements into the district's setting.

Prior to any action, the parking area would be fully documented to standards agreed to with the New Mexico SHPO. The character and integrity of the overall Caverns Historic District and cultural landscape would be retained. All of the projects described in this alternative would require additional consultation and compliance documentation with the New Mexico SHPO before they could be implemented. Pavement removal and revegetation would be designed to prevent erosion or burial of archeological and historic resources.

Alternative B. This alternative would permanently, adversely impact the Bat Cave Draw parking lot, an element of the Caverns Historic District and the cultural landscape. As in Alternative A, water collection and filtration systems, revegetation projects, and sewerline repair or replacement projects, would avoid all archeological and historic sites. Redesign of parking areas and restoration of natural drainage patterns would be designed to avoid secondary erosional effects on archeological and historic resources. Installation of alternative heating systems to historic structures would be designed so that there is no adverse effect on the structures.

The proposed changes to the Bat Cave parking area would have a permanent, adverse effect on this structure, but not on the overall character of the cultural landscape. The proposed actions would include removing or altering 300 feet (15%) of the original retaining walls of the parking area. The park would photo-document the existing condition of the retaining walls before undertaking the project. Reconstruction of the walls for the bus turn-around would be done in a manner that matches the character of the original wall and would reuse removed materials. Terraces would be revegetated with native plants with root systems that would not cause future damage to the remaining walls. The turn-around would be designed to fit within the current boundaries of the parking lot and would not expand beyond the current historic walls to the south or into the hillside to the north.

Construction of a new maintenance facility off of the escarpment would require a full archeological survey. Once detailed site plans were developed, an archeological survey of the area would be completed. Design plans and work contracts would stipulate that construction activities would have no effect on any archeological or historic properties. Environmental and cultural resource compliance would have to be done once the proposed designs were finalized.

Removal of non-historic structures in the developed area would have no adverse effect on the Caverns Historic District and cultural landscape. The automotive and carpentry shop (1962), are within the historic district and listed as supporting the historic architectural and landscape setting though not eligible for listing on the National Register. Since the period of significance for the district is considered to be 1926-1942, removal of these structures would not detract from the overall character of this Caverns Historic District.

The two Mission 66 residential units lie outside the boundaries of the Caverns Historic District. They are not eligible for the National Register. Since the period of significance for the district is defined as 1926-1942, removal of these structures would have no adverse affect on the character or integrity of the Caverns Historic District or cultural landscape. Removal of the Mission 66 residences and non-historic maintenance buildings would be done in a manner that would cause no effect on surrounding historic structures and archeological or historic sites.

Removal of the tennis court would have no adverse effect on the Caverns Historic District and cultural landscape. This structure is non-historic and lies outside the boundary of the Caverns Historic District. The removal would have no adverse effect on the integrity of the historic district. The modern structures, however, were built on top of an extensive prehistoric and historic scatter. Remains of several midden rings and other American Indian artifacts are intermingled with historic materials associated with the early living quarters of the guano mining era and the park staff. Tarpaper shacks were occupied in this area prior to the construction of the stone residences of the Caverns Historic District immediately to the west. Removal of the tennis court and other more recent structures would be designed and carried out in

consultation with the New Mexico SHPO to minimize the effects on the underlying historic remains of the site.

Under this alternative, the proposed actions would result in a permanent, major adverse effect on individual elements within the Caverns Historic District, but permanent, moderate effects on the overall cultural landscape. The proposed actions would result in no adverse effects on the overall character and integrity of the historic district. Archeological and historic sites would be protected and avoided during all construction and deconstruction phases of this plan. Since the Mission 66 residences, the non-historic maintenance structures, and the tennis court fall outside the designated period of significance, their removal could enhance the character of the Caverns Historic District by returning the appearance of the area to one similar to the early 1940s. All of the projects described in this alternative would require additional consultation and compliance documentation with the New Mexico SHPO before they could be implemented.

Cumulative Impacts: Reasonable foreseeable future actions such as rehabilitation of the visitor center, rehabilitation of the sewage collection system, and resurfacing of parking lots have the potential to adversely impact cultural resources. Since there are no activities under the No Action Alternative, this alternative would not be a component of the cumulative impacts. Permanent, minor to moderate adverse impacts to cultural resources under Alternatives A and B would contribute to the cumulative impacts on these resources.

Conclusion: There would be permanent, minor adverse impacts to cultural resources under Alternative A. There would be permanent, moderate adverse impacts to cultural resources under Alternative B. Because there would be no major, adverse impacts to a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment to park resources or values.

VISITOR USE AND EXPERIENCE

No Action Alternative. There would be no immediate effect on visitor experience under this alternative. However, long-term effects from chronic contamination, as well as from spills and accidents in the developed area, would have a major adverse impact on visitor experience at the park. Contaminants from the developed area would continue to build up in the cave and groundwater system. Spills and accidents would require surface cleanup, possibly with heavy machinery, or could require a shutdown of in-cave operations until the effects of the spill were evaluated and mitigated.

Alternatives A and B. Reducing bus access and parking in Bat Cave Draw could inconvenience visitors during peak visitation times. Since 1997, the park has been restricting access and parking to this area to handicapped visitors and buses with very few complaints. The use of off-escarpment parking and visitor shuttles would reduce the traffic on the main park road. This reduces the potential for catastrophic spills of gasoline and other materials during vehicle-vehicle accidents and helps to protect park wildlife by reducing the number of vehicle-animal accidents.

Construction activities would temporarily introduce adverse visual and audible elements to the visitor experience. Construction would take place during the off season to reduce the effects of these activities on visitors, so the impacts would be temporary and minor.

These alternatives would reduce only some of the potential cave contamination from spills of hazardous materials in Bat Cave Draw, including oil and gasoline. Reducing the potential for hazardous material contamination in the cave would ensure the safety of visitors and would prevent possible cave closures.

Alternative B. Restoration of a scene similar to that of the early 1940s would enhance the visitor experience at the park and could provide additional opportunities to interpret the park's early history for visitors. The Caverns Historic District period of significance was from the 1920s through the CCC era, closing in 1942. Preservation of the historic and landscape resources contained within the period of significance would allow the park to interpret the founding of the park and the major construction and development that took place during that period. The removal of non-historic buildings and paved areas would restore some of the natural setting of the area above the cavern.

Eliminating private vehicle parking, moving the bus turn-around and drop-off location away from the cave entrance would enhance and protect the natural qualities of the Bat Flight experience and improve the safety hazards that currently exist with vehicles driving close to pedestrian traffic near the natural entrance. This alternative would also reduce the amount of exhaust fumes and number of disturbances by vehicle headlights on the Bat Flight Program.

Cumulative Impacts: Reasonable foreseeable future actions such as rehabilitation of the visitor center, rehabilitation of the sewage collection system, and resurfacing of parking lots have the potential to adversely impact visitor use and experience. Since there are no activities under the No Action Alternative, this alternative would not be a component of the cumulative impacts. Short-term, minor to moderate adverse impacts to visitor use and experience under Alternatives A and B would contribute to the cumulative impacts on visitors.

Conclusion: There would be short-term, minor to moderate, adverse impacts to visitor use and experience under Alternatives A and B. Because there would be no major, adverse impacts to a resource or value whose conservation is 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents, there would be no impairment to park resources or values.

SOCIOECONOMICS

There are no actions under any alternatives that would limit visitation or access by the public to Carlsbad Cavern. The socioeconomic impact of the proposed and considered alternatives are therefore removed from further impact analyses.

FURTHER COMPLIANCE REQUIREMENTS AND ADDITIONAL WORK

If the preferred alternative (Alternative B) is selected, all of the following actions would be carried out. If Alternative A is selected, the actions listed under Bat Cave Draw, the existing maintenance area, and the historic office and residence area would be carried out. If the No Action Alternative is selected, none of the following actions would be necessary.

NATURAL RESOURCES

Once final design decisions are made, all affected areas will need to be re-surveyed in the proper season for all current state and federally-listed plant species. No exotic plants would be used to revegetate areas where pavement or buildings have been removed. Native species adapted to the area would be selected that would not damage cultural resources. Detailed descriptions and work scopes would be developed for each phase of the project and approved by park resource management staff prior to revegetation. The project area also contains several state-listed noxious weeds. The park would develop plans to prevent the spread of these noxious plants prior to any activities associated with the proposed alternatives.

There are several species of mammals, birds, and reptiles whose habitat may be affected by activities under the proposed alternatives. Once final design decisions are made and prior to any construction activity, site-specific surveys for these species and their habitats would be conducted.

CULTURAL RESOURCES

Memorandums of Agreement will be developed in consultation with the New Mexico SHPO, affiliated American Indian tribes, and the park to resolve adverse effects to individual historic structures, archeological of ethnographic resources, the Caverns Historic District, and the cultural landscape.

Visitor Center Area

The New Mexico SHPO would be provided with full details of parking lot redesign and evaluation of effects of redesign and modified drainage patterns on known archeological resources. Archeological monitoring of actions within 100 feet of any known archeological site would be required.

Bat Cave Draw Area

The New Mexico SHPO would be provided with full details of proposed modifications to the Bat Cave parking lot, including the bus turn-around site and modifications to the historic retaining walls; details on deconstruction and new construction methods; plans to retain the original character of the parking area within the modified structures; and complete documentation of existing conditions and setting of existing historic walls. Archeological monitoring of actions within 100 feet of any known archeological site would be required.

Existing Maintenance Area

The New Mexico SHPO would be provided with full details of demolition methods and efforts to mitigate incidental damage to historic structures; detail on new heating/cooling systems to be installed on historic structures and their effect on the integrity of the buildings; details on restoring natural drainage patterns and the effects on known historic and archeological features. Archeological monitoring of actions within 100 feet of any known archeological site would be provided.

New Maintenance Area

Once a final site and design specifications are developed, further NEPA compliance would be condcucted to evaluate the impacts of the site relocation. An archeological survey would be conducted in the area surrounding the construction site, including any adjacent roads, parking areas, and utility corridors. The New Mexico SHPO would be provided with survey results for concurrence on eligibility of sites, construction details, and any primary or secondary effects on known archeological or historic sites. The park would monitor actions within 100 feet of any known site, but would select a location away from archeological sites.

Historic Office and Residence Area

The New Mexico SHPO would be provided with full details on alternative heating/cooling systems to be added to historic structures and their effect on the integrity of the structures. Details would also be provided on installation of water containment and filtration systems, plans to repair and revegetate portions of the area, and the effects of those actions on archeological and historic sites.

Removal of Mission 66 Residences

Photo-documentation of the existing condition of the Mission 66 houses and research of associated documentation of their construction and development since 1962 would be completed prior to any demolition. The New Mexico SHPO would be provided with full details on demolition plans. Details would also be provided on efforts to avoid or mitigate effects on surrounding archeological sites or historic structures.

Tennis Court Area

A plan would be developed to remove the concrete surface without adverse impact to the underlying historic and archeological resources. This could involve limited testing for subsurface materials.

Consultation with Native American Tribes

The park has ongoing consultation relationships with 13 Native American tribes. Each of these tribes has expressed interest and concerns about the management of Carlsbad Cavern and surrounding resources. The park would consult with these tribes on each phase of this plan.

SPACE ALLOCATION PLAN

One of the primary goals of this plan is to protect cave resources while maintaining services and facilities for the public. Some resource protection can be accomplished through management decisions and changes in park policy. One such decision reduces the number of residents and employees in the developed area above Carlsbad Cavern. Reducing the number of residents reduces the amount of sewage generated and the number of vehicles parked above the cave.

As of June 2000, there were approximately 50 residents occupying the housing area on the north side of Bat Cave Draw. The park has instituted a policy of not providing housing for new, permanent employees. By October 31, 2001, all of the permanent employees, except for three required-occupant law enforcement officers, were moved out of the park. There are currently at most 22 (summer maximum) residents in the housing area, reducing the total by 28 people (56%) from previous levels.

Medium-term Plans

The goal over the next one to five years is to reduce the number of residents by more than 50%. The east group of Mission 66 buildings will be used for five to ten years as office and curatorial space for the Resources Stewardship and Science Division. This space is needed during the visitor center rehabilitation that is proposed to begin within the next five years. During this time, the possibility of constructing or leasing office space off of the escarpment will be investigated.

All of the required occupants and most of the seasonal and volunteers will be moved into the historic buildings. The women's seasonal dorms will be located in one of the western Mission 66 buildings.

An engineering evaluation will be performed on the existing sewage collection system to determine which lines need to be replaced to stop sewage releases. Priorities will be established for replacement and rehabilitation of sewage lines based on resource protection and availability of funds. During this time, additional funding sources will be located for long-term facility removal and/or relocation.

Long-term Plans

The park will maintain housing for 17 to 20 seasonal and volunteer employees, and temporary research housing in the historic buildings. At the same time, the park will pursue options to provide seasonal dorm space off the escarpment and may provide a transportation service to the park to reduce the impacts of vehicles on park resources. This would reduce the impacts from resident vehicles by almost 90% and would reduce the sewage output from residents by almost 95%. The park will also examine options for removing non-essential office, storage, and curatorial functions out of the developed area.

REFERENCES

Bremer, Mark. 1998. Preliminary assessment of environmentally-sound methods for treating and/or diverting rainwater run-off from parking lots and roads in the vicinity of Carlsbad Cavern. National Park Service draft report.

Brooke, Mark. 1996. Infiltration pathways at Carlsbad Caverns National Park determined by hydrogeologic and hydrochemical characterization and analysis. Master's Thesis, Colorado School of Mines, Golden, Colorado.

Carr, Ethan and Sarah Allabeck. 1998. Mission 66: Contextual history of National Park Service planning, design, and construction, 1945-1972, Draft Proposal.

Chauvin, Yvonne. 1999. Plant species survey for Carlsbad Cavern developed area. New Mexico Natural Heritage Program, University of New Mexico Biology Department. Report to Carlsbad Caverns National Park.

Colby, Catherine. 1988. National Register of Historic Places, inventory — nomination form, The Caverns Historic District, National Park Service.

Cunningham, K.I., D.E. Northup, R.M. Pollastro, W.G. Wright, E.J. LaRock. 1995. Bacteria, fungi and biokarst in Lechuguilla Cave, Carlsbad Caverns National Park, New Mexico. In: Deep-seated geochemical environments in karst. A.N. Palmer (editor) Environmental Geology. 25; 1, Pages 2-8. Springer International. New York-Berlin, International.

Carlsbad Caverns National Park. 1996. Final General Management Plan and Environmental Impact Statement, Carlsbad Caverns National Park, Carlsbad, New Mexico.

Cave and Karst Management Plan, Carlsbad Caverns National Park, 1995. On file at Carlsbad Caverns National Park, New Mexico.

Ek, David. 1991. Master list of cave invertebrates found within Carlsbad Caverns National Park. On file in cave resources office, Carlsbad Caverns National Park, New Mexico.

Federal Cave Resources Protection Act of 1988. 102 Stat. *4546*. Public Law 100-691-Nov.18, 1988. H.R. 1975.

Hunt, James B. 1999. Class III archeological survey report for the United States Department of the Interior's National Park Service, Carlsbad Caverns National Park, PAC Report No. 99041, NMCRIS No. 66195.

National Park Service, Carlsbad Caverns National Park, 2001. Briefing statement for the Appropriations Subcommittee Hearing on the wastewater system rehabilitation project. On file at Carlsbad Caverns National Park, NM.

National Park Service, 2001. DO#12, Conservation Planning, Environmental Impact Analysis and Decision Making.

National Park Service, 1997. DO#28, Cultural Resource Management Guideline.

National Park Service, 2001. Management Policies.

Northup, D.B., M.N. Spilde, and P.J. Boston, 1999. Microbial interactions with the limestone walls of Lechuguilla Cave, Carlsbad Caverns National Park, New Mexico, USA. Journal of Conference Abstracts, v.4(2):95, 11th Bathurst Meeting July 13th-l8th, 1999 Cambridge, United Kingdom.

Northup, D.B., K. Lavoie, and L. Mallory. 1997. Microbes in Caves. NSS News, v.55(4): 111.

Northup, D.B., D.L. Carr, M.T. Crocker, K.I. Cunningham, L.K. Hawkins, P. Leonard, W. C. Welbourn. 1994. Biological Investigations in Lechuguilla Cave. December, 1994 NSS Bulletin 56(2): 54-63.

van der Heijde, Paul K.M., Kenneth B. Kolm, Helen Dawson, Mark Brooke. 1997. Determining water infiltration routes from buildings located above Carlsbad Cavern, Carlsbad Caverns National Park, Carlsbad, New Mexico. International Groundwater Modeling Center report IGWMC-GWMJ 97-01, Golden, Colorado.

CONSULTATION/COORDINATION

Prepared By

Paul Burger, Hydrologist, Carlsbad Caverns National Park
Mark Bremer, Civil Engineer, Carlsbad Caverns National Park
Mark Pritchett, Landscape Architect/Job Captain, Denver Service Center

Carlsbad Caverns National Park

Paula Bauer, Interpretive Ranger
Dan Cockrum, Former Chief of Facility Management
Earl Coppersmith, Buildings and Utilities Foreman
Jeff Denny, Former Cultural Resource Specialist
Frank Deckert, Former Superintendent
Ed Greene, Chief of Interpretation
Aleta Knight, Project Coordinator and Compliance Officer
Dale Pate, Cave Resources Branch Chief
Jason Richards, Environmental Protection Specialist
David Roemer, Biologist, GIS Specialist
Jimmy Sillas, Roads and Trails Foreman
Gary Vequist, Former Chief, Resource Management and Visitor Protection
Renee West, Biological Resources Branch Chief

Denver Service Center

Ken Franc, Project Manager
Bob Merrick, Civil Engineer
Mark Tabor, Landscape Architect
Sandy Schuster, Editor

Intermountain System Support Office

Brian Carlstrom, GIS Specialist

Appendix 1. Estimated Costs of Preferred Alternative

(based on NPS, Denver Service Center Class C estimate in 2002 dollars)

Description		Cost
Employee Residence Area		
Remove existing Mission 66 residences		$ 166,038
Remove 6000 gallon propane tank		$ 6,000
Change HVAC system		$ 265,661
	Subtotal	**$ 437,699**
Existing Maintenance Area		
Remove non-historic maintenance buildings		$ 33,123
Revegetate site		$ 2,188
Remove 1000 gallon propane tanks		$ 4,862
Remove 2000 gallon UST		$ 36,465
Adapt remaining buildings for office and storage space		$ 270,450
Change HVAC system		$ 86,544
	Subtotal	**$ 433,632**
Off Escarpment Maintenance Area		
Construct new general maintenance buildings		$2,215,260
Construct paint storage building		$ 158,016
Construct parking/maintenace yard		$ 243,101
Construct access road		$3,008,378
Install water lines		$ 65,637
Install sewage lines		$ 82,654
Install electrical and telephone lines		$ 87,516
Revegetation		$ 109,396
	Subtotal	**$5,969,958**
Bat Cave Draw		
Remove Pavement		$ 84,852
Install storm water treatment (catch basins)		$ 18,233
Provide HC parking		$ 40,112
Construct Shuttle turn-around		$ 218,791
Revegetation		$ 43,758
	Subtotal	**$ 405,746**
Existing Visitor Center Area		
Install storm water treatment (catch basins)		$ 36,465
Reconfigure parking		$ 121,551
Seal and chip parking lots		$ 493,981
Construct enclosed wash area for restaurant		$ 30,388
Construct spill containment area and new diesel tank filling area		$ 60,775
	Subtotal	**$ 743,160**
Sewage System Improvements- Collection		
Includes construction and revegetation	Subtotal	**$ 127,500**
Sewage System Improvements- Outfall		
Includes construction and revegetation	Subtotal	**$1,240,000**
GROSS TOTAL		**$9,357,695**

Appendix 2. Overflow Mitigation Program

- Manually pump cave-holding tank three days a week (Tuesday, Thursday, and Saturday). Manual pumping increases water flow through holding tank and system, and decreases collection and buildup of solid materials.

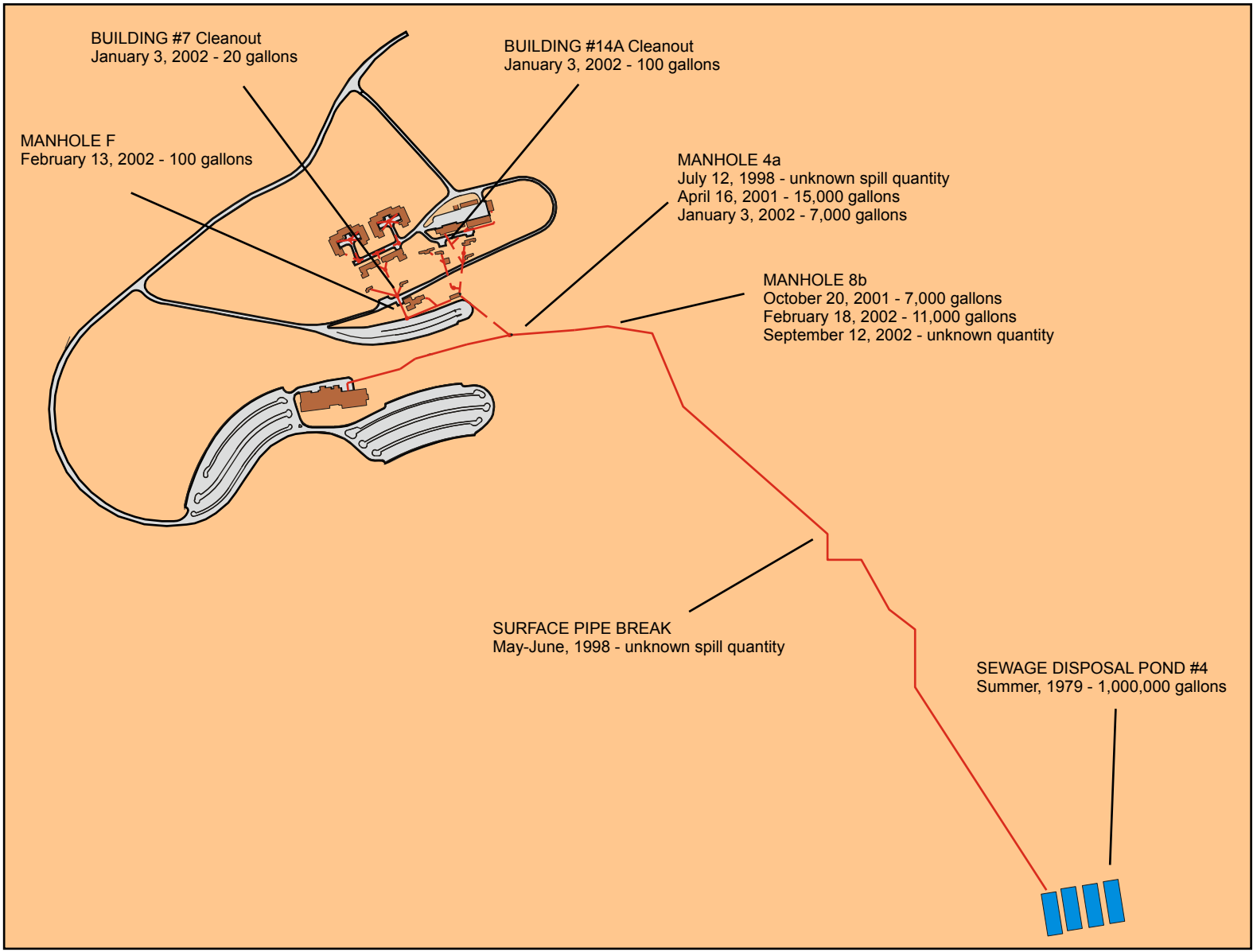
- In 2001, installed high-density polyethylene interior linings on manhole covers. This action decreased the amount of exfoliating material from steel lids from collecting in manholes and contributing to line blockages.

- Contract for annual professional cleaning of sewer outfall system. Service will commence in FY 2003.

- Annual inspection of all sewer outflow manholes for buildup of solid debris will commence in FY 2003.

- A Line Item PMIS package to replace the complete outfall sewer line is scheduled for commencement in 2003.

- Barring extreme circumstances, unplugging of outfall sewer lines will occur only during daylight. The increased safety risks for park personnel caused by night operations is clear and warrants delaying work until daylight. The required equipment for unplugging the outfall line is heavy, bulky, and requires at least two people to move, setup, and operate. The terrain is uneven, treacherous, and rattlesnakes are present. Precautions, including notifying residents in park will result in minimizing or completely avoiding any discharge at night.



Sewage System Spill Locations, Dates, and Quantities

Carlsbad Cavern Resource Protection Plan

Carlsbad Caverns National Park

US Department of the Interior

National Park Service

north

0 200 600 *FEET*