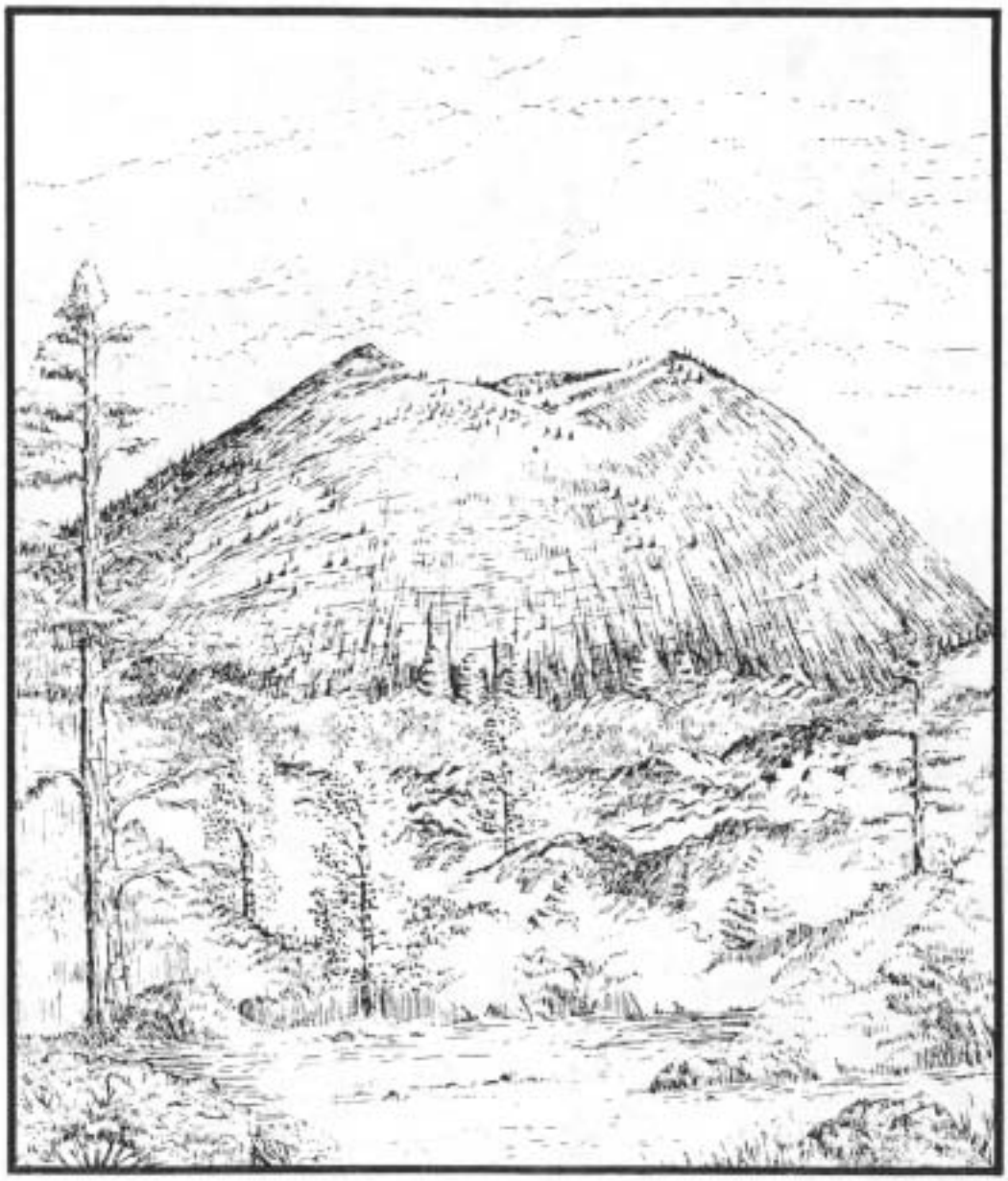
# Draft Environmental Impact Statement
# Draft General Management Plan

**September 2001**



# SUNSET CRATER VOLCANO

**National Monument • Arizona**

# Draft Environmental Impact Statement
# Draft General Management Plan

# SUNSET CRATER VOLCANO
## National Monument • Arizona

SUMMARY:

This general management plan will guide the management of the Sunset Crater Volcano National Monument for the next 10 to 15 years. Four alternatives were considered—a no-action and three action alternatives, including the National Park Service preferred alternative. The preferred alternative would provide increased educational opportunities and diverse experiences both within and outside of park boundaries. The park would be viewed as a destination for education and learning. Partnerships with the USFS, affiliated tribes, and educational institutions would provide interpretation and more consistent management of sites and features outside the park that are primary to the park's purpose. Boundaries would be adjusted for ease of management and to better protect geologic features. Most existing uses would continue. The park would remain day-use only, with 24-hour access on FR545, and visitor use would be spread throughout more resources. A new multiagency visitor center would be built near US89 to serve as the primary location to orient and serve visitors, and the existing visitor center would be adapted for use as an education center. The environmental impact statement assesses impacts to archeological resources; historic character of the built environment; long-term integrity of ethnographic resources, natural systems and processes, and geological resources; threatened, endangered, and sensitive species; visitors' ability to experience park resources; park neighbors, local, state, and tribal land management plans and land/resource managing agencies; and operational efficiency.

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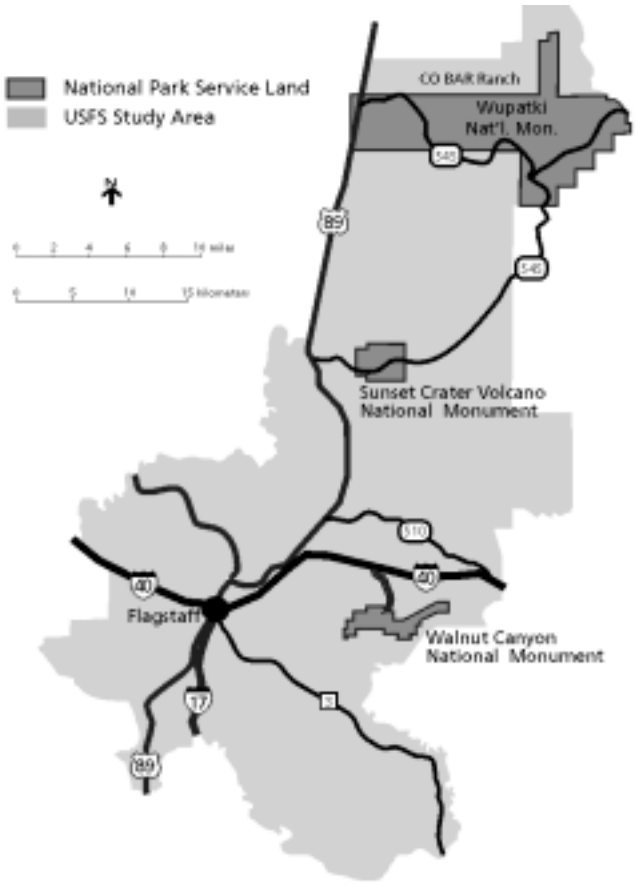
# PURPOSE OF AND NEED FOR THE PLAN

## PURPOSE OF THE GMP

The purpose of the general management plan (GMP) is to clearly define a direction for resource preservation and visitor use at Sunset Crater Volcano National Monument (NM). Wupatki is currently operating under a Master Plan approved in June 1982. It is the intent of this planning effort to provide a comprehensive direction for the next 10 to 15 years and to arrive at that direction through public participation. In fact this draft GMP is the result of extensive interaction with interested publics and affected government agencies begun in June 1996 (see Description of Scoping Process and Consultation and Coordination sections).

The approved plan will provide a framework for proactive decision making, including decisions on visitor use, natural and cultural resources management, and park development, which will allow park managers to effectively address future opportunities and problems. The general management plan will prescribe the resource conditions and visitor experiences that are to be achieved and maintained in the park over time. The clarification of what must be achieved according to law and policy is based on review of the park's purpose, significance, special mandates, and the body of laws and policies directing park management. Management decisions to be made where law, policy, or regulations do not provide clear guidance or limits will be based on the purpose of the monument, the range of public expectations and concerns, resource analysis, an evaluation of the natural, cultural, and social impacts of alternative courses of action, and consideration of long-term economic costs.




Combined USDA - USFS Flagstaff/Lake Mary Ecosystems Analysis and DOI - NPS Flagstaff Area National Monuments General Management Plan Study Area

Some of those conditions and experiences are specified already in law and policy, whereas others are open to debate and must be determined through planning. Based on determinations of desired conditions, the plan will outline the kinds of resource management activities, visitor activities, and development that would be appropriate in the monument in the future. However, the plan will not propose specific actions or describe how particular programs or projects will be implemented or prioritized. Those decisions will be

deferred to more detailed implementation planning, which will follow the broad, comprehensive decision making outlined in the general management plan.

## NEED FOR THE GMP

There were many issues and concerns that precipitated the need for a GMP. Administratively, the three parks of the Flagstaff Area (Wupatki, Sunset Crater Volcano, and Walnut Canyon National Monuments) were combined under one superintendent in 1990.Nationwide demographics and traffic patterns (Sunbelt migration, international visitors, aging of America, shorter vacations year-round) have increased peak visitation seasons and extended shoulder seasons. Flagstaff growth and housing development is occurring near park boundaries, impacting the visitor experience and remote character of the monument and increasing incompatible adjacent land uses. Traffic levels are increasing adjacent to and through the park; views are intruded on by mining operations, housing developments, and divided highways; and noise is increasing.

When Sunset Crater Volcano National Monument was established in 1930, boundaries were drawn around the volcano and its primary lava flow. Many associated features, such as the Kana-A lava flow, Bonito Park, related cones along the eruptive fissure line, and evidence of the displaced prehistoric community, are outside the monument boundary.

The park entrance road, Forest Road 545 (FR545), is maintained by the National Park Service (NPS) and cuts across the flank of Sunset Crater Volcano, creating impacts on natural features of the park. Although both Wupatki and Sunset Crater Volcano are closed at night, the access road common to both is not gated. The Park Service provides 24-hour emergency response along its entire 36 miles, 15 miles of which are in the monuments.

Development on private lands between Sunset Crater Volcano and Wupatki has produced year-round commuter traffic, which is increasing. Increased traffic has resulted in increased maintenance needs, occasional traffic accidents that need to be investigated by NPS rangers, occasional trash and garbage being left in park containers or along roadsides, and an increase in necessary contacts at the entrance station.

Visitor use and administrative needs exceed the capacity of the Sunset Crater Volcano visitor center. The visitor center is easily missed by visitors and lacks a view of, or immediate access to, the volcano or any major park features. Many visitors believe they will see a "crater," and the demand for a view of this aspect of the primary resource is unmet. (The volcano was closed to hiking in 1973 because of resource impacts.) Interpretive media are outdated or inaccurate, and there is no consistent integrated message between this and the other two Flagstaff Area monuments. Interpretive programs are offered as staffing permits.

Trampling of volcanic and other natural features has occurred both inside and outside of the monument. Trails are difficult to maintain on cinder and lava surfaces, and routes are sometimes unclear because of social trails. All of the area immediately surrounding the monument is managed by the U.S. Forest Service (USFS); the viewshed and natural soundscapes, however, are substantially impaired by nearby pumice mining at the base of the San Francisco Peaks and by off-road vehicle activities in the Cinder Hills area. The Cinder Hills Off-Highway Vehicle (OHV) Area occupies about 13,500 acres adjacent to and southeast of the monument. Activities within the area are largely unregulated and often result in physical intrusion onto the monument as well as visual and audible impacts to monument visitors. The OHV area is visible

from the Cinder Hills Overlook and within the monument boundary. The proximity of cinder cones that are protected to the degree of denying pedestrian traffic (within the monument), so near to similar formations that are allowed unlimited vehicular access (within the OHV Area) often evokes visitor comment. Substantial numbers of Cinder Hills users choose to travel through the monument to reach the OHV area.

In 1998, the staff of the Flagstaff Areas undertook an in-depth review and analysis of staffing needs for the three monuments and for support positions in headquarters. This process identified critical positions in visitor services, protection, resource management, maintenance, and administration that are integral to accomplishing the purposes of the monuments and the National Park Service mission. This review evaluated existing conditions and personnel shortfalls in terms of National Park Service abilities to provide for a safe, educational visitor experience and for adequate protection and preservation of park resources. A number of positions were identified as critical to maintaining operations at acceptable levels, for both current and future needs. These needs were identified prior to the general management planning process and are incorporated into the alternatives developed.

## Reaffirm What Must Be Achieved

Each unit in the National Park System is guided by agency-wide and park-specific laws, regulations, and policies. Understanding this guidance and how it affects each park's mission is fundamental to planning for the park's future. This section highlights the mission (expressed as park purpose, significance, and mission goals) and legal and policy mandates that guide management of the park. These mission and mandate statements define the sideboards within which all management actions must fall. All alternatives to be considered in the general management planning effort must be consistent with and contribute to fulfilling these missions and mandates.

### PARK MISSION

Sunset Crater National Monument was established by Presidential Proclamation No. 1911 on May 26, 1930, to provide proper protection for certain geologic formations. The monument name was changed November 16, 1990, to Sunset Crater Volcano National Monument by the Smith River National Recreation Act, P.L. 101-612. The monument occupies 3,040 acres totally surrounded by the Coconino National Forest.

The following purpose statement is based on and represents the agency's interpretation of the above-mentioned legislative mandates and NPS policies. The park purpose statement is the most fundamental criterion against which the appropriateness of all plan recommendations, operational decisions, and actions are tested.

- To preserve and protect Sunset Crater Volcano National Monument's geological formations, features, and resources for scientific interests and research, and for public interest, including scenic, educational, and recreational pursuits.

Park significance statements capture the essence of the park's importance to the nation's natural and cultural heritage. Understanding park significance helps managers to make decisions that preserve the resources and values necessary to the park's purposes. The following significance statements have been developed for Sunset Crater Volcano National Monument:

- Sunset Crater Volcano is the Colorado Plateau's most recent eruption of the

San Francisco Peaks Volcanic Field and is one of the longest-lived cinder cone volcanoes known in historic time, with an eruptive cycle that may span more than 100 years.

- The volcanic eruption profoundly affected people in the area and their lifeways and left a unique archeological and ethnographic record of human adaptation, response, and recovery to volcanic eruption. Sunset Crater Volcano and its natural resources continue to have cultural significance to contemporary native tribes.
- The park's volcanic features are seen now with few human disturbances and provide excellent opportunities for science, education, and interpretation, including insight into plate tectonics, ongoing geologic and ecological processes, and a larger view of how this area is important in the context of Southwestern U.S. and world geology. This dramatic landscape of visually striking and colorful geologic features provokes introspection.
- The microhabitat and climate of Sunset Crater Volcano create an unusual species mix, including lichens, molds, and endemic species that are highly visible examples of the scientific concepts of succession and adaptation.

## MISSION GOALS

Mission goals were developed for the three units in the Flagstaff Area National Monuments Strategic Plan (NPS 2000). They state that:

- Natural and cultural resources and associated values within the three Flagstaff Area monuments are protected and maintained in good condition and managed within their broader ecosystem and cultural contexts.
- Flagstaff Area National Monuments actively pursue acquisition of natural and cultural resource data through NPS staff and funding channels and through association with the scientific community. Current and complete scientific findings are available for communication to partners, integration into the interpretive program and use in the management decision process.
- Facilities, services, and recreational opportunities offered are in keeping with site-specific requirements of resource protection and visitor enjoyment. Safety measures are an integral part of the visitor experience.
- Through on-site and off-site education, the Flagstaff Area National Monuments promote visitor understanding of park purpose and significance, enhance appreciation and enjoyment, and promote an attitude of personal responsibility.
- Flagstaff Area National Monuments use current management practices, systems, and technologies to accomplish their missions.
- The Flagstaff Area National Monuments increase their capabilities through initiatives and support from other agencies, organizations, and individuals.

## SPECIAL MANDATES AND ADMINISTRATIVE COMMITMENTS

The monument has numerous special use agreements with other agencies:

*Law Enforcement Agreements between USFS and NPS:* National, regional, and local agreements exist that allow law enforcement operations on each other's lands.

*Memorandum of Understanding with Coconino County Sheriff's Department:* Outlines areas of responsibility within the national monument and provides for the deputization of NPS protection park rangers through the Coconino County Sheriff's department.

*Interpretive Partnership:* This partnership, which has been in operation for seven years, coordinates interpretive activities on NPS and USFS lands and encourages consistent messages through shared staffing.

*Cooperative Agreement with Department of Anthropology, Northern Arizona University:* Provides assistance to NPS for various cultural resource management activities, using NAU students and faculty to complete projects.

*Memorandum of Understanding with Museum of Northern Arizona:* Allows the museum to store and care for various artifacts from the three Flagstaff Area monuments, while retaining NPS ownership of the collection.

*Cooperative Agreement with Southwest Parks and Monument Association (SPMA):* Allows SPMA to operate a bookstore in each of the Flagstaff Area monuments and headquarters, with support provided to NPS from those sales.

*Memorandum of Understanding between USFS and NPS:* Outlines the responsibilities and uses of the administrative area at Sunset Crater Volcano National Monument, where there are NPS facilities on USFS lands, as well as the maintenance and jurisdiction on FR545.

*Doney Park Water Company Agreement:* Provides water for the Sunset Crater developed area, including Bonito Campground; establishes limits for water consumption/use.

## SERVICEWIDE LAWS AND POLICIES

As with all units of the National Park System, management of Sunset Crater Volcano National Monument is guided by the 1916 act creating the National Park Service, the General Authorities Act of 1970, the act of March 27, 1978, relating to the management of the National Park System, and other applicable federal laws and regulations, such as the Endangered Species Act and the National Historic Preservation Act.

Many resource conditions and some aspects of visitor experience are prescribed by these legal mandates and NPS policies. Although the attainment of some of these conditions has been deferred in the monument because of funding or staffing limitations, NPS will continue to strive to implement these policies at the monument with or without a new GMP. The GMP is not needed to decide, for instance, whether or not it is appropriate to protect endangered species, control exotic species, improve water quality, protect archeological sites, provide access for visitors with disabilities, or conserve artifacts.

The conditions prescribed by laws, regulations, and policies most pertinent to the planning and management of the monument are summarized in this section.

### Impairment

Current laws and policies require the analysis of potential effects to determine whether or not actions would impair park resources.

| Desired Condition | Source |
|---|---|
| While Congress has given the Service the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement (enforceable by the federal courts) that the Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise.<br><br>The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the | Management Policies |

| Desired Condition | Source |
|---|---|
| professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts. | |

The fundamental purpose of the National Park System, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the National Park Service the management 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. Although Congress has given the National Park Service the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or 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 it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park. A determination of impairment is made in the Environmental Consequences section for each impact topic.

## Natural Resource Management Requirements

### Air Quality

Sunset Crater Volcano is a class II air quality area. Current laws and policies require that the following conditions be achieved in the monument for air quality:

| Desired Condition | Source |
|---|---|
| Air quality in the monuments meets national ambient air quality standards (NAAQS) for specified pollutants. | Clean Air Act; NPS Management Policies |
| Park activities do not contribute to deterioration in air quality. | Clean Air Act; NPS Management Policies |

Overall, the regional air quality is good. Air flows generally down and away from the adjacent San Francisco Peaks and does not allow concentrations of most pollutants to accumulate within the monument. However, rapid growth and development in the Flagstaff area could begin to affect air quality in the parks. Some regional haze issues already exist in the Sunset Crater Volcano area, which is in the same airshed as Grand Canyon National Park. Current passive ozone monitoring at the monument indicates some elevation of ozone levels (ca 60 ppb) during the summer months prior to the onset of the monsoon season in July. Although the National Park Service has very little direct control over air quality within the airshed encompassing the monument, the Flagstaff Areas cooperate with the Arizona Department of Environmental Quality (ADEQ) and the Environmental Protection Agency to monitor air quality and ensure that air quality is not impaired.

The National Park Service will take the following kinds of actions to meet legal and policy requirements related to air quality:

- Enhance monitoring of localized air quality by establishing long-term monitoring stations for visibility impairment in the Sunset Crater Volcano area and continue monitoring ozone at the monument. (Air quality monitoring will be conducted in conjunction with regional air quality agencies.)
- Participate in regional air pollution control plans and regulations and review of permit applications for major new air pollution sources.
- Conduct park operations in compliance with federal, state, and local air quality regulations.

**Water Resources**

Current laws and policies require that the following conditions be achieved in the monument for water resources:

| Desired Condition | Source |
|---|---|
| The Service will perpetuate surface waters and groundwaters as integral components of park aquatic and terrestrial ecosystems. | Clean Water Act; Executive order 11514; NPS Management Policies |
| The Service will determine the quality of park surface and groundwater resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside of parks. | Clean Water Act; Executive Order 12088; NPS Management Policies |
| Natural floodplain values are preserved or restored. | Executive Order 11988; Rivers and Harbors Act; Clean Water Act; NPS Management Policies |
| The natural and beneficial values of wetlands are preserved and enhanced. | Executive Order 11990; Rivers and Harbors Act; Clean Water Act; NPS Management Policies |

Surface water resources within Sunset Crater Volcano National Monument are almost nonexistent, except for local catchments upon lava flows and seepage areas around the perimeter of lava flows. There are relatively deep aquifers beneath the monument, one of which is used for drinking water. The monument includes areas of deep cinder deposits, and overlies aquifer-bearing geologic formations that are extensively fractured by volcanic vents and fissures. In this regard the monument may serve as a local aquifer recharge area.

The National Park Service will take the following kinds of actions to meet legal and policy requirements related to water resources:

- Apply best management practices (BMP) to all pollution-generating activities and facilities in the parks, such as NPS maintenance and storage facilities and parking areas; minimize use of pesticides, fertilizers, and other chemicals and manage them in keeping with NPS policy and federal regulations.
- Promote greater public understanding of water resource issues and encourage public support.

### Geologic Resources

Current laws and policies require that the following condition be achieved in the park for geologic resources:

| Desired Condition | Source |
|---|---|
| Geologic features will be protected. Certain fragile geologic features will be monitored to determine if measures are needed to prevent or stop human-caused damage (areas of special management considerations will be determined through management zoning decisions in the GMP). | Monuments' enabling legislation; NPS Management Policies |

Sunset Crater Volcano is very young in geologic time and one of the few undisturbed cinder cone volcanoes within northern Arizona. The volcano offers unique insight into fresh lava and cinder weathering processes, soil formation, and pioneering vegetation establishment. Geologic resources in the monument are adversely affected by disturbance to unique cinder volcano, lava flow, cinder barren, spatter cone, and other volcanic features caused by human activities inside and outside park boundaries. Inside the park, some areas receiving heavy visitor use suffer from severe erosion on cinder cone slopes, and the breakage and loss of lava and spatter cone surfaces. This is particularly evident on the abandoned crater overlook trail and along the Lava Flow Trail. Areas of deep cinder deposits are easily disturbed by human trampling, which hinders the development of soils and survival of vegetation.

The National Park Service will take the following kinds of actions to comply with legal and policy requirements related to geologic resources:

- Inventory and map specific volcanic features in order to determine their relative uniqueness and assess current damage levels.
- Initiate studies of the deep cinder deposits to understand off-trail trampling impacts to natural soil formation and vegetation establishment processes.
- Take actions appropriate to the management zone to deter further damage to unique volcanic features, possibly including the strategic placement of handrail barriers and information on the sensitivity of these features.

### Species of Special Concern

Current laws and policies require that the following conditions be achieved for species of special concern in the park:

| Desired Condition | Source |
|---|---|
| Federal- and state-listed threatened and endangered species and their habitats are sustained. | Endangered Species Act; NPS Management Policies |
| Populations of native plant and animal species function in as natural a condition as possible except where special management | Monuments' enabling legislation; NPS Management Policies |

| Desired Condition | Source |
|---|---|
| considerations are warranted. (Areas with special management considerations will be determined through management zoning decisions in the GMP.) | |
| The Service will strive to restore extirpated native plant and animal species to parks when specific criteria are met. | Monuments' enabling legislation; NPS Management Policies |
| Management of populations of exotic plant and animal species, up to and including eradication, will be undertaken wherever such species threaten park resources or public health and when control is prudent and feasible. | NPS Management Policies; Executive Order 13112, Invasive Species |

Many natural areas support populations of species that are sensitive to human disturbance and development. If these species are in serious decline, they are protected by law. Preserving the prehistoric landscape of Sunset Crater Volcano may also provide a unique refuge for certain species that are sensitive to other land uses. Two unique plant species are found only within the areas of deep cinder deposits. Fractured lava flows and lava tube features may provide habitat for rare bat species and other unique wildlife. Certain rare plant species may be subject to collection for cultural reasons, and better information on them is needed to ensure that populations remain stable.

In addition, the monument provides foraging habitat for the endangered Mexican spotted owl and northern goshawk, which are known to occur nearby in surrounding U.S. Forest Service lands. Although not officially listed as threatened or endangered, pronghorn antelope are declining in the region. Seasonal pronghorn antelope movements are completely thwarted in areas where fenced roadsides form continuous barriers.

Development for visitor access, visitor use, and administrative activities within the monument influences plant and animal species distribution. Roads divide natural areas, and act as barriers or create crossing hazards for wildlife. Roads, trails, and disturbed areas also function as corridors for invasive species to move into the monument, which may alter unique habitats and completely displace rare species. A sustained effort is needed to control these threats to native vegetation and wildlife habitats.

The National Park Service will take the following kinds of actions to comply with legal and policy requirements related to native species and to manage the park "in as natural a condition as possible":

- Inventory and catalog the plants and animals occurring in the monument.
- Regularly monitor the distribution and status of selected species that are (1) indicators of healthy ecosystem function and inherent biodiversity, (2) rare or protected, (3) nonnative, and (4) native species capable of creating resource problems (e.g., overpopulation may result in undue competition or alter available habitat for other species).
- Nurture research that contributes relevant knowledge for conserving native species and ecosystem processes.
- Restore species populations and their habitats where feasible.
- Manage native species in management zones designated for historic scene, active recreation, operations, or other prescribed uses; plantings of nonnative species in such zones would follow NPS policies (e.g., limited use of noninvasive plants only where justified by historic scene or operational needs).

- Control or eliminate nonnative invasive plants and animals where there is a reasonable expectation of success and sustainability; control efforts would be prioritized in order of:
  - threat to legally protected or uncommon native species and habitats
  - threat to visitor health or safety
  - threat to scenic and aesthetic quality
  - threat to common native species and habitats
- Manage diseases and pests in similar priority order to those listed above for nonnative species.
- Educate visitors and neighbors on threats to native species and ways to conserve these species.
- Cooperate with Arizona Game and Fish, the U.S. Forest Service, Arizona Department of Transportation (ADOT), and local landowners to sustain the regional pronghorn antelope herd.

### Wildland Fire

Current laws and policies require that the following conditions be achieved regarding wildland fire in the park:

| Desired Condition | Source |
|---|---|
| Park fire management programs are designed to meet park resource management objectives while ensuring that firefighter and public safety are not compromised. All wildland fires are effectively managed through application of the appropriate strategic and tactical management options. | NPS Management Policies, National Fire Management Plan |

A fire management plan and environmental assessment will be prepared for Sunset Crater Volcano National Monument. The plan will identify the appropriate tactics for suppressing wildfires and the objectives for using management-ignited fire. Aggressive suppression tactics are only proposed when human life, property, and adjacent ranch lands are threatened. Wupatki has agreements with neighboring fire protection agencies to efficiently share local personnel, equipment, and funds for fire emergency response. In the event a large, regional fire should occur, the monument would participate in an appropriate response as coordinated by the National Interagency Fire Center.

Although Sunset Crater Volcano's 3,000 acres are dominated by expanses of barren lava and cinder deposits, there are pockets of mature ponderosa pine forest and pinyon woodland that could sustain a wildfire. Forest vegetation surrounding the monument likely burned more frequently in the past, which promoted native herbaceous cover and biodiversity, thinned trees, and prevented dead wood accumulation and intensely hot fires. Limited management-ignited fires may be proposed, mainly to restore the role of fire to local forests and meadows.

The Park Service will take the following kinds of actions to comply with legal and policy requirements related to fire management:

- Suppress all unwanted wildfires as quickly as possible.
- Initiate research into the role of fire in maintaining natural vegetation within the monument; use the results to identify desired vegetation condition and management-ignited fire objectives; revise the Fire Management Plan accordingly.
- Ensure management-ignited fires comply with Arizona Department of Environmental Quality air quality regulations.

### Night Sky

The monument's night skies are features that contribute to the visitor experience.

| Desired Condition | Source |
|---|---|
| The Service will preserve, to the greatest extent possible, the natural lightscapes of parks, which are natural resources and values that exist in the absence of human-caused light. Recognizing the roles that light and dark periods play in natural resource processes and the evolution of species, the Service will protect natural darkness and other components of the natural lightscape in parks. To prevent the loss of dark conditions and of natural night skies, the Service will seek the cooperation of park visitors, neighbors, and local government agencies to prevent or minimize the intrusion of artificial light into the night scene of the ecosystems of parks. | NPS Management Policies |

The National Park Service will take the following kinds of actions to comply with this policy:

- Monument staff will work with local communities and other agencies to encourage protection of the night skies.
- Monument staff will evaluate impacts on the night skies caused by facilities within the monument. If light sources within the monument are determined to be affecting night skies, monument staff will study alternatives, such as shielding lights, changing lamp types, or eliminating unnecessary sources.

### Natural Soundscapes

An important part of the NPS mission is to preserve or restore the natural soundscapes associated with national parks. The sounds of nature are among the intrinsic elements that combine to form the environment of our national parks. The natural ambient soundscape is the aggregate of all the natural sounds that occur in parks, together with the physical capacity for transmitting natural sounds. Natural sounds occur within and beyond the range of sounds that humans can perceive and can be transmitted through air, water, or solid materials. Natural sounds are slowly and inexorably disappearing from most NPS units.

| Desired Condition | Source |
|---|---|
| The National Park Service will preserve, to the greatest extent possible, the natural soundscapes of parks. The Service will restore degraded soundscapes to the natural condition wherever possible and will protect natural soundscapes from degradation due to noise (undesirable human-caused sound).<br>Using appropriate management planning, superintendents will identify what levels of human-caused sound can be accepted within the management purposes of parks. The frequencies, magnitudes, and durations of human-caused sound considered acceptable will vary throughout the park, being generally greater in developed areas and generally lesser in undeveloped areas. In and adjacent to parks, the Service will monitor human activities that generate noise that adversely affects park soundscapes, including noise caused by mechanical or electronic devices. The Service will take action to | NPS Management Policies |

| Desired Condition | Source |
|---|---|
| prevent or minimize all noise that, through frequency, magnitude, or duration, adversely affects the natural soundscape or other park resources or values, or that exceeds levels that have been identified as being acceptable to, or appropriate for, visitor uses at the sites being monitored. | |

The Park Service will take the following kinds of actions to comply with this policy:

- Activities causing excessive or unnecessary unnatural sounds in and adjacent to parks, including low-elevation aircraft overflights, will be monitored, and action will be taken to prevent or minimize unnatural sounds that adversely affect park resources or values or visitors' enjoyment of them.
- NPS will work with the Federal Aviation Administration (FAA), tour operators, commercial businesses, and general aviation interests to encourage aircraft to fly outside of the monument, especially for those flights where the presence of the monument is incidental to the purpose of the flight (i.e., transit between two points). Actions that might be considered to encourage pilots to fly outside the monument include identifying the monument on route maps as a noise-sensitive area, educating pilots about the reasons for keeping a distance from the park, and encouraging pilots to fly in compliance with FAA regulations and advisory guidance, in a manner that minimizes noise and other impacts.
- Monument staff will continue to require tour bus companies to comply with regulations that reduce noise levels (e.g., turning off engines when buses are parked).

Noise generated by NPS management activities will be minimized by strictly regulating administrative functions such as aircraft use and use of motorized equipment. Noise will be a consideration in the procurement and use of equipment by park staff.

## Cultural Resource Management Requirements

### Archeological Resources

Current laws and policies require that the following conditions be achieved for archeological resources in the park:

| Desired Condition | Source |
|---|---|
| Archeological sites are identified and inventoried, and their significance is determined and documented.<br><br>Archeological sites are protected in an undisturbed condition unless it is determined through formal processes that disturbance or natural deterioration is unavoidable.<br><br>In those cases where disturbance or deterioration is unavoidable, the site is professionally documented and salvaged. | National Historic Preservation Act; Executive Order 11593; Archeological and Historic Preservation Act; Archeological Resources Protection Act; the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; Programmatic Memorandum of Agreement among the NPS, Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); NPS Management Policies |

Portions of the park have not been systematically surveyed or inventoried. Precise information about the location, characteristics, significance, and condition of the majority of archeological resources in the park is lacking, and impacts are

difficult to measure. The National Park Service will take the following kinds of actions to meet legal and policy requirements related to archeological sites:

- Survey and inventory archeological resources and document their significance.
- Treat all archeological resources as eligible for listing on the National Register of Historic Places (NRHP), pending a formal determination by the National Park Service and the Arizona State Historic Preservation Officer (SHPO) as to their significance.
- Protect all archeological resources determined eligible for listing on, or listed on, the NRHP; if disturbance to such resources is unavoidable, conduct formal consultation with ACHP, SHPO, and affiliated American Indian tribes in accordance with the National Historic Preservation Act.

### Historic Properties

Current laws and policies require that the following conditions be achieved in the park for historic properties (e.g., buildings, structures, roads, trails, cultural landscapes):

| Desired Condition | Source |
|---|---|
| Historic properties are inventoried and their significance and integrity are evaluated under National Register criteria.<br><br>The qualities that contribute to the eligibility for listing or listing of historic properties on the NRHP are protected in accordance with the Secretary of the Interior's Standards (unless it is determined through a formal process that disturbance or natural deterioration is unavoidable). | National Historic Preservation Act; Executive Order 11593; Archeological and Historic Preservation Act; the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; Programmatic Memorandum of Agreement among the NPS, Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); NPS Management Policies |

Many of the historic properties in the park exhibit various stages of deterioration owing to a lack of systematic preservation maintenance. A study of planning and architecture of the NPS Mission 66 program is under way. The study will provide the park with baseline data necessary for the long-term preservation of these resources.

The National Park Service will take the following kinds of actions to meet legal and policy requirements related to historic properties:

- Complete a survey, inventory, and evaluation of historic properties under National Register criteria.
- Complete a survey, inventory, and evaluation of cultural landscapes.
- Submit inventory/evaluation results to SHPO with recommendations for eligibility to the National Register.
- Determine the appropriate level of preservation for each historic property formally determined to be eligible for listing, or listed on, the National Register (subject to the Secretary of the Interior's Standards).
- Implement and maintain the appropriate level of preservation for such properties.
- Analyze the design elements (e.g., materials, colors, shape, massing, scale, architectural details, site details) of historic structures and cultural landscapes in the monument (e.g., buildings, bridges, trails, roads and intersections, curbing, signs, picnic tables) to guide rehabilitation and maintenance of sites and structures.

### Indian Trust Resources

Secretarial Order 3175 requires that any anticipated impacts to Indian trust resources from a proposed project or action by Department of Interior agencies be explicitly addressed in environmental documents. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes.

| Desired Condition | Source |
|---|---|
| Anticipated impacts to Indian trust resources are addressed in environmental documents. | Secretarial Order 3175; NPS Management Policies |

Although there are no Indian trust resources in Sunset Crater Volcano, resources important to Indian tribes were identified during the scoping process by the tribes themselves, and that information was carefully incorporated into the design of alternatives so that these resources would be protected under any alternative considered.

### Ethnographic Resources

Certain contemporary American Indian and other communities are permitted by law, regulation, or policy to pursue customary religious, subsistence, and other cultural uses of park resources with which they are traditionally associated. The National Park Service plans and executes programs in ways that safeguard cultural and natural resources while reflecting informed concern for the contemporary peoples and cultures traditionally associated with those resources.

To accomplish these goals, NPS will do the following:

- Survey and inventory ethnographic resources and document their significance.
- Treat all ethnographic resources as eligible for listing on the National Register of Historic Places, pending a formal determination by NPS and Arizona SHPO as to their significance.
- Protect all ethnographic resources determined eligible for listing or listed on the NRHP; if disturbance to such resources is unavoidable, conduct formal consultation with ACHP and SHPO in accordance with the National Historic Preservation Act.
- Conduct regular consultations with affiliated tribes to continue to improve communications and resolve any problems or misunderstandings that occur.
- Continue to encourage the employment of American Indians on the park staff to improve communications and working relationships and encourage cultural diversity in the workplace.
- Provide for access to and use of natural and cultural resources in parks and collections by American Indians that is consistent with park purposes, does not unreasonably interfere with American Indian use of traditional areas or sacred resources, and does not result in degradation of park resources. Through consultation, an agreement with tribes on access issues will be developed.

In addition, consultation with affiliated Indian tribes was conducted throughout the course of the planning process. Tribes were funded to identify ethnographic resources within the three Flagstaff Area monuments, and this information was considered in developing alternatives.

| Desired Condition | Source |
|---|---|
| Ethnographic information will be collected through collaborative research that recognizes the sensitive nature of such information. | NPS Management Policies |
| All agencies shall accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of these sacred sites. | Executive Order 13007 on American Indian Sacred Sites |
| The National Park Service acknowledges that American Indian tribes, including Native Alaskans, treat specific places containing certain natural and cultural resources as sacred places having established religious meaning and as locales of private ceremonial activities. Consistent with E.O. 13007, the Service will, to the extent practicable, accommodate access to and ceremonial use of Indian sacred sites by religious practitioners from recognized American Indian and Alaska Native tribes, and avoid adversely affecting the physical integrity of such sacred sites. | NPS Management Policies, E.O. 13007 on American Indian Sacred Sites |
| Other federal agencies, state and local governments, potentially affected American Indian and other communities, interest groups, State Historic Preservation Officer, and the Advisory Council on Historic Preservation will be given opportunities to become informed about and comment on anticipated NPS actions at the earliest practicable time. | National Historic Preservation Act; Programmatic Memorandum of Agreement among the NPS, Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); Executive Order 11593; American Indian Religious Freedom Act, American Indian Graves Protection and Repatriation Act, Executive Order 13007 on American Indian Sacred Sites; Presidential Memorandum of April 29, 1994, on Government-to-Government Relations with Tribal Governments; NPS Management Policies |
| All agencies shall consult with tribal governments prior to taking actions that affect federally recognized tribal governments. These consultations are to be open and candid so that all interested parties may evaluate for themselves the potential impact of relevant proposals. Parks will regularly consult with traditionally associated American Indians regarding planning, management, and operational decisions that affect subsistence activities, sacred materials or places, or other ethnographic resources with which they are historically associated. | |
| American Indian Religious Freedom Act; Presidential Memorandum of April 29, 1994, on Government-to-Government Relations with Tribal Governments; NPS Management Policies | |
| Certain research data may be withheld from public disclosure to protect sensitive or confidential information about archeological, historic, or other NPS resources when doing so would be consistent with FOIA. In many circumstances, this will allow the NPS to withhold information about ethnographic resources. | NPS Management Policies |
| American Indians and other individuals and groups linked by ties of kinship or culture to ethnically identifiable human remains will be consulted when remains may be disturbed or are encountered on park lands. | NPS Management Policies; American Indian Grave Protection and Repatriation Act |

### Collections

Current laws and policies require that the following conditions be achieved in the park for museum collections:

| Desired Condition | Source |
|---|---|
| All museum objects and manuscripts are identified and inventoried, and their significance is determined and documented.<br>The qualities that contribute to the significance of collections are protected in accordance with established standards. | National Historic Preservation Act; American Indian Religious Freedom Act; Archeological and Historic Preservation Act; Archeological Resources Protection Act; American Indian Graves Protection and Repatriation Act; NPS Management Policies |

The Flagstaff Area curatorial/museum collections are at risk. Improper storage and lack of adequate security and fire protection systems at facilities that house the collections threaten their safety and integrity. Significant portions of the archeological and historical collections remain uncataloged, and the collections continue to be scattered throughout various facilities.

The National Park Service will take the following kinds of actions to meet legal and policy requirements related to collections:

- Construct and staff an approved curatorial facility to house the Flagstaff Area collections.
- Ensure objects are housed in proper storage. Ensure that museum collections not housed in NPS repositories are preserved, protected, and documented, according to National Park Service standards.
- Acquire and catalog all park museum collections in accordance with standards in the NPS Museum Handbook. All cataloging information will be made accessible in the Automated National Catalog System.
- Develop a collection management program according to NPS standards to guide protection, conservation, and use of museum objects.
- Implement the collection management program.

### Visitor Experience and Park Use Requirements

Current laws and policies require that the following conditions be achieved in the parks regarding visitor experience and park use:

| Desired Condition | Source |
|---|---|
| Visitor and employee safety and health are protected. | NPS Management Policies |
| Visitors understand and appreciate park values and resources and have the information necessary to adapt to park environments; visitors have opportunities to enjoy the parks in ways that leave park resources unimpaired for future generations. | NPS Organic Act; Monuments' enabling legislation; NPS Management Policies |
| Park recreational uses are promoted and regulated, and basic visitor needs are met in keeping with park purposes. | NPS Organic Act; Monuments' enabling legislation; Title 36 of the Code of Federal Regulations; NPS Management Policies |
| All reasonable efforts will be made to make NPS facilities, programs, and services accessible to and usable by all people, including those with | Americans with Disabilities Act; Architectural Barriers Act; Rehabilitation Act; NPS Management Policies |

| Desired Condition | Source |
|---|---|
| disabilities. | |
| Visitors who use federal facilities and services for outdoor recreation may be required to pay a greater share of the cost of providing those opportunities than the population as a whole. | NPS Management Policies; 1998 Executive Summary to Congress, Recreational Fee Demonstration Program, Progress Report to Congress, Volume I--Overview and Summary (U.S. Department of the Interior, National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management; U.S. Department of Agriculture, Forest Service) |
| The park has identified implementation commitments for visitor carrying capacities for all areas of the unit. | 1978 National Parks and Recreation Act (P.L. 95-625); NPS Management Policies |

These laws, regulations, and policies leave considerable room for judgment regarding the best mix of types and levels of visitor-use activities, programs, and facilities. For this reason, most decisions related to visitor experience and use are addressed in the Decide What Might Be Achieved section and in the alternatives. However, the authority to charge fees is dictated by law and is therefore the same for all alternatives.

The Land and Water Conservation Fund Act (16 USC 460l et seq.) allows NPS to collect recreation fees of the appropriate type for its parks, facilities, and programs. Fees are to be reasonable and are determined in accordance with the criteria and procedures contained in the Land and Water Conservation Fund Act and regulations in 36 CFR 71. Fees collected under this authority are returned to the U.S. Treasury. Fees are also being collected for special park uses under 16 U.S.C. 3(a) and 31 U.S.C. 3701, in accordance with OMB Circular A-25. Under this authority, NPS recovers the costs incurred for providing special park uses, but returns to the U.S. Treasury any revenues in excess of costs.

Congress authorized the recreational fee demonstration program to begin on October 1, 1995, and to end on September 30, 2002. The program authorizes NPS and other agencies to implement and test new fees. The program allows the participating agencies to retain all of the demonstration project revenues and to retain at least 80 percent of the revenues at the sites where they are collected. These revenues yield substantial benefits because they provide on-the-ground improvements at local recreation sites. For NPS, the majority of new recreation fee revenues are dedicated to reducing identified backlogged maintenance, infrastructure, and resource management needs. Some of the demonstration fee revenues are reinvested into infrastructure and new collection methodologies to prepare additional areas to collect fees and provide for overall collection efficiency across NPS.

Regulations governing visitor use and behavior in units of the National Park System are contained in Title 36 of the Code of Federal Regulations and Superintendent's Compendium. These regulations have force of law and address a number of use limitations, such as limits on commercial activities.

Under the 1978 National Parks and Recreation Act (P.L. 95-625), NPS is required to address the issue of carrying capacity in its general management plans. The concept of carrying capacity is intended to safeguard the quality of park resources and visitor experiences. Identifying desired resource conditions and visitor experience by zone is part of general management planning. At this

level of decision making, the desired resource conditions and experiences describe carrying capacity in qualitative terms. These qualitative terms are then translated into quantitative standards over time during implementation planning.

The National Park Service will take the following kinds of actions to meet legal and policy requirements related to visitor experience and park use:

- Provide opportunities for visitors to understand, appreciate, and enjoy the park (management directions are explored in the alternatives within this broad policy).
- Continue to enforce the regulations in 36 CFR.
- Ensure that all park programs and facilities are accessible to the extent feasible.
- Complete a carrying capacity implementation plan, which will succeed this GMP. This plan will identify indicators and standards, develop a monitoring strategy, and identify management actions needed to address conditions when standards are reached or exceeded.
- Implement a carrying capacity monitoring program.
- Take management action as necessary to keep resource and visitor experience conditions within established standards.

## Relations with Park Neighbors and Other Agencies

Sunset Crater Volcano National Monument is managed as part of a greater ecological, social, economic, and cultural system. Current policy requires the following:

| Desired Condition | Source |
|---|---|
| Public participation in planning and decision making will ensure that the Park Service fully understands and considers the public's interests in the parks, which are part of their national heritage, cultural traditions, and community surroundings. The Service will actively seek out and consult with existing and potential visitors, neighbors, people with traditional cultural ties to park lands, scientists and scholars, concessioners, cooperating associations, gateway communities, other partners, and government agencies. The Service will work cooperatively with others to improve the condition of parks; to enhance public service; and to integrate parks into sustainable ecological, cultural, and socioeconomic systems. | NPS Management Policies |
| In the spirit of partnership, the Service will also seek opportunities for cooperative management agreements with state or local agencies that will allow for more effective and efficient management of the parks, as authorized by section 802 of the National Parks Omnibus Management Act of 1998 (16 USC 1a-2l). | |

The National Park Service will take the following kinds of actions to meet legal and policy requirements related to park neighbors:

- Continue to establish and foster partnerships with public and private organizations to achieve the purposes and mission of the monument. Partnerships will be sought for resource protection, research, education, and visitor enjoyment purposes.

- Park staff will keep landowners, land managers, local governments, and the general public informed about park management activities. Periodic consultations will occur with landowners and communities affected by park visitors and management actions. The Park Service will work closely with local, state, and federal agencies and tribal governments whose programs affect, or are affected by, activities in the monument. Monument staff will continue their regular consultations with the Arizona State Historic Preservation Office, the Arizona State Game and Fish Department, and Indian tribes. In particular, NPS will maintain a close working relationship with the U.S. Forest Service to meet mutual management needs with staff from the Peaks and Mormon Lake Ranger Districts on the Coconino National Forest. Park staff will continue to meet as needed with staff from Northern Arizona University (NAU) Departments of Anthropology, Geography, Geology, and School of Forestry; the Museum of Northern Arizona; the U.S. Geological Survey (USGS); U.S.G.S. National Resources Division, Colorado Plateau Field Station at NAU; Coconino Plateau Natural Reserve Lands; City of Flagstaff; Arizona State Lands Department; Coconino County; Natural Resources Conservation Services; and the U.S. Fish and Wildlife Service. Organizations that the monument staff periodically keep informed-depending on the issue-include Grand Canyon Trust, National Parks and Conservation Association, Nature Conservancy, Sierra Club, Friends of Walnut Canyon, and neighboring national parks.
- Monument staff will continue to participate in cooperative regional planning to ensure that the monuments are treated as issues of regional concern.

## Sustainable Design/Development

Sustainability can be described as the result achieved by doing things in ways that do not compromise the environment or its capacity to provide for present and future generations. Sustainable practices minimize the short- and long-term environmental impacts of development and other activities through resource conservation, recycling, waste minimization, and the use of energy efficient and ecologically responsible materials and techniques.

| Desired Condition | Source |
|---|---|
| Facilities are integrated into the park landscape and environs with sustainable designs and systems to minimize environmental impact. Development does not compete with or dominate park features, or interfere with natural processes, such as the seasonal migration of wildlife or hydrologic activity associated with wetlands.<br><br>Any facility development, whether it be a new building, a renovation, or an adaptive reuse of an existing facility, includes improvements in energy efficiency and reduction in "greenhouse gas" emissions for both the building envelope and the mechanical systems that support the facility. Maximum energy efficiency is achieved using solar thermal and photovoltaic applications, appropriate insulation and glazing strategies, energy-efficient lighting and appliances, and renewable energy technologies. Energy- | NPS Management Policies |

| Desired Condition | Source |
|---|---|
| efficient construction projects are used as an educational opportunity for the visiting public. | |

The NPS Guiding Principles of Sustainable Design (1993) directs NPS management philosophy. It provides a basis for achieving sustainability in facility planning and design, emphasizes the importance of biodiversity, and encourages responsible decisions. The guidebook articulates principles to be used in the design and management of tourist facilities that emphasize environmental sensitivity in construction, use of nontoxic materials, resource conservation, recycling, and integration of visitors with natural and cultural settings. Sustainability principles have been developed and are followed for interpretation, natural resources, cultural resources, site design, building design, energy management, water supply, waste prevention, and facility maintenance and operations. The Park Service also reduces energy costs, eliminates waste, and conserves energy resources by using energy-efficient and cost-effective technology. Energy efficiency is incorporated into the decision-making process during the design and acquisition of buildings, facilities, and transportation systems that emphasize the use of renewable energy sources.

In addition to abiding with these principles, the following will also be accomplished:

- Park staff will work with appropriate experts to make the monument's facilities and programs sustainable. Value analysis and value engineering, including life cycle cost analysis, will be performed to examine the energy, environmental, and economic implications of proposed park developments.
- The park staff will support and encourage suppliers, permittees, and contractors to follow sustainable practices.
- Park interpretive programs will address sustainable park and nonpark practices.

## Special Use Management Requirements

### Rights-of-Way and Telecommunication Infrastructure

Current laws and policies require that the following conditions be achieved in the park:

| Desired Condition | Source |
|---|---|
| Park resources or public enjoyment of the parks are not denigrated by nonconforming uses<br>Telecommunication structures are permitted in the parks. to the extent that they do not<br>jeopardize the park's mission and resources.<br>No new nonconforming use or rights-of-way will be permitted through the parks without specific statutory authority and approval by the director of the National Park Service and only if there is no practicable alternative to such use of NPS lands. | Telecommunications Act; 16 USC 5; 16 USC 79; 23 USC 317; 36 CFR 14; NPS Management Policies; Director's Order 53A, Wireless Telecommunications |

The Telecommunications Act of 1996 directs all federal agencies to assist in the national goal of achieving a seamless telecommunications system throughout the United States by accommodating requests by telecommunication companies

for the use of property, rights-of-way, and easements to the extent allowable under each agency's mission. Unlike with other nonconforming uses, the National Park Service is legally obligated to permit telecommunication infrastructure within the parks if such facilities can be structured to avoid interference with park purposes.

The National Park Service will take the following kinds of actions to meet legal and policy requirements related to special uses of park lands:

- Determine appropriate locations and stipulations before permitting telecommunication infrastructure on NPS lands in order to ensure the protection of park resources and quality visitor experiences while endeavoring to respond positively. Applications, sites, and stipulations will be based on the management zoning scheme determined by the GMP.

## Description of Scoping Process

### NOTICES, NEWSLETTERS, AND MEETINGS

The notice of intent (NOI) to prepare an environmental impact statement was published in the Federal Register May 19, 1997 (62 FR 27272). The NOI indicated availability of the first newsletter, from which comments were accepted until June 30, 1997. The first newsletter (April 1997) described purpose and significance statements for all three Flagstaff Area parks and identified preliminary issues. A mail-back comment form was included, asking the public if they agreed with the material in the newsletter, if they had recommendations on improvement, and if there were issues or problems that had been missed. Comments from the newsletter were collated and presented at an open house August 20, 1997, in Flagstaff. Twenty-nine comment forms were returned by mail. Additional comments were taken at the open house. Primary issues added by the public included funding, access, and the planning process.

The second newsletter, released in February 1998, detailed public response to the first newsletter, described the final purpose and significance statements, and explained the preliminary range of management zones. Another mail-back comment form was included, which asked the public if the management zones included the experiences they felt were important and if they recommended any changes. Nine responses were received.

A third newsletter, issued in November 1998, combined and organized comments received from newsletters #1 and #2 into decision points and related problems to be solved by alternatives in the draft environmental impact statement. This newsletter also introduced draft alternatives for the three parks and two alternatives proposing a combination of Sunset Crater and Wupatki. Again, a mail-back form was included. This newsletter was followed by another public open house, held in Flagstaff, December 3, 1998, and attended by about 60 people.

The third newsletter and the open house that followed elicited a large response compared with the previous newsletters. One hundred and twenty-eight individual responses were received, along with a petition that had 1,200 signatures and 541 copies of a form letter. The issue generating the petition and form letter was the proposal to expand the boundaries at Sunset Crater and Wupatki and eliminate the use of off-highway vehicles. Other actions proposed in the alternatives (increased access, road closures, and road expansion) received small numbers of responses, relatively equal for and against.

The fourth newsletter, issued in May 1999, described the decision to prepare a plan concurrently with the Forest Service.

All newsletters were posted on the Internet on the National Park Service planning web page. All comments that were received through June 1999 were considered in this EIS.

A number of meetings were held with staff from the Forest Service and Arizona Game and Fish Department to discuss impacts that the alternatives might have on adjacent recreational activities and impacts to wildlife and their movement corridors and to try to ensure that NPS planning would be in support/harmony with other agencies' planning efforts. Many of the conversations focused on joint or comanagement of resources and visitor uses. A number of meetings were held with the affiliated tribes, including Havasupai Tribe, Hopi Tribe, Hualupai Tribe, Navajo Nation, San Juan Paiute Tribe, Tonto Apache Tribe, White Mountain Apache Tribe, Yavapai Apache Nation, Yavapai-Prescott Tribe, and Zuni Tribe. Meetings with the tribes were held to determine traditional uses, desired continuing uses, ethnography information, sacred sites data, consultation protocol, and issues related to repatriation of human remains and artifacts.

## TRIP FACT SHEETS

To determine if existing park visitors' needs were being met, trip fact sheets were set out in each of the three visitor centers. Visitors filled out the sheets voluntarily. The trip fact sheets were a one-page check-off that asked visitors where they were from, why they came to the park, how they preferred to learn about the park, and what they would take advantage of, if it were available. A total of 4,091 trip sheets, spanning a 15-month time frame, were collected and collated.

Responses were fairly consistent for the three monuments. The following five items were considered highly desirable by visitors to the three monuments:

- Want short and longer hiking trails.
- Want to be able to step off the trail for picture taking.
- Want self-guided activities.
- Want to learn by ranger programs.
- Want to learn by museum exhibits.

## VISITOR USE STUDY

As a complement to the public meetings, newsletters, and trip fact sheets, a visitor use study was conducted to gather more in-depth information on visitors, their experience, behavior, and how behavior affects resources.

Approximately 1,200 mail-back questionnaires were distributed in conjunction with an on-site interview. A total of 885 questionnaires were returned--287 for Sunset Crater Volcano, 304 for Walnut Canyon, and 294 for Wupatki. The on-site survey repeated the questions asked in the trip fact sheets, whereas the mail-back questionnaire provided more detailed information. The following information was asked:

- What sites did visitors visit, and how long did they stay at each site?
- In which activities did visitors participate?
- What problems did visitors encounter?
- What were visitors' feelings about seeing other visitors?
- What added to or detracted from their park experience?

Sunset Crater Volcano attracts visitors interested in looking at the scenery, looking at visitor center exhibits, taking pictures, hiking and walking, exploring the lava flows, and taking a self-guided tour. Things that bothered visitors included not being able to go to the top of the volcano and confusing and missing trail markers. When asked about what they would like

to see changed, most visitors responded, "nothing." They did say they wanted more, longer trails, access to the top of Sunset Crater, more interpretive information, and better information on volcano formation (Lee and Treadwell 1999).

## Decide What Might Be Achieved

### ISSUE ANALYSIS AND CONCERNS

Many issues and concerns were identified by the park staff, other agencies, and the general public as part of the scoping for this general management plan. These issues and concerns were then categorized according to how they could be resolved. The list of things to be addressed in the general management plan will include major planning issues (decision points), the resources and values that could be at stake in choosing one course of action over another (impact topics), and the range of management prescriptions (management zones). These elements are described below. The impact topics are also addressed in the evaluation of alternatives in the Environmental Consequences section of this plan.

### DECISION POINTS

Based on public comments and NPS concerns, there are four major points about which decisions must be made in this GMP. The considerations following each statement were actual scoping comments received.

**1. We need to decide to what extent we can provide visitor access to cultural and natural resources without unacceptable impacts to those resources.**

**Considerations:**

- Monitoring and protection of resources is difficult.
- Popular resources are trampled by visitors.
- Additional research is needed to understand the relationships between numbers of visitors and resource impacts.
- There is a need to understand tribal requirements for access to and use of resources without disruption by visitor use.
- Trail use often exceeds design capacity, causing safety and resource protection concerns (trails are subject to erosion and rockfalls).

**2. Important park goals are to ensure adequate visitor orientation and education and to minimize use impacts. We need to decide whether to accomplish this by increasing facilities and services or by limiting entrance points and visitor circulation.**

**Considerations:**

- Existing buildings do not meet current visitor or employee needs; visitation often exceeds visitor center and parking lot capacities.
- Visitors do not receive necessary information before they encounter sensitive resources.
- Resources are being lost because of vandalism and theft.
- Visitor centers and exhibits do not reflect current scientific thinking or relationships between sites and people.
- Some facilities are located in prime resource areas and may be causing undue impacts on those resources; other facilities are not sustainable or designed for the landscape.
- Existing staffing and budget levels limit visitor services.

**3. We need to decide the extent to which park operations, visitor experiences, and resource protection can be integrated across the three Flagstaff Area parks or whether they need to be treated separately.**

**Considerations:**

- There is redundancy and inefficiency in park facilities and infrastructure; much of the infrastructure is antiquated and inadequate.
- Park units and park operations are not consistently integrated and structured to address prioritized needs.
- Systems and programs do not ensure clear and effective communication among the staff or with visitors.
- Static funding and staffing levels require maximum use and efficiency of park facilities, infrastructure, and programs.

**4. We need to determine to what extent we can protect park values through agreements and/or partnerships with park neighbors and inholders and/or boundary adjustments and land acquisition.**

**Considerations:**

- Rapid regional growth and development adjacent to parks increase the potential for damage to resources, viewsheds, and visitor experience.
- Confusion sometimes arises from the presence of multiple agencies with common boundaries and/or resources but different management policies and visitor use regulations.
- There are land management, land trades, and "friendly condemnation" issues near park boundaries involving the state and the U.S. Forest Service.
- Strategies are needed for dealing with private land in the parks while preserving private property rights.

## RESOURCES/VALUES AT STAKE IN THE PLANNING PROCESS

During scoping, the resources and values that could potentially be at stake in selecting various future directions for the parks were identified. Public and park staff input was considered. The following impact topics were derived from this scoping input for Sunset Crater Volcano:

- Long-term integrity of archeological resources
  - Scientific integrity of cultural resources
- Historic character of built environment
  - Historic resources
  - Cultural landscapes
- Ethnographic Resources
  - Long-term scientific and traditional integrity of culturally sensitive areas (shrines, gathering sites, landforms, resource collection areas, etc.)
- Natural Systems and Processes
  - Conserving native plant and animal communities
  - Maintaining natural geomorphic and soil formation processes
  - Preserving unfragmented natural systems
  - Conserving wildlife populations
  - Maintaining the natural character/condition of ponderosa pine forest and pinyon woodland
  - Controlling the spread of invasive, nonnative plant species
  - Maintaining the integrity of natural systems for ecological research
- Threatened, Endangered, and Sensitive Species
  - Federally listed threatened and endangered species, "species of concern," and critical habitats
  - Other sensitive plants, animals, and unique habitats identified during the scoping process
- Geologic Resources
  - Preserving unique geologic features such as cinder volcanoes, lava flows, lava tubes, cinder barrens, spatter cones
  - Preserving the integrity of geological resources for scientific research
- Ability to experience park resources
  - Access to park resources by the general public
  - Access to a full spectrum of park resources for visitors with disabilities
  - Uncrowded visitor experiences
  - Personal freedom (inside and outside park boundaries)

Traditional employee/visitor experiences (interpretation through personal services, access to favorite sites)
Traditional recreational activities (biking, climbing, etc.)
Access to information provided by collections (ability to see the "real thing")
Minimally altered environment
Ability to experience scenic, recreational, and educational pursuits
Visibility of night skies
Natural soundscapes, ability to hear natural sounds
Ability of public to understand park resources
Visitor understanding of regional context

- Effects on park neighbors; local, state, and tribal land management plans; and land/resource managing agencies

  Effects on neighbors' access and emergency response
  Economic contribution of park to local economies
  Access to culturally sensitive areas by traditional users
  Traditional land uses external to boundary
  Possible conflicts between the proposed action and local, state, or Indian tribal land use plans, policies, or controls for the area concerned

- Operational efficiency

  Employee and visitor health and safety
  Ability to enforce park regulations and protect park values
  Staff
  Facilities
  Distance to work
  Management of collections and other resources
  Ease of communication
  Utilities
  Employee housing

## TOPICS DISMISSED FROM FURTHER ANALYSIS

### Socially or Economically Disadvantaged Populations

Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. None of the alternatives considered would result in any identifiable adverse human health effects. Therefore, there would be no direct or indirect adverse effects on any minority or low-income population or community. The impacts on the natural and physical environment that occur from any of the alternatives would not significantly and adversely affect any minority or low-income population or community. Although there are several Indian tribes nearby, a series of consultation meetings has resulted in alternatives carefully crafted to incorporate and resolve the tribal concerns identified. Therefore environmental justice was dismissed as an impact topic.

### Prime and Unique Agricultural Lands

In August 1980, the Council on Environmental Quality directed that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as prime or unique. Prime or unique farmland is defined as a soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. According to NRCS, none of the soils in the project area are classified as prime or unique farmlands. Therefore, the topic of prime and unique farmlands was dismissed as an impact topic in this document.

### Air Quality

The President's Council on Environmental Quality guidelines for preparing environmental impact statements require the lead agency to analyze the impacts of the proposed action and alternatives on air quality. Under each of the proposed

management alternatives for Wupatki National Monument, visitor use and administrative operations would generate similar levels of air pollutant emissions from motor vehicles and motorized equipment, water and sewage treatment operations, propane and natural gas-fueled appliances, and wood-burning stoves used to heat employee residences. Some dust and fumes would be generated during the maintenance, improvement, construction, or removal of roads, trails, and other facilities. The NPS would follow established policy requiring the use of energy-efficient and environmentally friendly products and processes whenever possible. Although public visitation and motor vehicle use are expected to increase during the next 20 years, levels of vehicle exhaust are not expected to dramatically increase or significantly contribute to regional air pollutant loads. Although the NPS proposes the limited use of fire to manage ponderosa pine forest within the monument, further analysis of air quality impacts is deferred until a fire management plan and environmental assessment can be prepared.

None of the identified air pollutant sources would generate enough quantities to require a discharge permit under U.S. Environmental Protection Agency and Arizona Department of Environmental Quality regulations. The impacts of these emissions are deemed to be negligible on the local environment and regional air quality for the proposed action and all alternatives. Therefore, they are excluded from further environmental analysis.

### Water quality

The President's Council on Environmental Quality guidelines for preparing environmental impact statements require the lead agency to analyze the impacts of the proposed action and alternatives on water quality. Impacts to intermittent drainage systems, wetlands/floodplains, and riparian environments are assessed separately in the Environmental Consequences section. Under each of the proposed management alternatives for Sunset Crater Volcano National Monument, visitor use and administrative operations would require similar amounts of drinking water and generate similar levels of water pollutants from road run-off, facility maintenance operations, and water and sewage treatment operations. All wastewater and sewage from the visitor center, employee housing, and toilets is treated and discharged through infiltration fields. None of the existing or proposed facilities would be located in the vicinity of regulated surface waters. Although infiltration systems are located in proximity to as much a 700 feet of highly porous cinder deposits and volcanically fractured bedrock, the nearest reliable aquifer beneath these facilities is at least 1,900 feet deep. The aquifer may be hydraulically isolated from the surface by horizontal rock formations of limestone and sandstones. Water pollutant discharges would be managed in compliance with U.S. Environmental Protection Agency and Arizona Department of Environmental Quality regulations. The NPS would follow established policy requiring the use of water-conserving technology and environmentally friendly products. Although public visitation and motor vehicle use are expected to increase during the next 20 years, the level of incidental hydrocarbon run-off from roads is not expected to dramatically increase or contaminate local waterways. For these reasons, the proposed action and all alternatives are deemed to have a negligible impact on the environment and water quality and this topic is excluded from further environmental analysis.

### Wetlands, Floodplains, and Riparian Habitats

The Clean Water Act, Executive Order 11990, Executive Order 11988, and the

President's Council on Environmental Quality guidelines for preparing environmental impact statements require the lead agency to analyze the impacts of the proposed action and alternatives upon wetlands and floodplains. In addition, public scoping typically identifies widespread concern over riparian habitat conditions within the Southwestern United States. The geologic events that formed Sunset Crater Volcano resulted in areas of deep cinder deposits and highly fractured basalt flows. Surface water from precipitation events quickly percolates deep underground and generally does not accumulate on the surface. The monument boundary includes an area of high terrain relative to the surrounding topography, and no intermittent drainage features are evident. There are virtually no surface water resources within the monument, except for seasonal water catchments upon and local seepage around the perimeter of lava flows. None of these features are believed to meet jurisdictional wetland criteria under the Clean Water Act, and no areas within the monument function as floodplains. For these reasons, the proposed action and all other alternatives are deemed to have negligible impacts upon the regional environment, and this topic is excluded from further analysis.

## OUTSTANDING PARK VALUES AND RESOURCE CONCERNS

Sunset Crater Volcano represents the Colorado Plateau's most recent volcanic eruption. It is the youngest, least-eroded cinder cone in the San Francisco Volcanic Field, and it may be one of the longest-lived cinder cone volcanoes, with an eruptive cycle that may span more than 100 years. The significance of Sunset Crater Volcano extends well beyond the geological events themselves. The powerful geologic processes that formed the volcano profoundly affected the way of life of local inhabitants during the 11th and 12th centuries and shaped both the landscape and the ecology of the area. Furthermore, the young age of this volcano and its location in a relatively undeveloped landscape provides an unparalleled opportunity to study plant succession processes and ecological change in an arid volcanic landscape.

At the time of the monument's establishment, the precise timeframe and geologic processes responsible for the creation of Sunset Crater were unknown. Geological work beginning in the 1970s dated some features near Sunset Crater cinder cone and analyzed the sequence of Sunset Crater's eruptions. Geologists continue to work out the details of the eruptions but are now confident in the identification of those features that compose the Sunset Crater volcanic event.

According to Volcanoes of North America (Wood and Kienle 1990), "The eruption began with the opening of a 15-km-long fissure, accompanied by curtain of fire activity and the growth of a small lava flow at the southeast end. Strombolian fountaining then localized near the northwest end and Sunset Scoria Cone grew, with the simultaneous deposition of a widespread scoria layer. At the same time the 11-km-long Kana-A lava flow issued from the cone. This was followed by further cone building and production of the Bonito Lava Flow."

It is commonly held among the geologists who have studied Sunset Crater that the volcanic features along Sunset Crater's fissure form a line of successively older parts of the Sunset Crater volcanic event (Richard Holm, pers. comm.). According to Holm and Moore (1987): "Volcanic deposits formed during the Sunset Crater eruption include the scoria cone of Sunset Crater, two basalt lava flows that extruded from its base, three rows of small scoria and agglutinate cones east-southeast of Sunset Crater, a basalt lava flow from vent

512 about 6.2 mi (10 km) east-southeast of Sunset Crater, and a tephra blanket that originally covered 800 mi2 (2,080 km2)." They further indicate there is evidence that the Sunset Crater tephra blanket was laid down while Gyp Crater and Vent 512 deposits were still hot. They also state that "the rows of small cones east-southeast of Sunset Crater probably resembled the well-known 'curtain of fire' eruption style on Hawaii."

Prior to the eruption of Sunset Crater, the area in and immediately surrounding the monument was occupied by farmers who lived in small, scattered hamlets adjacent to their fields. When Sunset Crater erupted, the prehistoric inhabitants of the area, whom archeologists call Sinagua, apparently moved out of harm's way. No evidence has been found indicating that the people were surprised by the eruptions, and no human remains have been found indicating deaths occurred as a direct result of the volcanic activity. There are some indications of prayer offerings given as lava flowed from the base of the volcano. The Sinagua soon discovered that the deep cinder/ash fall in the immediate vicinity of Sunset Crater was not farmable, but as they moved northward and the depth of ash diminished, they found that the cinder cover acted as a moisture-retaining mulch, allowing low elevation areas that were previously unsuitable for farming to produce successful crops. Most archeologists believe that the creation of this new farmland by the Sunset Crater eruption was a primary reason for the development of the complex culture in what is today Wupatki National Monument.

Dr. Harold Colton, founder of the Museum of Northern Arizona (MNA), first recognized the connection between Sunset Crater and nearby buried pithouse ruins in the early 1930s, several years after Sunset Crater Volcano National Monument was established. Research by MNA archeologists revealed that the people who built these pithouses had witnessed Sunset Crater's birth in 1064. It was tree-ring dating of timbers found in these pithouses and the nearby pueblo structures of Wupatki that gave geologists a more definitive date for the beginning of the Sunset Crater eruption.

Several contemporary American Indian tribes, including Hopi, Navajo, Yavapai-Apache, and White Mountain Apache, maintain ties to Sunset Crater and its associated volcanic features. Hopi shrines situated within and outside of the current boundaries of Sunset Crater Volcano National Monument are part of a sacred landscape linking the Hopi Mesas with the San Francisco Peaks. Several shrines are located along a prehistoric trail that crosses the Little Colorado River near Black Falls, then passes through the Wupatki area and the Cinder Hills to the north en route to Sunset Crater. The trail then contours around the northern flank of Sunset Crater and Bonito Park to the west, before descending toward Flagstaff and the eastern slope of the San Francisco Peaks.

Hopi oral traditions include stories about the eruption of Sunset Crater. The Hopi believe that their ancestors' spirits, the Kachinas, travel from the San Francisco Peaks to Hopi and back each year via Sunset Crater and Bonito Park, and some deities are believed to reside in the immediate area. (Kana-A lava flow is named after a Hopi deity associated with Sunset Crater Volcano). The Navajo and Apaches also have oral traditions about Sunset Crater, and they consider the Cinder Hills area in general to be a traditional cultural property because of events that took place there in the mythical past.

Sunset Crater is the most recent volcano on the entire Colorado Plateau. As such, Sunset Crater and its associated volcanics

are a valuable resource for the study of ecological succession. The story of ecological succession on the cinder cones of the San Francisco Volcanic Field is not well understood. Succession in this arid region is exceedingly slow, and biologists believe the 250-year-old pinyons in the area are the first colonists of this relatively new landscape. Recent work by ecologists has established that the pinyon pines are physiologically stressed and may lend insight to how plants can cope with stressors such as global warming. The complex web of plant and animal interactions in the pinyon forest around the volcano is under a great deal of study by biologists (Whitham 1999, pers. com.). The plants colonizing the cinders and lava flows today are especially fragile. Furthermore, the Cinder Hills surrounding Sunset Crater provide the primary habitat for one sensitive endemic species, Penstemon clutei.

Although the volcanic features and ecology within the current monument boundaries remain relatively undisturbed, this is not the case immediately outside the monument boundaries. Since the 1970s, a popular off-highway vehicle (OHV) use area has been located adjacent to Sunset Crater within the Coconino National Forest. The current management plan for Coconino National Forest specifies continued use of the red-topped cinder cones by OHVs. Despite official closure to off-road vehicle use, the Kana-A lava flow and the cinder fall area to the east and north of the monument are subject to trespass OHV use, which also occurs within the monument on an occasional basis. OHV tracks cause long-term scarring and erosion to the cinder cones and other geological features of the fissure. The difficulty in rehabilitating erosional scars on cinder cones is exemplified by the history of the footpath on Sunset Crater Volcano. The trail to the top of Sunset Crater was closed in 1973 because of excessive erosion (in places foot traffic and erosion had caused the trail to become a hip-deep rut). Despite intensive efforts to obliterate the trail and extensive rehabilitation efforts, the scar remains visible on the crater's side. OHV tracks on cinder cones are typically on very steep grades and have caused deep rutting on slopes of features that are part of the Sunset Crater volcanic chain.

Although mining of cinders does not currently occur on the lands surrounding Sunset Crater Volcano, mining of pumice deposits is currently occurring in close proximity. Pumice mining on the slopes of San Francisco Mountain affects the monument viewshed. This impact is particularly noticeable from the Lava Flow Trail, where the story of Sunset Crater and its relation to the greater San Francisco Volcanic Field is most actively interpreted.

# ALTERNATIVES

## DEVELOPMENT OF ALTERNATIVES

### Resource Analysis

As the first step in the alternatives development process, landscape units were plotted, sensitive resource areas were mapped, and existing visitor experiences (driving, hiking, viewing archeological sites) were identified. Natural and cultural resource inventories were evaluated. Visitor use statistics were gathered and studied. The planning team also discussed areas where visitors or park staff have noted problems in the past and sought the underlying reasons for those problems.

Landscape units plotted for Sunset Crater Volcano included: steep timbered hills, rolling timbered hills, timbered cinder hills, cinder hills, pristine black dune, crater, and lava flow. The appropriateness of these landscape units for use and development was considered.

Information on the following issues/existing conditions and resources was overlaid to create maps highlighting areas that were particularly sensitive to human use: boundary/adjacent uses, visitor use, roads/trails/development, boundaries/fences, impact areas, ethnographic/sacred sites, threatened/endangered/endemic species/habitat, wetlands, soils/geologic features, sensitive cultural areas, pristine areas, and safety concerns. In meetings with the Forest Service, maps showing cultural resource information (traditional cultural properties, National Register of Historic Places properties, collecting areas, inventoried archeological site densities, and historic uses), sensitive species, current rules and regulations, stakeholders, and experiences were prepared.

This analysis aided in the development and placement of management zones and facilities in different alternatives. Desirable resource conditions and visitor experiences for each zone were identified. This analysis and the sensitive areas maps were consulted when decisions were made about how to place zones and facilities in different alternatives. Other measures taken to check feasibility and determine potential impacts included field-checking alternative ideas and proposals and consulting with resource experts and other agencies. Input from newsletters and scoping was also used to draft alternatives. Input from visitor surveys provided a better understanding of what visitors value, what their expectations are, and what problems they experience.

The goal was to ensure that the draft alternatives did not include actions with unacceptable effects on park resources or visitors or actions having no public support. For example, sensitive eagle areas were mapped, and those areas were considered off limits for visitor use in order to protect the eagles. An alternative considered early in the process would have closed the loop road connecting Wupatki and Sunset Crater Volcano; this alternative was rejected because of the lack of public support.

### Management Zones

Within the broad parameters of the park mission and mission goals, various approaches to park resource protection, use, and development are possible. Different approaches can be used to address the decision points previously identified in the planning process (Purpose

and Need, Decide What Might Be Achieved section). For all three Flagstaff Area monuments, potential management zones were identified and then applied for each monument to meet the different alternative concepts developed.

Management zones identify how different areas of the park could be managed to achieve a variety of resources and social conditions and to serve recreational needs. Each zone specifies a particular combination of physical, biological, social, and management conditions. Different actions would be taken by the Park Service in different zones with regard to the types and levels of uses and facilities.

Ten possible zones were described that could be appropriate to various areas in the three Flagstaff Area monuments. Ideas for the range of zones came from responses to the newsletters and from park staff. In formulating alternatives for future park conditions and management, preparers placed these zones in different locations or configurations on the ground, based on different alternative concepts. The eight zones applicable to Sunset Crater Volcano National Monument are described below.

## RESOURCE PRESERVATION ZONE

### Resource Condition or Character

Resources in this area are fragile and may be in a range of conditions from pristine to endangered. Management actions for resource protection would be high, and tolerance for resource degradation would be very low.

### Visitor Experience

Access to these areas would be restricted and permitted only for the purposes of research, traditional cultural activities, or other well-justified special uses. The areas would provide maximum preservation of fragile and/or unique resources, endangered species, sacred sites, and so on. Although access would be restricted, visitors could benefit from the experience of learning that particularly sensitive resources are preserved for future generations.

### Appropriate Kinds of Activities or Facilities

There would be no facilities or developments for visitors, but off-site interpretation would be extensive, to promote visitor education about the value of resource protection. As noted, access would be by permit only for approved activities. Telecommunication infrastructure would not be permitted in this zone.

## DISCOVERY ZONE

### Resource Condition or Character

Resources would appear pristine. On-site controls and restrictions would be minimal and subtle. The tolerance for resource modifications and degradation would be very low.

### Visitor Experience

Visitors would explore remote areas in a wilderness-like setting, free from modern intrusions. These areas could be trailed or untrailed. Trails would be primitive in nature (unsurfaced and no wider than 2 feet), and no other facilities would be present. Solitude, natural soundscape, and undirected discovery would be key to this experience. Opportunities for independence, closeness to nature, challenge, and adventure would be common, and visitors would need to have individual outdoor skills and be self-sufficient. There would be a very low probability of encountering other visitors or evidence of visitor impacts. Off-site management of visitors could include eligibility requirements before entering such an area, and limits on numbers of visitors and length of stay could be in place.

### Appropriate Kinds of Activities or Facilities

No facilities except for primitive trails would be appropriate in these areas. Cross-country hiking would be the predominant activity. Telecommunication infrastructure would not be permitted in this zone.

## EXTENDED LEARNING ZONE

### Resource Condition or Character

Visitors, sites, and trails would be intensively managed to ensure resource protection and public safety. Areas would be predominately natural, but the sights and sounds of people would be evident. Resources could be modified for essential visitor needs (such as trails and interpretive media) and park operation needs (such as hardening of archeological sites), but they would be changed in a way that harmonizes with the natural and cultural environment. Except for essential changes, the Park Service's tolerance for resource degradation would be low.

### Visitor Experience

The emphasis in this experience would be on visiting and learning about significant park resources. These experiences could be either self-guided or ranger-led. Intimate interaction with resources would be offered where possible without undue resource impacts. Structure and direction would be provided, (e.g., trails, interpretive media, signs), but some opportunities for discovery would also be available. Visitors would need to exert some physical effort and make at least a moderate time commitment. At certain times of the day or season there could be opportunities for solitude, but in general there would be a moderate probability of encountering other visitors. The probability of encountering park staff and other evidence of NPS management would be high.

### Appropriate Kinds of Activities or Facilities

Trails (which could be surfaced and up to 5 feet wide), overlooks, and wayside exhibits and other interpretive media would be appropriate in these areas. Support facilities, such as rest rooms and small picnic areas, could also be present. Predominant activities would include hiking, viewing resources, and attending interpretive walks and talks. Telecommunication infrastructure would not be permitted in this zone.

## GUIDED ADVENTURE ZONE

### Resource Condition or Character

Resources in these areas would appear pristine. Low levels of management for resource protection and visitor safety would be appropriate in these areas, but any resource modifications would be minimal and would harmonize with the natural environment. Tolerance for resource degradation in these areas would be low.

### Visitor Experience

Visitors would explore park resources as part of a guided group. Areas where this experience would be offered would usually be untrailed and free from developments. Intimacy with resources, learning, social interaction among the group, and the security of a guided experience would be key elements of this experience. The probability of encountering other groups would be low, and there would be some opportunities for individual solitude. The environment would offer a moderate level of challenge, but the need for individual outdoor skills would be low.

### Appropriate Kinds of Activities or Facilities

No permanent facilities would be appropriate in these areas except for primitive trails if deemed necessary for

resource protection. Hiking and camping with a guide would be the predominant activity in these areas. Telecommunication infrastructure would not be permitted in this zone.

### HIKING ZONE

#### Resource Condition or Character

Resources would appear pristine. On-site controls and restrictions would be used if needed for resource protection. The tolerance for resource modifications and degradation would be low.

#### Visitor Experience

Visitors would explore the park using unpaved trails. Trails would be semi-primitive (unsurfaced and no wider than 4 feet), and few other facilities would be present. Visitors would need to make a moderate time commitment. There would be a low probability of encountering NPS staff and a moderate probability of encountering other visitors or evidence of visitor impacts. Off-site management of visitors could include eligibility requirements before entering such an area, and limits on numbers of visitors and length of stay could be in place.

#### Appropriate Kinds of Activities or Facilities

Few facilities except for trails, trailheads, occasional pit toilets, and minimal interpretation would be appropriate in these areas. Hiking would be the predominant activity. Telecommunication infrastructure would not be permitted in this zone.

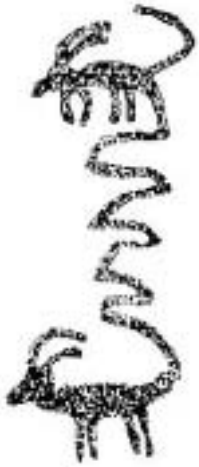
### OVERVIEW EXPERIENCE ZONE

#### Resource Condition or Character

Resources would appear natural, but paving or other management actions would be taken as necessary to protect resources. Visitors would interact with resources only to the extent possible without undue impact to those resources. Because of the need for visitors to understand park significance, some primary resources must be available for visitors to view in these areas.

#### Visitor Experience

Visitors would get an overview of park resources and significance in a short time frame and with a minimum of physical exertion. Park orientation and interpretation of primary park themes would be important elements of this experience. Interaction and encounters with other visitors and park staff would be common, but overcrowding would be avoided. Although structured intimacy with some park resources could be possible, viewing resources from a distance or from trail or overlook facilities would be more common.



#### Appropriate Kinds of Activities or Facilities

Sightseeing, learning about the park, short walks, and attending interpretive programs would be common activities in these areas. Orientation and interpretation facilities, such as visitor centers, kiosks, wayside exhibits, and other interpretive media would be appropriate. Support facilities such as rest rooms and picnic facilities could also be present. Telecommunication infrastructure would not be permitted in this zone.

### MOTORIZED SIGHTSEEING ZONE

#### Resource Condition or Character

Intensive management would be provided in this area to ensure resource protection and public safety (e.g., fences, intensive law enforcement, and restrictions on visitor activities). Resources might be modified (e.g., paving or felling hazard trees) for essential visitor and park operational needs.

### Visitor Experience

The paved roadways and associated developments in this area would be used for touring the park, enjoying scenic overlooks and interpretive media, and gaining access to other park areas. Visitor attractions would be convenient and easily accessible. The visitor experience would be generally dependent on a vehicle or bicycle, would involve driving along a well-maintained, paved road, and would be perceived as linear/sequential in nature. Observing the natural environment would be important, and there would be a sense of adventure, but there would be little need for visitors to exert themselves, apply outdoor skills, or spend a long time in the area. The probability of encountering other visitors would be high, and there would be a moderate probability of encountering NPS staff.

### Appropriate Kinds of Activities or Facilities

The motorized sightseeing experience would occur in a substantially developed area. The paved roads, pullouts, overlooks, and associated short trails and picnic areas, parking areas, and other facilities that support visitor touring would be included in these areas. Most facilities and some trails would be accessible in this area. Telecommunication infrastructure would not be permitted in this zone.

### ADMINISTRATIVE ZONE

### Resource Condition or Character

The natural environment would be modified for park operation needs, but they would be changed in a way that harmonizes with the natural environment. These areas would not be close to sensitive natural or cultural resources, if such resources could not be adequately protected.

### Visitor Experience

These areas would not be intended for visitor use; however, if visitor use did not conflict with the primary use of the area, incidental use could be permitted.

### Appropriate Kinds of Activities or Facilities

Facilities necessary for park operations or surrounding land uses are appropriate in this area, including park maintenance yards, residential areas, access roads, and utility areas and corridors. Telecommunication infrastructure would be permitted in this zone, in the following locations. For Wupatki, Sunset Crater, and Walnut Canyon radio repeater needs, NPS uses a site at O'Leary Peak on USFS lands. Installation of telecommunications equipment at this site would require permission from the Forest Service. A radio repeater was once located on Woodhouse Mesa near the park visitor center at Wupatki. The Park Service would consider requests for location of equipment at this site based on the ability to install the equipment without visual intrusion and without loss or disturbance of natural or cultural resources. Because of the fragile nature of the resource, no use of NPS land at Sunset Crater for telecommunications would be permitted. If a new visitor center were constructed near I-40 at Walnut Canyon, there could be an opportunity to locate telecommunication equipment there, or at the water tower that is part of the current administrative zone.

## Boundaries Expansion Criteria

### SUNSET CRATER VOLCANO

The monument currently preserves most of Sunset Crater Volcano and one of the two lava flows created during the eruption of Sunset Crater. At the time of the monument's establishment in 1930, the Kana-A lava flow and the volcanic evidences of the fissure system that eventually produced the Sunset Crater

cinder cone were not known to be of park significance. Geological investigations beginning in the 1970s dated some features near Sunset Crater cinder cone and analyzed the sequence of Sunset Crater's eruptions. Geologists are now confident in the identification of those features that make up the Sunset Crater volcanic event. It is commonly held among geologists who have studied Sunset Crater that the succession of volcanic features along the fissure forms a line of successively older parts of the magmatic event. Clearly these features are part of the Sunset Crater eruption story, and as such, constitute resources of primary park purpose and significance.

Several contemporary American Indian tribes, including Hopi, Navajo, Yavapai-Apache, and White Mountain Apache, maintain ties to Sunset Crater and its associated volcanic features. Hopi shrines within and outside the current boundaries of Sunset Crater National Monument are included in a sacred landscape that links the Hopi Mesas with the San Francisco Peaks. Stories about the eruption of Sunset Crater are a part of Hopi oral tradition. The Hopi believe that their ancestors' spirits, the Kachinas, travel from the San Francisco Peaks to Hopi and back each year via Sunset Crater and Bonito Park, and some deities are believed to reside in the immediate area (Kana-A lava flow is named after a Hopi deity associated with Sunset Crater Volcano). Bonito Park, which lies outside the monument boundaries, has been identified as a significant traditional cultural property to the Hopi, and because of its cultural importance, the Hopi have requested that Bonito Park be included within the monument to afford additional protection to the area. The Navajo and Apache consider the cinder hills around Sunset Crater to be traditional cultural properties based on their associations with events that occurred in the mythical past.

Since the 1970s, the geological and ecological features and the ethnological values of the Sunset Crater area have been subject to much degradation, as they form the center of the popular Cinder Hills Off-Highway Vehicle (OHV) Recreation Area within the Coconino National Forest. The current management plan for Coconino National Forest specifies continued use of the red-topped cinder cones by OHVs. Despite official closure to off-road use, the Kana-A lava flow and the cinder fall area to the east and north of the monument are subject to frequent trespass OHV use.

The ability of visitors to understand the full story of Sunset Crater is hampered because visitors are unable to access primary resources related to park significance, particularly the fissure area and Gyp Crater to the southeast. The current OHV use in the Cinder Hills OHV Area precludes park visitors from hiking in this area for safety reasons. Visitors would be endangered by the vehicular traffic if they were to venture out of current park boundaries to explore the fissure area. Because erosion is dramatically altered by OHV tracks, visitors are also not able to glimpse, even from a distance, an accurate picture of the geological processes that have been at work for about 1,000 years, sculpting the landscape of the volcano and its associated features.

Noise from OHV use encroaches within the existing park boundaries, adversely impacting visitor enjoyment and understanding of park resources. Scars on the landscape and views of OHV traffic, as well as the ensuing dust, are clearly visible from Cinder Hills Overlook, the one viewpoint from which it is possible to interpret the significance of the row of cinder cones that mark the fissure that produced Sunset Crater.

OHV tracks cause long-term scarring and significant erosion to the cinder cones and other geological features of the fissure. The difficulty of rehabilitating erosional

scars on cinder cones is exemplified by the history of the footpath on Sunset Crater Volcano. The trail to the top of Sunset Crater was closed in 1973 due to excessive erosion. (In places foot traffic and erosion had turned the trail to a hip-deep rut.) Despite extensive efforts to obliterate and rehabilitate the trail, the scar remains visible on the crater's side. OHV tracks on cinder cones are often on very steep grades, and have caused deep rutting on slopes of features that are part of the Sunset Crater volcanic chain. In some locations, old OHV trails have been abandoned because the ruts have cut into the underlying deposits, making it impossible for the vehicles to negotiate. Continued use of the OHV area will contribute to this acceleration of erosion and damage to the geological features on the cinder cones.

Expansion of current monument boundaries, to include critical resources and for administrative purposes, was considered as part of the planning process, as specified in Section 604 of the National Parks and Recreation Act of 1978 (16 U.S.C. 1a-5et seq.). Authority for modifying boundaries is contained in the Land and Water Conservation Fund Act amendments of June 10, 1977 (Public Law 95-42). Consideration for modifications to the boundaries was based on one or more of the following criteria: (1) expansion would include significant resources or opportunities for public enjoyment, (2) expansion would address operational and management issues, or (3) expansion would protect monument resources critical to fulfilling the purpose of the park. Boundary expansions are considered practical or necessary if: (1) the added lands could feasibly be administered, taking into consideration the size of the proposed expansion, configuration, ownership, costs, and so on, and (2) that other alternatives for management and resource protection are not considered adequate. The following provides a brief description of the boundary expansion options that were considered and ultimately presented in various alternatives that were developed.

## Administrative Boundary Expansion (Alternative 1)

Current boundaries for the monument are mostly drawn along section and property ownership lines. Often they do not coincide with the terrain or topography features, and cut across drainages, ridges, cinder cones, and other similar features. The boundaries also cut across a number of secondary Forest Service roads.

This alternative proposes that approximately 1,564 acres of land administered by the U.S. Forest Service surrounding the monument be transferred to the National Park Service. This limited expansion and adjustment of monument boundaries would primarily be for management purposes and would be solely an administrative change of landownership between the National Park Service and the U.S. Forest Service.

The primary intent of this expansion would be for administrative purposes. The minor boundary adjustment would result in the inclusion within monument boundaries of entire minor topographic features that directly contribute to the significance of the park, and eliminate some of the existing impacts associated with the management and maintenance of the existing boundary lines and delineating fencing. Boundaries would be more logically placed in areas that enhance the preservation of significant geologic features and would allow the placement of the required boundary delineations and fencing in less invasive and more manageable and maintainable locations. The expansion would also eliminate a number of forest roads that cross in and out of the monument boundaries and place them entirely within Forest Service ownership. Finally, it would

increase the amount of protection and preservation of significant features along the existing south boundary from further adverse impacts caused by the adjacent Cinder Hill OHV area. These impacts have resulted in soil erosion and the denuding of scrub and herbaceous plant growth, which is inhibiting natural plant succession.

The U.S. Forest Service does not strongly oppose the minor administrative boundary adjustments presented in this alternative.

### Boundary Expansion, Bonito Park (Alternative 2)

This alternative proposes that approximately 3,677 acres of land administered by the U.S. Forest Service surrounding the monument be transferred to the National Park Service. The alternative would expand the boundaries to accommodate administrative needs, as described for Alternative 1, and would include Bonito Park and land to the south to accommodate a new visitor center location. Both of these areas contain resources that contribute to the significance of the park and afford exceptional views of most of the primary resources of the park, specifically Sunset Crater Volcano. Most importantly, this proposal would allow the removal of all administrative and visitor facilities from the heart of the park and would allow for restoration of damaged critical resources and provide a more pristine experience. It would remove a major commuter road through the park and allow the park to be closed at night, further protecting fragile park features. Rerouting the entrance road would allow the visitor center to be located so that the public could be oriented before entering the park.

The U.S. Forest Service has objections to the expansion of park boundaries considered in this alternative. Their preference is to exercise all options available to protect the resources that contribute to the significance of the park, without having to transfer administrative jurisdiction to the NPS.

### Boundary Expansion, Cinder Hills (Alternative 3)

This proposal calls for the expansion of park boundaries to accommodate administrative needs, as described for Alternative 1 and to ensure that natural resources that contribute to the significance and primary purpose of Sunset Crater Volcano National Monument are contained within park boundaries. In contrast with the situation in 1930, today we have accurate dating of volcanic features that are part of the eruptions and can definitively identify which features in the landscape are part of Sunset Crater's eruption. This proposal seeks to expand the boundaries of the park to include all the geologic features that are part of the Sunset Crater eruption. Approximately 8,590 acres of land administered by the U.S. Forest Service would be transferred to the National Park Service.

This expansion would include a significant portion of the Cinder Hills OHV Area. Resources of direct significance to park purpose are being severely impacted by OHV use, causing erosion of cinder cones and vents, and denuding scrub and herbaceous plant growth, which inhibits natural plant succession. Mining of cinders does occur on lands included in this proposal, and the mining of cinders and pumice deposits is occurring in nearby areas. These activities are a potential threat to identified primary resources. National monument status would afford a higher level of protection to these geologic and ethnographic features by excluding OHV use, mining, and other consumptive uses on these lands.

The boundary expansion would necessarily eliminate OHV traffic from the resources that are part of the Sunset Crater magmatic event, and trails and

interpretive sites would allow visitors to experience these features unimpeded by motorized traffic. Along with rehabilitation of the geological features, protection of natural processes would make it possible for visitors to experience the full story of the Sunset Crater eruption.

This proposed expansion would require that the Cinder Hills OHV Area be removed, and possibly relocated onto other federal, state, or private lands. This would have a substantial impact on the OHV users of the area and on any location the activity would be moved to.

The U.S. Forest Service has objections to the expansion of park boundaries considered in this alternative. Their preference is to exercise all options available to protect the resources that contribute to the significance of the park, without having to transfer administrative jurisdiction to the National Park Service. This would be accomplished by increased management use requirements on the OHV area.

## Actions Common to All Alternatives

Short-range planning is under way simultaneously with this GMP to meet immediate operational needs that will continue to exist regardless of the alternative selected. These are identified in National Park Service-wide initiatives, in Flagstaff Area National Monuments planning documents, such as the Strategic Plan, Annual Performance Plan, Comprehensive Interpretive Plan, and Resources Management Plan, and in local action plans to resolve safety, accessibility, facility maintenance, and similar issues.

### A. PARTNERSHIPS AND BOUNDARY EXPANSION

All alternatives presented recognize the opportunity for partnerships, for the protection of cultural and natural resources, with the USFS, the State of Arizona, and private landowners. USFS lands surrounding Sunset Crater Volcano will be managed in accordance with decisions reached in the Flagstaff Lake Mary Ecosystem Analysis (FLEA) planning process, but the two agencies will actively coordinate a variety of activities. There will be increased emphasis on monitoring the effects of recreation, grazing, and other human uses on these lands; documentation of unacceptable impacts will provide a basis for management changes to control those effects.

### B. INTERPRETIVE EXHIBITS

Planning and design of new wayside exhibits and museum exhibits is in progress, in accordance with the Flagstaff Areas Comprehensive Interpretive Plan, to improve visitor understanding and appreciation of Sunset Crater Volcano resources. New wayside exhibits will replace and expand the existing system of interpretive signs along FR545 and at major existing visitor use areas, that is, at Bonito Park, Lava Flow Trail, Lenox Trail, and the Painted Desert picnic area. New museum exhibits will replace the outdated and inaccurate exhibits at the existing visitor center. Like the wayside exhibits, they will convey current knowledge of the park's natural and cultural resources and explain their significance.

### C. CAMPGROUND EXPANSION

Bonito Campground will be expanded by the USFS to provide group camping, a day-use area for educational group gatherings, and an upgraded amphitheater for programs. USFS has agreed that the campground will remain in its current location no longer than the life of this general management plan.

### D. CURATORIAL FACILITY

A new 4,000-square-foot curatorial building will be constructed in the administrative area to provide for the

long-term care and preservation of museum objects and specimens from all three monuments. The facility will occupy a site totaling approximately 8,000 square feet. Water, sewer, and electrical utilities and a road will be extended to the site.

### E. MAINTENANCE/RESOURCE MANAGEMENT FACILITY

A new 20,000-square-foot maintenance, resources management, and ranger support facility will be constructed in the Sunset Crater Volcano administrative area. It will include vehicle and equipment storage, supplies and materials storage, offices, and a meeting room. The facility will occupy a site totaling approximately 40,000 square feet. Utilities and roads will be extended to the site, and a parking area will be constructed.

### F. O'LEARY PEAK ROAD CLOSURE

The USFS will gate the road up O'Leary Peak to prevent nonofficial vehicle access beyond the campground. A portion of the route, ending at a scenic viewpoint, will be available for hikers seeking a view down into Sunset Crater.

### G: ACCESSIBILITY

The National Park Service will remain committed to increasing accessibility to facilities, programs, and services for all visitors, including those with disabilities. New construction and modifications to existing public facilities will comply with the Americans with Disabilities Act and other requirements. To the extent feasible, access will be provided to natural and cultural resource features through modification of existing trails, pullouts, and so on. Occasional vehicular access may be allowed, by special arrangement with the USFS, to a portion of the O'Leary Peak Road to accommodate visitors with disabilities. Where terrain or other constraints prevent physical access to major features, efforts will be made to provide alternative experiences through exhibits, photographs, electronic virtual tours, or other means.

### H. SAFETY

Necessary actions will be taken in the course of all activities to ensure employee and visitor safety. All facilities work will be designed to upgrade and improve safety features. New and remodeled facilities will be thoroughly evaluated during the design process to ensure that safety remains an upfront consideration. Actions will be taken as needed to address the threat of hantavirus, which is present in many older storage facilities throughout the park.

### I. BACKCOUNTRY CLOSURE

The backcountry of Sunset Crater Volcano National Monument (defined as all areas beyond designated roads, trails, or developed facilities within the monument) is closed to unguided entry. Unguided entry to areas other than the Sunset Crater cinder cone was allowed until 1998 General Management Plan discussions determined that the impacts were highly visible and potentially damaging to sensitive resources. The number of visitors requesting such access is small, and similar experiences are available on nearby USFS lands. The closure will be made permanent through the formulation and publishing of a special regulation. While various alternatives may allow guided activities to continue in the park backcountry, there will be no unguided access.

## ALTERNATIVE DESCRIPTIONS

## No-Action Alternative: Existing Conditions

With its graceful contours and dramatic regional context, Sunset Crater Volcano provides inspiring scenery and provokes curiosity about the area's volcanic history. As the youngest of 600-800 volcanic features within the San Francisco Peaks Volcanic Field, it is a natural attraction for

the scientific and academic communities as well as the general public.

Entrance to Sunset Crater Volcano National Monument is via FR545, both ends of which connect with US89, creating a loop drive that also serves Wupatki (see Existing Conditions map). An orientation wayside immediately adjacent to US89 provides introductory information about the monument. A pullout about one mile east of the US89 junction provides a scenic view of Bonito Park and an interpretive exhibit. A visitor center and maintenance/housing area are one mile further east, on Coconino National Forest land near the monument boundary. These facilities were constructed and are operated by NPS under an agreement with the Forest Service. Associated with the visitor center are park residences, a maintenance facility, and a maintenance storage area. The existing use and development is based on planning initiated in the late 1950s and put into place in the late 1960s. Additional details regarding the current use and development of the monument can be found in the *Affected Environment, Operational Efficiency* section.

Sunset Crater Volcano is operated as a day-use area, and the park is closed, but not gated, at night. Entrance fees are required at Sunset Crater Volcano National Monument; access is limited to established trails, roadways, and developed facilities. Areas not designated and identified for public activities are closed to unguided entry.

In 1967, the 44-unit Bonito Campground was constructed by the Forest Service across from the visitor center. It is being expanded to include group sites.

A 20-car parking area and rest room are provided near the Lava Flow Trail. The one-mile Lava Flow Trail is a self-guided loop exploring a variety of volcanic formations. The one-mile Lenox Crater Trail provides an opportunity to climb a cinder cone.

The Cinder Hills overlook near the eastern boundary of the monument provides a view of numerous cinder cones in the area. About 3.5 miles east is the Painted Desert overlook, a small picnic area constructed by the Forest Service and jointly operated under a cooperative agreement.

The Cinder Hills Off-Highway Vehicle (OHV) Area is about 13,500 acres on USFS lands immediately southeast of the monument. Activities within the area often result in physical intrusion onto the monument as well as visual and audible impacts to monument visitors. The OHV area is visible from the Cinder Hills Overlook, a point of interest stop along the flank of Sunset Crater Volcano, and within the monument boundary. The proximity of Sunset Crater Volcano (protected even from pedestrian traffic) to similar cinder formations (with unlimited vehicular access) often provokes visitor comment. Substantial numbers of Cinder Hills users choose to travel through the monument to reach the OHV area.

The NPS and USFS have long worked cooperatively in the areas of law enforcement, wildland fire, resource protection and management, interpretation, and facility management at Sunset Crater Volcano, and will continue to do so. NPS staff frequently assists visitors in finding suitable USFS lands on which to engage in recreational and other activities that may not be suitable on NPS lands. Conversely, USFS staff direct visitors who are looking for more structured interpretive visits to NPS lands. Cooperation extends to the sharing of equipment and staffing, administration of special use permits, research permits, and a variety of other areas. Maintenance and administration of the Painted Desert picnic area and USFS portions of FR545 are primarily the responsibility of the NPS through an agency Memorandum of

Understanding. The distinct missions of the two agencies offer a greater range of opportunity for many visitor activities.

Visitor satisfaction with the current park experience is high as measured by the Visitor Survey Card responses. (Machlis 2000) The 2000 survey showed that 98% of visitors were satisfied with opportunities for "learning about nature, history or culture" and 97% were satisfied with "sightseeing opportunities." Eighty-four percent were satisfied with outdoor recreation (camping, bicycling, boating, hiking, etc.) opportunities.

## Alternative 1 (Preferred): Focus on Extended Learning

### GENERAL CONCEPT

The goal of this alternative is to provide increased educational opportunities and diverse experiences both within and outside of park boundaries. The park would be viewed as a destination for education and learning. Partnerships with the USFS, affiliated tribes, and educational institutions would provide interpretation and more consistent management of sites and features outside the park that are primary to the park purpose. Minor boundary adjustments would be made for ease of management and to align park boundaries and associated fencing with topographic features rather than along section lines. Geologic features would be better protected within a single jurisdiction, and management of existing USFS secondary roads would be clarified. Most existing uses would continue. The park would remain day-use only, with 24-hour access on FR545, and visitor use would be spread throughout more resources. A new multiagency visitor center would be built near US89 to serve as the primary location to orient and serve visitors. The existing visitor center would be adapted for use as an education center.

This alternative responds to requests to not limit access and to emphasize education, outreach, and local involvement. It acknowledges that, from a visitor viewpoint, there is little distinction between national park and national forest boundaries. Increased partnerships for visitor orientation and educational activities would more efficiently provide contact with the missions and personnel of both agencies. With the new visitor center, both park and forest users would be better oriented before entering public lands, and encountering sensitive resources. Through this alternative, visitors would be provided with information and opportunities that would encourage greater stewardardship of public lands.

### KEY ACTIONS

- Vehicle access via FR545 would remain the same as it is now.
- The Park Service and USFS would jointly construct and operate a new visitor center near the intersection of FR545 and US89. Before the specific location is determined, additional environmental analysis and coordination with the USFS would be necessary. The new visitor center would provide visitor orientation for both park and forest visitors before they encounter sensitive resources. The existing housing and maintenance area would be retained; the maintenance area would be rehabilitated.
- The existing visitor center would be retained for office space and adapted for use as an education center, with facilities for group presentations, workshops, and similar programs.
- A hiking trail would be formalized between Bonito Campground and the Lava Flow Trail.
- Additional extended learning activities, both self-guided and guided, would be developed in conjunction with the new visitor center/Bonito Park vicinity. New

media, programs, and workshop presentations would be possible using the existing visitor center and new group campground facilities.

- A broader range of resources would be interpreted in an Extended Learning Zone in the vicinity of the Lava Flow and Lenox Crater Trail system.
- Consistent with the concept of this alternative, efforts would be made to provide a broader range of educational and interpretive programs aimed at in-depth learning. Some of these experiences would be provided through partnerships with USFS, affiliated tribes, organizations, institutions, and/or other agencies.
- Park boundaries would be adjusted for ease of management. Corresponding adjustments would be made to the boundary of the USFS OHV area.
- Areas of the park not zoned for administrative or visitor use would be closed to protect resources.

## Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### GENERAL CONCEPT

This alternative would extend a high degree of protection for park resources by removing and relocating some facilities and would provide more diverse experiences than the No-Action Alternative (see Alternative 2 map). To take advantage of this visitor experience would require slightly more effort than under the No-Action Alternative. Primary points of interest would be reached as destinations rather than roadside attractions. Visitors would be better insulated from modern day intrusions. The desired outcome is that visitors would spend more time engaged in in-depth learning activities than at present. The increased diversity of experience would be provided via new trails and new interpretive media and activities. The park road would be gated at night. A new visitor center and campground would be constructed south of Sunset Crater Volcano, and both park and forest orientation would be provided at this location.

As in Alternative 1, visitors would be in contact with employees from both NPS and USFS. Short roads to key areas of the park would eliminate the current drive-through experience. More of the monument would be experienced by trail and self-guided activities. Visitors would be able to connect the stories of Sunset Crater Volcano and Wupatki National Monuments by experiencing the dramatic landscape changes along FR545, as well as through interpretive media within the monuments and at waysides.

Boundaries would be adjusted for administrative purposes, as described in Alternative 1, and would include significant resources located at Bonito Park and south of existing park boundaries. Removing all administrative and visitor facilities (except toilets) from the heart of the park would allow for restoration of damaged critical resources and provide a more pristine experience. The ability to close the park at night would further protect fragile park features. Rerouting the entrance road would allow for placement of the visitor center so that the public could be oriented before exploring the park, while maintaining a drive between Sunset Crater Volcano and Wupatki National Monuments. Should visitation levels dictate, numbers of people could be controlled through use of a shuttle or reservation system. This alternative includes concepts described in the third newsletter as Combined Alternative 1.

### KEY ACTIONS

- Entry to the park would be via a new paved road system using FR776. FR414, which is currently an unimproved road, would be converted to the monument's main entrance road. This road would be closed at night. Portions of FR545 between Bonito Park and the Lava Flow Trail would be retained as dead-end spurs to these features. Visitors could reconnect to FR545 just east of the park and continue toward Wupatki.
- A new visitor center would be built south of Sunset Crater Volcano, affording dramatic views and increased educational opportunities (exhibits, media, auditorium, curatorial storage/research, etc.). The existing visitor center and associated facilities would be removed and the area rehabilitated. Bonito Campground would be removed from its present location, and the NPS would construct a new campground south of the park, near the new visitor center.
- A portion of FR545 beyond the Lava Flow Trail at the base of Sunset Crater Volcano would be rehabilitated and converted to a foot trail. An additional hiking trail would be constructed around Bonito Park.
- Additional extended learning activities, both self-guided and guided, would be developed in the vicinity of, and in conjunction with, the Lava Flow Trail, Lenox Crater trail, and the northwest side of Sunset Crater Volcano.
- Park boundaries would be expanded to the west to include the Bonito Park area and to the south to include the new visitor center location. Corresponding adjustments would be made to the boundary of the USFS OHV area.
- Areas of the park not zoned for administrative or visitor use would be closed to protect resources.

## Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### GENERAL CONCEPT

This alternative would extend NPS management and protection by expanding park boundaries to the southeast to include key features of the eruption and geologic story of the Sunset Crater volcanic chain (see Alternative 3 map). Boundaries of Sunset Crater Volcano National Monument were drawn in 1930, before scientific study revealed the full extent of geologic features related to the eruption. This alternative would provide consistent protection of these resources, including the entire Bonito and Kana-A lava flows, the red-topped cinder cones along the Cinder Hills fissure, Vent 512, and Double Crater and would allow visitors to experience the entire geologic story. Partnerships with USFS would continue for visitor orientation and educational activities near the new visitor center, resource preservation at Bonito Park, and cooperative management of neighboring lands.

Most existing uses would continue. The developed areas of the park would be managed for day use only. FR545 would be open 24 hours. Visitor use would be spread throughout more resources. A new multiagency visitor center would be constructed near US89 to serve as the primary location to orient and serve visitors to both park and forest lands. The existing visitor center would be adapted for use by educational groups. Diverse experiences would be provided via new trails and new interpretive media and activities in a quieter natural setting.

Guided tours would be provided to key geologic features, following completion of resource inventories and impact assessments. Untrailed hiking and a greater degree of solitude would be possible in specified areas.

Off-highway vehicle activity would remain subject to USFS management but would be removed from within the expanded NPS boundaries. FR776 south of the Double Crater trailhead would be gated for administrative use only.

### KEY ACTIONS

- FR545 would remain open 24 hours a day, and new pullouts would be constructed to provide views of the Kana-A lava flow.
- A new multiagency visitor center would be constructed near the junction of FR545 with US89. Before the specific location is determined, additional environmental analysis and coordination with the USFS would be necessary. The existing visitor center would be modified to serve as an education center for groups.
- The new visitor center would provide visitor orientation for both NPS and USFS facilities, resources, and regulations, and would provide in-depth interpretation of natural and cultural resources at a regional level. Construction of new facilities would provide locations for interpretive programs and workshops for a variety of audiences. Both NPS and USFS would be represented at the new visitor center, and information/interpretation would be presented to visitors in a cohesive manner.
- Extended learning opportunities would be available in the visitor center/Bonito Park vicinity, in the area between Lenox Crater and Lava Flow Trails, and in the Cinder Hills area.
- A hardened trail would be constructed between Bonito Campground and the Lava Flow Trail to provide a convenient pedestrian route for campers. A new trail would be established into the fissure zone, providing access to Gyp and/or Double Craters. The trailhead would be located on FR776 near the junction with FR545. FR776 would be gated beyond that point and designated for administrative use only.
- Park boundaries would be expanded in cooperation with the USFS, to include key resources northeast and southeast of existing boundaries. OHV use would cease on the portions of the USFS OHV area included within the new boundaries, and extensive rehabilitation would be undertaken.
- The area within the expanded park boundaries would be zoned as Guided Adventure, with the exception of the Hiking Zone to Double Crater and the Discovery Zone at Cinder Hills. A Discovery Zone in the Cinder Hills area would provide opportunities for exploration in a more wilderness-like setting.
- Areas of the park not zoned for administrative or visitor use would be closed to protect resources.

## Alternatives Considered But Eliminated From Detailed Evaluation

### SUNSET CRATER VOLCANO/WUPATKI: EMPHASIZE PRESERVATION AND LIMIT MOTORIZED SIGHTSEEING

#### General Concept

This alternative (identified in the third newsletter as Combined Alternative 2) would extend a high degree of protection to park resources. Consistent with a preservation emphasis, fewer areas of the parks would be seen by car, and in some cases, visitors would have to exert more effort to see sites at Wupatki. No new sites

would be opened to visitation. Ranger-guided backcountry tours to Crack-in-Rock would cease. New wayside exhibits would be limited, and the parks would be physically closed at night. The number of facilities would be reduced and relocated to less-sensitive areas. Although there would be impacts from construction of new facilities, buildings would not intrude on cultural and natural landscapes and impact sites as they do now.

The parks would not be connected by a loop drive. Visitors would enter the parks at the existing US89 entrances and return via the same route. The new visitor centers would be located at the park entrances, and visitors would be oriented before encountering park resources. Visitors would experience a more natural, undisturbed, and quiet Sunset Crater Volcano with the removal of a portion of the park road. In both parks, emphasis would be placed on opportunities for learning about the parks via self-guided or ranger-led activities at existing sites and trails. Boundaries would be adjusted to incorporate Coconino National Forest land containing administrative facilities and some features essential to the monument's story; at Wupatki, the emphasis of boundary expansions would be on acquiring lands to enhance the preservation of cultural and natural systems rather than on providing for more diverse visitor experiences. The Combined Alternative 2 map shows how the parks would be zoned and how boundaries would be changed.

This alternative responds to scoping concerns about the need to educate visitors before they encounter park resources (especially at the north entrance to Wupatki) and recommendations to restrict access and control use to ensure that resources are adequately protected. This is consistent with scoping suggestions that placing certain areas off-limits would be acceptable if they could be seen by other means and explanations were provided. This alternative also would reduce the impact caused by facilities and developments in prime resource areas and would simplify managed visitor use (shuttle systems, reservations, ticketing), should a future need arise. An increase in funding would be needed to build new facilities; however, NPS would not spend as much time and money as it does now providing 24-hour emergency service and maintaining multiple residences and 36 miles of FR545.

## Key Actions

### At Wupatki:

- Visitors would enter the park at the existing north entrance and return via the same route. FR545 would end at the junction with the Wukoki Road, and the remainder of the road to the south entrance would eventually be removed and rehabilitated. (A portion of the road would be retained for access to the Peshlakai residence until expiration of this special use permit). The road would be gated at the north entrance and closed at night. Provisions would be made for emergency access.
- Access to the current developed sites (Lomaki, Citadel, Doney Mountain, Wupatki, and Wukoki) would remain as it is now. Vehicle access could become managed if crowding/visitor experience indicators were exceeded and control of visitor numbers warranted.
- The road to Black Falls Crossing would be maintained for access to the Navajo Reservation, and consistent with the concept of the alternative, would be used for administrative use. Access to the park via FR150 would be eliminated.
- To better accomplish visitor orientation/education, a new visitor center would be built at the north junction of FR545 and US89. Park

administrative offices, maintenance facility, and minimal housing would be part of this complex. All existing maintenance, storage facilities, and park housing would be removed, except for one historical structure (residence #1), and the areas would be rehabilitated. Offices would be removed from the existing visitor center, creating space for curatorial storage/research.

- Existing picnic areas would be retained, but rest rooms would be upgraded to environmentally sound, sanitary facilities (e.g., use of dehydrating or composting systems, waterless soap, etc.).
- To make the most of existing sites developed for visitation, new interpretive media (guides, brochures, etc.) and programs would be developed.
- The function of the existing visitor center would shift from visitor orientation to being a museum with additional display of collections, new exhibits, and interpretive media, some of which would allow visitors to experience and "see" sites and resources that are otherwise inaccessible or closed.
- Consistent with the concept of this alternative, overnight backpacking trips to Crack-in-Rock and backcountry guided day hikes would be discontinued. Off-trail backcountry hiking would not be permitted. The existing primitive road to Crack-in-Rock would be retained for patrol/ resource protection functions.

**At Sunset Crater Volcano:**

- Vehicle access on existing FR545 would be from US89 to the Lava Flow Trail parking area only. Visitors would exit the park via the same route. O'Leary Peak Road would be closed to motorized access and promoted as a hiking opportunity. Off-trail backcountry hiking would not be permitted.
- Consistent with the concept of day use, Bonito Campground would be removed. The Park Service would seek an agreement with USFS to relocate camping to the west side of US89, near the junction of FR545. Park housing, maintenance facilities, and administrative offices would be removed and the areas rehabilitated. The existing visitor center, which is inadequate, would also be removed and a new visitor center built west of Bonito Park, affording a view of the volcano and increased educational opportunities. Minimal administration, maintenance, and housing facilities would be part of this complex.
- To acquire associated features, the proposed boundary would incorporate sections 21 and 22, and portions of sections 12, 15, 16, 17, and 20 of T23N, R8E.
- In addition to the current self-guided and ranger-led activities, FR545 from the Lava Flow Trail parking to the eastern park boundary would revert to a hiking trail with ranger-led activities and self-guiding interpretive media. Lenox Crater, Bonito Lava Flow, and pithouses near Bonito Park would be interpreted via a variety of media and activities. Wayside exhibits would be developed for the park road. A contact station and waysides would provide improved orientation to the Lava Flow Trail and new extended learning opportunities accessed from that location.

## Basis for Rejection of This Alternative

This alternative was rejected because significant public input discouraged closing the connecting loop road between the monuments. There was concern about

access to the private property between the monuments and to the Navajo Reservation. There was also concern about losing the link between the two monuments' stories and about losing the transition from ponderosa pine into the lower desert environment and the scenic vistas that are available along FR545.

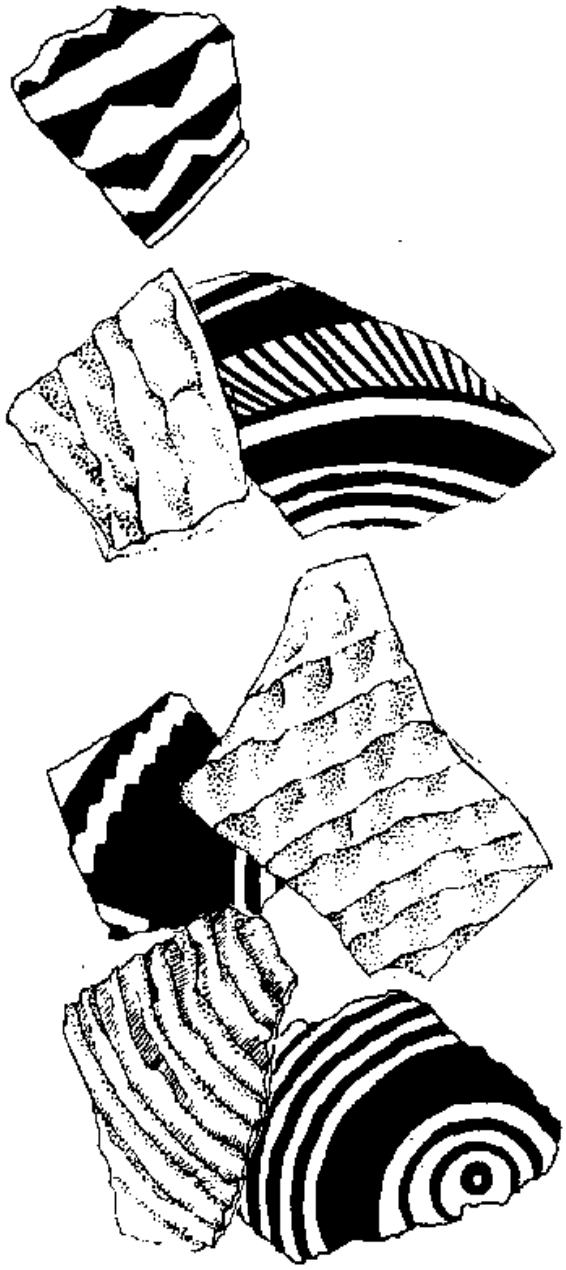
## REGIONAL PLANNING CONSIDERATION

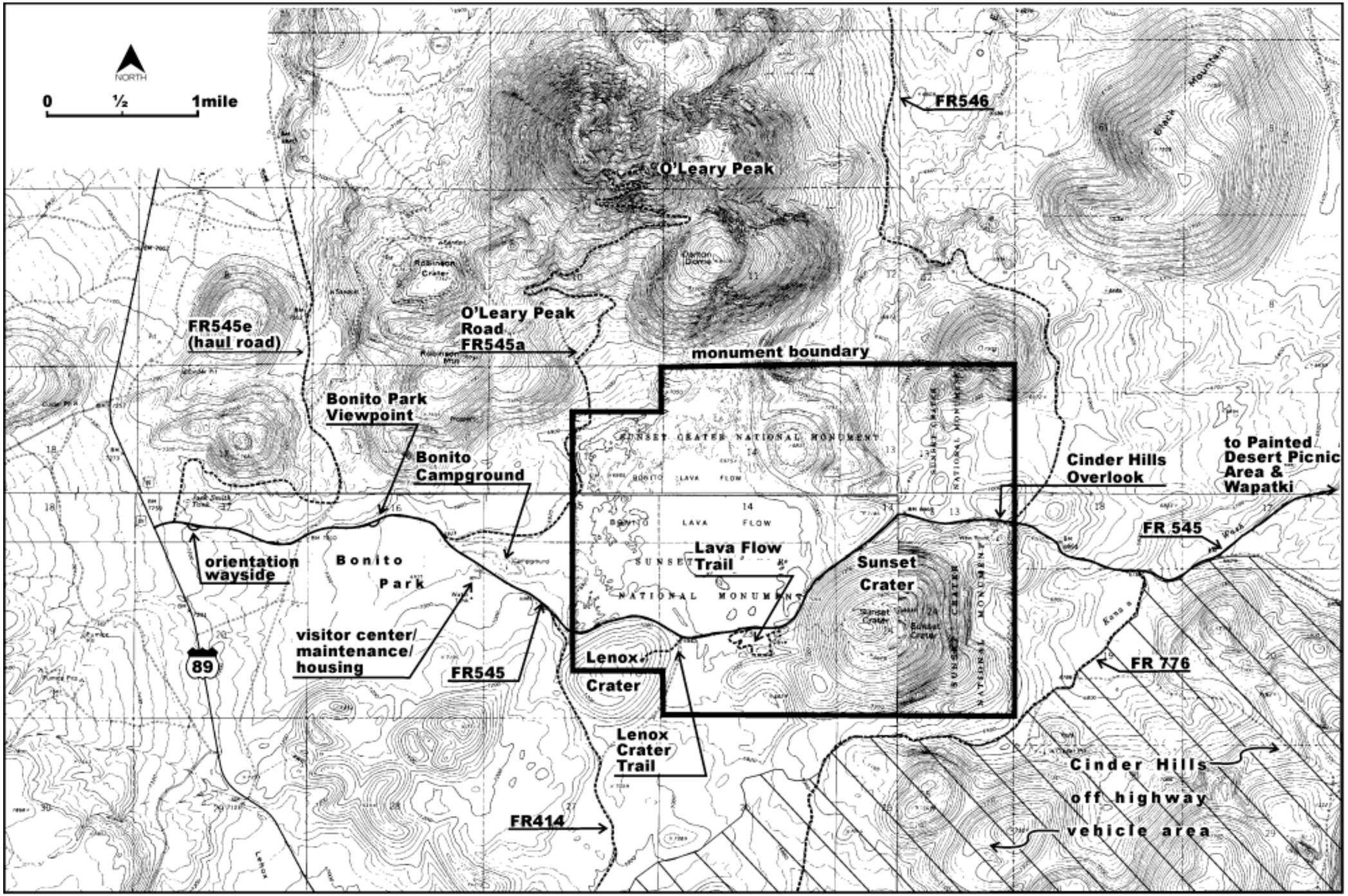
### General Concept

The National Parks and Conservation Association (NPCA), in an earlier letter, urged the Park Service to expand boundaries at Sunset Crater Volcano and Wupatki National Monuments to include all the land between the two monuments. (See Regional Planning Consideration map.) The NPCA recommendation was based on acquiring features, sites, and landscapes primary to park purposes and on protecting park viewsheds, values, and the resources of these associated lands. Such an expansion would enhance interpretation of park themes, provide diverse visitor experiences, and transfer from the Forest Service to the National Park Service land that is in many ways perceived as part of the parks and within which NPS has de facto management by virtue of proximity and presence. The goals of the NPCA recommendation could also be achieved through partnership with USFS, rather than through boundary expansions.

### Basis for Rejection of This Alternative

Analysis of this alternative indicated that joint planning/management with USFS could achieve the same goals without actual transfer of lands. Elements of this alternative were incorporated into Wupatki Alternative 3 and Sunset Crater Volcano Alternative 3.






**Sunset Crater Volcano National Monument - Arizona**
**Existing Conditions**

UNITED STATES DEPARTMENT OF THE INTERIOR - NATIONAL PARK SERVICE

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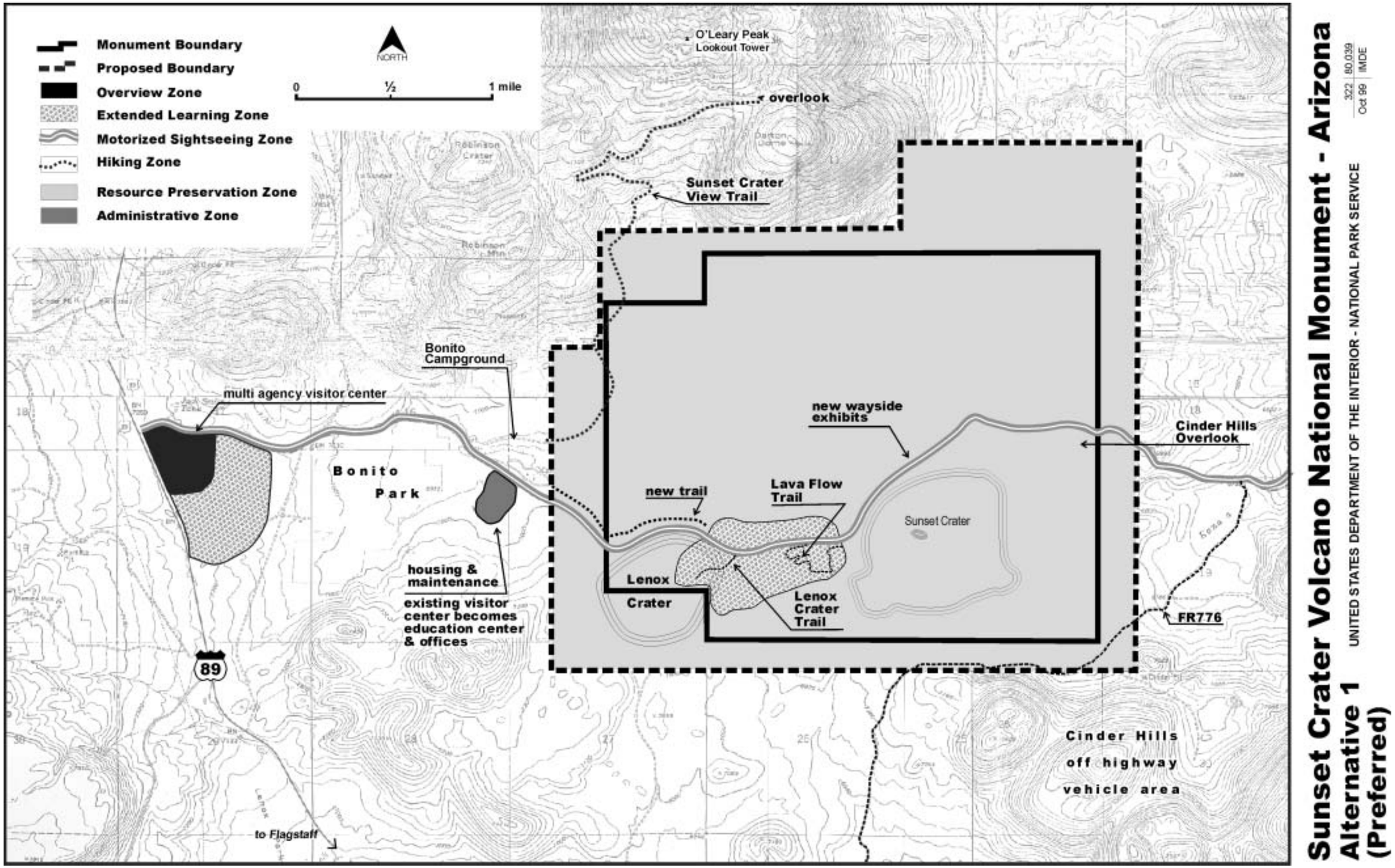


**Sunset Crater Volcano National Monument - Arizona**
**Alternative 1 (Preferred)**
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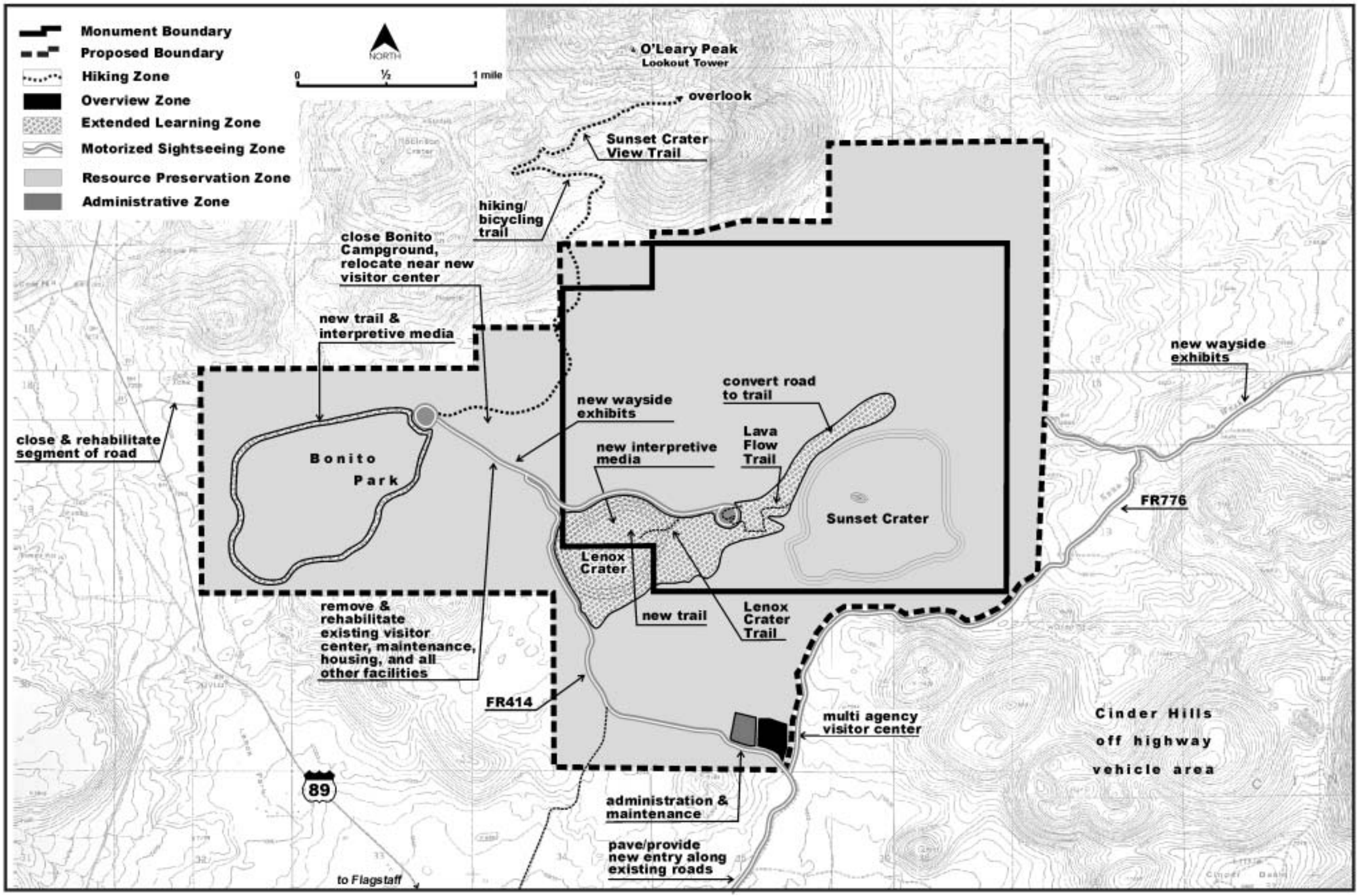


**Sunset Crater Volcano National Monument - Arizona**
**Alternative 2**
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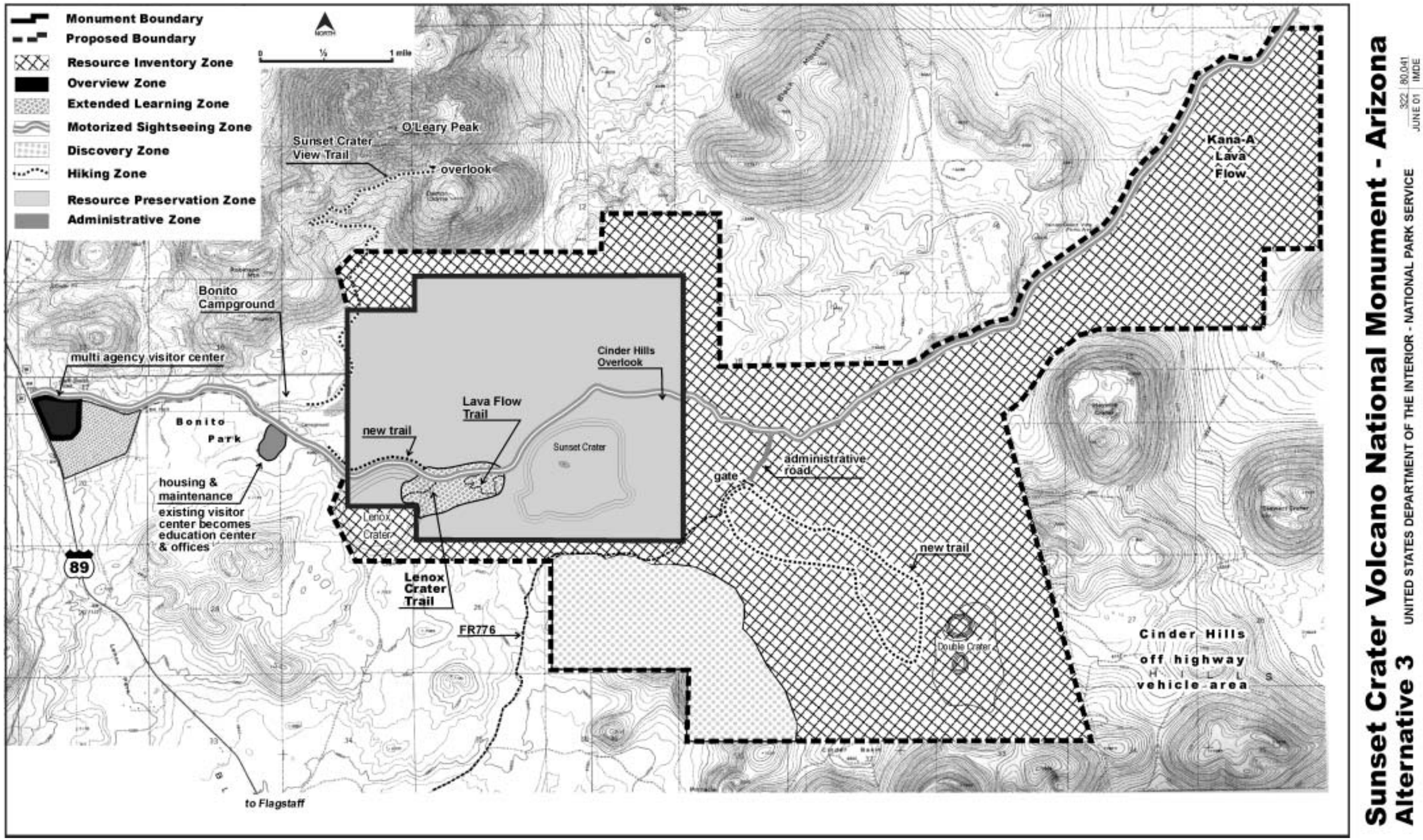
Monument Boundary
Proposed Boundary
Resource Inventory Zone
Overview Zone
Extended Learning Zone
Motorized Sightseeing Zone
Discovery Zone
Hiking Zone
Resource Preservation Zone
Administrative Zone
0 ½ 1 mile
O'Leary Peak
Sunset Crater View Trail
overlook
Kana-A Lava Flow
Bonito Campground
multi agency visitor center
Bonito Park
housing & maintenance
existing visitor center becomes education center & offices
89
Cinder Hills Overlook
Lava Flow Trail
new trail
Sunset Crater
Lenox Crater
Lenox Crater Trail
FR776
gate
administrative road
new trail
Double Crater
Cinder Hills off highway vehicle area
to Flagstaff
Sunset Crater Volcano National Monument - Arizona
Alternative 3
UNITED STATES DEPARTMENT OF THE INTERIOR - NATIONAL PARK SERVICE
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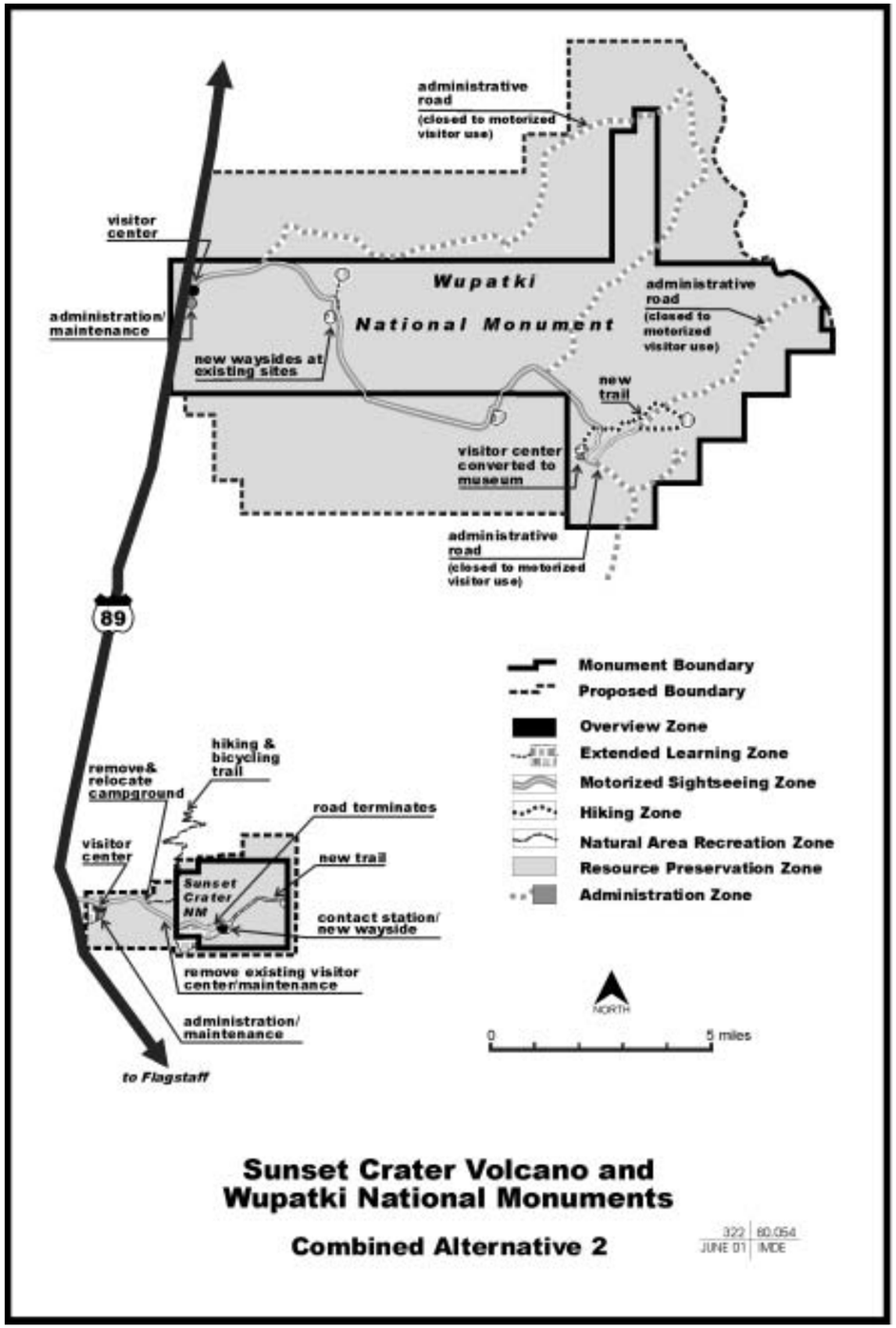


**Sunset Crater Volcano and Wupatki National Monuments**

**Combined Alternative 2**

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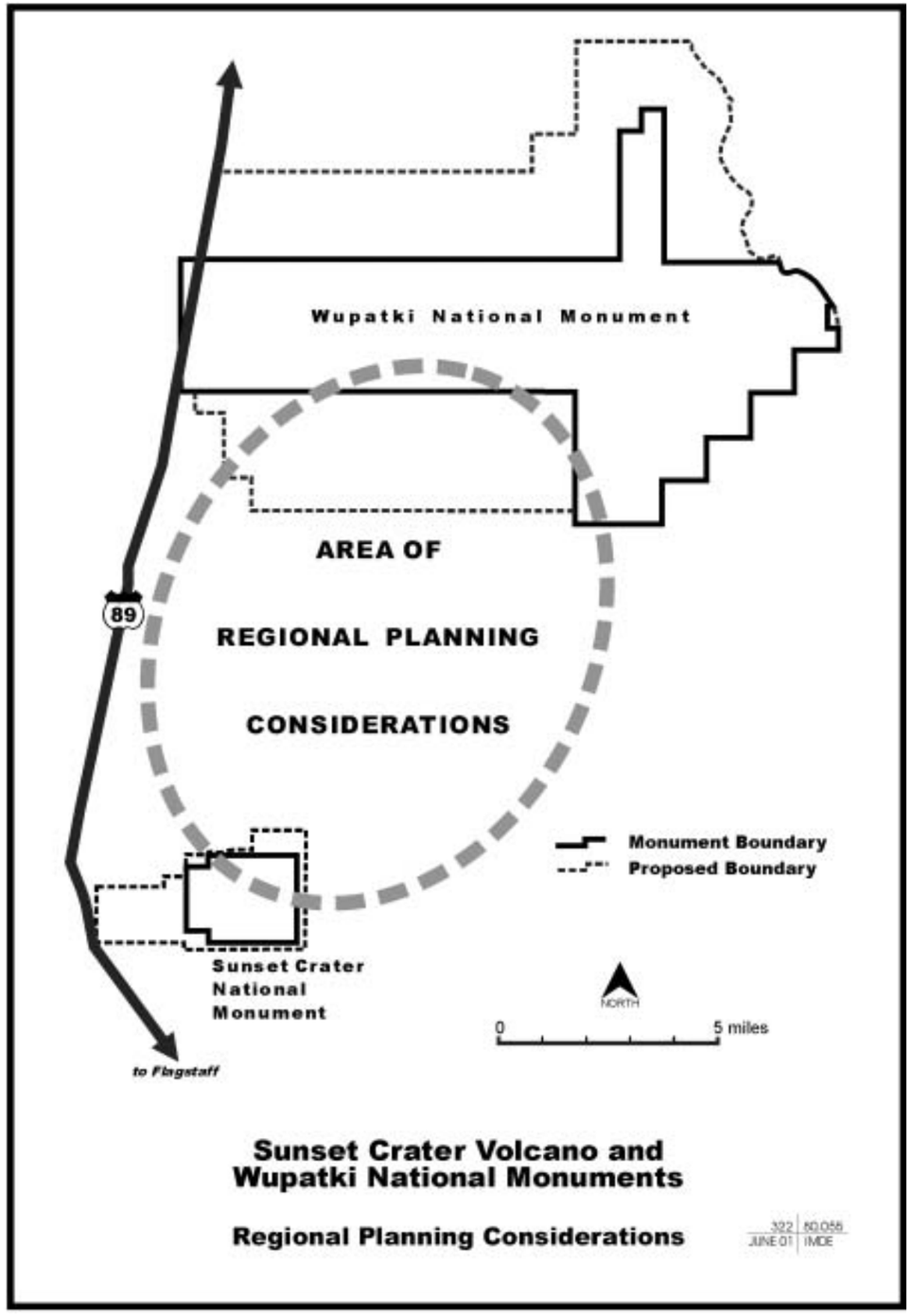


**Sunset Crater Volcano and Wupatki National Monuments**

**Regional Planning Considerations**

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## MITIGATING MEASURES

Under any of the action alternatives proposed, there would be mitigating measures used to reduce the effects of actions. They include the following.

Preservation, rehabilitation, and restoration, as well as the daily, cyclical, and seasonal maintenance of cultural resources, would be undertaken in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties.

Wherever possible, new facilities would be located to avoid impacts to important park resources and values. In many areas soils and vegetation are already impacted to a degree by various human and natural activities. Construction would take advantage of these previously disturbed areas wherever possible.

All new construction would be completed utilizing sustainable practices, such as the use of environmentally friendly materials, sustainable building materials, and efficient utility systems. Components of such projects would also be assessed for visual quality. Utilities and support functions, such as water, sewer, electricity, roads, and parking areas will be evaluated and designed to mitigate visual impacts.

Temporary impacts associated with construction would occur, such as soil and vegetation disturbance and the possibility of soil erosion. In an effort to avoid introduction of exotic plant species, no hay bales would be used. Hay often contains seed of undesirable or harmful alien plant species. Therefore, on a case-by-case basis the following materials may be used for any erosion control dams that may be necessary: rice straw, straws determined by NPS to be weed-free (e.g., Coors barley straw or Arizona winter wheat straw), cereal grain straw that has been fumigated to kill weed seed, and wood excelsior bales. Standard erosion control measures such as silt fences and/or sand bags would also be used to minimize any potential soil erosion.

Potential compaction and erosion of bare soils would be minimized by conserving topsoil in windrows. The use of conserved topsoil would help preserve micro-organisms and seeds of native plants. The topsoil would be respread in as near to the original location as possible, and supplemented with scarification, mulching, seeding, and/or planting with species native to the immediate area. This would reduce construction scars and erosion.

Although soil side-cast during construction would be susceptible to some erosion, such erosion would be minimized by placing silt fencing around the excavated soil. Excavated soil may be used in the construction project; excess soil would be stored in approved areas. If used, silt fencing fabric would be inspected weekly or after every major storm. Accumulated sediments would be removed when the fabric is estimated to be approximately 75% full.

Revegetation plantings would use native species from genetic stocks originating in the park. Revegetation efforts would be to reconstruct the natural spacing, abundance, and diversity of native plant species. All disturbed areas would be restored as nearly as possible to preconstruction conditions shortly after construction activities are completed. The principal goal is to avoid interfering with natural processes.

Some petrochemicals from construction equipment could seep into the soil. To minimize this possibility, equipment would be checked frequently to identify and repair any leaks. Any blasting would conform with NPS-65, Explosives Use and Blasting Program (1991), specifications. All blasting would use the minimum amount necessary to accomplish the task. All

blasting would be used to shatter, not distribute, any material.

Construction zones would be identified and fenced with construction tape, snow fencing, or some similar material prior to any construction activity. The fencing would define the construction zone and confine activity to the minimum area required for construction. All protection measures would be clearly stated in the construction specifications and workers would be instructed to avoid conducting activities beyond the construction zone as defined by the construction zone fencing.

Prior to any land-modifying activity, a qualified professional archeologist would inspect the present ground surface of the proposed development site and the immediate vicinity for the presence of cultural remains, both prehistoric and historic. Should newly discovered or previously unrecorded cultural remains be located, additional investigations would be accomplished prior to earth-disturbing activities. Similarly, in those areas where subsurface remains appear likely, an archeologist would be on hand to monitor land-modifying actions.

Construction activities would affect the uppermost layers of earth as vehicles compact the soils and alter the horizontal and vertical distribution of buried archeological remains. These activities would also destroy surface sites by damaging and destroying artifactual remains and their contextual environments. Loss of these resources could be partially mitigated through excavation and curation prior to construction. Additional archeological investigations, including recording and mapping, and a rigorous program of sampling/collecting/testing of archeological features and artifacts would be performed in those areas where cultural remains would be affected by the plan.

Should construction unearth previously undiscovered archeological resources, work would be stopped in the area of any discovery and the park would consult with the State Historic Preservation Officer/Tribal Historic Preservation Officer and the Advisory Council on Historic Preservation, as necessary, according to §36 CFR 800.13, Post Review Discoveries. In the unlikely event that human remains are discovered during construction, provisions outlined in the American Indian Graves Protection and Repatriation Act (1990) would be followed.

The Park Service would ensure that all contractors and subcontractors are informed of the penalties for illegally collecting artifacts or intentionally damaging archeological sites or historic properties. Contractors and subcontractors would also be instructed on procedures to follow in case previously unknown archeological resources are uncovered during construction. Equipment traffic would be minimized in the area of the site. Equipment and materials staging areas would also avoid known archeological and ethnographic resources.

Efforts to identify ethnographic resources will continue in consultation with traditionally associated tribes. A traditional use study will be conducted to understand how associated tribes have used park resources in the past and will need to continue to use them in the future. Based on the results of the study, agreement documents will be developed with associated tribes to ensure access to traditionally used resources in keeping with NPS policies Executive Order 13007. Tribal consultation will continue to take place with the implementation of individual undertakings pursuant to the NHPA to ensure that previously unidentified ethnographic resources are not affected.

The flow of vehicle traffic on roads would be maintained as much as possible during

construction periods. Construction delays would normally be limited. There may be some periods when the nature of the construction work may require temporary road closures. All efforts would be made to reduce these as much as possible and to alert park staff as soon as possible if delays longer than normal are expected. Visitors would be informed of construction activities and associated delays. Traffic would be managed to ensure timely access to private residents and ranches along the road.

Contractors would coordinate with park staff to reduce disruption in normal park activities. Equipment would not be stored along the roadway overnight without prior approval of park staff. Construction workers and supervisors would be informed about the special sensitivity of park values, regulations, an appropriate housekeeping.

## SELECTION OF THE PREFERRED ALTERNATIVE

In order to develop proposed actions, all of the alternatives for each park were evaluated. To minimize the influence of individual biases and opinions, the team used an objective analysis process called "Choosing by Advantages" (CBA). This process, which has been used extensively by government agencies and the private sector, evaluates different choices (in this case, the alternatives for each park) by identifying and comparing the relative advantages of each according to a set of criteria.

One of the greatest strengths of the CBA system is its fundamental philosophy: decisions must be anchored in relevant facts. For example, the question "Is it more important to protect natural resources or cultural resources?" is "unanchored," because it has no relevant facts on which to make a decision. Without such facts, it is impossible to make a defensible decision. The CBA process instead asks which alternative gives the greatest advantage. To answer this question, relevant facts would be used to determine the advantages the alternatives provide. To ensure a logical and trackable process, the criteria used to evaluate the alternatives were derived from the impact topics in the EIS. Alternatives were evaluated to see how well they:

- MAXIMIZE PROTECTION OF CULTURAL RESOURCES (long-term integrity of archeological resources and cultural landscapes, historic character of the built environment, long-term integrity of ethnographic resources)
- MAXIMIZE PROTECTION OF NATURAL RESOURCES (long-term integrity of natural systems and processes, threatened and endangered species and sensitive species, long-term integrity of geological features, floodplains, and riparian habitat)
- EXPAND DIVERSITY OF VISITOR EXPERIENCE (ability to experience full range of resources related to significance, provide a diversity of opportunities to experience park resources, and perceived wild character)
- LIMIT EFFECT ON NEIGHBORS (park neighbors; local, state, and tribal land management; land/resource managing agencies)
- IMPROVE OPERATIONAL EFFICIENCY (health and safety, conservation, distance to work, management of resources, communication)

Alternatives for each of the three monuments were rated on the attributes relating to each of the factors just listed. Then the advantages of the attributes were compared and the alternative with the most advantages was selected. Costs for each alternative versus advantages provided were compared and analyzed.

A GMP provides a framework for proactive decision making, including decisions on visitor use, natural and cultural resource management, and park development. The plan prescribes resource conditions and visitor experiences that are to be achieved and maintained over time. Park development is considered in general needs rather than in specifics. For the purposes of cost estimating, general assumptions are made regarding amounts and sizes of development. These assumptions are then carried across to all alternatives so that comparable costs can be considered for each alternative.

Staffing considerations are considered to be a part of life cycle costing. The existing staff for the three monuments totals 42, which includes shared management, division chiefs, and administration. Approximating a breakdown between the parks, the staffing is Wupatki, 16, Walnut Canyon, 14, and Sunset Crater Volcano, 12. The current staffing provides minimal resource protection and visitor service, and many tasks within the monuments are being deferred. The parks' 5-year FTE projection increases staffing levels in all three monuments by one-third. By park, the staffing would be Wupatki, 21.3, Walnut Canyon, 18.7, and Sunset Crater Volcano, 16. These figures are base staffing needed for the no-action alternative. Staffing increases needed by different alternatives are included in Appendix C. Those costs are included in Table 1: Summary of Comparative Costs.

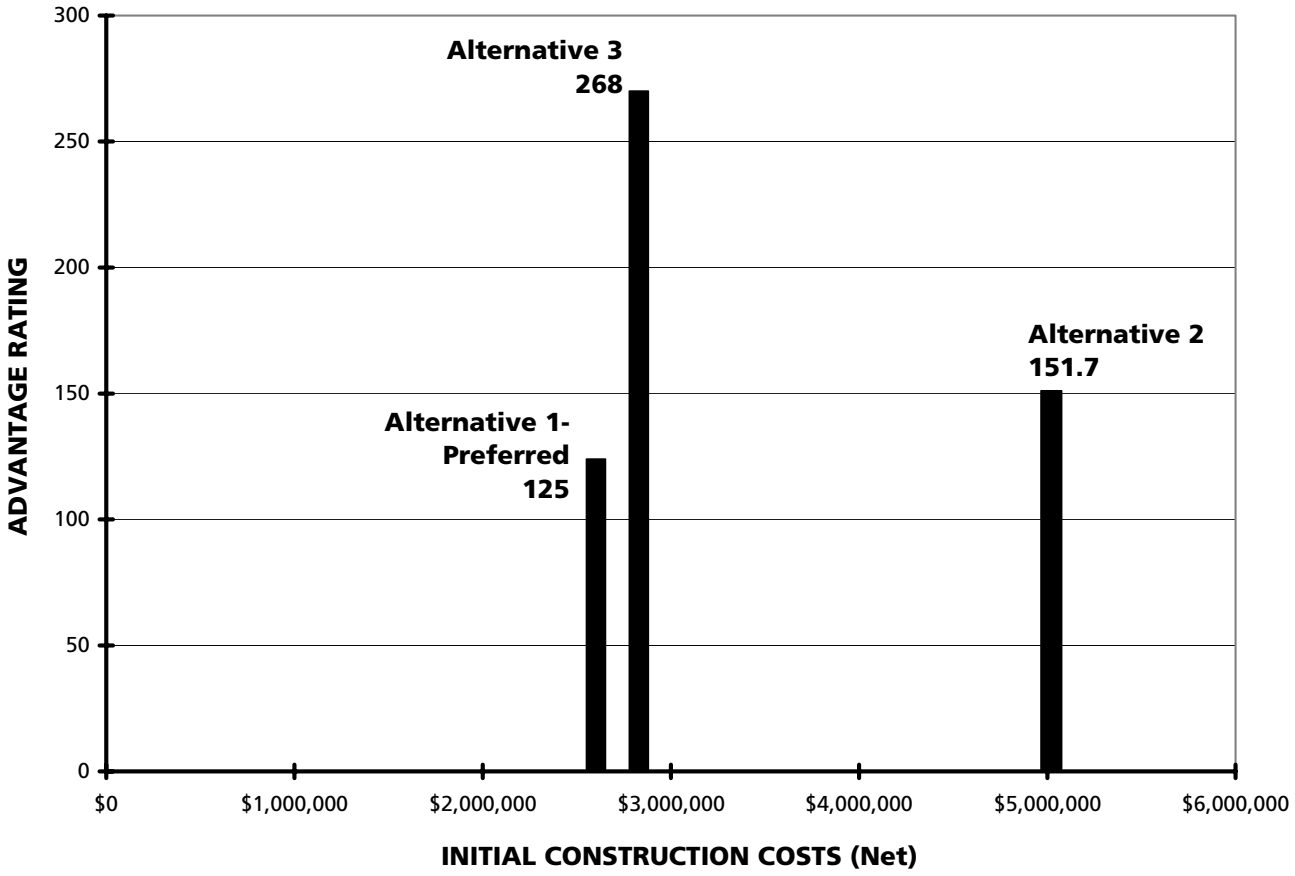
Costs identified in the GMP are not intended to replace more detailed consideration of needs, sizes, and amounts of future development. They should not be used as a basis for money requests until further analysis has been completed. Costs and items considered are shown in appendix C.

Comparative costs for the alternatives include both initial development costs and total life cycle costs. Initial development costs are the estimated construction costs of the alternatives. Demolition, labor, and materials for buildings, roads, trails, exhibits, and parking are included. Estimated costs are based on costs for similar types of development in other parks from the Denver Service Center Class "C" Estimating Guide. Life cycle costs consider the costs of each alternative over a period of time. Life cycle costs include the costs of operating buildings, the staffing required, maintenance, and replacement costs of alternative elements. The life cycle costs below are for a 25-year period. It is important to note that all estimates are general, in keeping with the general nature of GMP alternatives, and should be used for comparison purposes only.

**Table 1: Summary of Comparative Costs (FY 2000 Dollars)**

| | **Alternative 1 - Preferred** | Alternative 2 | Alternative 3 |
|---|---|---|---|
| **Initial Development Costs** | **$2,604,000** | $5,055,500 | $2,801,000 |
| **Total Life Cycle Costs (present worth)** | **$2,935,594** | $5,387,094 | $4,367,874 |

**Choosing by Advantages**




Selection of the preferred alternative considers the advantages provided by each alternative (from the CBA) as compared with the cost of the alternative. The chart below summarizes the results. Alternative 1 is the least expensive and provides a higher quality visitor experience than the No-Action Alternative. Alternative 3 provides substantial additional advantages for natural resources, due to the increased land base and proposed use changes. However, there was little support for the boundary changes proposed in that alternative, especially by the Forest Service. Alternative 2 provided slightly more advantages than Alternative 1, primarily in cultural and natural resource protection. However, the additional $2,450,000 in costs did not justify the additional resource protection.

## ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA), which is guided by the Council on Environmental Quality (CEQ). The CEQ provides direction that "[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101:(1) fulfill the responsibilities of each generation as trustee of the environment

for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradations, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety, of individual choice; (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

"Generally this means the alternative that causes the least damage to the biological and physical environment. It also means the alternative that best protects, preserves, and enhances historic, cultural, and natural resources." (Council on Environmental Quality, "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations" (40 CFR 1500-1508), Federal Register Vol. 46, No. 55, 18026-18038, March 23, 1981: Question 6a)

The No-Action Alternative represents the current management direction for Sunset Crater Volcano National Monument. The existing use and development of the park is based on planning initiated and implemented during the Mission 66 program. Personal services interpretation and resource protection patrols are sporadic at the four interpreted areas (Bonito Park Pullout, Lenox Crater Trail, Lava Flow Trail, and Cinder Hills Overlook) and the Painted Desert picnic area. For resource protection purposes, areas of the park not zoned for administrative or visitor use are closed to unguided entry. Since the No-Action Alternative maintains the Mission 66 designed visitor experience the diversity for educational opportunities and the protection of natural and cultural resources is limited. Protection of natural and cultural resources would not be as enhanced as under Alternatives 2 and 3. The No-Action Alternative does not impact access to neighboring lands, unlike Alternatives 2 and 3. The No-Action Alternative does not fully realize provisions 3, 4, 5, and 6 of the goals.

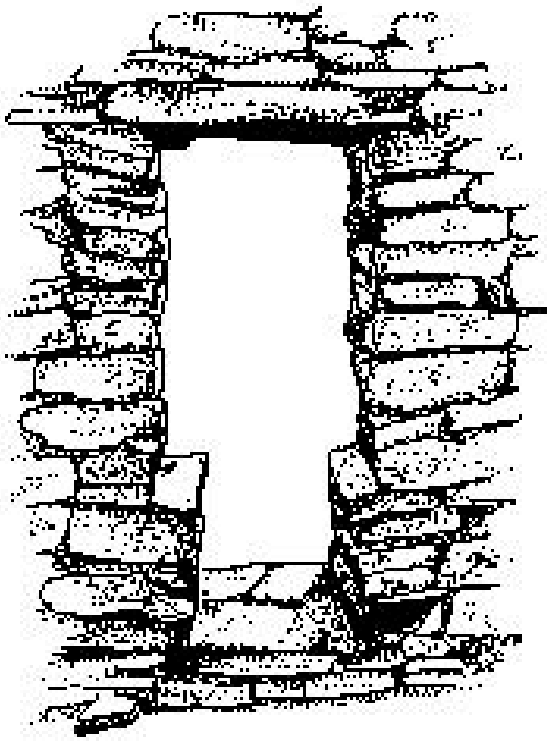
Alternative 1 provides increased educational opportunities and diverse experiences both within and outside park boundaries. With the construction of a new visitor center, both park and forest users would be better oriented before entering public lands and encountering sensitive resources. Increased partnerships for visitor orientation and educational activities would more efficiently provide contact with the missions and personnel of both agencies, meeting goals 3 and 5. Visitors would be provided with information and opportunities that would encourage greater stewardship of public lands meeting national environmental policy goal 4. Significant geologic resources related to the history of Sunset Crater Volcano would not become part of the park, but would be protected and interpreted through partnerships with the USFS, partially fulfilling goal 6 of the National Environmental Policy Act.

Alternative 2 strives to limit motorized sightseeing in the park and focus on longer and more intensive educational programs to enhance the protection of cultural and natural resources meeting national environmental policy goal 6. This alternative restricts the visitor experience by eliminating the drive through experience in favor of a longer intensive stay. This alternative also limits access by park neighbors to the OHV area and by Navajo residents and Alpine Rancho residents who use FR545 to commute to Flagstaff. National environmental policy

goals 3, 4, and 5 are not fully realized under this alternative to the same extent as they are under Alternative 3. In addition, Alternative 2 does not fully realize provisions 3 and 5 of the goals as compared with Alternatives 1 and 3.

Alternative 3 would extend NPS management and protection by expanding park boundaries to include USFS land to the southeast to include key features of the eruption and geologic story of the Sunset Crater volcanic chain. The inclusion of the entire Bonito and Kana-A lava flows, red-topped cinder cones along the Cinder Hills fissure, Vent 512 and Double Crater would allow visitors to experience the entire geologic story, meeting national environmental policy goal goals 1 and 2, and partially fulfilling goal 4. The developed areas of the park would be managed for day use only, and FR545 would remain open 24 hours. Visitor use would be spread throughout more resources, and a new multiagency visitor center would be constructed near the junction of US89 and FR545 to orient visitors prior to interacting with sensitive park and forest resources. The existing visitor center would be adapted for use by educational groups, and diverse experiences would be provided via new trails and new interpretive media and activities in a quieter natural setting meeting goal 3 and partially meeting goals 4 and 5. The proposed expansion would substantially reduce the boundaries of the Cinder Hills OHV Recreation Area. OHV use would cease on the portions of the USFS OHV recreation area included within the new boundaries. Extensive rehabilitation would be undertaken. National environmental policy goals 5 and 6 would not be fully realized under this alternative.

After careful review of potential resource and visitor impacts, and developing proposed mitigation for impacts to natural and cultural resources, the environmentally preferred alternative is Alternative 1. Alternative 1 surpasses the other alternatives in best realizing the full range of national environmental policy goals as stated in § 101 of the National Environmental Policy Act. Although other alternatives may achieve greater levels of individual protection for cultural or natural resources, or better enhance visitor experience, Alternative 1 overall (1) provides a high level of protection of natural and cultural resources while concurrently attaining the widest range of neutral and beneficial uses of the environment without degradation; (2) maintains an environment that supports diversity and variety of individual choice; and (3) integrates resource protection with an appropriate range of visitor uses.



| Table 2: Summary of Alternatives | | | |
|---|---|---|---|
| **No-Action Alternative: Existing Conditions** | **Altenative 1 (Preferred): Focus on Extended Learning** | **Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use** | **Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use** |
| The No-Action Alternative would involve no new construction, additional trail developments or realignments other than planning that is under way to meet immediate operational needs that would continue to exist for all alternatives. These are continuation of partnerships with USFS, State of Arizona and private landowners for the protection of cultural and natural resources; new wayside and museum exhibits; expansion of Bonito Campground by USFS; a new curatorial building in the administrative area for long-term care and preservation of museum objects and specimens from all three Flagstaff Area monuments, with associated utilities and a road extended to the site; a new maintenance, resources management, and ranger support facility at the Sunset Crater Volcano administrative area, including vehicle, equipment, supplies, and materials storage, offices, a meeting room, also with associated utilities, parking area, and a road extended to the site. All construction/modifications will comply with Americans with Disabilities Act and other requirements and will be designed to upgrade and improve safety features. | **The goal of the preferred alternative is to provide increased educational opportunities and diverse experiences both within and outside of park boundaries. The park would be viewed as a destination for education and learning. Partnerships with the USFS, affiliated tribes, and educational institutions would provide interpretation and more consistent management of sites and features outside the park that are primary to the park purpose. Minor boundary adjustments would be made for ease of management and to align park boundaries and associated fencing with topographic features rather than along section lines. Geologic features would be better protected within a single jurisdiction, and management of existing USFS secondary roads would be clarified. Most existing uses would continue. The park would remain day-use only, with 24-hour access on FR545, and visitor use would be spread throughout more resources. A new multiagency visitor center would be built near US89 to serve as the primary location to orient and serve visitors. The existing visitor center would be adapted for use as an education center.** | Alternative 2 would extend a high degree of protection for park resources by removing and relocating some facilities and would provide more diverse experiences than the No-Action Alternative. Visitor experience would require slightly more effort than under the No-Action Alternative. Primary points of interest would be reached as destinations rather than roadside attractions. Visitors would be better insulated from modern day intrusions. The desired outcome is that visitors would spend more time engaged in in-depth learning activities than at present. The increased diversity of experience would be provided via new trails and new interpretive media and activities. The park road would be gated at night. A new visitor center and campground would be constructed south of Sunset Crater Volcano, and both park and forest orientation would be provided at this location. Visitors would be in contact with employees from both NPS and USFS. Short roads to key areas of the park would eliminate the current drive-through experience. More of the monument would be experienced by trail and self-guided activities. Visitors would be able to connect the stories of Sunset Crater Volcano and Wupatki National Monuments by experiencing the dramatic landscape changes along FR545, as well as through interpretive media within the monuments and at | Alternative 3 would extend NPS management and protection by expanding park boundaries to the southeast to include key features of the eruption and geologic story of the Sunset Crater volcanic chain. Boundaries for the monument were drawn before the full extent of geologic features related to the eruption was known. This alternative would provide consistent protection of these resources, including the entire Bonito and Kana-A lava flows, the red-topped cinder cones along the Cinder Hills fissure, Vent 512, and Double Crater, and would allow visitors to experience the entire geologic story. Partnerships with USFS would continue for visitor orientation and educational activities near the new visitor center, resource preservation at Bonito Park, and cooperative management of neighboring lands. Most existing uses would continue. The developed areas of the park would be managed for day use only. FR545 would be open 24 hours. Visitor use would be spread throughout more resources. A new multiagency visitor center would be constructed near US89 to serve as the primary location to orient and serve visitors to both park and forest lands. The existing visitor center would be adapted for use by educational groups. Diverse experiences would be provided via new trails and new interpretive media and activities in a quieter natural |

| Table 2: Summary of Alternatives | | | |
|---|---|---|---|
| **No-Action Alternative: Existing Conditions** | **Altenative 1 (Preferred): Focus on Extended Learning** | **Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use** | **Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use** |
| | | waysides. Boundaries would be adjusted for administrative purposes, as described in Alternative 1, and would include significant resources located at Bonito Park and south of existing park boundaries. Removing all administrative and visitor facilities (except toilets) from the heart of the park would allow for restoration of damaged critical resources and provide a more pristine experience. The ability to close the park at night would further protect fragile park features. Rerouting the entrance road would allow for placement of the visitor center so that the public could be oriented before exploring the park, while maintaining a drive between Sunset Crater Volcano and Wupatki National Monuments. Should visitation levels dictate, numbers of people could be controlled through use of a shuttle or reservation system. | setting. Guided tours would be provided to key geologic features, following completion of resource inventories and impact assessments. Untrailed hiking and a greater degree of solitude would be possible in specified areas. Off-highway vehicle activity would remain subject to USFS management but would be removed from within the expanded NPS boundaries. FR776 south of the Double Crater trailhead would be gated for administrative use only. |

| Table 3 Summary of Major Impacts | | | | |
|---|---|---|---|---|
| | **No-Action Alternative: Existing Conditions** | **Alternative 1 (Preferred): Focus on Extended Learning** | **Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use** | **Alternative 3: Expand Park boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use** |
| ***Archeological Resources*** | There would be no major impacts to archeological resources under the No-Action Alternative. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | **In comparison to existing conditions, Alternative 1 would have a major, adverse effect on a relatively small but concentrated number of archeological resources located near the new visitor center and Extended Learning Zone. Although the exact number of archeological resources that would be affected by this alternative is unknown (because an intensive archeological inventory has not been completed and specific locations for new facilities have not been decided), a larger number of resources would be impacted in Alternative 1 than under existing conditions. The adverse impacts would be offset to some degree by the benefits of an increased USFS presence and increased opportunities to orient and educate visitors before they encounter sensitive resources. The net effect, however, would be major and adverse for the long-term integrity of specific archeological resources. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.** | Alternative 2 would have a moderate adverse effect on the long-term integrity of archeological resources located in the vicinity of Bonito Park and the new visitor center. These effects would be minimized by careful placement of the trail system and facilities. Most impacts would be indirect, resulting from increased visitor use of these areas. Although there would be an overall reduction in archeological integrity, it would not be to the extent that the resources would become ineligible for listing in the National Register of Historic Places. In addition to those mentioned, there would be other minor and moderate effects, both beneficial and adverse, to the integrity of archeological resources as a result of this alternative. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | Under Alternative 3, there would be major, long-term, adverse effects to the integrity of 12-15 archeological resources located in proximity to the new visitor center and expanded campground. Relative to existing conditions, however, the cumulative effects of this alternative on the long-term integrity of a majority of archeological resources would be major and beneficial, because of the elimination of OHV impacts within the significantly expanded park boundaries, the increased NPS and USFS presence in the area, and the zoning of a large area of the expanded monument for long-term preservation purposes. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. |
| ***Historic Character of the Built Environment*** | The No-Action Alternative would have long-term moderate adverse impact on the prehistoric and Mission 66 landscapes. There would be an overall reduction of historic integrity of both | **Alternative 1 would have long-term moderate adverse impacts on the prehistoric and Mission 66 landscapes. There would be an overall reduction of integrity in both landscapes, but not to the** | Alternative 2 would have long-term major adverse impacts to the Mission 66 designed landscape, and long-term major benefit and long-term moderate adverse impact to the prehistoric | Alternative 3 would have long-term moderate adverse impacts and long-term major benefits on the prehistoric landscape, and would have long-term moderate adverse impacts on the Mission |

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| | landscapes, but not to the extent that they would no longer be eligible to be listed in the National Register of Historic Places. Any future alteration to the prehistoric and Mission 66 landscapes, in conjunction with the moderate, adverse cumulative impacts of previous changes and this alternative could result in moderate, adverse cumulative impacts to both designed landscapes. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | **extent that they would no longer be eligible to be listed in the National Register of Historic Places. Any future alterations to the prehistoric and Mission 66 landscapes, in conjunction with the moderate adverse, cumulative impacts of previous changes and this alternative could result in moderate, adverse cumulative impacts to the prehistoric and Mission 66 designed landscapes. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.** | landscape. There would be an overall reduction of historic integrity in the Mission 66 landscape, but not to the extent that it would no longer be eligible to be listed in the National Register of Historic Places. Any future alterations of the Mission 66 landscape, in conjunction with the adverse, cumulative impacts of previous changes and this alternative, could result in major, adverse cumulative impacts to the Mission 66 landscapes. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | 66 landscapes. There would be an overall reduction of historic integrity in the landscapes, but not to the extent that they would no longer be eligible to be listed in the National Register of Historic Places. Any future alterations of the landscapes, in conjunction with the adverse cumulative impacts of previous changes and this alternative, could result in major, adverse cumulative impacts to the prehistoric and Mission 66 landscapes. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. |
| ***Ethnographic Resources*** | The No-Action Alternative would continue to have some moderate to major adverse impacts to some ethnographic resources, but the actions common to all alternatives would improve many existing conditions and have a moderate to major beneficial effect on some ethnographic resources and the cultural values that give them significance. None of the adverse impacts would constitute an impairment as defined by NPS management guidelines. In addition to those mentioned, there would be other, less severe effects as a | **Alternative 1 would have moderate to major long-term beneficial impacts to ethnographic resources, with the development of agreements among the NPS and associated tribes for continued tribal involvement in park management and interpretive planning, The exceptions to these beneficial effects are the continued moderate to major adverse effects of OHV uses on the ethnographic landscape and possibly visitor access to Lenox Crater. None of the adverse impacts would constitute an** | Alternative 2 includes actions that will have both beneficial and adverse effects on ethnographic resources. The effects of some proposed actions will need additional evaluation in conjunction with associated tribes. The effects of the actions common to all alternatives would be the same as those described under the No-Action Alternative. None of the adverse impacts would constitute an impairment as defined by NPS management guidelines. In addition to those mentioned, there would be other, less severe effects as a | Alternative 3 includes actions that will have mainly beneficial and some adverse effects on ethnographic resources and landscapes. The effects of some proposed actions will need additional evaluation in conjunction with associated tribes. The effects of the actions common to all alternatives would be the same as described in the No-Action Alternative. None of the adverse impacts would constitute an impairment as defined by NPS management guidelines. In addition to those mentioned, there would be other, less severe |

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| | result of implementing this alternative. | **impairment as defined by NPS management guidelines. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.** | result of implementing this alternative. | effects as a result of implementing this alternative. |
| ***Natural Systems and Processes*** | There would be no major impacts under the No-Action Alternative. Minor and moderate impacts are caused by the existing road through the monument and by visitor use in concentrated areas such as the Lava Flow Trail and the Lenox Crater Trail. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | **Under Alternative 1, there would be no major impacts to the long-term integrity of natural systems of Sunset Crater Volcano National Monument Some minor and moderate impacts would be caused by the road through the monument, construction of the new visitor center, and some trail construction and visitor use impacts in the Extended Learning Zones. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.** | Under Alternative 2, there would be no major impacts to the long-term integrity of natural systems and processes at Sunset Crater Volcano National Monument. Some minor to moderate impacts would occur with construction of new facilities and new trails, but these would be mostly offset by removal and rehabilitation of buildings and road segments in other areas. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | Alternative 3 would have a major beneficial effect on preserving the long-term scientific integrity of natural systems and processes within the monument. The minor adverse impacts that would accompany development of the new visitor center and extended learning zone would be substantially offset by the benefits of more visitor orientation at the new visitor center, increased NPS/USFS presence in the area, inclusion of additional very significant resources within monument boundaries, and zoning of large areas within the monument for long-term preservation purposes. In addition to those mentioned, there would be other, less severe effects as a result of imple-menting this alternative. |
| ***Threatened, Endangered, and Sensitive Species*** | Under current NPS management there are no major adverse impacts to threatened, endangered, or sensitive species. There are some negligible to minor effects to sensitive plant and animal species and unique | **Alternative 1 would cause no major effects to threatened, endangered, or sensitive species or unique habitats. There is the possibility of minor adverse impacts to sensitive plant species where new trails and facilities** | Alternative 2 would cause no major impacts to threatened, endangered, or sensitive species. Some negligible to minor effects to sensitive plant species would occur from construction of new facilities and hiking trails. | Alternative 3 would have a major beneficial impact by preserving more habitat for sensitive plant species in particular. There would be some negligible to minor effects to both sensitive plant and animal species from |

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| | habitats from current visitor use and NPS facilities. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | **would be constructed, however, surveys prior to these activities would minimize any impacts. There could be minor to moderate impacts to pronghorn antelope use of Bonito Park as a fawning area due to disruption of movement corridors and human disturbance. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.** | Moderate impacts may occur to pronghorn movement and use of Bonito Park as a fawning area. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | construction of new facilities and trails. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. |
| ***Geological Resources*** | Sunset Crater Volcano has been impacted by past visitor use, resulting in deep scars eroded into the steep cinder cone slopes that are still visible today. Existing NPS operations and visitor use in the Lenox Crater, southwestern Bonito Lava Flow perimeter, and Lava Flow Trail area are resulting in long-term, negligible to minor adverse impacts to large-scale cinder cone and lava flow geologic features, and long-term, moderate impacts to smaller features, such as spatter cones and lava flow surfaces. Development and recreational use of lands surrounding the monument are causing long-term moderate adverse impacts to the cinder cones adjacent to Sunset Crater, and long-term, major adverse impacts to the geologic features associ- | **Alternative 1 would likely have no major impacts to geologic features within Sunset Crater Volcano National Monument. Many of the impacts associated with this alternative, including potential cumulative impacts, are very similar to those described for the No-Action Alternative. Increased visitor-use impacts within the proposed Extended Learning Zone between the Lava Flow Trail, Lenox Crater, and southern edge of the Bonito Lava Flow could result in long-term, minor adverse impacts to large-scale geologic features, such as cinder cones and lava flows, but could result in long-term, moderate adverse impacts to uninventoried, small, and unique geologic features. In addition to those mentioned, there would be** | Alternative 2 would cause no major impacts to geological features within Sunset Crater National Monument. The boundary of the monument would be expanded to approximately 6,700 acres, effectively doubling the area within the monument. As much as 8% of the expanded monument area would be used for road and trail access, visitor support and NPS administrative facilities, and visitor activities. The remaining 92% would be closed to protect sensitive geologic resources. The new visitor center, campground facilities, and upgraded entrance road along FR414 would be constructed in a heavily impacted recreational use area and likely have negligible impacts to geologic resources. A new trail | Alternative 3 would likely have no major impacts to geologic features within Sunset Crater Volcano National Monument. Visitor use impacts to geologic resources within the original monument boundary are very similar to the No-Action Alternative. The boundary would be expanded to include significant geologic resources associated with the eruption of Sunset Crater Volcano. This action would ensure the long-term integrity of geologic resources by protecting them from increased off-road-driving impacts. Increased visitor use impacts within the proposed Extended Learning Zone between the Lava Flow Trail, Lenox Crater, and southern edge of the Bonito Lava Flow could result in long-term, minor adverse impacts to |

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| | ated with the Sunset Crater Volcano eruption. The scientific geological value of Sunset Crater Volcano National Monument should become even greater as associated and irreplaceable geologic features within the eastern San Francisco Volcanic Field continue to be permanently impacted. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | **other, less-severe effects as a result of implementing this alternative.** | around Bonito Park would also likely have negligible impacts to geologic resources. Increased visitor use within the Extended Learning Zone and trails within the central monument area would have long-term, minor adverse impacts to large-scale geologic features, but could cause long-term, moderate adverse impacts to smaller, more unique geologic features unless they are fully mapped and inventoried, and use within the area carefully planned. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | large-scale geologic features, such as cinder cones and lava flows, but could result in long-term, moderate adverse impacts to uninventoried, small, and unique geologic features. Dispersed guided and unguided hiking activity would be permitted within most of the boundary expansion area. Although this area is heavily impacted by off-road vehicle use, the impacts of sustained visitor use are difficult to predict, and would depend upon the visitor numbers and the primary season of use. While large-scale geologic features would likely continue to recover from vehicle impacts, dispersed hiking activity could cause long-term minor adverse impacts to these geologic features. In addition, dispersed hiking activity could cause long-term, moderate adverse impacts to smaller, more unique geologic features unless they are fully mapped and inventoried, and use within the area is carefully planned. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. |
| ***Ability to Experience Park Resources*** | The No-Action Alternative would continue to provide major benefits to some visitors, particularly | **Alternative 1 would provide major benefits to both park and forest visitors seeking compre-** | Alternative 2 would provide major benefits to both park and forest visitors seeking comprehen- | Alternative 3 would result in major benefits to both park and forest visitors seeking comprehensive |

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| | fits to some visitors, particularly those wanting a brief introduction to the volcanic landscape, with emphasis on major features visible from the road or from short trails. Park facilities and many features would remain accessible; recent construction of an accessible paved loop on the Lava Flow Trail would provide access to representative volcanic features and views for visitors with physical disabilities and others whose time or abilities are not suited to the cinder surface of the longer trail loop. The ability to look at scenery, especially along FR545 en route to Wupatki, enjoy an uncrowded park setting, and listen to natural sounds would continue as major benefits, at least in the near future. Continuation of traditional interpretive programs, such as talks, guided walks, and campground programs would provide moderate benefits for visitors. Distant views of some features would remain available from the Cinder Hills overlook, but would at times be impacted by the dust and noise from OHV activity on adjacent USFS lands. This impact would be minor depending on the time of the year. Continued presence of the OHV area would pose moderate ad- | **forest visitors seeking comprehensive information on and interpretation of regional resources and recreational opportunities. Construction of a multiagency visitor center with new exhibits, conversion of the existing visitor center to an education center, and installation of new wayside exhibits would provide major benefits to visitor understanding of resources and the ability to see the "real thing." Benefits of accessibility would remain similar to those identified under the No-Action Alternative. Ability to experience scenery would be enhanced slightly and would remain a major benefit to visitors. Traditional interpretive programs would continue as a moderate benefit, and new programs would be offered, using facilities of the new visitor center, education center, and expanded campground. The types and degrees of impact by the OHV area would be unchanged from those described under the No-Action Alternative. Lack of opportunities to experience longer hikes and more remote volcanic vistas, natural soundscapes, and a minimally altered environment would remain moderate, adverse impacts. The new visitor center, despite its** | est visitors seeking comprehensive information on and interpretation of regional resources and recreational opportunities. It would be of particular benefit to park visitors wanting to experience resources in a quieter, more pristine environment, because facilities would be removed from the heart of the park, and the drive-through experience would be eliminated. Construction of a new multiagency visitor center would provide major benefits to visitor understanding of resources and the ability to see the "real thing." Changes to the road system, rehabilitation of disturbed areas, and construction of new trails would provide access to a greater variety of natural and cultural resources, while enhancing ability to experience scenery and a less altered environment. In most areas of the park, natural soundscapes would be enhanced, because of the lack of passing traffic, and visitors would feel less crowded. These benefits would extend to visitors with disabilities, since facilities and most trails would be designed for full accessibility. Traditional interpretive programs would continue as a moderate benefit, with additional opportunities at the new visitor center and campground. | information on and interpretation of regional resources and recreational opportunities. It would be of particular benefit to park visitors wanting to explore the full range of volcanic features significant to the story of Sunset Crater Volcano.<br>Construction of a new multiagency visitor center, conversion of the existing visitor center to an education center, and installation of new wayside exhibits would provide major benefits to visitor understanding of resources and the ability to see the "real thing." New longer trails would provide access to a full range of features, including intact cinder cones, volcanic vents, lava bombs, and the broad volcanic scene within the Cinder Hills, which make up the beginning of the Sunset Crater Volcano story. Rehabilitation of resources damaged by OHV use would provide major long-term benefits to visitors' ability to experience a minimally altered environment, and natural sounds would prevail, both along trails and at the Cinder Hills Overlook. Traditional interpretive programs would continue as a moderate benefit, and new programs would be offered, using facilities of the new visitor center, education center, and campground. Additional guided hikes might be offered into the Kana-A lava flow, an area not |

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| | verse impacts, by effectively precluding access to the Cinder Hills by visitors wanting longer hikes, more remote landscapes, or the opportunity to see extensive volcanic features related to Sunset Crater Volcano. Other visual intrusions would remain, both inside the park and within the viewshed. These range from NPS facilities to distant mines, but all present moderate adverse impacts to the ability to experience a minimally altered environment. The existing visitor center would continue in use, limiting the space available for interpretive exhibits and contributing to incomplete visitor understanding of park resources-a moderate adverse impact. As park visitation increases, crowding in this small structure would further impact visitor experience. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | **major benefits to visitor understanding, would present the possibility of moderate adverse impacts on uncrowded visitor experiences, by funneling greater numbers into existing parking areas and trails. This effect would be accentuated at times by the presence of greater numbers and organized groups in the campground. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.** | This alternative would result in moderate adverse impacts by continuing to limit access to volcanic resources closely related to park significance but located outside park boundaries. Types and degrees of OHV impact would remain similar to those described in the No-Action Alternative and would vary from minor to major at different times. Visitor awareness of OHV impacts would increase, because of the location of the new visitor center and campground nearby. There could be moderate adverse impacts on personal freedoms in the future, if reservation or shuttle systems were implemented to control numbers of visitors. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | available under the No-Action Alternative. Access for visitors with disabilities would be similar to that described for the No-Action Alternative. All facilities and existing trails would remain accessible, but, because of terrain, the Cinder Hills experience would probably be available only from the overlook. This alternative would result in long-term adverse impacts to OHV recreational users. Approximately 25% of the designated OHV area would be removed from use, including some of the most heavily used routes. Impacts would be minor by definition (the number of OHV users represents approximately 15% of park visitation), but would affect the majority of those users. The new visitor center, despite its major benefits to visitor understanding, would present the possibility of moderate adverse impacts on uncrowded visitor experiences, by funneling greater numbers into the park. This effect would be accentuated at times by the presence of greater numbers and organized groups in the campground. However, the new access to the Cinder Hills would disperse some of this use from existing developed areas. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. In addition to those mentioned, there would be other less |

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| | | | | severe effects as a result of implementing this alternative. |
| ***Park Neighbors*** | Within existing conditions, the management actions of the NPS provide many beneficial impacts to other agencies and neighbors. Existing conditions result in only minor, long-term, adverse impacts to the workload of others in terms of additional administrative tasks, interpretive planning, agreement reviews, and joint planning efforts. There could be minor, long-term adverse impact to park neighbors in terms of increased congestion on FS545. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | **Under Alternative 1, there would be minor to moderate, short- and long-term, adverse impacts to the Forest Service, resulting from their participation in the development and operation of a new visitor facility, including planning, construction, and staffing commitments, and resulting from changes to the OHV recreational area. There could be a number of beneficial impacts such as those discussed in the No-Action Alternative. Increased congestion and contact with others would have a moderate, long-term impact on American Indian tribes seeking traditional cultural uses. The management actions of the NPS may result in minor to moderate, short and long-term, adverse impacts to the workload of others in terms of additional administrative tasks, interpretive planning, agreement reviews, and joint planning efforts. There could be minor adverse impact to park neighbors in terms of increased congestion on FR545. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.** | Under Alternative 2, there would be major, short- and long-term adverse impacts to the Forest Service, resulting from their participation in the development and operation of a new visitor facility, including planning, construction, and staffing commitments, and resulting from reducing the size of the OHV recreational area. There could be a number of beneficial impacts such as those discussed in the No-Action Alternative. Visitor activities and hiking in new areas could have moderate, long-term impacts on American Indian tribes seeking traditional cultural uses. The closure of FR545, increased traffic on FR766 and encroachment of OHV activities would have moderate, long-term impacts on some park neighbors. Shared maintenance of FR766 and FR545 could have major, long-term impacts on the Forest Service and/or Coconino County. The implications of development of Roden Crater would be the same as identified in the No-Action Alternative. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | Under Alternative 3, there would be major, short- and long-term adverse impacts to the Forest Service, resulting from their participation in the development and operation of a new visitor facility, including planning, construction, and staffing commitments, and resulting from the reduction in size and potential relocation of the OHV recreational area. There could be a number of beneficial impacts as discussed in the No-Action Alternative. Increased congestion and contact with others would have a moderate, long-term adverse impact on American Indian tribes seeking traditional cultural uses. Alterations in the Cinder Hills OHV Area and the resulting displacement of many recreational users could have moderate, long-term adverse impacts to park neighbors, because of likely intrusions of this activity and associated noises, dust and congestion into their immediate neighborhoods. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. |

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| ***Operational Efficiency*** | The No-Action Alternative would result in no substantial change in the operations of the park from existing conditions. There would be long-term minor to major beneficial effects from the new waysides, new facility construction, accessibility, and health and safety improvements, and the backcountry closure. Most of the major roads providing access to the park would likely see an increase in visitor and commuter traffic, which would result in additional congestion and a likely increase in accidents. Maintenance needs would increase. Increased use of all roads leading to the park would increase the difficulties that already exist in protecting park resources, including entry into areas of the park that are closed to visitation and intentional and unintentional damage to resources. The effects to facilities, utilities, and staffing would be long term and adverse, with small to measurable changes. Without improvement to the visitor center or utilities, conditions would worsen. Many improvements are needed to protect visitor and staff health and safety. Current staff levels have achieved a certain level of efficiency; however, limitations | **Changes resulting from implementing Alternative 1 would have an overall benefit on operational efficiency. There would be long-term, minor to major beneficial effects from the new waysides, new facility construction, accessibility and health and safety improvements, and the backcountry closure. Improvements and additions would be made to facilities that would protect visitors and improve staff health and safety concerns. There would be moderate, adverse impacts resulting from the construction of the new visitor center, curatorial, and maintenance/resources management facility and the trails proposed to connect Bonito Campground to the Bonito Lava Flow. These actions would create moderate, short-term adverse impacts; however, following construction they would have minor to moderate impacts on operational efficiency. Most impacts would be in the form of increased maintenance needs for facilities and trail systems and increased resource protection and preservation needs. This alternative would not fully address road issues, which would continue to have minor to moderate adverse impacts on** | Implementation of Alternative 2 would have long-term, major benefits to the operational efficiency of the park. There would be long-term, minor to major beneficial effects from the new waysides, accessibility, and health and safety improvements, and the backcountry closure. Improvements and additions would be made to facilities that would protect visitors and improve staff health and safety concerns. Most of the issues regarding visitor access would be reduced or eliminated. Access to the park would be managed, which would increase the protection and preservation of park resources and reduce the need for law enforcement patrols and the need for 24-hour emergency response. This alternative would dramatically improve the facilities that are used in park operations and provide staff with functional facilities and a safe working environment. Major costs would be associated with the proposed construction of new facilities, new paved roadways, and the rehabilitation of areas that would no longer be used for park operations. This would have moderate, short-term adverse impact on operational efficiency. Following construction, there | Changes resulting from implementing Alternative 3 would have an overall long-term benefit on operational efficiency. There would be long-term, minor to major beneficial effects from the new waysides, new facility construction, accessibility and health and safety improvements, and the backcountry closure. There would be moderate adverse impacts resulting from construction of the proposed new visitor center and trails. Major long-term efforts would be needed to effect the rehabilitation of newly acquired land that has been substantially impacted by OHV use. These actions would create short-term, major, adverse impacts; however, following construction and rehabilitation activities, there would be minor to moderate adverse impacts to operational efficiency. Most impacts would be in the form of increased maintenance needs for facilities and trail systems and increased resource protection and preservation needs. Major long-term benefits would be realized with the expansion of park boundaries, which would include resources that contribute to the significance of the park. The alternative would align |

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| | do exist that inhibit the park's ability to provide adequate levels of resource protection and preservation, maintenance of existing facilities, and visitor services. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | **operational efficiency. This proposal would also include a limited expansion of park boundaries to accommodate administrative needs, which would have a major beneficial effect on operational efficiency. The most significant would be that the expansion would align park boundaries logically along topographic features. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.** | would be a negligible to minor adverse impact on operational efficiency. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. | boundaries logically along topographic features, and would result in a reduction in impacts to the park's primary resources. Because the OHV is so heavily impacted, there would be a substantial commitment of resources and staff to rehabilitate and restore the area. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative. |

| Table 4: Objectives Met by Alternatives | | | | |
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| **Objective** | **No-Action Alternative: Existing Conditions** | **Alternative 1 (Preferred): Focus on Extended Learning** | **Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use** | **Alternative 3: Expand Park Boundaries to Preserve Park-related Resources and Provide Diverse Opportunities for Visitor Use** |
| **1. Maximize Protection of Cultural Resources** | Access to the park is limited to established trails, roadways, and developed facilities. Orientation waysides, visitor center exhibits and NPS personnel provide visitors with protection and preservation messages. Activities within the OHV area often result in physical intrusion onto the monument. | **The NPS and USFS would construct and operate a joint visitor center near the intersection of FR545 and US 89. The new visitor center would provide visitor orientation for both park and forest visitors before they encounter sensitive resources. Areas of the park not zoned for administrative or visitor use would be closed to protect resources.** | The existing visitor center and campground would be removed and the areas rehabilitated. The new visitor center would provide visitor orientation for both park and forest visitors before they encounter sensitive resources. Park boundaries would be expanded to the west to include the Bonito Park area and to the south to include the new visitor center location. Corresponding adjustments would be made to the boundary of the USFS OHV area. Areas of the park not zoned for administrative or visitor use would be closed to protect resources. | Park boundaries would be expanded in cooperation with the USFS, to include key resources northeast and southeast of the existing boundaries. OHV use would cease, and the area would be rehabilitated. Areas of the park not zoned for administrative or visitor use would be closed to protect resources. The new multiagency visitor center would provide visitor orientation for both NPS and USFS resources and regulations. |
| **2. Maximize Protection of Natural Resources** | Access to the park is limited to established trails, roadways, and developed facilities. Orientation waysides, visitor center exhibits and NPS personnel provide visitors with protection and preservation messages. Activities within the OHV area often result in physical intrusion onto the monument | **The NPS and USFS would construct and operate a joint visitor center near the intersection of FR545 and US 89. The new visitor center would provide visitor orientation for both park and forest visitors before they encounter sensitive resources. Areas of the park not zoned for administrative or visitor use would be closed to protect resources.** | The existing visitor center and campground would be removed and the areas rehabilitated. The new visitor center would provide visitor orientation for both park and forest visitors before they encounter sensitive resources. A portion of FR545 beyond the Lava Flow Trail at the base of Sunset Crater Volcano would be rehabilitated and converted to a hiking trail. Park boundaries would be expanded to the west to include the Bonito Park area and to the south to include the new visitor | Park boundaries would be expanded in cooperation with the USFS, to include key resources northeast and southeast of the existing boundaries. OHV use would cease and the area would be rehabilitated. Areas of the park not zoned for administrative or visitor use would be closed to protect resources. The new multiagency visitor center would provide visitor orientation for both NPS and USFS resources and regulations. |

| Table 4: Objectives Met by Alternatives | | | | |
|---|---|---|---|---|
| **Objective** | **No-Action Alternative: Existing Conditions** | **Alternative 1 (Preferred): Focus on Extended Learning** | **Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use** | **Alternative 3: Expand Park Boundaries to Preserve Park-related Resources and Provide Diverse Opportunities for Visitor Use** |
| | | | center location. Corresponding adjustments would be made to the boundary of the USFS OHV area. Areas of the park not zoned for administrative or visitor use would be closed to protect resources. | |
| **3. Expand Diversity of Visitor Experience** | The one-mile Lava Flow Trail is a self-guided loop exploring a variety of volcanic formations. The one-mile Lenox Crater Trail provides an opportunity to a climb a cinder cone. The Cinder Hills overlook provides a view of numerous cinder cones in the area. Activities within the OHV area result in visual and audible impact to monument visitors. | **The existing visitor center would be retained and adapted for use as an education center with facilities for group presentations, and workshops. A hiking trail would be formalized between Bonito Campground and the Lava Flow Trail. Additional extended learning activities, both self-guided and guided, would be developed in the vicinity of and in conjunction with the new visitor center. A broader range of resources would be interpreted in an Extended Learning Zone in the vicinity of the Lava Flow Trail and Lenox Crater Trail system.** | Additional extended learning activities, both self-guided and guided, would be developed in the vicinity of, and in conjunction with, the Lava Flow Trail, Lenox Crater, and the northwest side of Sunset Crater Volcano. A portion of FR545 beyond the Lava Flow Trail at the base of Sunset Crater Volcano would be rehabilitated and converted to a hiking trail. | The new visitor center would provide visitor orientation for both NPS and USFS facilities, resources, and regulations, and would provide in-depth interpretation of natural and cultural resources at the regional level. Construction of new facilities would provide locations for interpretive programs and workshops for a variety of audiences. Both NPS and USFS would be represented at the new visitor center, and information/ interpretation would be presented to visitors in a cohesive manner. Extended learning opportunities would be available in the visitor center/ Bonito Park vicinity, in the area between Lenox Crater and Lava Flow Trails, and in the Cinder Hills area. A trail would be constructed between Bonito Campground and the Lava Flow Trail. A new trail would be established in the fissure zone providing access to Gyp and/or Double Crater. |

| Table 4: Objectives Met by Alternatives | | | | |
|---|---|---|---|---|
| **Objective** | **No-Action Alternative: Existing Conditions** | **Alternative 1 (Preferred): Focus on Extended Learning** | **Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use** | **Alternative 3: Expand Park Boundaries to Preserve Park-related Resources and Provide Diverse Opportunities for Visitor Use** |
| **4. Limit Effect on Neighbors** | The Cinder Hills Off-Highway Vehicle (OHV) Area is about 13,500 acres on USFS lands immediately southeast of the monument. The visitor center, housing, and maintenance area are located on Coconino National Forest land and were constructed and are operated by the NPS under an agreement with the USFS. | **Vehicle access via FR545 would remain the same as it is now. The NPS and USFS would jointly construct and operate a new visitor center. Boundaries of the OHV area would be adjusted to accommodate park expansion.** | Entry to the park would via a new road system using FR776. FR414, which is currently an unimproved road, would be converted to the monument's main entrance road. Portions of FR545 between Bonito Park and the Lava Flow Trail would be retained as dead-end spurs to these features. A new visitor center would be jointly constructed and operated by the NPS and USFS. Park boundaries would be expanded to the west and the south. Corresponding adjustments would be made to the boundary of the USFS OHV area. | FR545 would remain open 24 hours a day. Park boundaries would be expanded in cooperation with the USFS, to include key resources northeast and southeast of existing boundaries. OHV use would cease on the portions of the USFS OHV area included within the new boundaries, and extensive rehabilitation would be undertaken. |
| **5. Improve Operational Efficiency** | The NPS and USFS work cooperatively in areas of law enforcement, resource protection and management, interpretation and facility management. | **Park boundaries would be adjusted for ease of management. Corresponding adjustments would be made to the boundary of the USFS OHV area. The NPS and USFS would jointly construct and operate a new visitor center at the junction of FR545 and US 89.** | A new visitor center would be jointly constructed and operated by the NPS and USFS. Park boundaries would be expanded to the west to include the Bonito Park area and to the south to include the new visitor center location. The existing visitor center and associated facilities would be removed from its present location and relocated south of the park near the new visitor center. | A new multiagency visitor center would be constructed near the junction of FR545 and US 89, and the existing visitor center would be modified to serve as an education center for groups. |

# AFFECTED ENVIRONMENT

## LONG-TERM INTEGRITY OF ARCHEOLOGICAL RESOURCES

Impact topics were identified through the scoping process. Concerns covered by this section include maintaining the long-term scientific integrity and culturally sensitive values of archeological sites, including prehistoric and historic architecture, shrines, cultural modified landforms, agricultural field systems, rock art, and other cultural features.

### Region

The high arid Colorado Plateau region of the American Southwest is world-renowned for its abundant, well-preserved archeological resources. Archeological remains in the region reflect several distinct lifeways and adaptive strategies, including hunting and gathering, horticulture, livestock grazing and, after the mid-19th century, participation in the Euro-American global economy.

Prior to the eruption of Sunset Crater, the area in and immediately surrounding the monument was occupied by farmers who lived in small, scattered hamlets adjacent to their fields. When Sunset Crater erupted, the prehistoric inhabitants of the area, whom archeologists call Sinagua, apparently moved out of harm's way. No evidence has been found indicating that the people were surprised by the eruptions, and no human remains have been found indicating deaths occurred as a direct result of the volcanic activity. However, numerous pithouse dwellings were burned and filled with cinders from the eruption. Many of these "pre-eruptive" sites have been found on Forest Service lands surrounding the monument.

Dr. Harold Colton, founder of the Museum of Northern Arizona (MNA), first recognized the connection between Sunset Crater and the nearby buried pithouse ruins in the early 1930s, several years after Sunset Crater National Monument was established. Research by MNA archeologists revealed that the people who built these pithouses had witnessed Sunset Crater's birth in 1064. It was tree-ring dating of timbers found in these pithouses and the nearby pueblo structures of Wupatki that gave geologists a more definitive date for the beginning of the Sunset eruption.

According to Colton's reconstruction of events, the Sinagua farmers soon discovered that the deep cinder/ash fall in the immediate vicinity of Sunset Crater was not farmable, but as they moved northward and the depth of ash diminished, the cinder cover acted as a beneficial moisture-retaining mulch. This mulching effect allowed drier, lower elevation areas that were previously unsuitable for farming to produce successful crops. At the same time, favorable climatic conditions coincident with the volcanic activity may have increased the desirability of these lower elevation areas for farming. Today, most archeologists believe that the eruption of Sunset Crater, with its consequent displacement of local settlers from what was once a heavily occupied farming area, in conjunction with the creation of new farmland to the north, was a primary reason for the noticeable geographical shift of 12th-century settlements and subsequent development of the multiethnic complex culture in what is today Wupatki National Monument.

## Park

Although not specifically set aside to preserve archeological remains, Sunset Crater Volcano protects an important piece of prehistory relating to the impact of the 11th-century Sunset Crater Volcano eruption on the prehistoric occupants of the southern Colorado Plateau. The development of the prehistoric Sinagua culture in the Flagstaff area was profoundly affected by the geologic forces that formed Sunset Crater. The importance of Sunset Crater Volcano as a geologic feature cannot be separated from its significance as a key influence in the evolution of human cultures in the Flagstaff region. The relationship between the archeological and geological resources of Sunset Crater National Monument is reciprocal: previous studies of archeological sites in the vicinity of Sunset Crater have been instrumental in improving our understanding of the geologic processes and timing of events that shaped Sunset Crater while, at the same time, current studies of the volcano and associated lava flows are helping us to decipher the sequence of events that shaped human prehistory in the region. Furthermore, the area retains importance to numerous American Indian tribes living in the area today. Therefore, although Sunset Crater Volcano National Monument was originally set aside to protect and interpret a geologic phenomenon, its cultural significance is at least equally important.

Only a handful of archeological sites have been documented within the boundaries of Sunset Crater Volcano or on the adjoining administrative lands. This low number of documented sites reflects the fact that only about 1 percent of the 3,040 acres in the monument has been intensively inventoried for archeological resources. Some nearby areas lying outside monument boundaries on USFS lands have been inventoried at various levels of intensity, including most of the NPS administrative area, the USFS campground, and some of the forested terrain adjoining Bonito Park. These nearby inventories provide a general basis for predicting the types and numbers of sites likely to be found within monument boundaries.

Three prehistoric archeological sites are located within the maintenance yard behind the visitor center and two others are in close proximity to the visitor center. A prehistoric pottery cache was found by visitors within the Bonito Lava Flow, and at least one Hopi shrine is known to exist in the Lava Flow area. Undoubtedly, there are additional post-eruptive archeological sites within the monument boundaries that await future discovery.

Approximately 68 archeological sites have been recorded within one mile of the current monument boundaries. The majority of these sites (41) are buried Sinagua pit structures dating between A.D. 650-1065. In addition, there are at least five prehistoric masonry structures, one cave containing a prehistoric pottery cache, and 13 artifact scatters without associated architecture. There are also several historic sites, including a logging railroad grade, a collapsed homestead cabin, and a shade structure.

No archeological resources are currently interpreted to visitors within the monument boundaries or adjacent forest areas; however, there are plans to develop at least one previously excavated pithouse site on USFS lands for future interpretive purposes.

# HISTORIC CHARACTER OF THE BUILT ENVIRONMENT

## Region

The historic built environment of the region has been shaped like that of many small Western towns, by timber, cattle grazing, and the mining industry (Cline

1994). A few grand homes survive in the area, constructed by Flagstaff's first entrepreneurs in the late 19th century. The majority of structures built during Flagstaff's early days represent the working class. Areas like Milton (mill town) housed mill workers and their families (Cline 1976).

Science and education also shaped the historic built environment of the region. In 1894 Flagstaff was chosen as the site for Lowell Observatory, and in 1899 Northern Arizona Normal School (now Northern Arizona University) opened as a preparatory school for teachers.

The Civilian Conservation Corps (CCC) added much to the region, constructing roads, trails, fences, phones lines, and a golf course clubhouse in Flagstaff (Cline 1994).

The landscapes of the region are many and span great lengths of time. Landscapes from the prehistoric Sinagua culture overlap with other prehistoric groups, including the Kayenta Anasazi and Cohonina. Melded in this region are natural features and cultural elements shared by historic Navajo and Paiute groups, early cattle and sheep ranchers, and lumbermen.

## Park

The Sunset Crater Volcano visitor center complex (maintenance outbuildings, visitor center, and apartments) was constructed as part of the NPS Mission 66 construction program, and few alterations have occurred at the visitor center complex. A metal roof was added to the visitor center in the early 1990s, and portions of the enclosed maintenance yard were roofed to cover heavy equipment, but, on the whole, the complex remains close to its original design and layout. A general Service-wide moratorium has been placed on major changes to structures built during the NPS Mission 66 era, but in the Intermountain Region this has been modified to include review by a Mission 66 review board. Proposed changes are reviewed by the board, and a determination to proceed with construction can be granted, based upon criteria (e.g., the significance of the structure, how any character-defining features of the structure would be affected, and whether or not the work would be done in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties. In addition, the eligibility of Mission 66 era structures for listing in the National Register of Historic Places can be determined by the review board prior to completion of the context study.

Visitors currently experience the Mission 66 visitor center and exhibits remaining from that period. Two trails developed during this period are also available: the Lava Flow Trail and the Lenox Crater Trail.

Cultural landscapes at Sunset Crater Volcano have never been identified. A cultural landscape inventory (CLI) needs to be conducted to identify issues such as historic land uses and the location and character of significant resources. A CLI is needed to avoid adverse effects and/or loss of unidentified cultural landscapes.

# LONG-TERM INTEGRITY OF ETHNOGRAPHIC RESOURCES

## Region

NPS guidelines describe ethnographic resources as "variations of natural and standard cultural resource types. They are subsistence and ceremonial locales and sites, structures, objects, and rural and urban landscapes assigned cultural significance by traditional users. The decision to call resources 'ethnographic' depends on whether associated peoples perceive them as traditionally meaningful to their identity as a group and the survival of their lifeways. When natural resources acquire meaning according to the different cultural constructs of a

particular group, they become ethnographic and thus cultural resources as well" (NPS 1997).

Sunset Crater Volcano National Monument in north-central Arizona is part of a region lying between extensive high-altitude national forest lands to the southwest and semi-desert mesas of the Hopi and Navajo Indian Reservations to the northeast. The latter forms the largest block of Indian tribal lands in the United States, including more than 25,000 square miles. These contemporary reservations are only a small portion of the customary lands occupied aboriginally and historically by the tribes, and to which the tribes retain deeply rooted traditional associations. The three Flagstaff Area monuments are an integral part of this larger traditional landscape. Many of the geographic features and natural and cultural resources identified by the tribes as culturally significant within the three monuments are historically or ceremonially interconnected with other landscape elements, geographic features, and archeological sites throughout the tribes' entire customary land bases. In addition to the Hopi and Navajo Tribes, who currently occupy the tribal lands adjacent to or near the monuments, many of the other tribes originally consulted early in the GMP planning process retain customary associations with many of the same resources and places throughout the region. A good literature-based overview of tribal associations with the Flagstaff Area monuments and surrounding region can be found in Brandt (1997).

## Park

In addition to the literature-based overview of tribal associations with the park proposed by Brandt, the Hopi, Zuni, and Navajo Tribes each conducted fieldwork and provided synopses of sensitive ethnographic resources at the park specifically for this GMP.

The Hopi Tribe describes the entire landscape related to the eruption of Sunset Crater as sacred and connected to Wupatki, the Little Colorado River, the San Francisco Peaks, the Grand Canyon and entire surrounding region. Within this landscape, cinder cones are particularly culturally sensitive, as are all cinder cones at Sunset Crater, particularly Sunset Crater itself and the lava rock associated with it. In addition to Sunset Crater and other cinder cones, the ice cave is an important ethnographic resource, as is O'Leary Peak and eagles that might be associated with it and Bonito Park and particular plant species within it.

Similarly to the Hopi Tribe, the Pueblo of Zuni considers the area encompassed by Sunset Crater Volcano National Monument as part of a much larger, interconnected sacred landscape. The Pueblo of Zuni also shares concerns about the places identified by the Hopi Tribe as culturally significant. In addition, the Pueblo of Zuni specifically identified the sensitivity of a particular stand of aspen trees within the boundaries of Sunset Crater Volcano National Monument, as well as any springs that might occur there.

The Navajo Nation also identifies the Sunset Crater landscape as part of a regional ceremonial landscape, and considers cinder cones throughout the general region to have particular cultural significance. Sunset Crater itself has been mentioned in Navajo ethnographic literature since 1897 as a place related to the travels of particular Navajo clans. Navajo Nation researchers for this GMP identified Sunset Crater itself, Bonito Park, and eight specific plant species as the ethnographic resources within Sunset Crater Volcano National Monument about which the Navajo Nation has concerns.

## LONG-TERM INTEGRITY OF NATURAL SYSTEMS AND PROCESSES

The integrity of the natural systems and processes within Sunset Crater Volcano National Monument depends upon conserving native plant and animal communities and maintaining natural geomorphic and soil formation processes. The monument is a very small natural area within a regional framework of lands that are primarily managed by the U.S. Forest Service for ecologically sustainable, multiple uses. Preserving the integrity of the monument's natural systems requires close coordination with the Coconino National Forest to ensure that the full complement of plant and wildlife species within the monument are conserved. During the public and agency scoping process, specific environmental impact issues were identified, including: preserving unfragmented natural systems; conserving wildlife populations; maintaining the natural character/condition of ponderosa pine forest and pinyon woodland vegetation; controlling the spread of invasive, nonnative plant species; and, maintaining the integrity of natural systems for ecological research. Additional summaries of affected threatened, endangered, and sensitive species, unique habitats, and geologic resources are presented in separate sections below.

### Region

Sunset Crater Volcano National Monument is located in the southern part of the Colorado Plateau. In this general region north of the Mogollon Rim, elevations vary from a low of 2,400 feet above sea level at the bottom of the Grand Canyon, to a high of 12,670 feet above sea level at the San Francisco Peaks, less than fifty miles away. The plateau was shaped by erosion to reveal geologic outcrops of red sandstone and white limestone. The area surrounding the monument is also characterized by an extensive volcanic field (the San Francisco Volcanic Field) with the prevalent remains of the San Francisco Volcano, surrounding smaller cinder cones, and lava flows. The Painted Desert stretches east of the volcanic field to Petrified Forest National Park. Soil types also vary within the region, depending upon whether they are derived from weathered limestone, sandstone, shale, or volcanic bedrock.

The climate of the region varies tremendously with elevation above sea level. Fifteen miles to the north, the Little Colorado River flows at 4,300 feet elevation along the eastern boundary of Wupatki National Monument. Wupatki receives approximately 6 to 7 inches of precipitation per year and experiences temperatures from -4° to 105° F. At Sunset Crater Volcano, the visitor center is located at 7,000 feet elevation and receives about 20 inches of precipitation annually and generally has colder winters and milder summers. Above 10,000 feet on the adjacent San Francisco Mountains, annual precipitation exceeds 40 inches, temperatures are considerably cooler, and the growing season is remarkably shorter.

The impressive array of geologic, elevation, and climatic differences within a relatively small geographic area has contributed to a considerable diversity of plant communities. This diversity is exhibited by the range of vegetation from alpine tundra on top of the San Francisco Peaks to Sonoran Desert at the bottom of the Grand Canyon. Within Sunset Crater Volcano, Wupatki, and Walnut Canyon National Monuments surrounding Flagstaff, one can observe many of the dominant vegetation types. Pinyon-juniper woodland, ponderosa pine forest, and lava flow and cinder barrens are common at Sunset Crater Volcano. A short distance away at Wupatki, one finds juniper

woodlands, Colorado Plateau grasslands, and Colorado Plateau desert scrub communities. Walnut Canyon contains a narrow stand of broadleaf deciduous forest along the bottom of the canyon, mixed-coniferous forest on north-facing slopes, and ponderosa pine forest and parkland above the canyon rim. Higher elevations harbor aspen groves, and spruce and fir forests.

Prehistoric, historic, and current land uses have undoubtedly played a major role in shaping the landscape of the area as well. In addition to relying heavily on agricultural land use, prehistoric peoples used native plants and animals and used fire to modify the environment. Regional Navajo sheepherding dates to the period of Spanish settlement of the Southwestern United States. A number of tribes, including the Navajo and the Hopi, continue to use plants, animals, and other natural resources in the region.

Historic and modern influences, including logging, agriculture, cattle ranching, hunting, mining, fire suppression, community development, and road and utility construction have together greatly affected and fragmented regional natural systems and processes. Although some dense forest stands still remain at the highest elevations of the San Francisco Peaks and on steep terrain along the Mogollon Rim, most accessible, old-growth forest has been extensively logged. In order to protect endangered species, logging on most public lands is now restricted. Forests are now being managed for ecologically sustainable multiple uses, and large areas of impacted forests are proposed for eventual restoration to presettlement conditions.

Fire has played a major role in shaping the vegetation in the entire region, as it has in most of the Southwestern United States. Forest management efforts to suppress wildfires during the last century are now known to have caused significant differences in forest function and habitat value. In extensive areas of fire-adapted ponderosa pine stands, tree densities have risen dramatically because fire no longer thins young trees from the stands. In some areas, tree densities have increased so drastically that there is severe risk of catastrophic fire. This type of fire is a dramatic contrast to the low-level natural fires that existed when pine stands were open and fires burned primarily in the understory.

Ecologists theorize that ranching activity and grazing pressure caused or contributed to a wide range of historic changes in ecosystems throughout the Southwestern United States, including loss of grassland cover and plant species diversity; reduction or extirpation of grassland-dependent wildlife; extirpation or extinction of predators; accelerated soils erosion and gullying of intermittent drainage systems; decreasing wildfire size and frequency; and loss of cottonwood-willow riparian vegetation, which has had significant adverse impacts to both migratory and breeding birds, and development of artificial water sources and alteration or elimination of natural surface waters for native plant and animal species. Grazing also favors the establishment of nonnative species. Environmental changes may be more apparent at lower elevations, where there is a documented increase in desert vegetation and noxious plants. Ranching and cattle stocking rates are changing as a result of widespread concerns over these impacts. Even though many of the changes to regional natural systems are likely permanent, ranching activity is trending more toward long-term ecological sustainability within the region.

Juniper woodland has been rapidly expanding into grasslands during the last century, but the underlying causes are the subject of scientific debate. Many ecologists believe that cattle grazing, in

combination with range-fire suppression, is favoring juniper encroachment into grasslands. Cattle remove much of the grass and forbs and enhance the ability of juniper seedlings to germinate and establish in what were once continuous grassland areas. Other scientists believe that we are witnessing a natural succession process in which junipers are returning to formerly occupied habitat. Human occupation of much of the region certainly must have included the use of any available wood sources for fuel and construction purposes.

Modern landownership patterns and uses have also resulted in increased habitat fragmentation within the region. Fences, especially double-fenced highway rights-of-way, prevent the regional movement of numerous wildlife species, including pronghorn antelope. Roads throughout the area serve as conduits for the spread of exotic weedy plants. Much of the land within the region is managed by the U.S. Forest Service for sustained multiple uses, including hunting, firewood collecting, grazing, off-highway vehicle use, backpacking, and hiking. A large area of the region belongs to sovereign American Indian tribes. Their cultures are traditionally tied to their lands, but little information is generated or available to understand the environmental impacts of tribal land management.

Large areas of arid lands within Southwestern United States have been invaded by nonnative plant species. On the Colorado Plateau, much of the remaining grasslands have been extensively invaded by nonnative annual bromegrasses, drastically altering natural fire regimes, displacing native perennial bunchgrasses, and reducing or eliminating forage or cover for grassland-dependent wildlife species. Riparian vegetation has been severely altered by tamarisk invasion, which has outcompeted most native cottonwood and willow stands and particularly affected both migratory and breeding birds.

## Park

Sunset Crater Volcano National Monument is dominated by a volcanic landscape. The Sunset Crater cinder cone and the northern half of Lenox Crater cinder cone lie at the southeastern and southwestern corners of the monument, respectively. Most of the surface area north of the two cones is covered by either the Bonito Lava Flow or deep volcanic cinder deposits, including an area of tall cinder hills within the northeastern quarter of the monument. Sunset Crater is very young in geologic time and one of the few undisturbed cinder cone volcanoes within northern Arizona. The volcanic features within the monument harbor a small but unique natural area of relatively undisturbed vegetation and wildlife habitats. The volcano also offers unique insight into fresh lava and cinder weathering processes, soil formation, and pioneering vegetation establishment.

An inventory of natural resources within Sunset Crater Volcano was completed during the late 1970s (Bateman 1976, 1979). This study remains the best available documentation of the monument's flora and fauna. Research has also examined plant succession in the area following the volcano's eruption (Eggler 1966). The vegetation is currently being mapped (Thomas 2001). Vegetation is relatively sparse within the monument, but soil pockets on cinder cone slopes, lava, and deep cinder deposits are dominated by ponderosa pine trees. An area of pinyon pine woodland dominates the northwestern corner. There are also a few small aspen stands on the north slopes of the cinder cones and around the perimeter of the lava flow. Given the small area within the monument, it is relatively rich in plant species, with 166 documented species. The sparse vegetation cover probably provides little forage and cover

for wildlife. The Bonito Lava Flow, which dominates more than 25% of the surface area within monument, is extremely inhospitable to foot travel and probably does not provide habitat for larger animals. Habitat for larger animals, such as deer, is probably restricted to the western, southern, and northern margins of the monument. Surface water resources are almost nonexistent within the monument, except for local catchments upon lava flows and seepage areas around the perimeter of lava flows. There are relatively deep aquifers beneath the monument, one of which is used for drinking water.

Although the area within the monument is highly fragmented by expanses of barren lava and cinder deposits, the pockets of mature ponderosa pine forest and pinyon woodland could sustain a small wildfire. Forest vegetation surrounding the monument likely burned more frequently in the past, which promoted native herbaceous cover and biodiversity, thinned trees, and prevented deadwood accumulation and intensely hot fires. Limited management-ignited fires may be proposed, mainly to restore the role of fire to local forests and meadows. Prior to conducting test burns, the NPS must prepare a fire management plan and accompanying environmental assessment to review potential impacts.

Of the total 3,000 acres within the monument, approximately 5% is currently affected by fences, roads, trails, NPS operations, and visitor activity. Most NPS operations and visitor support facilities, including the visitor center, campground, employee housing, maintenance shops, and utilities, occupy approximately 130 acres of Coconino National Forest land 1/2 mile to the west of the monument boundary. The current paved access road (FR545) may somewhat hinder the movement of pronghorn and other wildlife through the Coconino National Forest between Bonito Park and grassland habitat to the north (Bright and Van Riper III 2000). Within the monument, the paved road crosses fractured volcanic rocks or deep cinder deposits, and there is little evidence of disruption of surface drainage patterns because water percolates rapidly into the soil. There is one closed and abandoned primitive road along the base of Lenox Crater in the southwestern corner of the monument. The road is within the backcountry closure area and will likely remain as a scar on the natural landscape for decades.

Visitor use is currently concentrated between the campground and the western margin of the Bonito Lava Flow outside the monument and around the southern margin of the Bonito Lava Flow, Lenox Crater Trail, Lava Flow Trail, and Cinder Hills Overlook within the monument. Visitor-use impacts are primarily localized around these areas and include cinder surface disturbance, vegetation trampling, unplanned trail development, minor alterations in drainage patterns, noise, and disturbance to wildlife.

In 1998 most of the area within the monument was closed to public access to protect sensitive resources. Until that time, backcountry use was readily permitted, but the effect on natural systems is difficult to assess because the NPS maintained no statistics on visitation numbers or commonly visited areas. Backcountry access continues for authorized special uses, such as research and educational activities. There is occasional unguided hiking within the backcountry closure area, including the area to the north of the Bonito Lava flow and the cinder hills in the northeast corner of the monument. This will likely continue because there is insufficient staff to ensure frequent patrols.

There currently is little information on the distribution or impacts of nonnative plants within the monument. Nonnative plant

infestations, predominantly mullen (Verbascum thapsus), are generally confined to road corridors, developed areas, or areas of heavy visitation. These species benefit from the additional runoff associated with paved surfaces and often out-compete native vegetation along road shoulders. Nonnative plants may also rapidly colonize areas where the ground surface is heavily disturbed by equipment or heavy foot traffic. One patch of Camelthorn (Alhagi maurorum), a tenacious shrub species, and diffuse knapweed (Centauea diffusa) are known to occur along FR545. Some nonnative species have been planted by employees around their residences, but none of these are believed to be naturalizing and escaping into the surrounding environment. The monument currently lacks sufficient staff or funding to actively monitor or attempt to control nonnative species, however, attention to this issue is anticipated in the near future. Many species can potentially be controlled with persistent efforts to remove plants and control root systems with herbicides. Success in controlling an invasive species would be predicated on early detection of infestations before they grow out of control, or on the availability of ecologically sound and affordable technology.

The natural systems and processes surrounding the monument boundary have been influenced by historical logging and timber management practices, and to a lesser degree, by former ranching activity, game hunting, and predator control. The monument is a very small natural area within a regional framework of lands that are primarily managed by the U.S. Forest Service for ecologically sustainable, multiple uses. Preserving the integrity of the monument's natural systems requires close coordination with the Coconino National Forest to ensure that the full complement of plant and wildlife species within the monument are conserved. Primitive roads through the surrounding Coconino National Forest provide vehicle access within 1/4 mile for approximately 51/2 of the total 7 miles of boundary around the monument. Concerns remain that convenient driving access promotes incidents of off-road vehicle use, poaching, and unauthorized hiking within the closed area of the monument.

The Coconino National Forest currently manages the 13,500-acre Cinder Hills Off-Highway Vehicle (OHV) Recreational Area close to the southeastern boundary. The NPS remains concerned that heavy off-road vehicle use immediately adjacent to the monument is adversely affecting sensitive species populations, such as Penstemon clutei and Phacelia serrata, and disturbing most wildlife populations that transcend the monument boundary. The NPS hopes to alleviate these concerns through increased communication, monitoring ecosystem conditions, and better participation in the U.S. Forest Service planning process. If successful, these efforts could mitigate certain adjacent land use impacts on resources within the monument, including enforcement of regulations with regard to off-road driving and possible road closure, removal of fence segments, and joint fire management.

## THREATENED, ENDANGERED, AND SENSITIVE SPECIES

This section complements the preceding section on natural systems and processes and is intended to specifically address compliance with the Endangered Species Act. In addition to legally protected threatened and endangered species, a few "species of concern" occur within the monument and surrounding region, and their status is regularly assessed by regional federal, state, and tribal agencies. During the public and agency scoping process, pertinent impact issues were

identified regarding the conservation of federally listed threatened and endangered species, candidate species, and designated critical habitats that might be affected by a proposed action. The potential impacts to other sensitive plant and animal species and unique habitats are also considered.

## Region

The diversity of landscapes and habitats in the region naturally provides for impressive species diversity. Habitats range from alpine tundra on the San Francisco Peaks to Sonoran Desert at the bottom of the Grand Canyon. Old-growth coniferous forests and other vegetation communities in the region, combined with physiographic features such as canyons and mountains, provide habitat for a number of threatened, endangered, and sensitive species. Within Coconino County, Arizona, there are 5 plant, 9 animal (including fish), and 1 invertebrate species that are formally listed as threatened or endangered. There are another 54 plant, 51 animal (including fish), and 5 invertebrate species that may be exceedingly rare and are being monitored by the U.S. Fish and Wildlife Service, Arizona Game and Fish Dept., U.S. Forest Service, and Navajo Natural Heritage Program (Arizona Heritage Data Management System 2001).

Among all biological groups within the region, fish are threatened to the greatest extent. Several other plant, animal, and invertebrate species also require perennial streams, wetlands, or riparian habitats, reflecting the widespread alteration of entire region's freshwater ecosystems.

Of the region's rare plant species, several are endemic to the Mogollon Highlands region, including Bebb's willow (Salix bebbiana), and the San Francisco Mountains, including the San Francisco Peaks groundsel (Senecio franciscianus), listed as threatened. The Sunset Crater penstemon (Penstemon clutei) and cinder lady's tresses (Phacelia welshii) are locally endemic to the volcanic cinder deposits surrounding the San Francisco Volcanic Field. Riparian areas also harbor numerous plant species of concern, such as Navajo sedge (Carex specuicola), Alkali grass (Puccinella parishii ), which occurs at lower elevations in wetter sites north of the Little Colorado River, Mogollon columbine (Aquilegia desertorum), which occupies seeps and springs, and alcove bog orchid (Platanthera zothecina). A number of species, such as the Flagstaff pennyroyal (Hedeoma diffusum), inhabit ponderosa pine parklands, and likely depend upon fire to maintain an open forest canopy so that sunlight penetrates to the ground. Many species within the cactus family occupy very limited habitats and are sensitive to disturbance, including livestock grazing. Because of their popularity with horticulturists, all cactus species within Arizona are protected under state law.

The endangered Mexican spotted owl (Strix occidentalis lucida) is found within the region in dense, mixed-conifer forests, particularly in canyons. The U.S. Fish and Wildlife Service is in the process of designating critical habitat for the species. The owl occurs along the Grand Canyon, in Walnut Canyon, and near Sunset Crater Volcano. The Southwestern willow flycatcher, an endangered bird species, depends on very specific riparian habitat conditions along perennial streams within the region. Relatively large numbers of bald eagles (Haliaeetus leucocephalus) winter in the region, especially near Lake Mary, Mormon Lake, and Marshal Lake. Although recently removed from the endangered species list by the U.S. Fish and Wildlife Service, the peregrine falcon (Falco peregrinus anatum) inhabits steep cliff sites in the region. Even though the species is no longer considered threatened, population levels will continue to be monitored for a period of five years. Other raptors that are considered species of

concern include the northern goshawk and ferruginous hawk (Buteo regalis).

Although the golden eagle (Aquila chrysaetos) is not formally listed or considered a species of concern, wildlife managers and the general public are concerned about it, because of its low population density, ecological importance as predators and indicators of environmental quality, and traditional importance to American Indians. As with other wide-ranging raptor species, golden eagles have declined as a result of habitat loss, historic predator control programs, and power line electrocution. Eagles are legally protected from being killed or taken under the Eagle Protection Act. The U.S. Fish and Wildlife Service administers this act and annually issues permits to American Indian tribes to take specified numbers of golden eagles and feathers for ceremonial use. Golden eagles are solitary animals, and little is known about their distribution, number, and status around Wupatki. Although the U.S. Fish and Wildlife Service recently proposed a study to assess the status of the species throughout the Western United States, there is no regional management framework for ensuring the species remains viable.

Bat species are considered to have specialized habitat requirements and sensitivity to environmental impacts. Twelve species are currently monitored as species of concern.

Although not formally listed or considered a species of concern, pronghorn antelope (Antilocapra americana) are the focus of considerable wildlife management effort because they are attractive large herbivores and an important game species, and the public is concerned about their continued survival. The species was historically overhunted and nearly extirpated in the Southwestern United States. The continuing decline is primarily attributed to habitat fragmentation caused by conventional range fences, which antelope do not jump over and therefore must find weak sections of fence to cross under. Pronghorn herds are effectively confined and prevented from moving to water and forage during drought years or to lower elevations during severe winters. Other causes of decline include road mortality and continuing loss of grassland habitat. Wildlife managers are concerned about the pronghorn decline in the population in northern Arizona over the past few decades, including the herd west of Wupatki and north of the San Francisco Mountains (Bright and Van Riper III 2000). Local coyote populations have been controlled to protect pronghorn fawns from predation (Terry Miller, AZGF, pers. comm.).

## Park

The Arizona Heritage Database (Arizona Game and Fish Department 2001) was consulted via the Internet to generate a list of threatened and endangered species and other species of concern for Coconino County, Arizona. This list was compared with the inventory of natural resources within Sunset Crater Volcano completed by Bateman (1976, 1979), which remains the best available documentation of the monument's flora and fauna. In addition, a survey for special status plants at the Flagstaff Area National Monuments, including Sunset, was just completed (Huisinga et al. 2000). Currently, no federally listed threatened or endangered plant or animal species are known to occur in Sunset Crater Volcano National Monument.

One endangered species, the Mexican spotted owl, is known to occur on nearby U.S. Forest Service lands. The species lives and nests in dense, old-growth forest on steep mountain slopes or in deep canyons. Suitable habitat conditions are not likely found within the monument, but the Mexican spotted owl may rarely cross into

the monument in search of prey. The U.S. Fish and Wildlife Service recently proposed to designate critical habitat for the species, but did not include any forest lands in proximity to the monument.

At Sunset Crater, there are two plant species of concern-Penstemon clutei and Phacelia serrata. Both are short-lived wildflowers that are only found on cinder deposits within the San Francisco Volcanic Field. Populations of both species have been documented from numerous locations within the monument, including the area of heavy visitor use along the Lava Flow Trail. Recent studies have shown that Penstemon clutei is adapted to fire and other types of disturbance within ponderosa pine forest (2000 Southwest Rare Plant Conference Proceedings, in press). However, the NPS is uncertain about potential impacts resulting from current visitation and only recently proposed routine monitoring of these species.

An additional bird species of concern, the northern goshawk, is known to occur on nearby U.S. Forrest Service lands. The species is widespread but solitary across much of the United States and southern Canada (Association for Biodiversity Information 2000). It nests and breeds in a wide variety of habitats, including agricultural areas and formerly logged forests. In Arizona, goshawks prefer forest interior stands of large ponderosa pine trees. Suitable habitat conditions are not likely found within the monument, but the northern goshawk may rarely cross into the monument in search of prey.

Although they are not formally listed as a species of concern, the status of golden eagles (Aquila chrysaetos) within the region was identified during the public and agency scoping process. There are no records of golden eagle nests within Sunset Crater Volcano, but suitable nesting habitat is found on nearby U.S. Forest Service lands, and golden eagles may forage within the monument. They are known to be sensitive to human presence. If disturbed by noise or rapid movements, adult birds may fail to use a nest site or temporarily abandon their eggs or chicks, which exposes them to undue cold temperatures and/or predators. Some biologists recommend establishing a 1/4- to 2-mile-diameter buffer zone around nests.

Although not formally listed as a species of concern, the pronghorn antelope (Antilocapra americana) herd within the region was identified as a management issue during the public and agency scoping process. The species is being affected by large-scale habitat fragmentation and loss, and the regional pronghorn population has declined during the last few decades (Bright and Van Riper III 2000). Although pronghorn are not known to occur within the existing boundary of the monument, they are known to use nearby Bonito Park as a fawning ground. The proposed management alternatives include various boundary, access road, and visitor use changes that could have a range of effects upon Bonito Park and local movement corridors for this sensitive animal species.

In addition to sensitive species, three unique habitats within the monument were identified during the scoping process--pioneering vegetation stands isolated in the middle of the lava flows, pioneering vegetation islands on deep cinder deposits, and the downslope perimeter of lava flows where water seepage may be more prevalent. Localized stands of isolated vegetation are found on the relatively young and harsh surface terrain of the Bonito Lava Flow. These areas are relatively undisturbed and may have scientific value for studies of the unique ecological process of pioneering plant establishment and vegetation succession. Other localized vegetation "islands" of ponderosa pine, pinyon pine, and aspen effectively float on the

relatively young, deep cinder deposits. Soil formation is precarious on the cinder deposits because weathered soil particles must accumulate between the cinders in order for plants to germinate and survive. In the early stages, this process is easily disrupted by disturbance that dislodges the particles and causes them to sift into the cinders too deep to support plant germination and establishment. Around the "toe" of the lava flows, areas of water seepage may provide a unique microhabitat for plants. Water likely collects upon the hardened lava surface and is channeled through fracture systems to the perimeter of the flow where it may locally benefit plant life before quickly percolating deep into the adjacent cinder barrens. These isolated vegetation island habitats likely support Penstemon clutei and Phacelia serrata. All three unique habitats likely harbor numerous plants, provide scarce wildlife habitat that would not otherwise be found, and greatly contribute to overall biodiversity within the monument.

## LONG-TERM INTEGRITY OF GEOLOGIC RESOURCES

Sunset Crater Volcano National Monument was established to protect significant geologic resources. Impact topics were identified through the scoping process, and concerns covered by this section include: (1) preserving unique geologic features such as cinder volcanoes, lava flows, lava tubes, ice cave, cinder barrens, and spatter cones; (2) managing visitor use impacts to these features, especially the sensitive cinder barrens and ice cave; and, (3) preserving the integrity of geological resources to further scientific research.

### Region

Sunset Crater Volcano is located near the southern margin of the Colorado Plateau geologic province, which covers over 130,000 square miles and includes the "Four Corners" area of Arizona, Colorado, Utah, and New Mexico. The Colorado Plateau represents a huge block of the earth's crust that has remained relatively intact through hundreds of millions of years. The bedrock of the plateau is predominantly formed of thick sedimentary rock sequences of limestone, sandstone, and shale. The deposits originally accumulated under a series of seaways that inundated Western North America during the Paleozoic and early Mesozoic ages. During the last 65 million years, the sedimentary formations were raised more than a mile above sea level along with the uplift of the Rocky Mountains and the Sierra Madre of Mexico. As the uplift occurred, numerous volcanic centers erupted through the sedimentary formations and built the higher mountain ranges of the region. The forces of erosion have since weathered the land surface into a broken landscape of eroded volcanoes, expansive mesas, sharp ridges, and narrow canyons between 4,000 and 13,000 feet above sea level. The edges of various individual plateaus are defined by differential erosion rates of over- and underlying rock formations, displacement along major faults, or structural deformation and folding associated with monoclines, anticlines, and synclines. The regional drainage pattern and stream systems are also significantly controlled by the same underlying geological principals.

The major geologic subprovinces that surround Sunset Crater Volcano National Monument are the Mogollon-Coconino Plateau highlands to the south and west, and the Little Colorado River Basin-Painted Desert lowlands to the east and north. The Coconino Plateau is a lava-capped highland bounded on the south by the Mogollon Rim, the major geologic structural break between the Colorado Plateau of northern Arizona and the lower elevation, "Basin-and-Range" province of southern Arizona. The Coconino Plateau is deeply incised by several canyons,

including Walnut, Oak Creek, and Sycamore Canyons. Sequences of sedimentary rock are exposed in cross section on the inner canyon walls, typically beneath lava caps. The San Francisco Mountains and associated San Francisco Volcanic Field punctuate the Coconino Plateau. The San Francisco Mountains, at 12,700 feet, are the eroded remnants of a massive composite volcano. Large intrusive igneous rock domes and pyroclastic flows formed the mountains less than 5 million years ago. They have been sculpted by glaciers during the last 80,000 years.

The Little Colorado River has eroded the Painted Desert basin over a large area to the northeast of Sunset Crater Volcano. The river basin is dominated by sandstone and shale formations, which are relatively softer and more easily eroded than the adjacent volcanic highlands. Local sandstone spires, buttes, mesas, and "badlands" are the predominant landforms resulting from differential erosion between sandstone and shale beds.

## Park

Sunset Crater Volcano is located in two physiographic subprovinces: (1) the Coconino Plateau and: (2) the Little Colorado River Basin, both of which lie along the southern margin the Colorado Plateau. The Coconino Plateau is a highland bordered by several deep canyons and rimrock, and is characterized by expanses of lava flows and cinder cones. Extensive volcanic flows, domes, ash deposits, and cinder cones form the San Francisco Peaks and associated volcanic field.

Sunset Crater Volcano lies on the eastern perimeter of the San Francisco Volcanic Field (Holm and Moore 1987). The local terrain is rugged and dominated by basaltic cinder cones and lava flows. Sunset Crater was first named Sunset Mountain by John Wesley Powell in the 1880s. It is the youngest dated volcano in Arizona-it erupted from A.D. 1064 or 1065 until at least 1180, and was the last of more than 550 known basaltic vents in the San Francisco Volcanic Field. Around the monument boundary, portions of older volcanoes, lava flows, and ash deposits are weathered and eroded, and are partially or completely buried beneath the more recent volcanic events. Sunset Crater is viewed as unique by geologists, primarily because it is such a fresh and unweathered example of volcanic activity both within the San Francisco Volcanic Field and within the continental United States.

Sunset Crater Volcano is a classic example of a cinder cone volcano. During the eruption cycle, volcanic magma was ejected from a vent and thrown into the air while still in a hot, liquid state. The ejected magma cooled, crystallized, and fell as ash, cinder, and popcorn-sized particles (called "scoria"). Larger material (called "bombs") as much as 3 feet in diameter was also ejected. Larger, heavier material accumulated around the vent to build a cone-shaped volcano with a crater depression centered over the vent. The cone is approximately 1,000 feet high and more than a mile wide at the base. The crater is about 400 feet deep and 2,250 feet from rim to rim. Gaseous fumeroles at the crest of the cinder cone left distinct white, yellow, and pink mineral deposits. A blanket of ash and cinders ejected during the eruption covered more than 800 square miles around the cinder cone.

While Sunset Crater Volcano was erupting, two basalt lava flows originated at the base of the cinder cone. The Kana-A Flow (outside the monument boundary on the Coconino National Forest), an a'a type lava flow, extruded near the eastern base of Sunset Crater. The Kana-A flowed more than six miles to the northeast, filling a narrow valley. The Bonito Lava Flow, a composite pahoehoe and a'a lava flow, extruded from the northwest base of

Sunset Crater. The Bonito locally pooled over a 2-square-mile area between the west side of the cinder cone and five older volcanic domes and cones. The Bonito is believed to have accumulated, during at least three separate flows, to as much as 100 feet thick. While the Bonito lava was flowing away from the base of Sunset Crater, portions of the cinder cone were carried on top of the flow as far as a mile to the northwest (Holm 1987). The cinder cone quickly rebuilt itself through continued eruption as the lava flowed, which is evidenced by the cinder blanket on top of both the Kana-A and Bonito flows. In all, an estimated billion tons of material were erupted from the cinder cone and extruded in the two lava flows.

The basaltic magma that erupted from Sunset Crater Volcano flowed to the surface through a deep fracture in the earth's crust. The surface geologic expression of this fracture was a six-mile-long volcanic fissure, trending northwest to southeast. Sunset Crater erupted at the northwest end. During the peak of volcanic activity, at least nine other cinder cones, numerous smaller spatter cones and fumeroles, and three lava flows were simultaneously active along the fracture, forming a "ring-of-fire" style eruption much like those observed today in Hawaii. Most of the fracture, cinder cone, and lava flow system associated with Sunset Crater lies outside of the monument on the Coconino National Forest, and currently comprises about 25% of the Cinder Hills Off-Highway Vehicle (OHV) Recreation Area.

Geologic resources in the monument are adversely affected by disturbance to the unique cinder cone, lava flow, spatter cone, and other volcanic features caused by human activities inside and outside park boundaries. In addition, the deep cinder deposits are easily disturbed by human trampling, which hinders the development of soils and survival of vegetation (Eggler 1966). Inside the park, some areas receiving heavy visitor use suffer from severe erosion on steep cinder cone slopes, and the breakage, collapse, and loss of lava and spatter cone surfaces. This is particularly evident on the abandoned Crater Overlook Trail and along the Lava Flow Trail. Certain reaches of the Lava Flow Trail have recently been rerouted to protect unique features, and the NPS is currently considering the strategic placement of handrail barriers and improved information on unique or sensitive geologic features. The NPS is in need of a detailed geologic map and inventory of specific volcanic features within the monument in order to determine their relative uniqueness and assess current damage levels. Studies of the deep cinder deposits are also needed to determine if existing levels of off-trail trampling and trespass off-road vehicle use are seriously retarding natural soil formation and vegetation establishment processes. With this information, the NPS may take appropriate management action to deter further damage to unique volcanic features.

Most of the geologic features associated with the entire Sunset "Ring-of-Fire" eruption are on neighboring Coconino National Forest lands and are being severely disturbed and eroded within the Cinder Hills OHV Area. Such use also precludes interpretation of this fascinating geologic story to the visiting public.

## ABILITY TO EXPERIENCE PARK RESOURCES

The scoping process identified the visitors' ability to experience park resources related to park significance as an issue. Concerns include access to park resources by the general public, access to information provided by museum collections and ability to see the "real thing" (actual artifacts, dwellings, etc., as opposed to replicas or simulations); minimally altered

environment; access to a full spectrum of park resources for visitors with disabilities; ability of the public to understand park resources; ability to experience scenic, recreational, and educational pursuits; visitor understanding of regional context; uncrowded visitor experiences; visibility of night skies and natural soundscapes; and ability to hear natural sounds. Concerns also include personal freedom (inside and outside park boundaries); traditional employee/visitor experiences (interpretation through personal services, access to favorite sites); and traditional recreational activities (biking, climbing, etc.).

## Region

The Flagstaff Area monuments are relatively small enclaves of National Park Service management located within a geographic area dominated by the much larger Coconino National Forest. Although natural and cultural resources within the monuments are recognized and protected for their special significance, they cannot be separated from their regional context. The geologic, natural, historic, and prehistoric stories of these places continue across monument and forest boundaries and throughout much of northern Arizona; they can be fully appreciated and understood only as part of this larger picture.

Similarly, outdoor recreational opportunities abound in northern Arizona, on lands managed by a variety of agencies. The Flagstaff Area monuments are managed in accordance with the NPS mandate "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Concerns about traditional and proposed visitor experiences and recreational activities in the parks are evaluated in this context; it is recognized that certain activities, while inappropriate on NPS lands, are both appropriate and encouraged elsewhere. As population and development increase both locally and regionally, demand for recreational opportunities on public lands will increase accordingly. NPS information/education efforts are designed as part of a cooperative interagency effort to direct visitors to the best locations for their desired activities, whether on NPS, USFS, or other lands.

The public's ability to experience park resources is thus closely related to availability of resources on nearby non-NPS lands. Interpretation of park resources as part of a regional system is crucial, but not currently being accomplished. In all three Flagstaff Area monuments, wayside and museum exhibits are outdated and inaccurate and fail to emphasize the desired big picture. A major interpretive planning effort to replace wayside interpretive signs along trails and roadsides and to redo museum exhibits in the visitor centers is under way, concurrent with this GMP. The new exhibits will present a cohesive story, linking the natural and cultural resources of these three monuments with NPS, USFS, and other sites throughout the region. They will be designed for full accessibility, to serve visitors with disabilities and/or different learning styles. And they will enhance visitors' ability to see the "real thing," using the actual structure, feature, or artifact whenever possible, or models, electronic images, virtual tours, or other means when necessary. Programmatic accessibility for visitors with vision, hearing, and mental impairments is being addressed in the Comprehensive Interpretive Plan.

The opportunity to present this type of interpretive message in a comprehensive manner is great, since travel patterns of visitors to the Flagstaff Area monuments are fairly well defined. Visitor surveys

(1998) indicate that the majority of Sunset Crater Volcano/Wupatki visitors travel from south to north along FR545, the 36-mile scenic road connecting the two parks. Most (68-70%) are engaged in a longer trip and are en route to Grand Canyon National Park and/or points north. Of Wupatki visitors, 92% also go to Sunset Crater Volcano and 35% to Walnut Canyon; for 68% this is part of a longer trip.

## Park

As described in the Purpose and Need section, Sunset Crater's purpose is to "preserve and protect Sunset Crater Volcano National Monument's geological formations, features, and resources for scientific interests and research, and for public interest including scenic, educational, and recreational pursuits."

For many visitors, Sunset Crater Volcano is largely a drive-through experience, often in conjunction with a visit to Wupatki National Monument. A typical visit includes stops at the visitor center, one or two roadside pullouts, and the Lava Flow Trail. Much of this experience is available to visitors with mobility impairments. Spectacular views of the volcano, lava flow, nearby mountains, and the San Francisco Peaks are available to all visitors, and make up a highly significant element of the visitor experience.

Sunset Crater Volcano, the primary geological feature, is a prominent landmark for miles around. The trail to the top was closed in 1973, owing to highly visible impacts from heavy use. However, many visitors still expect to see the "crater," and continuing demand for a view of this aspect of the primary resource is unmet within the park. Such a view can be achieved only from the gravel road up O'Leary Peak, on USFS lands.

The NPS visitor center is located by cooperative agreement on USFS land. Several hands-on interactive exhibits demonstrate basic geological processes, and samples of volcanic rock are on display. A fully functioning seismograph records worldwide seismic activity and provides tangible evidence of the dynamic forces that helped create Sunset Crater Volcano. A seven-minute video explains the basics of the eruption and depicts people living in the area at the time. Interpretive programs, both talks and guided walks, are offered as staffing permits.

The self-guided Lava Flow Trail provides the primary opportunity to experience the volcanic environment. This one-mile loop interprets a variety of geologic features (a'a and pahoehoe lava flows, spatter cones, squeeze-ups, lava bubbles, the mouth of a lava cave, a lava tube, an earth crack, xenoliths, etc.) and relates the significance of the volcano to the rest of the San Francisco Volcanic Field. The slow progression of plant succession is also evident on the volcano and lava flow. One segment of the Lava Flow Trail is paved and meets accessibility standards. An ice cave located along the Lava Flow Trail was open for visitor exploration until the mid-1980s, when it was closed because of resource protection and safety concerns.

Nearby, a steep half-mile hike up Lenox Crater, an older cinder cone, provides interpretation of the volcanic terrain visible below. Other noteworthy geological features (lava bombs, several hills that rafted away from Sunset Crater on the lava flows, caves, and a 1/4-mile-long crack filled with squeeze-ups) are located in difficult terrain; because of sharp jumbled lava rock and steep cinder hills, most visitors do not venture far.

The Sunset Crater experience is complicated by the fact that not all resources related to park significance occur within the boundary. Other features of significance to the geology of Sunset Crater Volcano lie partially or completely outside park boundaries: 1) Lenox Crater is

a cinder cone much older than Sunset Crater. 2) The Kana-A lava flow, the first of the two major lava flows that emanated from the base of Sunset Crater, is visible along FR545. 3) The Cinder Hills, near the monument's eastern and southern boundaries, provide geological evidence for the curtain of fire activity that culminated in the Sunset Crater Volcano. They are visible from an overlook along FR545.

The Cinder Hills are also heavily used by off-highway vehicle (OHV) enthusiasts in the USFS-managed Cinder Hills OHV Area. The Forest Service estimates usage by approximately 30,000 individuals annually. Degradation of geological features and interruption of plant succession are evident, and other visitors are effectively deprived of the opportunity to experience this resource. The OHV community is passionate about keeping this opportunity available and has expressed willingness to work toward protection of fragile environments, in order to keep this special use area open.

Other recreational opportunities, including hiking, horseback riding, off-road vehicle use, and camping, are available on nearby USFS lands. Bonito Campground (USFS operated) allows for an overnight stay near the park, and provides the chance to view night skies and encounter crepuscular and nocturnal wildlife. Cyclists use FR545 as a training route and for recreational biking; occasional use of FR545 by organized auto or motorcycle groups is permitted.

The general lack of structures and roads lends an impression of a fairly pristine environment. However, there are visual intrusions on the landscape. The road itself slices through the middle of the lava flow and onto the flank of the volcano. A parking lot, rest room, and ranger kiosk at the Lava Flow Trail trailhead intrude upon the volcanic landscape at the base of the volcano. Scars from the long-closed trail up Sunset Crater remain as a reminder of the delicacy of this environment. Evidence of logging, fire suppression, and farming are also evident within the park viewshed, as are mines at the base of the San Francisco Peaks.

According to recent visitor surveys, visitors are generally satisfied with their experience in the park. Most are incorporating their trip to Sunset Crater Volcano into a larger travel plan, and the vast majority are on their way to or from Wupatki and Grand Canyon National Park. Many visitors want to explore lava flow features and to satisfy their curiosity. Visitors also expressed a desire to view scenery and to share the park with others (many visitors are locals who are giving a tour to family and/or friends). Frequent comments by return visitors attest to fond memories of climbing the volcano.

## PARK NEIGHBORS; LOCAL, STATE, AND TRIBAL LAND MANAGEMENT PLANS; AND LAND/RESOURCE MANAGING AGENCIES

Impact topics were identified through the scoping process, and concerns covered by this section include effects on neighbors' access and emergency response, economic contribution of the park to local economies, access to culturally sensitive areas by traditional users, traditional land uses external to park boundaries, and possible conflicts between the proposed action and local, state, or Indian tribal land use plans, policies, or controls.

### Region

Sunset Crater Volcano NM is north of the City of Flagstaff, Arizona. Phoenix, a rapidly growing metropolitan complex of more than two million people, is 150 miles south of Flagstaff. Flagstaff, a major community of northern Arizona, has a population of approximately 55,000 and

offers numerous services for the extensive ranching, lumber, and tourist activities of northern Arizona. The area between Flagstaff and Sunset Crater Volcano and Walnut Canyon is being subjected to increasing residential and business development. The remainder of the region surrounding the monuments is sparsely populated, although a private development (called "Alpine Ranchos") is increasing in population northeast of Sunset Crater Volcano, leading to substantial increases in nonpark travel on park roads.

Land use in the region varies from the expanding urban influences of Flagstaff near Sunset Crater Volcano and Walnut Canyon to low-intensity grazing at Wupatki. The Coconino National Forest, which borders Wupatki on the south and west, is under multiple-use management. The primary uses near the monuments are recreation and grazing.

Information from the U.S. Geological Survey indicates that some lands in the vicinity of the monuments are prospectively valuable for oil and gas, geothermal steam, and associated geothermal resources. Because of the lack of surface indications and drilling data, the potential for geothermal energy development and for discovery of oil and gas in the area is unknown at the present time. The Coconino National Forest and adjacent region are currently being studied by the U.S. Geological Survey and private corporations for potential geothermal development. Permits have been granted by the U.S. Forest Service to energy-related firms for research on Forest Service lands adjacent to the Wupatki boundary. Based on present information, there are no additional valuable leasable minerals. Minerals, including cinder, pumice, gypsum, miscellaneous clays, sulfur, and uranium, are reported in the area surrounding the park, and meteorites and meteorite diamonds have been reported in the vicinity. It is unknown to what extent, if any, these minerals exist at commercially valuable levels in the monument. A cinder quarry operation is located outside Sunset Crater Volcano, northwest of the visitor center. The haul road for this operation crosses the main park road (FR545) near US89.

Woodcutting, shooting/hunting, and off-road vehicle activities are evident throughout Forest Service areas adjacent to the monument. Occasionally, these activities spill over onto monument property and present illegal and incompatible use.

The location of the monument within this regional complex of public lands is one of the most important aspects determining its visitation pattern, as well as its resource management problems and programs.

Land management plans exist for some of the areas surrounding the monument. This general management plan will be compatible with the City Open Space/Greenway Plan, the County Regional Plan, the Forest Service Flagstaff Lake Mary Ecosystem Analysis (FLEA), the Forest Management Plan, and with the land and resource management plans of Babbitt Ranches, now called the Coconino Plateau Natural Reserve Lands. The Ranch has entered into an agreement with the Navajo and Hopi Tribes to manage their lands professionally with respect to the environment and resources conservation. The 1995 "Hopit Potskwaniat," Hopi Tribe Consolidated Strategic Plan, presents the goals of the Hopi Tribe to initiate sound planning for the development of tribal land and resources for the benefit of the Hopi People. The plan specifically addresses preservation of the Hopi way of life and the protection of sacred places and subsistence gathering areas.

There is no public transportation to any of the three Flagstaff Area monuments. Sightseeing bus tours are operated by

Nava-Hopi Tours, Grayline Tours, and smaller commercial companies throughout the year.

US89, a major north-south route through Arizona and Utah, and I-40 provide access to the parks from Flagstaff, which is served by Amtrak rail service, bus service, commercial airlines, and private vehicles via I-40 and I-17.

## Park

Sunset Crater Volcano National Monument is entirely surrounded by Coconino National Forest. The NPS visitor center and administrative, housing, and maintenance facilities are situated on Forest Service lands through a memorandum of understanding (MOU). Also through the MOU, NPS has responsibility for maintenance of FR545, the all-weather road serving Sunset Crater and Wupatki National Monuments, and for providing visitor protection and response to traffic incidents. Although both monuments are closed at night, FR545 is open at all times, except immediately following heavy snows or other emergency conditions.

Various park neighbors, including residents of Alpine Ranchos (a small community primarily northeast of the monument), the Navajo Reservation, and Chambers, as well as ranch employees of the Coconino Plateau Natural Reserve Lands, use FR545 for commuting to and from Flagstaff to the south and other points to the north. This route is also used by many off-highway vehicle users to reach the USFS Cinder Hills OHV Area.

Although several miles distant, the residents of Alpine Ranchos identify with the monument and its services, often stopping at the visitor center to request assistance from law enforcement rangers, to report crimes, and so on. Residents of reservation communities and Alpine Ranchos have expressed some concerns over any plans to terminate roads in the park, particularly as to effects on their quality of life, increased commuting time, and access to conveniences such as gas, phone, mail, and groceries. In addition, residents of communities in Doney Park (including Black Bill, Timberline, Doney Park, and Pioneer Valley) and adjacent areas have expressed some concerns over any plans to route additional traffic via FR776 or FR414, particularly as to effects on their quality of life, increased traffic, congestion, and noise.

Ten affiliated tribes have identified traditional relationships and/or cultural properties within park boundaries and have concerns about public access to sites; some groups need access to restricted use areas for plant gathering and traditional activities. Consultation with these tribes is routine and ongoing.

Users of the Cinder Hills OHV Recreation Area are organized and vocal regarding their desires for management of the area, but they are too transient a population to be considered park neighbors.

The NPS and USFS enjoy a cooperative relationship in regard to visitor information services. The two agencies have jointly planned exhibits for the visitor center and wayside exhibits along the park road, and share in a joint agency effort that offers interpretive programs at both NPS and USFS facilities. These include Bonito Campground, located across the road from the NPS visitor center.

The park has trained and commissioned law enforcement rangers and employees certified in emergency medical response and is usually the initial contact in an emergency. Calls for assistance to Bonito Campground and the Cinder Hills OHV Area are common. Off-hours response is, however, minimal. Cooperative law enforcement is performed through existing written agreements with the Coconino National Forest and the Coconino County Sheriff's Office. All commissioned park rangers are special

deputies of the County Sheriff's Office. Cooperative agreements in fire, facility maintenance, and resources management also result in NPS personnel taking action on USFS lands.

The National Park Service money generation model is a formula used to estimate the benefits attributed to the local economy resulting from the number of visitors to national park areas. The estimates of those contributions to the greater Flagstaff economy from Sunset Crater Volcano NM include tax revenue of $180,963 and a total spending revenue of $2,585,188 (based on the latest calculations from 1996).

The area is of great interest to various agencies involved in research, including the U.S. Geological Survey, Northern Arizona University, and others who, although they do not own or administer any lands, will have an interest in management decisions affecting the resources of the areas.

## OPERATIONAL EFFICIENCY

Operational efficiency refers to adequacy of the staffing levels and the quality and effectiveness of the infrastructure used in the operation of the park in order to adequately protect and preserve vital park resources and provide for an effective visitor experience. Also identified through the scoping process were concerns about employee and visitor health and safety and management of collections and other resources.

### Roads and Trails

Access to Sunset Crater Volcano National Monument is primarily via US89 and FR545. US89, the primary route serving northern Arizona, the Four Corners area, Grand Canyon National Park, Glen Canyon National Recreation Area, and many of the major national parks in southern Utah and southwestern Colorado, is being modified into a high-speed, four-lane divided highway. US89 is also a major commuter route for residents living on the Navajo and Hopi Reservations and local Flagstaff residents who are employed in many of the smaller towns on the reservation.

Because of the high speeds allowed on US89, visitors and employees are exposed to dangerous situations when entering and exiting the park on FR545. Traffic is controlled by a single stop sign on the FR545 side of the intersection.

The park entrance road, FR545, is a simple loop 2-way asphalt paved roadway. The overall condition of FR545 is fair to poor, with large sections of thermal, longitudinal, transverse, and block cracking. In many locations, the shoulders are too narrow and raveling. The road currently does not meet NPS standards. Accidents, although infrequent, are sometimes serious. Shoulder drop-offs could contribute to the severity of vehicle accidents. One hazardous section is just beyond the east boundary of Sunset Crater, extending for approximately seven miles east. The section is moderately steep and narrow with S-shaped curves. A number of recorded accidents have occurred at this location. Most are the result of excessive speed and failure to negotiate the road's sharp curves. The distance from medical response other than NPS exacerbates this issue, although local care providers are generally responsive to NPS needs.

The NPS currently has the primary responsibility for the maintenance of FR545; however, funding deficits significantly limit the nature and frequency of maintenance activities. Additional responsibilities include plowing the roadway during the winter months. Significant snowfall occurs at Sunset Crater, and the resultant icy conditions can cause serious road hazards.

A number of forest roads provide access around the park. Most are used by hunters, woodcutters, off-highway vehicle users, other recreationalists, and other users wanting to gain access to the Forest. FR545e is the only exception. This road is used predominately by "haul trucks" removing cinders and other material from mines in the area east of O'Leary Peak. These large trucks mix with visitor traffic. Although no accidents involving visitors and haul trucks are known to have occurred, the potential exists.

FR776, the primary entrance to the Forest Service Cinder Hills Off-Highway Vehicle Recreation Area, begins at US89 three miles south of the park and terminates at FR545 east of the monument.

FR414 provides access to the southwest corner of the park, where it is closed at the park boundary. A branch of FR414 connects with FR545 east of the monument entrance station. FR546 provides access to forest lands to the north and east of O'Leary Peak. FR545a ends at the top of O'Leary Peak. It begins west of the monument entrance station, skirts the west boundary of the park and actually crosses a segment of the northwest corner.

Because of staffing limitations, use of FR545 is not regulated except when the entrance station is in operation during the peak visitor season (May-September). Entrance fees for both Sunset Crater Volcano and Wupatki are collected at this location. The fee collection operation is moved into the visitor center during other months, resulting in the loss of visitor-orientation opportunities and significant losses of fee revenues because of drive-bys. Fees are not collected from commuters and forest users en route to forest lands beyond the park.

There is no ability to close the road through the park. Parking lots at points of interest are not gated, although park policy encourages daylight use only. This makes protection of park resources difficult. This situation has resulted in increased demands on funding and staffing (for road maintenance, housing to accommodate residential law enforcement and maintenance staff, 24-hour response, etc.). Encroachment into closed areas along the east and south boundaries of the park by OHV enthusiasts is a frequent occurrence.

Bonito Park wayside, located 3/4 of a mile west of the visitor center, provides an excellent view of the San Francisco Peaks, Bonito Park, and Sunset Crater Volcano.

The parking area for Lenox Crater is one mile east of the visitor center, on the north side of FR544. The 1/2-mile Lenox Trail starts on the south side of the highway and climbs to the top of Lenox Crater. The trail offers an opportunity to climb up a cinder cone and view the inside of a crater; the top of the crater provides a spectacular view of the San Francisco Peaks.

The Lava Flow Trail is 1.5 miles from the visitor center. The trailhead includes a large parking lot with picnic tables and rest room facilities. It is the most heavily used trail in the park. The one-mile loop trail skirts the base of the volcano and loops through the associated lava field, providing spectacular views of the associated geologic features and the Bonito Lava Flow. The trail also offers a number of overlooks that provide views of many of the geologic features in the area

The Cinder Hills Overlook is at the northeast boundary of the park, at the end of a short spur road. It provides an excellent view of the geological features specifically associated with the eruption of Sunset Crater Volcano.

Painted Desert Vista, eight miles east of the visitor center, contains a picnic area and provides excellent views of the Painted Desert.

Limited visitor interpretation is presented through evening programs at Bonito Campground, which is located on USFS land and operated by a concessionaire contracted by the Forest Service. The NPS has cooperative agreements to provide interpretive information.

There are no gas, food services, camping, or concession operations in the park, but most of these services can be found in Flagstaff, approximately 20 minutes away. The visitor center does contain a bookstore operated by the Southwest Parks and Monuments Association.

Generally, high summer temperatures pose the most significant threat to visitors. In addition, summer afternoon thunderstorms expose visitors to a high rate of lightning strikes and the potential for flooding. Winter storm conditions, including blowing and drifting snow, icy and snow packed roads, freezing temperatures, and extreme wind chill, can pose significant problems to visitors.

Visitors are exposed to uneven terrain on the Lenox Crater and Lava Flow Trails. Footing on and around the volcanic formations can be treacherous, and falls on volcanic material can result in serious cuts. Poisonous insects and reptiles are common, although interactions with humans are infrequent.

## Facilities

The visitor center, entrance station, and associated maintenance and housing areas are all located on USFS lands and are operated under a memorandum of understanding with USFS. The visitor center/maintenance complex, vintage Mission 66 construction, is directly south of FR545, approximately 1/2 mile west of the monument. The facility contains a small museum and book-selling area, attached offices, and rest rooms. The small area available for employee workspace and interpretation in the visitor center contributes to a feeling of disorder and crowding.

The Sunset Crater maintenance facility serves as the central office for the maintenance functions for the three Flagstaff Area parks. Maintenance facilities are attached to the south side of the visitor center and include a small maintenance office, a one-bay garage, and an open area for the storage of vehicles and small equipment. Routine tasks such as vehicle service and repairs, working on snowplows, and so on, must be conducted outside in adverse weather conditions. The entire facility is considered inadequate. A new facility is needed to address the overall needs for equipment parking, supplies and materials storage, and office and workspace.

The residential area consists of one single-family residence, three mobile homes, and two apartments. Housing is inadequate to park needs and is of substandard quality. Trailer pads are located nearby. Three employees are required to live in the park and provide minimal coverage for after-hours protection and emergencies.

The maintenance storage area is south of the visitor center complex and impacts a cultural resource on Forest Service land.

Bonito Campground, a large developed campground managed by the Forest Service, is directly across from the visitor center on FR545.

## Utilities

The monument uses a combination of park-owned/operated and municipal utilities. Electrical service is provided by the Arizona Public Service Company. Water is provided by the Doney Park Water Company but is stored in an elevated tank owned and maintained by NPS. The wastewater (sewer) system is NPS-owned and -maintained. Telephone service is provided by U.S. West and AT&T, although the monument owns its own

phone system. The park frequently experiences utility (electrical and phone service) outages, particularly during the summer monsoon season. This situation significantly impacts the park's ability to conduct business on a day-to-day basis, to use the Internet, and to connect with the outside world via computer, and it seriously impacts the staff's quality of life. Cell phone coverage in the park is extremely poor.

The park is connected to the other Flagstaff Area monuments and the headquarters office via radio. The repeater for the radio is located on O'Leary Peak adjacent to Sunset Crater Volcano and is subject to lightning damage.

The monument provides removal of solid waste to the county landfill.

## Staffing

A central headquarters, located in Flagstaff, provides administrative services for the three monuments and is the office location for the superintendent and the division heads for administration, resource management, ranger activities and fee collection, maintenance, and the cooperating association (Southwest Parks and Monuments Association). The facility also serves as a visitor information center for the three Flagstaff Area monuments as well as for other parks and points of interest in northern Arizona.

Resources management activities are accomplished by headquarters-based staff. The resource management staff and park law enforcement staff have implemented a resource monitoring and patrol program. Resource management staff conducts limited research; however, the majority of the research is done by various agencies and institutions and selected and qualified interested individuals.

Interpretive and law enforcement staffing is concentrated at the visitor center, and visitors services are provided primarily from that location. Because of the need to operate both an information desk and fee collection station, it is often difficult to provide staff at desired levels for patrols and interpretive programs.

Maintenance for the three monuments tends to be concentrated in this area as well, with Sunset Crater employees traveling to Walnut Canyon and Wupatki as needed for projects beyond those parks' capabilities. One maintenance employee is a required occupant at Sunset Crater Volcano. There is minimal staff to provide the necessary janitorial services.

The majority of museum collections (approximately 50,000 objects, including historic photographs, site files, archives, natural history specimens, and archeological, ethnographic, and historical items) for the Flagstaff Area National Monuments have been relocated to Wupatki, due to limited storage space and protection at Walnut Canyon and Sunset Crater Volcano. The storage environment at Wupatki is also poor, although it does provide a more secure location for the bulk of the collection.

All unprocessed collections, the rare book collection, the research library, and computer support are housed at the Flagstaff Area National Monuments headquarters office

Employee health and safety issues include potential exposure to hantavirus and other diseases caused by rodent infestations in government quarters and workspaces. Efforts to mitigate the presence of the rodents are ongoing, but mice and other rodents often get into buildings. During the winter months staff members are exposed to potentially dangerous driving conditions if they need to conduct business at the other Flagstaff area parks or headquarters during inclement weather.

# ENVIRONMENTAL CONSEQUENCES

## METHODOLOGY

All alternatives were evaluated for their effects on the resources and values determined during the scoping process, and impact topics were developed. For each impact topic, impacts are defined in terms of context, intensity, duration, and timing. Direct, indirect, and cumulative effects are discussed in each impact topic. Definitions of intensity levels varied by impact topic, but, for all impact topics, the following definitions were applied.

*Beneficial:* A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.

*Adverse*: A change that moves the resource away from a desired condition or detracts from its appearance or condition.

*Direct*: An effect that is caused by an action and occurs in the same time and place.

*Indirect:* An effect that is caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable.

*Short-term:* An effect that within a short period of time (generally one or two years but no more than five years) would no longer be detectable as the resource returns to its predisturbance condition or appearance; generally less than 5 years.

*Long-term:* A change in a resource or its condition that does not return to predisturbance condition or appearance and for all practical purposes is considered permanent.

All alternatives were also evaluated based on external factors, which, together with the actions of each NPS alternative, could have cumulative impacts. In order to determine cumulative impacts, a cumulative scenario was developed. That scenario included the following actions:

On Forest Service lands, there will be some reduction in roads. Monitoring of impacts will increase, but existing activities will continue unless monitoring shows resource damage or other problems. Forest closures/increased restrictions (including those related to fire hazard conditions) may transfer some pressure to parks. Increased access to different locations on USFS lands may affect park-eligible resources. The Forest Service is currently managing areas next to the city as open space, but would rather exchange such areas in accordance with regional land use plans. The urban boundary would then move closer to the parks. The Forest Service "Company's Coming" program could affect all three parks.

Increased growth of Flagstaff could mean more visits/demands for use of parks. Flagstaff is marketing the parks as part of their plan to attract more visitors. There are also increased tribal requests for use of renewable/nonrenewable resources.

The development of Roden Crater (near Alpine Ranchos) may increase traffic. Subdivision of lots in Alpine Ranchos may increase the population of the area.

US89 from Flagstaff to Wupatki's south boundary (and eventually north to Page) will be 4-lane.

Expansion of utility lines is proposed from Glen Canyon to the southwestern part of the Navajo Reservation.

There is a possibility that old pumice mines may be reactivated north of the monument.

Changes at Grand Canyon National Park could have implications for all three parks. The transportation plan restricts visitor use at the east entrance (visitors are no longer allowed to stop, just drive through). This could mean that visitors arriving in Flagstaff after visiting Grand Canyon may have more time to spend at Wupatki/Sunset Crater. There may also be increased use by Grand Canyon visitors who want the drive-through experience they can no longer get at Grand Canyon. However, there may be a decrease in the number of visitors, but more demand for things to do by those who do come.

The monument anticipates more requests for individual business permits for various services (guides, horseback rides, etc.).

Our ability to manage wildlife may be influenced by Arizona Game and Fish Department objectives. There will be increased ecosystem research (long-term monitoring).

Past activities like trail access to Sunset Crater and pothunting continue to have effects.

The use of off-road highway vehicles will continue to have effects on USFS land adjacent to the monument and occasional incidents of vehicle trespass within monument boundaries are likely to continue. Because OHV technology is changing, OHV users will be able to enter areas in the future where they couldn't go previously.

Use of the USFS campground will continue to affect the park.

## LONG-TERM AND SCIENTIFIC INTEGRITY OF ARCHEOLOGICAL RESOURCES

### Methodology

The National Historic Preservation Act requires agencies to take into account the effects of their actions on properties listed or eligible for listing on the National Register of Historic Places. The process begins with an identification and evaluation of cultural resources for National Register eligibility, followed by an assessment of effect on those eligible resources, and concluding after a consultation process. If an action (undertaking) could change in any way the characteristics that qualify the resource for inclusion on the National Register, it is considered to have an effect. No adverse effect means there could be an effect, but the effect would not be harmful to those characteristics that qualify the resource for inclusion on the National Register. Adverse effect means the effect could diminish the integrity of the characteristics that qualify the resource for the National Register.

In order to analyze the effects of the GMP alternatives on archeological resources, all available information on known archeological sites in the vicinity of Sunset Crater Volcano National Monument was compiled (Downum and Gumerman 1998). Map locations of archeological sites were compared with locations of proposed developments, proposed modifications to existing facilities, and proposed land uses. Predictions about short- and long-term impacts to archeological sites from visitation were based on previous studies of visitor impacts to archeological sites (Cinnamon n.d.; Coder et al. 1995a, 1995b; Downum et al. 1996; Fawcett 1993; Gale 1985; Green and LaBlanc 1979; Lightfoot and Francis 1978; Moore 1994; Nickens 1991; Nielsen 1991; U.S. General Accounting Office 1987; Wildesen 1982; Wood and Johnson 1978) and on recent monitoring data from the Flagstaff Area National Monuments (Fairley 1998; Johnson 1999; O'Hara and Johnson 1997). Sociological studies comparing the deterrent effects of signs vs. ranger presence on sites were also considered in this analysis (Clark 1976; Johnson and Vande Kamp 1996; Johnson et al. 1994;

Swearingen and Johnson 1994; Vande Kamp et al. 1994;).

Archeological sites are continually deteriorating, due primarily to the effects of weather and gravity. Left alone, sites will inevitably degrade over time. Impacts from human visitation and use contribute to the effects of natural agents of deterioration, and they can substantially increase the rate of site deterioration. In general, it is not possible to control the deterioration caused by natural elements. In contrast, it is possible to control the effects of human impacts through careful planning of activities and new developments, by educating visitors and park staff, and by limiting or directing locations of human activity in and around archeological sites.

If we exclude impacts caused by deliberate vandalism or artifact collection, most impacts resulting from visitor use are relatively minor when considered on an individual basis. However, for the purposes of this plan, it is necessary to consider the cumulative effects caused by hundreds or thousands of visitors at a given location over the life of this plan. Thus, for example, while a single guided tour to an archeological site may have a negligible effect on site integrity, the cumulative impact of hundreds of visitors over 10-15 years at dozens of sites can be substantial. In the following section, impacts are analyzed for each alternative based on the numbers of sites that would be affected in conjunction with the cumulative effects of various types of activities over the life of the plan.

For the purposes of this analysis, levels of impact to archeological resources were defined as follows:

*Negligible*: The impact on archeological sites is at the lowest levels of detection, barely perceptible and not measurable.

*Minor:* The impact on archeological sites is measurable or perceptible, but it is slight and localized within a relatively small area of a site or group of sites. The impact does not affect the character defining features of a National Register of Historic Places eligible or listed archeological site and would not have a permanent effect on the integrity of any archeological sites.

*Moderate:* The impact is measurable and perceptible. The impact changes one or more character defining feature (s) of an archeological resource but does not diminish the integrity of the resource to the extent that its National Register eligibility is jeopardized.

*Major:* The impact on archeological sites is substantial, noticeable, and permanent. The impact is severe or of exceptional benefit. For a National Register eligible or listed archeological sites, the impact changes a character defining features (s) of an archeological resource, diminishing the integrity of the resource to the extent that it is no longer eligible for listing in the National Register.

## Effects of the No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

The No-Action Alternative would involve no new construction, no additional trail developments, and no road realignments. FR545 would remain open to two-way traffic 24 hours a day.

The continuing use of the existing visitor center, roads and trails would directly and indirectly affect a few archeological resources located in the immediate vicinity of these existing facilities. Archeological resources adjacent to or easily accessible from public access areas would continue to be vulnerable to surface disturbance, inadvertent damage, and vandalism. Loss of surface archeological materials, alteration of artifact distribution, and a reduction of contextual evidence would

result. Some of these impacts could be mitigated through additional stabilization of site architecture (all front country sites have already been stabilized to some degree), rehabilitating social trails, and/or systematically collecting surface artifacts for long-term curation; over the long term, though, these management actions would detrimentally affect site integrity. Impacts to archeological sites from inappropriate visitor activities (artifact collection, graffiti, etc.) would continue to be a moderate long-term adverse effect. The impacts are considered to be moderate because few archeological sites are known to be located in or near the currently designated visitor-use areas. These adverse impacts would be offset somewhat by the fact that no sites would be adversely impacted by new trail developments or other new infrastructure improvements.

An upgrade/updating of interpretive media could improve long-term integrity of archeological resources through improving education of visitors about the significance and fragility of archeological resources and providing information on the various means of reducing visitor impacts to park resources. The effect of improved visitor education would be moderately beneficial.

Construction of a new maintenance facility and a curatorial facility in the administrative area would have a long-term moderate adverse effect on archeological resources. The impact is considered moderate because only one archeological site would be indirectly impacted by these developments; however, this site would be severely impacted over the long-term due to the proximity and inevitable enlargement of activity areas surrounding the new facility. These impacts would be partially mitigated through conducting a program of archeological data recovery.

Bonito Campground would remain in its present location and be expanded under the No-Action Alternative. Visitors using the campground and picnic areas would continue to compact soils in the vicinity and would remove surface artifacts from nearby sites. A loss of the surface archeological materials, alteration of artifact distribution, and a reduction of contextual evidence would result. Some of these impacts could be mitigated through rehabilitating social trails, and/or systematically collecting surface artifacts for long-term curation; however, over the long-term, these management actions would have a moderate adverse effect on archeological site integrity.

Closure and gating of the O'Leary Peak Road may have a minor adverse effect on archeological sites located in proximity to the road, as visitors moving at a more leisurely pace while hiking on the road would have a greater opportunity to observe and collect artifacts associated with these sites.

The current backcountry closure policy restricting visitor access to currently designated front country areas and requiring the issuance of permits for researchers and educational groups who have a special need to enter backcountry areas would remain in effect under the No-Action Alternative. In theory the closure should have a major beneficial effect on archeological resources by substantially reducing impacts from unguided visitation, such as collection of artifacts, destabilization of walls, soil compaction, social trailing, vandalism, and so on, thereby reducing the need for future impact mitigation. However, current operational requirements and staffing limits do not provide sufficient support staff to actively patrol and enforce the closure, and the inability to close the park at night further hinders enforcement of the closure. Hence, some impacts to backcountry resources are likely to continue under the No-Action Alternative. Resources in these areas would continue to

be vulnerable to both inadvertent disturbance and deliberate and illicit disturbance in the form of digging and collecting of archeological materials.

The boundaries of the monument would remain unchanged under the No-Action Alternative. Many archeological resources that are indirectly related to the purpose and significance of Sunset Crater Volcano would remain outside monument boundaries, where they would continue to be subject to impacts from multiple uses (mining, grazing, fuel wood harvesting, OHV impacts, etc.). The exclusion of these resources from the park would have a moderate adverse effect on their long-term and scientific integrity, due to continued degradation by multiple uses over the long term. The effect is considered moderate because archeological site densities in the designated OHV area are relatively low compared with some other nearby areas, and not all sites located in the OHV area are subject to impacts from OHV activities.

## CUMULATIVE EFFECTS

Past management strategies have allowed unlimited visitor access to virtually all areas of the monument. Recently, the backcountry areas of Sunset Crater Volcano National Monument were formally closed to unguided entry because of concerns over impacts to geological features, sensitive habitats, and traditional cultural sites.

The continuing growth of Flagstaff and ongoing efforts by the Flagstaff Chamber of Commerce to advertise the Flagstaff Area National Monuments as local tourist attractions could result in increased impacts to the monument's archeological resources as well as to archeological sites in the immediate vicinity. These impacts would primarily result from increased recreational impacts (e.g., incidental artifact collection, inadvertent destabilization of walls, social trailing, etc.), although impacts from vandalism and illegal excavations would likely increase as well. Continued growth in Flagstaff is also likely to result in significant development of private lands near the monument, which in turn is likely to result in increased unauthorized visitation to backcountry areas of the monument. Rural residential growth would also increase impacts to archeological resources on neighboring Forest Service lands.

Within the Flagstaff region generally, construction of new roads, housing subdivisions, mines, and other developments would continue to cause destruction of individual archeological sites. As the population of Flagstaff grows, recreational impacts on USFS lands and resources would continue to increase, resulting in additional degradation of archeological sites. As archeological sites are degraded and destroyed outside the monument, the relative rarity and importance of the archeological resources within the monument would increase.

Some Forest Service policies could have an adverse impact on the long-term integrity of archeological resources within and south of the monument. Continuation of the OHV area would continue to adversely affect any archeological remains located in that area because of compaction and erosion of soils, removal of stabilizing vegetation, and camping-related impacts. The Forest Service has indicated that it might institute a recreational impact-monitoring program on lands south of Sunset Crater Volcano National Monument; however, monitoring by itself will not mitigate the effects of recreational impacts on archeological resources. Currently, there are no plans to explicitly link monitoring results to specific management actions, so incremental degradation of archeological resources because of recreational impacts is likely to continue. On the other hand, proposed

road closures on Forest Service lands adjacent to the park would have a long-term, moderate beneficial effect on archeological resources outside the park boundaries by reducing ease of access to sites and the concomitant impacts from vehicular soil compaction and erosion, artifact collecting, and camping on sites located close to the roads.

### CONCLUSION

There would be no major impacts to archeological resources under the No-Action Alternative. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

Impacts from installation of new waysides, upgrading of interpretive exhibits, expansion of Bonito Campground, construction of the maintenance and curatorial facilities in the administrative area, closure of the O'Leary Peak Road to vehicles, upgrading of facilities to improve accessibility and safety, and closure of the backcountry areas of Sunset Crater Volcano National Monument to unguided entry would be the same as those identified for the No-Action Alternative.

The Bonito Park area is known to contain high densities of archeological sites, based on partial inventories of the surrounding area. Although the exact number of sites that would be affected by proposed construction of a new visitor center and development of a new Extended Learning Zone and associated facilities is unknown, a conservative estimate is that at least a dozen archeological sites would be impacted or completely destroyed by the construction of a new visitor center, trail system, and parking area adjacent to Bonito Park. Although the loss of resources could be partially mitigated through excavation and curation, the long-term effect would be permanent destruction, and, hence, it would be considered a major adverse effect.

The adverse impacts of constructing a new visitor would be offset somewhat by the fact that the relocation of the visitor center to US89 would help to ensure that most visitors would be adequately informed about the significance and fragility of resources both within and outside the monument and would be educated about means of minimizing impacts from visitation before they encounter resources. Thus, the relocation could have a minor to moderately beneficial effect on the long-term and scientific integrity of archeological resources. Conversion of the existing visitor center to an education center would not affect long-term and scientific integrity of archeological resources directly, although there could be minor beneficial indirect impacts by improving opportunities for in-depth education of the public on resource issues and protection measures.

Development of a new trail between Bonito Campground and the Lava Flow Trail would impact one archeological site. The impact would be moderately adverse. The impact to this site would be partially

mitigated through a program of photographic documentation.

The addition of a new Extended Learning Zone near US89 and the expansion of the existing Extended Learning Zone near the Lava Flow Trail would lead to increased impacts to archeological resources in proximity to those areas. With development of an interpretive trail and visitor center near Bonito Park, sites in this area would be subjected to increased impacts from visitation in the form of artifact collection, soil compaction, social trailing, and increased erosion. These impacts would be generally minor and incremental, but cumulatively they would be moderately adverse.

Under Alternative 1, the new visitor center and associated Extended Learning Zone and the hiking trail up O'Leary Peak would be jointly managed with USFS. Joint management would have a moderately beneficial effect on cultural resources outside the monument by increasing USFS presence and involvement in the management and interpretation of these areas. Increased USFS involvement in the management of archeological resources would result in more direct protection of these resources.

Minor boundary adjustments would have a beneficial effect on any cultural resources within proposed park additions by protecting them from OHV damage and other multiple use impacts such as recreational artifact collecting. Because of the relatively small area involved and the very limited likelihood of encountering archeological resources in these areas, however, the beneficial effect would be minor.

## CUMULATIVE EFFECTS

Cumulative effects would be the same as under the No-Action Alternative, with the following exceptions:

Past management strategies have allowed visitor access to virtually all areas of the monument. Recently, the backcountry areas of Sunset Crater Volcano National Monument were closed to unguided entry because of concerns over impacts to geological features, sensitive habitats, and traditional cultural sites. Implementation of Alternative 1 would continue this policy within most of the monument boundary, although there would be an expansion of the lava flow Extended Learning Zone and the addition of a new hiking trail.

Outside of current monument boundaries, the development of a new visitor center, trails, and parking area in the vicinity of Bonito Park would have a major adverse effect on archeological resources in that area, both as a result of the construction activities themselves and from the associated visitor uses that would follow. Although individual impacts from visitation would be mostly minor and incremental, the cumulative effects of changing visitor use patterns proposed under this alternative would be moderately adverse to the long-term integrity of the archeological resources located around Bonito Park. This is because a significant number of sites would gradually be degraded by incidental artifact collection, destabilization of walls, trampling of cultural deposits, and social trailing. Stabilization of these sites in order to withstand continuing visitor impacts would eventually be necessary. Cumulatively, the effects of Alternative 1 on long-term integrity of archeological resources would be major and adverse.

## CONCLUSION

In comparison to existing conditions, Alternative 1 would have a major, adverse effect on a relatively small but concentrated number of archeological resources located near the new visitor center and Extended Learning Zone. Although the exact number of archeological resources that would be

affected by this alternative is unknown (because an intensive archeological inventory has not been completed and specific locations for new facilities have not been decided), a larger number of resources would be impacted in Alternative 1 than under existing conditions. The adverse impacts would be offset to some degree by the benefits of an increased USFS presence and increased opportunities to orient and educate visitors before they encounter sensitive resources. The net effect, however, would be major and adverse for the long-term integrity of specific archeological resources. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of park resources or values.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

Impacts from installation of new waysides, upgrading of interpretive exhibits, expansion of Bonito Campground, construction of the maintenance and curatorial facilities in the administrative area, closure of the O'Leary Road to vehicles, upgrading of facilities to improve accessibility and safety, and closure of the backcountry areas of SUCR to unguided entry are the same as those identified for the No-Action Alternative. However, under this alternative, Bonito Campground and the new maintenance and curatorial facility would be removed, resulting in additional effects.

The park would be closed at night and gated at the new visitor center. Access from US89 via FR545 would be eliminated, as would access from the Cinder Hills Overlook westward. Closure of the park at night would probably have a minor benefit on the long-term and scientific integrity of cultural resources by limiting after-hours access to sites in the park.

The visitor center and administrative/maintenance facilities would be relocated to an undeveloped area south of the monument along FR776. The relocation of the visitor center to a new park entrance would theoretically have a beneficial effect on preserving the long-term/scientific integrity of archeological resources, by ensuring that most visitors are adequately informed about the significance and fragility of resources within the monument and are educated about means of minimizing impacts from visitation before they interact with the resources.

An unknown number of archeological sites would be impacted and/or destroyed as the result of constructing new facilities under Alternative 2, based on an incomplete inventory of archeological sites within and outside the current monument boundaries. Although precise numbers are unknown at this time, probably considerably fewer sites would be impacted from construction under Alternative 2 than under Alternative 1, but more would be impacted relative to existing conditions. However, this is dependent on final siting of the new visitor center, roads, campground, trails, and associated facilities. We know that at least one site would be impacted by proposed development of a new parking area at the base of the O'Leary Peak Trail.

The loss of resources could be partially mitigated through excavation and curation.

Under Alternative 2, the new visitor center and associated campground and the hiking trail up O'Leary Peak would be jointly managed. Joint management would probably have a beneficial affect on cultural resources outside monument boundaries by increasing USFS presence and involvement in the management and interpretation of these areas.

Alternative 2 would involve removal of the existing visitor center, existing campground, park housing and maintenance areas, plus removal of a section of FR545 north and west of Bonito Park and another section north of Sunset Crater to the Cinder Hills Overlook. These areas would be rehabilitated. Removal and rehabilitation of facilities around and including the current visitor center would serve as a major benefit to preserving the long-term and scientific integrity of nearby archeological sites (especially sites located in the current maintenance storage area). Also the lands north of FR776 would require some rehabilitation to mitigate effects of past OHV use. At least two known archeological sites adjacent to the western section of FR545 and three sites near the visitor center could potentially be impacted by proposed rehabilitation activities and would require monitoring and /or mitigation. Rehabilitation of these areas would have a moderate beneficial effect on the long-term integrity of a few archeological resources.

Closure of the road east of the Lava Flow Trail and conversion to a trail would not benefit archeological resources, because this conversion would result in increased pedestrian access to areas that currently receive very little visitation owing to a lack of pullouts along that section of the road. However, no archeological sites have been located within a previously inventoried 100-meter-wide corridor along this section of the road and hence, the effect would be negligible.

Alternative 2 would add a hiking trail around Bonito Park, and it would greatly expand extended learning opportunities between Lenox Crater and Sunset Crater. These areas currently receive relatively little visitation. The areas around Bonito Park and along the western edge of the Bonito Lava Flow are known to contain high concentrations of archeological sites, based on incomplete inventories of these areas. These sites would be subjected to increased impacts from visitation in the form of illegal artifact collection, soil compaction, social trailing and erosion, and inappropriate activities (digging, leaving New Age offerings, etc.) and ultimately might result in the need for mitigative actions. Most impacts from visitation would be individually minor and incremental, but the cumulative result would be moderately adverse.

Alternative 2 would involve significant expansion of current monument boundaries to include areas around Bonito Park, north of FR776, and minor additions on the east and north boundaries. In theory, boundary adjustments would have a beneficial effect on any archeological resources within the proposed park additions by proactively protecting them from OHV damage and other impacts from multiple uses such as timber cutting and camping. These benefits would be offset somewhat by increased visitation impacts to some sites in the expanded monument; however, the majority of sites would receive increased protection and reduced impacts as a result of boundary expansion. Overall, the boundary expansion would be a moderate benefit to archeological resources.

## CUMULATIVE EFFECTS

Cumulative effects would be the same as under the No-Action Alternative, with the following exceptions:

Past management strategies have allowed visitor access to virtually all areas of the monument. Recently, the backcountry areas of Sunset Crater Volcano National Monument were closed to unguided entry because of concerns over impacts to geological features, sensitive habitats, and traditional cultural sites. Implementation of Alternative 2 would continue this policy within most of the monument boundary, although there would be an expansion of the Lava Flow Extended Learning Zone. The expansion of the Lava Flow Extended Learning Zone is not likely to have any effect on archeological resources, as only one is currently known to exist in that area.

Outside of current monument boundaries, the development of a new trail and parking area in the vicinity of Bonito Park would have a major adverse effect to a few archeological resources in that area, both as a result of the construction activities themselves and from the associated visitor uses that would follow. Although individual impacts from visitation would be mostly minor and incremental, the cumulative effects of changing visitor use patterns proposed under this alternative would be moderately adverse to the long-term integrity of the archeological resources located around Bonito Park. This is because a significant number of sites would gradually be degraded by incidental artifact collection, destabilization of walls, trampling of cultural deposits, and social trailing. Stabilization of these sites in order to withstand continuing visitor impacts would eventually be necessary. Cumulatively, the effects of Alternative 2 on long-term integrity of archeological resources would be moderately adverse.

The development of a new visitor center and administrative area south of the monument could adversely affect any archeological resources that might be located in that area, both as a result of the construction activities themselves as well as from the associated visitor uses that would follow. However, few sites are likely to be present in this area, and most if not all of them could be avoided by proposed construction activities, so adverse impacts from construction of new facilities would be minor.

Alternative 2 would place a visitor center at the park entrance to ensure that visitors receive a thorough orientation to park values prior to encountering the resource. The location of the visitor center, coupled with the increased USFS presence in the area, would serve as a benefit to preserving long-term integrity of archeological resources.

Alternative 2 also involves a significant boundary expansion. The overall effects of boundary expansion would be a major benefit for archeological resources located in the expansion areas. When the various beneficial and adverse impacts are weighed against each other, the cumulative effects of Alternative 2 on long-term integrity of archeological resources would be minimally beneficial.

## CONCLUSION

Alternative 2 would have a moderate adverse effect on the long-term integrity of archeological resources located in the vicinity of Bonito Park and the new visitor center. These effects would be minimized by careful placement of the trail system and facilities. Most impacts would be indirect, resulting from increased visitor use of these areas. Although there would be an overall reduction in archeological integrity, it would not be to the extent that the resources would become ineligible for listing in the National Register of Historic Places. In addition to those mentioned, there would be other minor and moderate effects, both beneficial and adverse, to the integrity of archeological resources as a result of this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

Impacts from installation of new waysides, upgrading of interpretive exhibits, expansion of Bonito Campground, construction of the maintenance and curatorial facilities in the administrative area, closure of the O'Leary Peak Road to vehicles, upgrading of facilities to improve accessibility and safety, and closure of the backcountry areas of SUCR to unguided entry are the same as in the No-Action Alternative.

The Bonito Park area is known to contain high densities of archeological sites, based on partial inventories of the surrounding area. Although the exact number of sites that would be affected by proposed construction of a new visitor center and development of a new Extended Learning Zone and associated facilities is unknown, a conservative estimate is that at least a dozen archeological sites would be impacted or completely destroyed by the construction of a new visitor center, trail system, and parking area adjacent to Bonito Park. Although the loss of resources could be partially mitigated through excavation and curation, the long-term effect would be permanent destruction, and, hence, it would be considered a major adverse effect.

The adverse impacts of constructing a new visitor center would be offset somewhat by the fact that the relocation of the visitor center to US89 would help to ensure that most visitors would be adequately informed about the significance and fragility of resources both within and outside the monument and would be educated about means of minimizing impacts from visitation before they encounter resources. Thus, the relocation could have a minor to moderately beneficial effect on the long-term and scientific integrity of archeological resources.

Conversion of the existing visitor center to an education center would not affect long-term and scientific integrity of archeological resources directly, although there could be minor beneficial indirect impacts by improving opportunities for providing in-depth education to the public on resource issues and protection measures.

Under Alternative 3, as in Alternative 1, the new visitor center and associated Extended Learning Zone and the hiking trail up O'Leary Peak would be jointly managed with USFS. Joint management would have a moderately beneficial effect on cultural resources outside the monument by increasing USFS presence and involvement in the management and interpretation of these areas. Increased USFS involvement in the management of archeological resources would result in more direct protection of these resources.

The addition of a new Extended Learning Zone near US89, the expansion of the existing Extended Learning Zone at Lava Flow, and the formalization of two new trails would lead to increased impacts to archeological resources in proximity to those areas. With development of an

interpretive trail and visitor center near Bonito Park, sites in this area would be subjected to increased impacts from visitation in the form of artifact collection, soil compaction, social trailing, and increased erosion. These impacts would be generally minor and incremental, but cumulatively they would be moderately adverse. The addition of a hiking trail to Double Crater would presumably have a beneficial effect on any archeological resources in that vicinity, because removal of OHV activity would be prerequisite to any pedestrian use of the Double Crater area. However, because few archeological sites are known to be present in this area, the effect of this change on archeological resources would be minor.

Development of a new trail between Bonito Campground and the Lava Flow Trail would impact one archeological site. The impact would be moderately adverse. The impact to this site would be partially mitigated through a program of photographic documentation.

The major boundary adjustments proposed in Alternative 3 would have a long-term, major, beneficial effect on any cultural resources located within proposed park additions by protecting them from OHV damage and other "multiple use" impacts resulting from mining, camping, and timber cutting activities. These benefits would be offset somewhat by increased visitation impacts to some sites in the expanded monument. However, the sites would receive increased protection, and impacts from OHV activities would be eliminated, resulting in overall major beneficial effects to the long-term integrity of archeological resources.

## CUMULATIVE EFFECTS

Past management strategies have allowed visitor access to virtually all areas of the monument. Recently, the backcountry areas of Sunset Crater Volcano National Monument have been closed because of concerns over impacts to geologic features, sensitive habitats, and traditional cultural sites. Implementation of Alternative 3 would continue this policy within most of the existing monument area, although there would be an expansion of the lava flow Extended Learning Zone and the addition of a new hiking trail between Bonito Campground and Lava Flow Trail.

Outside of the current monument boundaries, however, the development of a new visitor center, trails, and parking area in the vicinity of Bonito Park would have a major adverse effect on archeological resources in that area, both as a result of the construction activities themselves and from the associated visitor uses that would follow. Although individual impacts from visitation would be mostly minor and incremental, the cumulative effects of this alternative on the long-term integrity of these archeological resources would be moderately adverse, because a significant number of sites would gradually be degraded by incidental artifact collection, destabilization of walls, trampling of cultural deposits, and social trailing. Stabilization of these sites in order to withstand continuing visitor impacts would eventually be necessary.

On the other hand, elimination of a portion of the OHV area by including it within the monument will have a major, beneficial effect on archeological remains in that area, because of the elimination of OHV impacts such as compaction and erosion of soils, destruction of vegetation, and camping-related impacts. Cumulatively, the effects of Alternative 3 on long-term integrity of archeological resources would be moderately beneficial.

## CONCLUSION

Under Alternative 3, there would be major, long-term, adverse effects to the integrity of 12-15 archeological resources

located in proximity to the new visitor center and expanded campground. Relative to existing conditions, however, the cumulative effects of this alternative on the long-term integrity of a majority of archeological resources would be major and beneficial, because of the elimination of OHV impacts within the significantly expanded park boundaries, the increased NPS and USFS presence in the area, and the zoning of a large area of the expanded monument for long-term preservation purposes. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of park resources or values.

## Irreversible/Irretrievable Commitments of Resources

As described under Unavoidable Adverse Effects, the continuing use of existing visitor centers and trails would directly and indirectly affect archeological resources in the immediate vicinity. Archeological resources adjacent to or easily accessible from public areas would continue to be vulnerable to surface disturbance, inadvertent damage, and vandalism. Visitor use of campgrounds and picnic areas would moderately compact soils and would disturb surface artifacts. A loss of the surface archeological materials, alteration of artifact distribution, and a reduction of contextual evidence would result. Under the No-Action Alternative, impacts to archeological sites from inappropriate visitor activities (artifact collection, graffiti, etc.) would continue to be a problem, because many visitors would encounter park resources before receiving an orientation at the visitor center. Overall, the effects of the No-Action Alternative would be moderately adverse to the long-term integrity of the archeological resources. Because these are nonrenewable resources, this is an irreversible/irretrievable loss of these resources. However, the most heavily used front-country areas contain few known archeological sites, so adverse impacts would have minimal effects.

In comparison with existing conditions, Alternative 1 would have a major adverse effect on a relatively small but concentrated number of archeological resources located near the new visitor center and Extended Learning Zone. Although the exact number of archeological resources that would be affected by this alternative is unknown (because an intensive archeological inventory has not been completed and specific locations for new facilities have not been decided), a larger number of resources would be impacted under Alternative 1 than under existing conditions. The adverse impacts would be offset to some degree by the benefits of an increased USFS presence and increased opportunities to orient and educate visitors before they encounter sensitive resources. The net effect, however, would be moderately adverse for the long-term integrity of archeological resources.

Under Alternative 2, most impacts from visitation would be individually minor and incremental, but the cumulative result would be moderately adverse and could result in an irretrievable loss of these resources.

Under Alternative 3, there would be major long-term adverse effects to the integrity of 12-15 archeological resources close to the new visitor center and expanded

campground. This could be mitigated through data recovery, but the loss of some information could be irreversible.

## Loss in Long-Term Availability or Productivity of the Resource to Achieve Short-Term Gain

Although there would be short-term effects from construction activities on archeological resources, under all action alternatives, data recovery efforts would mean that there would be no long-term loss of site information. Under the No-Action Alternative, the continuation of inadequate monitoring of cultural resources, combined with long-term visitor use, would likely reduce the availability of cultural resources sites for future education, interpretation, and development.

## Unavoidable Adverse Effects

Under the No-Action Alternative, the continuing use of existing visitor centers and trails would directly and indirectly affect archeological resources in the immediate vicinity. Archeological resources adjacent to or easily accessible from public use areas would continue to be vulnerable to surface disturbance, inadvertent damage, and vandalism. Visitor use of campgrounds and picnic areas would moderately compact soils and would disturb surface artifacts. A loss of the surface archeological materials, alteration of artifact distribution, and a reduction of contextual evidence would result. Impacts to archeological sites from inappropriate visitor activities (artifact collection, graffiti, etc.) would continue to be a major long-term problem, because visitors would continue to enter most of the front country and some backcountry sites without receiving prior orientation at the visitor center. Overall, the effects of the No-Action Alternative would be moderately adverse to the long-term integrity of the archeological resources.

In comparison with existing conditions, Alternative 1 would have a major adverse effect on a relatively small but concentrated number of archeological resources located near the new visitor center and Extended Learning Zone. Although the exact number of archeological resources that would be affected by this alternative is unknown (because a complete archeological inventory has not been completed and specific locations for new facilities have not been decided), a larger number of resources would be impacted under Alternative 1 than under existing conditions. The adverse impacts would be offset to some degree by the benefits of an increased USFS presence and increased opportunities to orient and educate visitors before they encounter sensitive resources. The net effect, however, would be moderately adverse for the long-term integrity of archeological resources.

An unknown number of archeological sites would be impacted and/or destroyed as the result of constructing new facilities under Alternative 2, based on an incomplete inventory of archeological sites within and outside the current monument boundaries. Although precise numbers are unknown at this time, probably fewer sites would be impacted from construction under Alternative 2 than under Alternative 1, but more would be impacted relative to existing conditions. However, this is dependent on final siting of the new visitor center, roads, campground, and associated facilities. Closure of the road east of the Lava Flow Trail would not benefit archeological resources, because this road would be converted into a new walking trail, thereby resulting in increased pedestrian access to areas that currently receive very little visitation, owing to lack of pullouts along that section of the road. Likewise, any benefits

from closure of the current entrance road would be offset by the addition of trails around Bonito Park, which would encourage pedestrian uses of areas that currently receive relatively little visitation. Increased pedestrian use would likely result in more visitation impacts to resources in these areas (e.g., social trailing, illegal collection, inappropriate uses, etc.) and ultimately could result in increased compliance actions, stabilization, and need for mitigation. The areas around Bonito Park and along the western edge of the Bonito Lava Flow (on the lower portion of O'Leary Peak Road) are known to contain archeological sites, based on incomplete inventories of these areas. These sites would be subjected to increased impacts from visitation in the form of illegal artifact collection, soil compaction, social trailing and erosion, and inappropriate activities (digging, leaving New Age offerings, etc.). Most impacts from visitation would be individually minor and incremental, but the cumulative result would be moderately adverse.

Under Alternative 3, there would be major long-term adverse effects to the integrity of 12-15 archeological resources located in proximity to the new visitor center and expanded campground. These effects would be similar to those described for Alternative 1. Unlike Alternative 1, however, the adverse impacts to a relatively small number of sites would be offset by the added protection afforded the majority of sites located within the expanded monument boundaries.

## HISTORIC CHARACTER OF THE BUILT ENVIRONMENT

### Methodology

The National Historic Preservation Act requires agencies to take into account the effects of their actions on properties listed or eligible for listing in the National Register of Historic Places. The assessment of impacts to the cultural resources followed a three-step process: (1) determining the area of potential effect of the proposed actions; (2) identifying the cultural resources within the area of potential effect that are either listed in or eligible for listing in the National Register of Historic Places (see Affected Environment); and (3) assessing the extent and type of impacts the proposed action may have upon cultural resources. An impact on a cultural resource occurs if an action has the potential of altering in any way the characteristics that qualify the resource for inclusion in the National Register. If a proposed action diminishes the integrity of such characteristics, it is considered to have an adverse effect. Impacts that may occur later than, or at a distance from the location of a proposed action are also potential impacts of the action, and are considered to be indirect impacts.

For the purposes of this analysis the following will be used to describe impacts to the built environment and cultural landscapes at Sunset Crater Volcano National Monument:

*Negligible:* The impact is at the lowest levels of detection, barely perceptible and not measurable.

*Minor:* The impact is slight, but detectable. The impact does not affect the character defining features of a National Register of Historic Places eligible or listed historic structure, cultural landscape, or historic district.

*Moderate:* The impact is readily apparent. For a National Register eligible or listed historic structure, cultural landscape, or historic district, the impact changes a character-defining feature(s) of the resource but does not diminish the integrity of the resource to the extent that its National Register eligibility is jeopardized.

*Major:* The impact is severe or of exceptional benefit. For a National Register eligible or listed historic structure, cultural landscape, or historic district, the impact changes a character defining features(s) of the resource, diminishing the integrity of the resource to the extent that it is no longer eligible or listed in the National Register.

## Effects Of The No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

Installation of new waysides exhibits would have a minor visual impact on the cultural landscape. To mitigate the impact, signs would be constructed of material that is compatible with the historic setting and the natural surroundings. New museum exhibits would be constructed, but would not alter the distinguishing characteristics of the Mission 66 visitor center.

The expansion of Bonito Campground would have long-term moderate adverse impact on the prehistoric landscape. To partially mitigate the impacts (both visual and physical), the campground would be designed and sited to avoid landscape features and constructed with materials compatible with the natural and cultural setting.

Both a curatorial facility and a maintenance/resource management facility would be constructed at the Sunset Crater Volcano administrative area. The curatorial facility would be constructed in view of the existing visitor center and in an area that has been tested for archeological resources; no archeological resources were found. There would be long-term moderate adverse visual impacts to the prehistoric landscape.

Construction of the curatorial facility would not change, obscure, or destroy the Mission 66 landscape's significant spatial organization, materials, and features. To partially mitigate visual impacts, the curatorial facility would be designed and sited to reduce visual impacts and would be constructed of materials that are compatible with the natural surrounding and historic setting. To prevent the appearance of a reconstruction, the curatorial facility would be compatible, yet differentiated from, the landscape's historic character. Construction of the curatorial facility would have a long-term moderate adverse impact on the Mission 66 designed landscape.

The maintenance/resource management facility would be constructed in an area that has not been previously disturbed. Archeological resources are known to be located in the area, but may be avoided through design and siting of the facility. Because the prehistoric and historic landscapes have not formally evaluated it is difficult to assess the impact of the proposed maintenance/resource management facility. The facility would be constructed away from the Mission 66 designed landscape, but would have a long-term moderate adverse impact on the prehistoric landscape. To partially mitigate visual impacts, the maintenance/resource management facility would be designed and sited to reduce visual impacts and would be constructed of materials that are compatible with the natural surroundings and historic setting.

Facilities would be upgraded to accommodate and meet current accessibility standards. Making historic buildings and structures accessible to the mobility impaired could result in the loss of historic fabric or the introduction of new visual and nonhistoric elements, resulting in long-term minor adverse impacts. For example, the doorways of buildings could require widening and ramps, or wheelchair lifts could be added to the exterior of buildings. The park

would strive, however, to develop design solutions to accessibility requirements that minimize impacts to cultural resources.

The Mission 66 visitor center would remain, as would the Mission 66 apartment complex and maintenance facility. Because few modifications have been made to the Mission 66 designed landscape and facilities, the integrity of the designed landscape remains intact (however, this landscape has yet to be formally evaluated).

## CUMULATIVE EFFECTS

The park boundaries represent the geographic area in which cumulative impacts that affect the built environment and cultural landscapes at Sunset Crater Volcano National Monument were identified.

During the Mission 66 program a visitor center, apartment complex, maintenance facility, trails and parking lots were constructed. The entrance road to the monument was formalized, along with parking lots at the Lenox Crater Trail and the base of Sunset Crater Volcano. A few modifications have occurred to the Mission 66 designed landscape, including relocation of the parking lot from the base of the volcano to the west approximately 1/4 mile to the present Lava Flow Trail, and the addition of three trailer houses and one house (adjacent to the apartment complex) in the 1980s. The curatorial and maintenance facilities would be constructed in the administrative area near the visitor center and apartment complex. Because the primary, original design elements of the Mission 66 designed landscape are still intact, the landscape is considered to be potentially National Register eligible (however, this landscape has yet to be formally evaluated). Any future alterations of the designed landscape could bring the integrity of the landscape as a whole (especially design) down to the level where National Register eligibility would be questioned.

Few alterations have been made to the overall monument landscape since the design and construction associated with the Mission 66 era landscape. Because few changes have occurred to the prehistoric landscape throughout the monument, the landscape is considered potentially National Register eligible (however, this landscape has yet to be formally evaluated). Any future alterations of the prehistoric landscape, however, could bring the integrity of the landscape as a whole down to the level where National Register eligibility would be questioned.

## CONCLUSION

This alternative would have long-term moderate adverse impact on the prehistoric and Mission 66 landscapes. There would be an overall reduction of historic integrity of both landscapes, but not to the extent that they would no longer be eligible to be listed in the National Register of Historic Places. Any future alteration to the prehistoric and Mission 66 landscapes, in conjunction with the moderate, adverse cumulative impacts of previous changes and this alternative could result in moderate, adverse cumulative impacts to both designed landscapes.

Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

The boundaries of the monument would be expanded to accommodate administrative adjustments. The proposed boundary expansion would include prehistoric landscapes that have been dissected by artificial boundaries. The inclusion of these resources in the park would be a major benefit to their long-term and scientific integrity by including them in lands being proactively managed for preservation purposes.

The effects of installing new wayside exhibits would be the same as those identified in the No-Action Alternative.

Effects of expanding the Bonito Campground would be the same as those identified for the No-Action Alternative.

Effects of constructing the curatorial facility and the maintenance/resource management facility would be the same as those identified for the No-Action Alternative.

Effects of upgrading facilities to accommodate accessibility would be the same as those identified for the No-Action Alternative.

Construction of a new visitor center would have long-term moderate adverse visual impact on the surrounding prehistoric cultural landscape. To partially mitigate visual impacts, the visitor center would be situated to reduce visual impacts and would be constructed of materials that are compatible with the natural surrounding and historic setting.

Adaptively rehabilitating the existing visitor center building would neither significantly alter the present form or character of the structure's exterior nor adversely affect any significant character-defining feature(s) of the structure's interior. If any materials were removed during rehabilitation, they would be evaluated to determine their value to the parks' museum collections and/or for their comparative use in future preservation work at the site. All rehabilitation work would be undertaken in accordance with the Secretary of the Interior's Standards for Treatment of Historic Properties (1995). Converting the visitor center to accommodate educational activities and offices would have a long-term minor to moderate impact on the building.

Construction of a new trail between Bonito Campground and the Lava Flow Trail would have long-term moderate visual impact on the prehistoric cultural landscape. The impacts could be mitigated by constructing the trail to avoid character-defining landscape features and building it with materials compatible with the historic setting and natural surrounding.

### CUMULATIVE EFFECTS

Various alterations to the prehistoric landscape, primarily by the Mission 66 designed landscape, have occurred over the years. Few changes have altered the Mission 66 landscape. The Mission 66 landscape included a road, trails, parking lots, visitor center, maintenance building, and apartment complex. In the 1980s the Lava Flow Trail parking lot was removed from the base of Sunset Crater Volcano and constructed approximately 1/4 mile west. Because the primary design elements of the prehistoric landscape remain intact, the landscape is considered to be potentially National Register eligible (however, this landscape has not been formally evaluated). Any future alterations of the designed landscape could bring the integrity of the landscape as a whole down to the level where National Register eligibility would be questioned.

Minor alterations have occurred to the Mission 66 designed landscape;

modifications include trail upgrades to meet standards of accessibility, relocation of the Lava Flow Trail parking lot, and the addition of trailer houses adjacent to the apartment complex. Because the primary original design elements of the Mission 66 designed landscape are still intact, the landscape is considered to be potentially National Register eligible (however, this landscape has yet to be evaluated). Any future alterations of the designed landscape, in conjunction with the moderate, adverse, cumulative impacts of both past changes and this alternative, would bring the integrity of the landscape as a whole (especially design) down to the level where it is no longer National Register eligible.

### CONCLUSION

This alternative would have long-term moderate adverse impacts on the prehistoric and Mission 66 landscapes. There would be an overall reduction of integrity in both landscapes, but not to the extent that they would no longer be eligible to be listed in the National Register of Historic Places.

Any future alterations to the prehistoric and Mission 66 landscapes, in conjunction with the moderate adverse, cumulative impacts of previous changes and this alternative could result in moderate, adverse cumulative impacts to the prehistoric and Mission 66 designed landscapes.

Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

The proposed boundary expansion would include prehistoric landscapes that have been dissected by artificial boundaries. The inclusion of these resources in the park would be a major benefit to their long-term and scientific integrity by including them in lands being proactively managed for preservation purposes.

Effects of installing new wayside exhibits would be the same as in No-Action Alternative.

Removing Bonito Campground would have long-term moderate benefit to the prehistoric landscape. The campground area would be rehabilitated and revegetated to restore the natural spacing, abundance, and diversity of native plant species. Following rehabilitation and revegetation, the area would more closely resemble its historic appearance.

Closing FR545 at the junction with US89 and at the base of Sunset Crater Volcano would alter the historic Mission 66 circulation pattern, resulting in a long-term moderate adverse impact to the Mission 66 drive-through experience.

The Mission 66 designed visitor center, apartment complex and maintenance facility would be removed. Removing the Mission 66 development would result in long-term major adverse impacts to the historic Mission 66 experience and designed landscape. Removing the facilities would eliminate contributing elements to the landscape, and would alter spatial organization and historic circulation patterns of the Mission 66 designed landscape.

The new curatorial facility and maintenance/resource management facility would be removed. Removal of these facilities in conjunction with the Mission 66 development and rehabilitation of the administrative site to a natural setting would be a long-term major benefit to the prehistoric landscape. Following rehabilitation and revegetation, the area would more closely resemble its prehistoric appearance.

Construction of a new visitor center would have long-term moderate visual impact on the surrounding prehistoric cultural landscape. To partially mitigate visual impacts, the visitor center would be designed and sited to reduce visual impacts and would be constructed of materials that are compatible with the natural surrounding and historic setting.

Construction of a new trail around Bonito Park would have long-term moderate visual impact on the prehistoric cultural landscape. The impacts could be mitigated by constructing the trail to avoid character defining landscape features and built with materials compatible with the historic setting and natural surrounding.

## CUMULATIVE EFFECTS

Minor alterations have occurred to the Mission 66 designed landscape; modifications include trail upgrades to meet standards of accessibility, relocation of the Lava Flow Trail parking lot, and the addition of trailer houses adjacent to the apartment complex. Because the primary original design elements of the Mission 66 designed landscape are still intact, the landscape is considered to be potentially National Register eligible (however, this landscape has yet to be evaluated). Any future alterations of the designed landscape, in conjunction with the adverse, cumulative impacts of both past changes and this alternative, would bring the integrity of the landscape as a whole (especially design) down to the level where it is no longer National Register eligible. The long-term major adverse impacts, as well as, any potential impacts of future actions would result in major, adverse cumulative impacts to the Mission 66 designed landscape.

Because few alterations have occurred to the prehistoric landscape of the monument, the landscape is considered potentially National Register eligible (however, this landscape has yet to be formally evaluated). Removing the Mission 66 designed landscape and the more recent development (trailer houses, curatorial facility, maintenance/resource management facility and campground) would be a long-term major benefit to the prehistoric landscape. Rehabilitating and revegetating the former Mission 66 landscape would return the area to more of a semblance of its historic appearance. Any future alterations of the prehistoric landscape, in conjunction with the adverse, cumulative impacts of both past changes and this alternative (such as the construction of a trail around Bonito Park), would bring the integrity of the landscape as a whole down to the level where it is no longer National Register eligible. The long-term moderate adverse impacts, as well as any potential impacts of future actions would result in moderate, adverse cumulative impacts to the prehistoric landscape.

## CONCLUSION

This alternative would have long-term major adverse impacts to the Mission 66 designed landscape, and long-term major benefit and long-term moderate adverse impact to the prehistoric landscape. There would be an overall reduction of historic integrity in the Mission 66 landscape, but not to the extent that it would no longer be eligible to be listed in the National Register of Historic Places. Any future alterations of the Mission 66 landscape, in conjunction with the adverse, cumulative impacts of previous changes and this

alternative, could result in major, adverse cumulative impacts to the Mission 66 landscapes.

Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

The proposed boundary expansion would include prehistoric landscapes that have been dissected by artificial boundaries. The inclusion of these resources in the park would be a major benefit to their long-term and scientific integrity by including them in lands being proactively managed for preservation purposes.

Effects of installing new wayside exhibits would be the same as described under the No-Action Alternative.

Effects of expanding the Bonito Campground would be the same as those described for in No-Action Alternative.

Effects of constructing the museum storage facility and the maintenance/resource facility would be the same as those described for the No-Action Alternative.

Effects of upgrading facilities to accommodate accessibility would be the same as under the No-Action Alternative.

Developing new pullouts along FR545 at Kana-A lava flow would have long-term moderate visual impacts on the historic Mission 66 road, and would have long-term moderate adverse impacts on the prehistoric cultural landscape by damaging or destroying landscape features (such as field alignments). However, the road would be designed to avoid as many landscape features as possible and would be constructed of materials that are compatible with the natural surrounding and historic setting.

Construction of a new visitor center near the junction of US89 and FR545 would have a long-term moderate adverse visual impact on the surrounding prehistoric cultural landscape. To partially mitigate visual impacts, the visitor center would be designed and sited to reduce visual impacts and would be constructed of materials that are compatible with the natural surrounding and historic setting.

Construction of the trail between the Bonito Campground and the Lava Flow Trail would have long-term moderate visual impacts on the prehistoric cultural landscape. The impacts could be mitigated by constructing the trail to avoid landscape features and built with materials compatible with the historic setting and natural surroundings.

Rehabilitating the OHV area would have a long-term major visual benefit to the prehistoric and Mission 66 landscapes. The OHV area would be rehabilitated and revegetated to restore the natural spacing, abundance, and diversity of native plant species. Following rehabilitation and revegetation, the area would more closely resemble its historic appearance.

### CUMULATIVE EFFECTS

Few changes have occurred to the Mission 66 designed landscape; modifications include trail upgrades to meet standards of accessibility, relocation of the Lava Flow Trail parking lot, and the addition of

trailer houses adjacent to the apartment complex. Because the primary original design elements of the Mission 66 designed landscape are still intact, the landscape is considered to be potentially National Register eligible (however, this landscape has yet to be evaluated). Any future alterations of the designed landscape, in conjunction with the adverse, cumulative impacts of both past changes and this alternative, would bring the integrity of the landscape as a whole (especially design) down to the level where it is no longer National Register eligible. The long-term major adverse impacts and potential impacts of future actions could result in major, adverse cumulative impacts to the Mission 66 designed landscape.

Because few alterations have occurred to the prehistoric landscape of the monument (primarily from Mission 66 development), the landscape is considered potentially National Register eligible (however, this landscape has yet to be formally evaluated). Any future alterations of the prehistoric landscape beyond the scope of what is proposed in this alternative could bring the integrity of the landscape as a whole down to a level where National Register eligibility would be questioned. Rehabilitating the OHV area would be a long-term major benefit to the prehistoric landscape.

### CONCLUSION

This alternative would have long-term moderate adverse impacts and long-term major benefits on the prehistoric landscape, and would have long-term moderate adverse impacts on the Mission 66 landscapes. There would be an overall reduction of historic integrity in the landscapes, but not to the extent that they would no longer be eligible to be listed in the National Register of Historic Places. Any future alterations of the landscapes, in conjunction with the adverse cumulative impacts of previous changes and this alternative, could result in major, adverse cumulative impacts to the prehistoric and Mission 66 landscapes.

Because there would be no major adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Irreversible/Irretrievable Commitments Of Resources

There would be an irreversible/irretrievable commitment of resources under Alternative 2. All Mission 66 facilities would be removed from the park.

## Loss In Long-Term Availability Or Productivity Of The Resource To Achieve Short-Term Gain

The continuing lack of a cultural landscape inventory would lead to long-term loss of the integrity of these resources.

## Unavoidable Adverse Impacts

The No-Action Alternative would have long-term moderate adverse impact on the prehistoric and Mission 66 landscapes from the construction of the curatorial facility and the maintenance/resource management facility. There would be long-term moderate adverse visual impact from the installation of new wayside exhibits. Upgrading facilities to meet accessibility standards would have a long-term minor impact on Mission 66 facilities.

Alternative 1 would have long-term moderate adverse impacts on the

prehistoric landscape from and Mission 66 landscapes from the construction of the curatorial facility and the maintenance/resource management facility. Construction of the new visitor center at the junction of US89 and FR545 would have a long-term moderate adverse impact on the prehistoric cultural landscape.

Alternative 2 would have long-term major adverse impacts to the Mission 66 designed landscape. The Mission 66 development (visitor center, maintenance building, and apartment complex) would be removed from the park. Construction of a new visitor center on FR776 would have a long-term moderate visual impact on the prehistoric cultural landscape.

Alternative 3 would have long-term moderate adverse impacts on the prehistoric and Mission 66 landscapes from the construction of a curatorial facility and maintenance/resource management facility. There would be a long-term moderate visual impact to the prehistoric cultural landscape from the construction of a new visitor center at the junction of FR545 and US 89.

## LONG-TERM INTEGRITY OF ETHNOGRAPHIC RESOURCES

### Methodology

Ethnographic resources are those cultural and natural resources to which park-associated communities ascribe cultural significance and that continue to play a role in a community's identity and way of life. Only members of the communities to whom the resources hold cultural value can determine ethnographic resources and potential impacts to them. After initial consultation meetings with representatives of several American Indian tribes having possible traditional associations with park lands and resources, the tribes determined that the Hopi, Zuni, and Navajo Tribes have the closest association with resources that could be affected by various management alternatives. The National Park Service entered into small contracts with each of these tribes to visit the parks and identify culturally significant resources that might be affected by various management alternatives. The Hopi and Navajo Tribes and the Pueblo of Zuni submitted information on ethnographic resources concerns to the National Park Service and participated in the GMP planning process during all stages of development. Because the ethnographic resources identified by the tribes are important in each tribe's history, and because the resources are interconnected with places and resources located throughout customary tribal lands, any impacts to ethnographic resources would be regional in scope. In addition, because ethnographic resources are tied to communities' cultural identities, effects to the resources also have an effect on the communities to which they are tied in perpetuity. Therefore, the duration of impacts to ethnographic resources is forever. Although the tribes themselves did not identify the intensity of potential impacts to ethnographic resources, the National Park Service defines intensity as follows:

*Negligible:* The impact is at the lower levels of detection.

*Minor:* The impact is slight, but detectable.

*Moderate:* The impact is readily apparent.

Major: The impact is severely adverse or exceptionally beneficial.

Any adverse impacts to ethnographic resources would be readily apparent to the tribes to whom the resources hold cultural significance, and in most cases, because impacts to these resources affect cultural identity and ways of life, most adverse impacts would be considered severely adverse. Therefore, most impacts to ethnographic resources, whether

beneficial or adverse, would be moderate to major.

## Effects of the No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

Under the No-Action Alternative, conditions would remain as they are at the present time, with the exception of the actions common to all alternatives. Associated tribes regard the entire landscape around Sunset Crater as sacred, so any existing impacts that are not addressed by actions common to all alternatives will continue to constitute moderate to major adverse impacts. Among these impacts may be the effects of OHV use on the portions of the Sunset Crater landscape beyond park boundaries and related impacts to park lands and resources. An additional adverse impact might be the one-mile Lenox Crater Trail, which provides climbing opportunities on a cinder cone, all of which have been identified as sacred places to associated tribes. Actions common to all alternatives that will alleviate adverse impacts of some existing conditions include:

- Enhanced partnerships and boundary expansion, which will include increased coordination between NPS and USFS, monitoring the effects of various land uses, the potential for management changes to control adverse effects, and the potential for tribal input into future management planning;
- New interpretive exhibits, which will also provide the opportunity for tribal involvement in the development of interpretive messages, which may include increased educational emphasis on the cultural significance of the Sunset Crater landscape to associated tribes;
- Closure of the road to O'Leary Peak, which will help protect the cultural values of this sensitive ethnographic resource; and
- Closure of the backcountry, which will also help protect ethnographic resources from the effects of unguided visitation

### CUMULATIVE EFFECTS

Prior to the establishment of monument boundaries, the lands encompassed by what is now Sunset Crater Volcano National Monument were part of the customary use areas or traditional lands of several American Indian tribes. These lands include medicinal plants, prayer offering places, homes of deities, pilgrimage routes, and other places integral to tribal cultural identity and continuity.

With the establishment of federal land management boundaries, including Sunset Crater Volcano National Monument, the construction of fences, and the implementation of land use regulations, traditional tribal uses and treatment of resources were precluded over the years. Increased visitation interfered with ceremonial activities at certain places within monument lands, and closure of some areas many have inhibited tribal access to certain culturally significant areas. Interpretive messages were developed that did not include tribal knowledge of the natural and cultural history of the park and its resources.

The cumulative effects of monument operations on ethnographic resources and the tribes associated with them in the past have been major and long term. Under the No-Action Alternative, some adverse impacts to ethnographic resources would continue into the future, such as the effects of OHV uses on the overall ethnographic landscape and visitor access to Lenox Crater. In general, existing conditions would be improved by the actions common to all alternatives, specifically those beneficial cumulative impacts resulting from improved

partnerships with neighboring land managers, improved interpretive exhibits, and the closure of the O'Leary Peak Road and the backcountry (with provision of tribal access to sensitive ethnographic resources).

### CONCLUSION

The No-Action Alternative would continue to have some moderate to major adverse impacts to some ethnographic resources, but the actions common to all alternatives would improve many existing conditions and have a moderate to major beneficial effect on some ethnographic resources and the cultural values that give them significance.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

Overall, this alternative would benefit ethnographic resources by increasing partnerships with the USFS, associated tribes and educational institutions to improve interpretation and consistent management of sites and features outside the park that are primary to the park's purpose. Since the park has been identified by associated tribes as part of a larger ethnographic landscape, any management alternative that improves the larger geographic context of which the park is a part would have a beneficial impact on culturally sensitive resources. Boundary adjustments may be beneficial to ethnographic resources if the adjustments include increased protection of the ethnographic landscape or specific ethnographic resources identified for this GMP. Adverse effects to the overall ethnographic landscape would continue to the extent that current OHV uses continue, as would adverse effects to an ethnographic resource with continued visitor access to Lenox Crater. Effects of the actions common to all alternatives would be the same as described under the No-Action Alternative.

### CUMULATIVE EFFECTS

Overall, the cumulative effects of this alternative would be beneficial to ethnographic resources due to increased partnerships with adjacent land management agencies and associated tribes. These partnerships would help protect ethnographic resources by improved interpretation and education for park visitors about the cultural values associated with park lands and resources, and by tribal participation in developing consistent management regimes for the ethnographic landscape of which the monument is a part. Adverse impacts to ethnographic resources would continue as long as OHV uses impact the larger landscape in general, and continued access to Lenox Crater may have adverse cumulative impacts on that ethnographic resource. Park boundary adjustments and closure of areas that are not zoned for administrative and visitor use would have cumulative beneficial effects by protecting ethnographic resources from the effects of visitation

### CONCLUSION

With the development of agreements among the NPS and associated tribes for continued tribal involvement in park management and interpretive planning, this alternative would have moderate to

major long-term beneficial impacts to ethnographic resources. The exceptions to these beneficial effects are the continued moderate to major adverse effects of OHV uses on the ethnographic landscape and possibly visitor access to Lenox Crater.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

This alternative would provide increased protection of ethnographic resources within the present monument boundaries by removing much of the current development, thereby restoring some of the larger ethnographic landscape that gives individual ethnographic resources cultural significance. However, the development of new facilities south of Sunset Crater may have an adverse effect on aspects of the ethnographic landscape or on individual ethnographic resources that have not yet been identified or evaluated. The increased emphasis on connecting the stories of Sunset Crater and Wupatki, as well as development of updated interpretive media would more accurately reflect tribal knowledge of the natural and cultural histories of the broader ethnographic landscape, thus having a beneficial effect on ethnographic resources through public education.

The effects on ethnographic resources of developing a new entrance road and visitor facilities south of Sunset Crater would need to be more thoroughly evaluated. Having the current entrance road, FR545, dead-end at Bonito Park, which would be included in park boundaries, could encourage more visitor use of Bonito Park. Increased visitor use of Bonito Park could conflict with ongoing tribal cultural uses, thus having an adverse effect on this ethnographic resource. Similarly, the effects of development of a hiking trail at the base of Sunset Crater Volcano and additional learning activities associated with the Lenox Crater Trail would need to be evaluated in conjunction with associated tribes. Associated tribes regard Sunset Crater Volcano as a particularly significant ethnographic resource along with all volcanic cones comprising the larger ethnographic landscape. The effects of the actions common to all alternatives would be the same as those described for the No-Action Alternative.

### CUMULATIVE EFFECTS

Some aspects of this alternative will have long-term beneficial cumulative effects on ethnographic resources, including the restoration of the ethnographic landscape within current monument boundaries and the development of updated interpretive media incorporating tribal perspectives of the ethnographic context of park resources. The cumulative effects on ethnographic resources and landscapes due to development of new access routes into the monument and new visitor facilities south of current monument boundaries would require further analysis in conjunction with associated tribes. Long-term adverse effects to Bonito Park, Sunset Crater Volcano, and Lenox Crater could result from development of extended learning activities and increased visitor use of these ethnographic resources. These effects could be

minimized by the inclusion of tribal participation in long-range management and interpretive planning.

### CONCLUSION

This alternative includes actions that will have both beneficial and adverse effects on ethnographic resources. The effects of some proposed actions will need additional evaluation in conjunction with associated tribes. The effects of the actions common to all alternatives would be the same as those described under the No-Action Alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

Overall, this alternative would have beneficial impacts to ethnographic resources due to the expansion of park boundaries to include more of the features of the regional ethnographic landscape of cultural significance to associated tribes. The removal of OHV activities from the expanded park boundaries would have a particularly beneficial effect on the ethnographic landscape. Enhanced management partnerships with the USFS would also benefit culturally sensitive resources, as would the development of new educational programs, provided that interpretive planning incorporates tribal input. Extended learning opportunities in the Lenox Crater and particularly Bonito Park vicinities could have moderate to major adverse effects on these ethnographic resources and any such planning would require extensive tribal involvement. Effects of the actions common to all alternatives would be the same as those described in the No-Action Alternative.

### CUMULATIVE EFFECTS

In general, this alternative would have moderate to major long-term beneficial effects to ethnographic resources by protecting and restoring more of the ethnographic landscape context of culturally significant resources within park boundaries. Beneficial effects would also result from the inclusion of associated tribes in the long-term planning of educational programs and activities that could include increased emphasis on the cultural significance of ethnographic resources and their broader landscape context. Moderate to major adverse effects to Lenox Crater and especially Bonito Park could result from the development of increased visitor access to these ethnographic resources, but these effects could be minimized with appropriate tribal input into long-range management planning.

### CONCLUSION

This alternative includes actions that will have mainly beneficial and some adverse effects on ethnographic resources and landscapes. The effects of some proposed actions will need additional evaluation in conjunction with associated tribes. The effects of the actions common to all alternatives would be the same as described in the No-Action Alternative.

Because there would be no major adverse impacts to resources whose conservation is

(1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Irreversible/Irretrievable Commitments of Resources

There would be no irreversible/irretrievable commitments of resources.

## Loss in Long-Term Availability or Productivity of the Resource to Achieve Short-Term Gain

There would be no short-term gains resulting in long-term losses.

## Unavoidable Adverse Impacts

Under the No-Action Alternative, existing adverse effects to ethnographic resource would continue. Associated tribes regard the entire landscape around Sunset Crater Volcano as sacred. Existing impacts include the present development and visitor facilities, OHV uses, visitor access to the tops of craters, and intrusion on traditional uses of culturally significant places, such as Bonito Park. Under all action alternatives, these adverse impacts would be reduced through improved interpretation and consistent management of features.

# LONG-TERM INTEGRITY OF NATURAL SYSTEMS AND PROCESSES

## Methodology

All available information on known natural resources was compiled. Where possible, map locations of sensitive resources were compared with locations of proposed developments and modifications of existing facilities. Predictions about short- and long-term site impacts were based on previous studies of visitor impacts to natural resources and recent monitoring data from the Flagstaff Area National Monuments. Sociological studies comparing the deterrent effects of signs versus ranger presence on sites were also considered in this analysis. Intensity of effects are articulated in the effects analysis as follows:

*Negligible:* An action that would affect very few individuals of species populations, or affect the existing physical environment within Sunset Crater Volcano National Monument. The change would be so small or localized that it would have no measurable or perceptible consequence to the populations or natural system function.

*Minor:* An action that would affect a relatively small number of individuals of species populations, or affect the existing physical environment within Sunset Crater Volcano National Monument. The change would require considerable scientific effort to measure, be limited to relatively few individuals of the populations, be very localized in area, and have barely perceptible consequences to the populations or natural system function.

*Moderate:* An action that would cause measurable affects on: (1) a relatively moderate number of individuals within a species population, (2) the existing dynamics between multiple species (e.g.,

predator-prey, herbivore-forage, vegetation structure-wildlife breeding habitat), (3) a relatively large habitat area or important habitat attributes, or (4) a large area of the natural physical environment within Sunset Crater Volcano National Monument. A species population, plant and animal communities, habitats, or natural system function might deviate from normal levels under existing conditions, but all species would remain indefinitely viable within the monument.

*Major:* An action that would have drastic consequences for species population numbers, dynamics between multiple species, habitat area or important habitat attributes, or the existing physical environment within Sunset Crater Volcano National Monument. The change would be readily apparent throughout the monument area. A species population, plant and animal communities, habitats, or natural system function would be permanently altered from normal levels under existing conditions, and species would likely be extirpated within the monument.

## Effects of the No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

Much of the current development associated with the monument's administration and maintenance is outside the monument's formal boundary. This includes the visitor center, housing, and the maintenance complex, which are on U.S. Forest Service lands. A USFS campground is also located just adjacent to the monument's boundary. Approximately 130 acres of USFS lands is currently impacted by visitor use and support infrastructure. These developed areas cause a minor adverse long-term impact by alteration of wildlife habitat and movement and changes to vegetation. Bonito Campground is currently being expanded to provide group camping, a day-use area for educational group gatherings and an upgraded amphitheater for interpretive programs. Short-term minor impacts to natural systems and processes will result from clearing trees and vegetation for the expanded camping and day-use areas. Long-term minor impacts will occur from increased visitor use in the area. Trampling of plants, soil compaction and disturbance of wildlife could increase with this expansion.

The Cinder Hills OHV Area, approximately 13,500 acres, lies to the southeast of the monument. Much of this area is visible from the Cinder Hills Overlook, which is within monument boundaries, creating both a visual and aural intrusion. Trespass of off-highway vehicles into the monument causes damage to vegetation and increases disruption of the cinder structure, which inhibits establishment of new plants. Vegetation succession and wildlife movement experience a minor to moderate adverse impact because of this activity.

A range of impacts is associated with the existing road system and motor vehicle access. FR545 is used by everyone who tours the park. Local residents use the road year-round at any time of the day or night. Motor noise from passing vehicles would frequently disturb wildlife. The road bisects the park and creates a barrier to the movement of many small mammals and reptiles and also creates a hazard for larger mammals, including antelope and deer. Visitor and local traffic contribute to the overall numbers of vehicles traveling through the monument, which have a moderate adverse impact on the natural quiet of the monument. The road also serves as a center of spread for a variety of invasive, nonnative plant species, including mullein, melilotus, and toadflax, which are introduced via fill material used in maintaining road shoulders. These species

thrive in disturbed areas and in time could spread away from the road and displace native vegetation, changing vegetation composition. This would constitute a minor, long-term, adverse impact.

The construction of new curatorial and maintenance/resource management facilities in the administrative area of Sunset Crater Volcano NM will disturb approximately 48,000 square feet (8,000 sq. ft. by the curatorial facility, 40,000 sq. ft. by the maintenance/resource management facility) of ponderosa pine forest. Planning and construction of these facilities will be accomplished so as to minimize the impact, but an unknown number of ponderosa pines will have to be removed, as well as all understory vegetation within the footprint of the buildings and parking lots. This will cause a long-term minor adverse impact to natural systems and processes by removal of vegetation, alteration of wildlife habitat, and the long-term vegetation management required in a developed area.

The closure of the O'Leary Peak Road to all vehicles except for administrative use will have a negligible to minor beneficial impact to natural systems and processes by substantially reducing the amount of vehicle traffic on the road. Reduced vehicle traffic will slow down unnatural erosion due to road deterioration. This will also reduce the impacts related to road maintenance activities, such as the introduction and spread of nonnative plants and disturbance and compaction of areas adjacent to the road.

The heaviest visitor impacts to the current monument resources are concentrated in the Lava Flow Trail area (both sides of the park road) and the Lenox Crater Trail. Social trails develop frequently in the Lava Flow Trail area and further extend the impact of the main trail into other nearby areas. The trail leading up Lenox Crater is on a steep slope and causes unnecessary erosion of the cinder substrate. For the most part, these impacts occur in cinder substrate, but there have also been minor to moderate impacts to lava features in these areas as well. Impacts to geologic features will be discussed in a following section. Primarily the impacts are the result of concentrated use on a substrate that is prone to movement when compressed by foot traffic. In areas where cinders are very deep, moisture is not readily available to plants. Because very little organic material is present, cinder is a very difficult substrate for plants to become established on. Given the added disruption of foot traffic and the fact that foot traffic is not confined to just the established trails, relatively large expanses of cinder areas have been impacted, and plant succession has been halted. The NPS has attempted to obliterate trails as they are formed, by raking them out. This activity, when performed on a regular basis, constantly moves the soil surface around, adding to the difficulty of plant establishment. Adverse impacts are moderate and long term in these areas where use has been concentrated, although some of the impacts are being mitigated through the use of physical barriers and interpretive signing to keep visitors on the trails.

Sunset Crater Volcano itself has been closed to foot traffic since 1973, because the trails on the volcano had become deeply eroded, up to the depth of six feet, exposing pine tree roots and eliminating vegetation. Although the trails were rehabilitated, scars are still visible, and for the most part, vegetation has not been reestablished. The impact after nearly 30 years of closure is moderate. Within recent years, the rest of the backcountry (defined as all areas beyond designated roads, trails, or developed facilities) has been closed to unguided entry. Currently approximately 130 acres within the monument are disturbed by roads, trails, or developed facilities. This is less than 5%

of the monument's area and constitutes a minor, long-term adverse impact.

Some of the softer lava surfaces are also subject to increased erosion by foot traffic, but this topic will be the focus of the section called Long-Term Integrity of Geologic Resources.

### CUMULATIVE EFFECTS

The geographic area used in the consideration of cumulative impacts includes the western portion of the Little Colorado River watershed and is bounded in the south by the Mogollon Plateau and Clear Creek, the Little Colorado River and Painted Desert on the east, and the San Francisco Peaks and Coconino Plateau on the west.

The adjacent OHV area managed by the Forest Service has a moderate to major impact on vegetation. The most direct impact by off-highway travel occurs when vehicles drive over individual plants, ripping them out or crushing them. Constant ground disturbance by OHVs will impede plants from establishing on cinder surfaces. Trails created on steep slopes change runoff and erosion patterns, which also has a minor to moderate impact on vegetative processes.

Forest management activities of the lands surrounding Sunset Crater also pose threats to natural processes in the area. Hunting affects animal populations and sometimes leads to illegal poaching of park wildlife. These impacts would be minor to moderate and long term.

Growing development in the area south of the monument could greatly increase recreational pressures on the monument and surrounding lands and would also further disrupt wildlife corridors and displace raptors and other birds. This could also lead to an increase in local traffic on the road through the monument, which could have a minor to moderate impact on wildlife crossing the road as well as on the natural quiet.

### CONCLUSION

There would be no major impacts under the No-Action Alternative. Minor and moderate impacts are caused by the existing road through the monument and by visitor use in concentrated areas such as the Lava Flow Trail and the Lenox Crater Trail. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

Impacts under Alternative 1 resulting from expansion of Bonito Campground, continued use of FR545, construction of new curatorial, maintenance, and resource management facilities, the closure of the O'Leary Peak Road, and the continued use of the Lava Flow and Lenox Crater Trails would be the same as those described for the No-Action Alternative.

The construction of a new visitor center near the junction of FR545 and US89 would result in vegetation removal, the introduction and spread of nonnative plants, and long-term management of vegetation in a developed zone, which would constitute a minor impact to vegetation succession processes.

Conversion of the existing visitor center to an education center would not affect the long-term integrity of natural systems and processes directly, although there could be beneficial indirect impacts by improving NPS ability to provide in-depth education to the public on resource issues and resource protection.

Constructing a new trail from Bonito Campground to the Lenox Crater/Lava Flow Trail area would cause a minor impact to the area and associated natural resources, because it would be constructed adjacent to the existing road and in the area of an informal trail. Theses impacts would include increased soil compaction, introduction of nonnative plants, and destruction of native vegetation, although the trail would be planned and constructed to avoid destroying as much vegetation as possible.

The addition of new Extended Learning Zones near the new visitor center and in the Lenox Crater/Lava Flow Trail area would increase impacts to natural processes and systems in these areas. Trail development for self-guided activities could cause an increase in introduction and spread of nonnative plant species and soil compaction, as well as destruction of native vegetation. Cinder soil and vegetation succession processes would be further disturbed in a wider area. There would be a long-term minor adverse impact to natural systems and processes in these areas due to trail construction and visitor use impacts.

Under this alternative, approximately 1,500 acres would be added to the monument through minor boundary adjustments. These additional acres would increase Sunset Crater Volcano's area by nearly 50%, and nearly all of this area would be closed to visitor use. This would be a moderate beneficial impact to natural systems and processes, as it would protect the fragile cinder substrate from further disturbance, allowing soil formation and vegetation succession processes to continue in an unimpeded manner.

The formalization of a backcountry closure policy at Sunset Crater Volcano would have a moderate beneficial effect on preserving the long-term integrity of natural resources by eliminating impacts from visitation, including social trails, and disruption of vegetative processes as mentioned earlier. Less than 5% of the monument's land would be open and available for visitor use. The beneficial effects of closure would be dependent on adequate enforcement and proactive NPS management within the designated preservation zone.

## CUMULATIVE EFFECTS

The cumulative effects for Alternative 1 would be the same as those described for the No-Action Alternative.

## CONCLUSION

There would be no major impacts to the long-term integrity of natural systems of Sunset Crater Volcano National Monument under Alternative 1. Some minor and moderate impacts would be caused by the road through the monument, construction of the new visitor center, and some trail construction and visitor use impacts in the Extended Learning Zones. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

Impacts under Alternative 2 resulting from construction of new curatorial, maintenance, and resource management facilities, the closure of the O'Leary Peak Road, and the continued use of the Lava Flow and Lenox Crater Trails would be the same as described for the No-Action Alternative.

Entry to the monument would be completely altered under this alternative. FR545 from US89 to Bonito Park would be closed and rehabilitated, as would the section east of the Lava Flow Trail to the new eastern boundary. FR414 would be upgraded and paved and become the monument's entrance road. The park would be closed at night and gated at the new visitor center, which would be located south of the monument on FR776. Closure of the park at night and elimination of FR545 as a through road would probably have a minor beneficial impact to the long-term integrity of natural processes and systems. Traffic on portions of the road still remaining would be greatly reduced and occur only during daylight hours. This would substantially reduce disturbance of wildlife movement patterns and disturbance due to noise. After-hours access to the park would be limited, which would greatly deter illegal activities such as hiking on Sunset Crater or in any of the backcountry closure area, and OHV trespass

Both FR776 and FR414 would need to be upgraded and paved under this alternative. FR776 is currently a well-maintained gravel road, and activities involved in paving it would cause negligible to minor impacts to natural processes during actual construction and for the long term. FR414 is an unmaintained road in cinder substrate and would need considerable work. Widening and leveling of the road would necessitate removal of some ponderosa pines and understory vegetation along its length. This could also alter drainage patterns. Adverse impacts from this activity would be moderate and long term.

The construction of a new visitor center and associated facilities would disturb an unknown area of ponderosa pine forest. An unknown number of trees would need to be removed for the construction of these buildings, parking areas, and campground, altering wildlife habitat. This would have a long-term, minor impact on natural systems and processes in the immediate area. The relocation of the visitor center to a new park entrance would have a beneficial effect on preserving the long-term integrity of natural systems and processes by ensuring that most visitors are adequately informed about the significance and fragility of resources within the monument and are educated about means of minimizing impacts from visitation before they enter the park. On the other hand, greater distance between the new visitor center and prime park resources might have an adverse effect on the prevention of illegal activities that result in impacts to sensitive resources.

The existing visitor center, housing area, and maintenance facilities, and the USFS-managed Bonito Campground would be removed and the areas rehabilitated. This would return natural processes, vegetation, and wildlife habitat to an area that has been impacted for many years. Though the removal of buildings and facilities would cause short-term adverse impacts to the area from movement and activities of construction vehicles, the long-term impacts would be moderate and beneficial.

Under Alternative 2, FR545 west of Lava Flow Trail and north of Sunset Crater would be converted to a walking trail. Conversion of the road east of the Lava Flow Trail to a walking trail would be beneficial to the primary monument resource by removing the road from the shoulder of the volcano. Currently, the road alters the natural slope of the cinder cone, which affects the rate and manner of cinder movement down the slope. Converting the road to a trail would lessen the alteration of slope and allow a more natural cinder movement process. Also, impacts due to road maintenance would be reduced. However, there is some chance that visitors would wish to leave the trail to explore new areas of the monument and in the process create new trails, compact soils, and disturb native vegetation, a minor, long-term, adverse impact.

Placing a trail around Bonito Park would cause minor adverse impacts to the vegetation in the area by construction of the trail itself as well as by increasing visitor use. Initial construction of the trail would require removal of vegetation and compaction of soil. Trails can often serve as introduction routes for nonnative and invasive plant species, displacing native vegetation and disrupting the plant composition. Trails can also cause increased erosion and change drainage patterns. Planning and construction of the trail would proceed with both of these considerations in mind, and all possible actions would be taken to minimize these impacts. This trail would also cause moderate impacts to pronghorn antelope, which use Bonito Park as a fawning area, and are sensitive to human presence.

The Extended Learning Zone in this alternative would occupy a larger area, encompassing all of Lenox Crater and continuing past the Lava Flow Trail to the northwest of Sunset Crater. The same sort of impacts in this zone would occur as under Alternative 1, but they would be spread throughout a greater area.

Alternative 2 would involve significant expansion of current monument boundaries to include areas around Bonito Park, north of FR776, and minor additions on the east and north boundaries. This would add approximately 3,600 acres to the monument. Boundary adjustments would have a minor to moderate beneficial effect on any natural resources within the proposed park additions by proactively protecting them from OHV damage and other impacts from multiple uses. Also the lands north of FR776 would require some rehabilitation to mitigate effects of past OHV use. Rehabilitation of these areas would begin to restore more acreage to a near-natural state, which would have a moderate beneficial impact on natural resource systems within the monument.

Elimination of off-trail backcountry access throughout much of the monument would have a moderate beneficial impact on the long-term integrity of natural systems by restoring natural processes in areas that have been greatly impacted by OHV use and retaining near-pristine conditions in areas that have been closed. The beneficial effects of closure are dependent on adequate enforcement and proactive NPS management within the designated Resource Preservation Zone.

## CUMULATIVE EFFECTS

The cumulative effects for Alternative 2 would be the same as those described for the No-Action Alternative.

## CONCLUSION

There would be no major impacts to the long-term integrity of natural systems and processes at Sunset Crater Volcano National Monument under Alternative 2. Some minor to moderate impacts would occur with construction of new facilities and new trails, but these would be mostly

offset by removal and rehabilitation of buildings and road segments in other areas. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

Impacts from FR545 would be the same as those described under the No-Action Alternative, with the exception of impacts caused by the construction of added pullouts near the Kana-A lava flow. Construction of these pullouts would constitute a negligible to minor adverse impact by removing vegetation.

Impacts from expansion of Bonito Campground would be the same as described under the No-Action Alternative.

The impacts associated with construction of a new interagency visitor center near the junction of FR545 and US89 would be the same as those described under Alternative 1, as would impacts resulting from conversion of the existing visitor center to an education center.

The impacts associated with Extended Learning Zones near the visitor center and in the Lenox Crater/Lava Flow Trail would be the same as those described under Alternative 1.

Impacts associated with the trail from the campground to Lava Flow Trail area would be the same as described in Alternative 1. Development of a new loop trail that travels from the junction of FR545 and FR776 to Double Crater would cause minor to moderate long-term adverse impacts from disruption of soil formation and vegetation succession processes in areas where there has been no disturbance. However, the trail would be developed in proposed new lands of the monument formerly included in the Cinder Hills OHV Area. A trail through this area, where OHV use has been heavy, would constitute a considerable benefit.

Expanding the boundary to include approximately 4,500 acres of the current OHV area would have a major, long-term, beneficial affect on the integrity of natural systems. This would remove significant acreage from disturbances caused by off-highway vehicles, including crushing and pulling of plants by running over them with vehicles, repeated disturbances of the cinder structure, and disruptions to wildlife movement and plant succession. Under existing conditions, organic surface materials are constantly being removed by OHV activity, vegetation is being destroyed, and plant succession is halted in the areas of OHV use. Geological processes are also greatly degraded by this OHV activity. Expanding the boundary an additional 4,000 acres would also bring the Kana-A lava flow into the monument, along with other smaller areas south and north of the current boundary.

The addition of a Discovery Zone in the southwest corner of the expanded monument would cause some impacts due to visitor use, though at most this would involve development of primitive trails. This would be a significant benefit over current use of the area, which is part of

the Cinder Hills OHV Area. Dispersed hiking and primitive trail development could have a minor to moderate adverse impact on cinder soil formation and vegetation succession processes, though this impact would probably be offset by the removal of OHV use from a large portion of land within the proposed new boundary.

The elimination of backcountry access through implementation of a formal closure policy for the portion of Sunset Crater Volcano north of FR545 would have a minor beneficial effect on preserving the long-term scientific integrity of natural systems and processes by eliminating impacts from visitation. The beneficial effects of closure are dependent on adequate enforcement and proactive NPS management within the designated preservation zone.

### CUMULATIVE EFFECTS

The cumulative effects for Alternative 3 would be the same as those described for the No-Action Alternative, with the following exception:

The inclusion of part of the adjacent Cinder Hills OHV area, currently managed by the Forest Service, within monument boundaries would have a major beneficial effect on natural systems by removing off-highway travel from approximately 4,500 acres of the Cinder Hills area. This would allow plant succession to proceed and would remove vehicular and noise disturbance from a significant area of wildlife habitat.

The cumulative impacts of Alternative 3 to natural systems are largely beneficial, because it would increase habitat for vegetation and wildlife by removing OHV use and protecting large areas northeast and southeast of the monument. The development of additional trails and a new visitor center would have minor effects on vegetation and wildlife in the area.

### CONCLUSION

Alternative 3 would have a major beneficial effect on preserving the long-term scientific integrity of natural systems and processes within the monument. The minor adverse impacts that would accompany development of the new visitor center and adjoining extended learning zone would be substantially offset by the benefits of additional visitor orientation provided at the new visitor center, the increased NPS and USFS presence in the area, the inclusion of additional very significant resources within monument boundaries, and the zoning of large areas within the monument for long-term preservation purposes. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Irreversible/Irretrievable Commitments of Resources

Some soils, vegetation, and wildlife habitat would be permanently removed to build trails or expanded visitor facilities and to upgrade roads. These would be irreversible commitments of resources.

## Loss in Long-Term Availability or Productivity of the Resource to Achieve Short-Term Gain

Some soils, vegetation, and wildlife habitat would be permanently removed

and unavailable for other purposes to build trails, campsites, or expanded visitor facilities and upgrade roads. Wildlife habitat or vegetation could also be degraded by providing increased access to undisturbed areas. Wildlife could also be disturbed through the creation of trails and the access they provide.

## Unavoidable Adverse Impacts

Under the No-Action Alternative, the existing park road bisects the park and creates a barrier to the movement of many small mammals and reptiles. The vehicles traveling through the monument have a moderate adverse impact on the natural quiet of the monument. The road also serves as a center of spread for a variety of invasive, exotic plant species. These species thrive in disturbed areas and in time could spread away from the road and displace native vegetation and change vegetation composition, which would be a minor, long-term, adverse impact. The heaviest visitor impacts to the current monument resources are concentrated in the Lava Flow Trail area (both sides of the park road) and at Lenox Crater. Social trails develop frequently in the Lava Flow Trail area and extend the impact of the main trail into other areas nearby. For the most part, these impacts occur in cinder substrate with more minor impacts occurring to lava, primarily because of its more durable nature. Impacts are severe in these areas where use has been concentrated. Primarily the impacts are the result of concentrated use on a substrate that is prone to movement when compressed by foot traffic. In areas where cinder is very deep, moisture is not readily available to plants. Because very little organic matter is present, cinder is a very difficult substrate for plants to become established on. Given the added disruption of foot traffic and the fact that foot traffic is not confined to just the established trails, relatively large expanses of cinder areas have been impacted and plant succession has been halted. Impacts are moderate and long term in these areas where use has been concentrated. Trespass of off-highway vehicles into the monument from the adjacent Cinder Hills OHV Area causes damage to vegetation and increases disruption of the cinder structure, which inhibits establishment of new plants. Plant succession and wildlife movement experience a minor to moderate adverse impact because of this activity.

Construction activities under all of the action alternatives would disturb soils and vegetation and lead to the introduction and spread of exotic plant species. Increased social trailing could adversely affect vegetation. Wildlife would be disturbed by human activities in the monuments.

# THREATENED, ENDANGERED, AND SENSITIVE SPECIES

## Methodology

Information on possible threatened, endangered, and sensitive species was gathered, including searching information on USFS lands, the natural resource inventory completed in the late 1970s (Bateman 1979), and the Arizona Game and Fish Department Heritage database. Information from prior research at Sunset Crater Volcano was also incorporated. No management actions that would knowingly potentially impact any threatened or endangered species were included in the alternatives. Map locations of sensitive resources were compared with locations of proposed developments and modifications of existing facilities. Known impacts caused by road and trail construction were also considered. Sociological studies comparing the deterrent effects of signs versus ranger presence on sites were also considered in this analysis. Intensity of effects are defined as follows.

*Negligible:* An action that would not affect any individuals of a sensitive species or their habitat within Sunset Crater Volcano National Monument.

*Minor:* An action that would affect a few individuals of sensitive species or have very localized impacts upon their habitat within Sunset Crater Volcano National Monument. The change would require considerable scientific effort to measure and have barely perceptible consequences to the species or habitat function

*Moderate:* An action that would cause measurable affects on: (1) a relatively moderate number of individuals within a sensitive species population, (2) the existing dynamics between multiple species (e.g. predator-prey, herbivore-forage, vegetation structure-wildlife breeding habitat), or (3) a relatively large habitat area or important habitat attributes within Sunset Crater Volcano National Monument. A sensitive species population or habitat might deviate from normal levels under existing conditions, but would remain indefinitely viable within the monument.

*Major:* An action that would have drastic and permanent consequences for a sensitive species population, dynamics between multiple species, or almost all available critical or unique habitat area within Sunset Crater Volcano National Monument. A sensitive species population or its habitat would be permanently altered from normal levels under existing conditions, and the species would be at risk of extirpation from the monument.

## Effects of the No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

Currently, no federally listed threatened or endangered plant or animal species are known to occur in Sunset Crater Volcano National Monument.

There are two plant "species of concern" for which there are recent records within Sunset Crater-Penstemon clutei and Phacelia serrata (Huisinga et al. 2000). Penstemon clutei is a perennial, endemic to northern Arizona and found mostly at Sunset Crater and nearby cinder cones. Its distribution is limited to the range of its specialized habitat requirements-cinder soils on gentle slopes in relatively open areas of ponderosa pine forest. Phacelia serrata is an annual species also endemic to northern Arizona with mostly similar habitat requirements and a slightly larger distribution. Both species have shown some affinity to recently disturbed sites, such as burned areas.

Under the No-Action Alternative, the construction of the curatorial and maintenance/resource management facilities have the most potential to impact populations of the two plant species of concern. Rare plant surveys that were conducted in the monument did not include the administrative area that is on USFS land, but this area is possible habitat. Surveys for these two species would be conducted prior to construction of the facilities and areas containing populations of these plants would be avoided.

Expansion of Bonito Campground to include group camping, a day-use area for educational group gatherings, and an amphitheater could have minor adverse impacts to sensitive plant species in the immediate area. Individual plants could be destroyed during construction, and long-term impacts could continue due to trampling and other visitor use activities.

Existing roads, trails, and NPS support facilities are located in proximity to known locations and/or known habitats for many of the sensitive plants. Routine maintenance activities have the potential to introduce and spread nonnative plant

species, which can compete for habitat and may impact sensitive plant species. Current visitor activity near developed areas likely results in localized off-trail vegetation trampling. Most of the monument remains closed to general visitor access in order to protect sensitive natural resources. The backcountry closure also effectively protects most sensitive plant habitats from disturbance. Occasional dispersed hiking within the closed area occurs during guided hikes, resource monitoring studies, scientific research, educational activities, other special uses, and unauthorized hiking.

Closure of the O'Leary Peak Road to vehicles except for administrative use could have a minor beneficial impact to sensitive plant species.

Continued field studies are needed to routinely assess the distribution and status of sensitive species, and to ensure they are not impacted by current visitor use, NPS operations, and new construction. Under the No-Action Alternative, occasional incidental trampling of vegetation during off-trail activities would continue to occur. For these reasons, the No-Action Alternative would likely have long-term, negligible to minor adverse impacts on plant "species of concern."

One endangered species, the Mexican spotted owl (Strix occidentalis lucida) is known to occur on nearby USFS land. Another bird "species of concern," the northern goshawk (Accipter gentilis), is also known to occur on nearby USFS land. Although not formally listed as "species of concern," pronghorn antelope (Antilocapra americana) and golden eagle (Aquila chrysaetos) were identified as environmental issues during the public and agency scoping process.

Strix occidentalis lucida, Accipter gentilis, and Aquila chrysaetos are all found in the general vicinity of O'Leary Peak, and good nesting habitat for all three birds is found on O'Leary Peak. There are likely some negligible to minor adverse impacts to the possible nesting of these species because of disturbance by humans traveling through the area, which would cause birds to alter their roosting and hunting patterns and, in extreme cases, abandon a nest site.

As use of the park by endangered and sensitive bird species is most likely sporadic foraging behavior, current NPS park operations and visitor use patterns are likely to have only a negligible impact. Prior to planning and construction of any new facilities, the USFS will be consulted regarding nest locations and surveys may be undertaken to ensure no disturbance of nesting areas.

Bonito Park, which is located just west of the monument, is also on USFS lands. Current use is very sporadic; few people walk out into the park, and individuals from affiliated tribes collect some plants from the area, but in terms of sensitive plant species only Penstemon clutei is known to occur there. Bonito Park is also a known fawning area for pronghorn antelope. Owing to the low visitor use of this area, there is a negligible effect to the sensitive species that are found there.

Roads through the monument and USFS lands may present a noise disturbance and barrier to movement of pronghorn antelope. There also may be incidental mortality due to vehicle traffic. The impact from current roadways and vehicle traffic is likely minor, adverse, and long term.

In addition to the "species of concern," three unique habitats were also identified as occurring in Sunset Crater Volcano National Monument: pioneering vegetation stands isolated in the middle of the lava flows, pioneering vegetation islands on deep cinder deposits, and the downslope perimeter of lava flows where water seepage may be more prevalent. The generally difficulty in traversing the

lava flow, coupled with the backcountry closure, effectively protects the pioneering vegetation island in the middle of the lava flow. There are no adverse impacts from current NPS operations on this unique habitat. Pioneering vegetation islands on deep cinder deposits and unique vegetation found on the perimeter of the lava flow are subject to some impacts from visitor use near the expanded Bonito Campground and from the O'Leary Peak Road. These impacts are likely minor and long term.

## CUMULATIVE EFFECTS

The geographic area used in the consideration of cumulative impacts includes the western portion of the Little Colorado River watershed and is bounded in the south by the Mogollon Plateau and Clear Creek, the Little Colorado River and Painted Desert on the east, and the San Francisco Peaks and Coconino Plateau on the west.

The adjacent OHV area, managed by the Forest Service, has moderate impact on the two sensitive plant species. The most direct impact of off-highway travel occurs when vehicles drive over individual plants, ripping them out or crushing them. Constant ground disturbance by OHVs would impede plants from establishing on cinder surfaces. A thin layer of silty soil beneath the cinders is an important microhabitat for the species, because it retains water longer. This silty layer can be damaged if OHV tracks become deep enough. Impacts to these plants in the Lava Flow Trail area are minor. Cumulative impacts from NPS operations and visitor use is long term and minor.

An approved recovery plan for the Mexican spotted owl is being implemented, and the northern goshawk is being managed as a species of concern by the Forest Service. These management actions are most likely having a moderate to major beneficial effect on these populations. The use of the road up O'Leary Peak could have minor adverse impacts to the raptors found in that area. Cumulative impacts to the Mexican spotted owl and northern goshawk are negligible.

The widening of US89 to four lanes from Flagstaff to the south boundary of Wupatki could have a moderate impact on pronghorn antelope movement in the geographic area because they do not cross fenced highways. Pronghorn are declining regionally in northern Arizona. Current visitor use of Bonito Park is sporadic and dispersed. Current roads and OHV use in the surrounding area create a barrier to movement of pronghorn into Bonito Park. These impacts are minor and long term and likely have a minor cumulative impact to pronghorn regionally.

## CONCLUSION

Under current NPS management there are no major adverse impacts to threatened, endangered, or sensitive species. There are some negligible to minor effects to sensitive plant and animal species and unique habitats from current visitor use and NPS facilities. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

The impacts on endangered and sensitive species and unique habitats from use and maintenance of FR545 and the O'Leary Peak Road and expansion of Bonito Campground would be the same as those identified for the No-Action Alternative

The impacts on endangered and sensitive species and unique habitats from visitor activities at the Lava Flow and Lenox Crater Trails would be the same as under the No-Action Alternative.

Impacts on endangered and sensitive species and unique habitats from NPS operation and maintenance of the existing visitor center, employee housing, offices, shops, parking lots, and utilities would remain highly concentrated at the same locations and would be the same as those identified for the No-Action Alternative.

The existing backcountry closure area would be formally recognized as a Resource Preservation Zone, and unauthorized access would be prohibited. Visitor use and NPS operations impacts to sensitive species and unique habitats within the Resource Preservation Zone would be the same as identified for the No-Action Alternative.

The construction of a new visitor center near US89 could cause minor impacts to sensitive plant species because of vegetation removal and the introduction of nonnative plants. Surveys to determine locations of sensitive plant species would be conducted and appropriate mitigation would be employed if areas containing these plant species could not be avoided. The new visitor center and associated Extended Learning Zone could have a minor to moderate impact on pronghorn antelope that use Bonito Park as a fawning area. Movement corridors from lower elevation grassland into Bonito Park have not been identified, but may be through or near the area where the new visitor center is proposed to be located. Increased human and vehicle presence could disrupt the pronghorns' traditional movement patterns.

The new trail from the campground to the Lenox Crater/Lava Flow Trail area would have only negligible to minor impact on sensitive plant species, because it would be located along a currently used social trail, where the soil is already compacted. This trail could have a long-term, minor adverse impact on the unique habitat associated with the base of the lava flow. Visitor use could lead to trampling of unique vegetation associations and young aspens.

New trail construction in the Extended Learning Zones could have an adverse minor impact to sensitive plant species by removing individual plants and compacting soils, but trails can be placed so as to avoid concentrated areas of the plant. Trail construction and visitor trampling in the Extended Learning Zone between Lenox and Sunset Craters could destroy individuals of the species, although areas containing the plants would be avoided to the extent possible. Isolated successional vegetation islands could be impacted by visitor use, as well, although trails will be planned to minimize any possible impacts.

Boundary adjustments would have a minor to moderate beneficial impact on any sensitive species located within proposed park additions, as the new land will be placed within the Resource Preservation Zone. This would reduce or eliminate any visitor use impacts.

### CUMULATIVE EFFECTS

The cumulative effects of Alternative 1 would be similar to those expected under the No-Action Alternative.

### CONCLUSION

Alternative 1 would cause no major effects to threatened, endangered, or sensitive species or unique habitats. There is the possibility of minor adverse impacts to sensitive plant species where new trails and facilities would be constructed, however, surveys prior to these activities would minimize any impacts. There could be minor to moderate impacts to pronghorn antelope use of Bonito Park as a fawning area due to disruption of movement corridors and human disturbance. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

The impacts on sensitive species and unique habitats from use and maintenance of the O'Leary Peak Road would be the same as those identified for the No-Action Alternative.

The impacts on sensitive species and unique habitats from visitor activities at the Lava Flow and Lenox Crater Trails would be the same as described for the No-Action Alternative.

The existing backcountry closure area would be formally recognized as a Resource Preservation Zone, and unauthorized access would be prohibited. Visitor use and NPS operations impacts to sensitive species and unique habitats within the Resource Preservation Zone would be the same as identified for the No-Action Alternative.

Under Alternative 2 the road system and the way vehicles enter the park would be significantly changed. Closing portions of FR545 and rehabilitating them would have beneficial impacts on pronghorn movement and sensitive plant species. However, this benefit could be offset by the upgrading and paving of both FR414 and FR776. The ability to close the monument during the night would minimize impacts from vehicle traffic and illegal activities, giving added protection to all sensitive species within the boundaries.

Construction of a new visitor center, associated facilities, and campground would cause some short-term minor adverse impacts to sensitive plant species during the construction and associated ground disturbance and minor long-term impacts due to loss of habitat and visitor use. However, these impacts may be offset by the removal and rehabilitation of the existing visitor center, associated facilities, and campground. FR545 west of Lava Flow Trail and north of Sunset Crater would be converted to a walking trail, which could have a negligible adverse impact to sensitive plant habitat if visitors were allowed to wander off the existing road area and impact new areas.

The trail construction and use around Bonito Park would have a minor adverse impact to sensitive plants, owing to removal of vegetation and soil compaction of the trail, though the trail could be routed to avoid areas where these plants grow. However, off-trail trampling and illegal collection would have a long-term

minor impact on these species. This trail would also have a moderate adverse effect on pronghorn antelope that use Bonito Park as a fawning area. Pronghorn are sensitive to human presence and avoid contact with people. Allowing people to hike a trail that completely encircles Bonito Park could cause the pronghorn to change their movement and use patterns.

The Extended Learning Zone between Lenox Crater and Sunset Crater would likely include the development of trails and allow more visitors to travel off the trail, which could have a minor adverse impact to the sensitive plant species because of trampling and soil compaction.

The area included in the boundary expansions to the east and south would also give added protection to sensitive species by eliminating off-trail travel in these areas. OHV activities would be eliminated from areas north of FR776. Elimination of off-trail backcountry access throughout much of the monument would have a minor beneficial impact on sensitive plant species in the area by eliminating trampling, illegal collection, and soil compaction. The same can be said for the elimination of OHV uses in the areas described.

As use of the park by endangered and sensitive bird species is most likely sporadic foraging behavior, all changes to park operations and visitor use patterns under this alternative are likely to have only a negligible impact. Prior to planning and construction of any new facilities, the USFS would be consulted regarding nest locations, and surveys may be undertaken to ensure no disturbance of any protected nesting areas.

### CUMULATIVE EFFECTS

The cumulative effects of Alternative 2 would be similar to those expected under the No-Action Alternative.

### CONCLUSION

Alternative 2 would cause no major impacts to threatened, endangered, or sensitive species. Some negligible to minor effects to sensitive plant species would occur from construction of new facilities and hiking trails. Moderate impacts may occur to pronghorn movement and use of Bonito Park as a fawning area. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

Impacts to endangered and sensitive species and unique habitats from FR545 would be the same as expected under the No-Action Alternative, with the exception of impacts associated with the added pullouts near the Kana-A lava flow. Construction of these pullouts could constitute a negligible to minor adverse impact by removing sensitive plant species.

Impacts to endangered and sensitive species and unique habitats from the expansion of Bonito Campground would

be the same as described under the No-Action Alternative.

Impacts to endangered and sensitive species and unique habitats from the construction of a new visitor center near the junction of FR545 and US 89, the creation of Extended Learning Zones, and the development of a trail between Bonito Campground and the Lava Flow Trail would be the same as those described under Alternative 1.

Building a new trail from the junction of FR545 and FR776 to the Double Crater area would have negligible to minor adverse impacts to sensitive plants due to trampling and other visitor use impacts. There could also be a minor impact to pronghorn movement through the area. However, these impacts would be considerably offset by the removal of OHV use from the entire area, which would constitute a major beneficial impact to sensitive plant and animal species.

Expanding the boundary to include a portion of the current OHV area would have a major, long-term, beneficial impact to sensitive plant species. This would remove substantial acreage from disturbances caused by off-highway travel, including vehicles crushing and pulling out plants by running over them, disturbing the microhabitat required by these plants to grow, and repeated disturbances of the cinder structure. Closure of the Cinder Hills area to OHV use could also have a moderate beneficial impact on pronghorn, by removing the motor vehicle disturbances to movement corridors in the area and allowing the pronghorn to use the vegetation found on top of many cinder cones, a favorable browsing location for them.

The area in the new lands would be zoned as Guided Adventure, except for the hiking trail to Double Crater and the Discovery Zone. Impacts to sensitive plants and unique habitats in the Guided Adventure Zone would be expected to be minor and long term. Any guided hiking routes would be planned accordingly to minimize impacts to populations of sensitive plants and vegetation islands. Human presence may impact pronghorn movement slightly. In the Discovery Zone, visitors would also have self-guided opportunities in areas without trails, or on primitive trails. Trampling and other visitor use effect could have minor adverse impacts on sensitive plants. However, the removal of OHV use from nearly 4,000 acres would greatly improve habitat for these plants, and reduce physical impacts. Visitor use impacts would be monitored in these two areas, and the level of use adjusted accordingly.

The existing backcountry closure area would be formally recognized as a Resource Preservation Zone, and unauthorized access would be prohibited. Visitor use and NPS operations impacts to sensitive species and unique habitats within the Resource Preservation Zone would be the same as described for the No-Action Alternative.

## CUMULATIVE EFFECTS

The cumulative impacts of Alternative 3 to endangered and sensitive species and unique habitats would be similar to those identified for the No-Action Alternative, except for the removal of OHV use from a substantial amount of adjacent land. The area would be rehabilitated and no further damage to sensitive species would occur. This would constitute a moderate to major beneficial impact to all sensitive species.,

## CONCLUSION

Alternative 3 would have a major beneficial impact by preserving more habitat for sensitive plant species in particular. There would be some negligible to minor effects to both sensitive plant and animal species from construction of new facilities and trails. In addition to

those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

### Irreversible/Irretrievable Commitments of Resources

There would be no irreversible or irretrievable commitments of threatened or endangered species.

### Loss in Long-Term Availability or Productivity of the Resource to Achieve Short-Term Gain

Some wildlife habitat or vegetation could also be degraded by providing increased access to undisturbed areas. Wildlife could also be disturbed through the creation of trails and the access they provide.

### Unavoidable Adverse Impacts

Under all the alternatives, the road system would interfere to varying degrees with the local movement or migration of sensitive animal species, and would rarely result in incidental injury or mortality. Construction activities under all of the action alternatives would locally disturb sensitive plant and animal species habitats and potentially increase the area dominated by nonnative, invasive plant species. Visitor use would likely result in local vegetation trampling and impacts to rare plants and increased disturbance to sensitive wildlife species, particularly pronghorn.

## LONG-TERM INTEGRITY OF GEOLOGICAL RESOURCES

### Methodology

This section analyzes the impacts of the various management alternatives upon the geologic resources within Sunset Crater National Monument. Discussion of impacts to vegetation, wildlife, sensitive species, and unique habitats is presented elsewhere. Available information on geologic history and features in the monument was reviewed, including the Flagstaff Area National Monuments Resources Management Plan (1996), Smiley's geology and dating of Sunset Crater Volcano (1958), Museum of Northern Arizona Notes (1929) on Sunset Crater and lava flow research, Holm and Moore's description of the geology of Sunset Crater (1987), and Holm's study of the Bonito Lava flow association with the Sunset Crater cinder cone (1987). Impact topics identified through the public and agency scoping process include preserving the unique recent geologic volcanic features within the monument and preserving the scientific integrity of the associated geologic landscape that is part of the Sunset Crater Volcano eruption. Large-scale features include cinder cones, fresh lava surfaces, and deep cinder deposits. Smaller features include lava tubes, ice caves, fumerole vents, and spatter cones. Geologic resources associated with Sunset Crater Volcano were compared with locations of proposed developments and modifications of existing facilities and current uses. Intensity of impacts are defined as follows:

*Negligible:* An action that would cause no change in existing geologic features.

*Minor:* An action that would locally affect only widespread or common geologic features within the monument. The

change would have barely perceptible consequences to the integrity of geologic resources.

*Moderate:* An action that would affect a unique and irreplaceable geologic feature or a large area of widespread geologic features within the monument. The change would result in permanent partial loss of the integrity of geologic resources.

*Major:* An action that would destroy or permanently impair unique and irreplaceable geologic features or most of a large-scale geologic resource within the monument. The change would result in permanent loss and/or largely compromise the integrity of geologic resources.

## Effects of the No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

Under the No-Action Alternative, roads, trails, and visitor support facilities within the monument boundary occupy approximately 130 acres, or less than 5% of the total geologic landscape within the monument. The remaining 95% of the monument is closed to general public access in order to protect sensitive natural and cultural resources.

The new NPS curatorial storage, resource management, and maintenance facilities would likely be constructed near existing facilities on Coconino National Forest lands in mature geologic terrain, where soils and vegetation are well developed. The new facilities would not impact exposed geologic features associated with the eruption of Sunset Crater Volcano and Bonito Lava Flow.

Historic visitor use of the Crater Overlook Trail (now closed) on the steep, west-facing cinder slope of Sunset Crater Volcano resulted in deep erosion of the trail route. The trail has been closed for more than 30 years, but the impacts from prior erosion and NPS restoration actions are still evident. Under the No-Action Alternative, Sunset Crater and most of the monument would remain closed to visitor use, and should continue to recover from historic use impacts.

The existing entrance road follows along the northwestern base of Sunset Crater Volcano. A level area was cut into the lower slope for the road base. This causes minor slumping of the cinder slope, and small volumes of cinder material must be periodically removed from the road shoulder. The road also provides convenient visitor access to the cinder cone, resulting in casual unauthorized scrambling on its slopes. The continued use of the existing road under the No-Action Alternative would likely result in continued long-term, minor adverse impacts to the steep cinder cone slopes.

The planned closure of the O'Leary Peak Road to general public use would likely eliminate some vehicle impacts to deep cinder deposits and steep slopes near the peak, and reduce unauthorized access around the western and northern perimeter of the monument in areas that are not routinely patrolled. This would likely result in long-term, negligible to minor beneficial impacts to geologic resources on both the Coconino National Forest and Sunset Crater Volcano National Monument.

The existing trail on Lenox Crater also traverses steep cinder slopes, and is readily subject to the severe erosion problems that historically impacted Sunset Crater. Heavy, unmanaged visitor use upon Lenox Crater, one of the only two cinder cones within the monument, would likely result in long-term, minor to moderate adverse impacts to cinder cone features within the monument. More than 300,000 visitors per year walk the Lava Flow Trail, and the local area surrounding the trail has long been impacted by visitor activity. Many people wander off the established trail

into nearby areas of deep cinder deposits, establishing unplanned trail segments, and trampling footprint patterns into the original cinder surface. The NPS has no information on how long footprint patterns persist before they naturally weather out. The Lava Flow Trail also passes close to two spatter cones. Visitors often climb on them, breaking or "polishing" their surfaces and accelerating erosion of the remaining features. This results in long-term moderate, adverse impacts to these local and unique geologic features.

Overnight visitors often hike from the campground into the western side of the monument, resulting in numerous unplanned trails. Visitors frequently climb and hike the western margin of the Bonito Lava Flow, which may result in specimen collection, local breakage, or collapse of surface features of the lava flow. In addition, visitors choose to hike along the road shoulder from the campground to the Lenox Crater area. The current expansion of the existing campground would likely result in a relatively small increase in overnight visitation and associated impacts to the western boundary of the monument and the Bonito Lava Flow. Under the No-Action Alternative, continuing visitor activity from the campground area would likely result in long-term, minor adverse impacts to large-scale geologic features, similar to those described above.

Off-road vehicles infrequently trespass along the southern and eastern boundary of the monument. Vehicle tracks are now evident around the southern base of both Sunset Crater and Lenox Crater. One incident left permanent tracks across the entire south side of Sunset Crater. Within the monument boundary, trespass off-road driving is resulting in long-term, minor to moderate adverse impacts to large-scale cinder cone geologic features. The frequency of trespass activities may be increasing. The NPS has become concerned enough about these impacts to seek funding to construct 3 miles of vehicle-proof cable barrier along the entire southern and eastern boundary of the monument.

## CUMULATIVE EFFECTS

The geographic area of consideration for cumulative impacts is the San Francisco Volcanic Field on the east side of the San Francisco Mountains and the associated area of recent geologic events such as basaltic volcanoes, vents, lava flows, and cinder deposits.

Under the No-Action Alternative, the cumulative impacts of public visitation and NPS operations at Sunset Crater Volcano National Monument on the integrity of geologic resources are difficult to estimate. Many of the geologic features are unique and irreplaceable if lost. The monument is very small relative to the surrounding geologic landscape, and could be rapidly impacted by any combination of management decisions and activities. The primary adverse cumulative impacts from NPS management would likely result from a failure to manage increased visitation, road traffic, and poorly planned support facilities. Over time, these circumstances would exacerbate adverse impacts to both large- and small-scale geologic features, including: erosion and gullying on steep slopes on the two accessible cinder cones; increased wearing of unplanned trail segments in cinder deposits; increased disruption of cinder weathering and soil formation processes; and increased collection, breakage, polishing, and collapse of lava flow surface and spatter cone features. Although visitor carrying capacity has not been established, a threshold could be reached where the adverse impacts to geologic resources, especially unique small-scale features, exceed those stated above in the analysis.

The greatest cumulative impacts to the geological resources of the eastern San Francisco Volcanic Field are mostly a result of activities beyond the control of the NPS. Much of the San Francisco Mountains are protected under the Wilderness Act. The U.S. Forest Service is currently proposing regional minerals leasing withdrawals within the San Francisco Volcanic Field. A pumice mining lease on the eastern slopes of the San Francisco Mountains was recently bought out and cancelled by the U.S. Forest Service. Strawberry Crater, an older cinder cone volcano, is protected within designated wilderness and managed by the U.S. Forest Service. Except for the wilderness and mineral withdrawal areas, very few geologic features are protected within the area of basaltic cinder cones and lava flows on the eastern side of the volcanic field.

Numerous activities are affecting geologic resources surrounding the monument. Off-road driving is causing long-term, moderate adverse impacts to much of the area, and long-term, major adverse impacts to distinct geologic features associated with the Sunset Crater Volcano eruption. These impacts appear to be accelerating under existing U.S. Forest Service management of the Cinder Hills OHV Area. Commercial surface mining for cinder material on private and state lands has resulted in the partial removal of numerous cinder cones and is expected to result in the eventual loss of entire cinder cone features. Some cinder borrow pits are still active on the Coconino National Forest. Neighborhoods are rapidly growing in the area immediately south of the Coconino National Forest, and local recreational use, such as hiking, horseback riding, motorcycle and OHV use, and off-road driving are impacting the cinder cones and cinder barrens. Nearby Roden Crater is being heavily modified as part of a private artistic venture. Many smaller local features within the eastern volcanic field, such as fumerole vents and spatter cones, may be completely obliterated. Lava flows are likely being impacted the least, because of their naturally inaccessible terrain. The scientific geological value of Sunset Crater Volcano National Monument should become even greater as associated and irreplaceable geologic features within the eastern San Francisco Volcanic Field continue to be permanently impacted.

## CONCLUSION

Sunset Crater Volcano has been impacted by past visitor use, resulting in deep scars eroded into the steep cinder cone slopes that are still visible today. Existing NPS operations and visitor use in the Lenox Crater, southwestern Bonito Lava Flow perimeter, and Lava Flow Trail area are resulting in long-term, negligible to minor adverse impacts to large-scale cinder cone and lava flow geologic features, and long-term, moderate impacts to smaller features, such as spatter cones and lava flow surfaces. Development and recreational use of lands surrounding the monument are causing long-term moderate adverse impacts to the cinder cones adjacent to Sunset Crater, and long-term, major adverse impacts to the geologic features associated with the Sunset Crater Volcano eruption. The scientific geological value of Sunset Crater Volcano National Monument should become even greater as associated and irreplaceable geologic features within the eastern San Francisco Volcanic Field continue to be permanently impacted. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant

National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

The impacts from continued use of FR545 and Cinder Hills Overlook would remain the same as described for the No-Action Alternative. The impacts from closure of the O'Leary Peak Road would remain the same as described for the No-Action Alternative. The existing campground, housing, and maintenance facilities would be retained, and impacts would remain the same as under the No-Action Alternative. Although the existing visitor center would be converted to office space and adapted for educational activities, resulting impacts to geological resources would likely remain the same as expected for the No-Action Alternative.

Under Alternative 1, slight boundary expansion on all four sides would add approximately 1,500 acres to Sunset Crater National Monument. The boundary adjustment would include the remainder of Lenox Crater at the southwest corner of the monument and the remainder of the cinder hills on the northern boundary. The expansion also adds a buffer around the south and east sides of the monument between the base of Sunset Crater and the existing Cinder Hills OHV Area boundary. Lastly, the boundary adjustment would allow better control of unauthorized driving access on the O'Leary Peak Road. These adjustments would increase protection of more geologic features associated with the Sunset Volcano eruption, including reduction of illegal OHV use impacts outside of the existing Cinder Hills OHV Area boundary. This would have long-term, minor beneficial impacts to the integrity of geologic resources.

Under this alternative, as much as 5% of the expanded monument area would be used for road and trail access and visitor activities. The remaining 95% would be closed to protect the geologic resources. Establishing a Resource Preservation Zone would have long-term, moderate beneficial impacts to the integrity of geologic resources.

New visitor center facilities are proposed in an area of mature geologic terrain having deep soils and well-established vegetation. Constructing the new facilities would have a negligible impact to geologic resources within the area. For the same reason, visitor activities in the vicinity of the new visitor center would also have negligible impacts to geologic resources.

Under Alternative 1, an existing, unplanned hiking trail linking the Bonito Campground, Lenox Crater, and Lava Flow Trail would be formalized. Increased visitor use of the new trail would possibly be offset because the trail would concentrate visitor disturbance within a smaller area of deep cinder deposits along the route. This would result in negligible impacts to geologic resources along the trail route.

An Extended Learning Zone would be established in the vicinity of the Lava Flow Trail and Lenox Crater Trail system. The zone would more than triple the area of visitor use around Lenox Crater and Bonito Lava Flow. Increased visitation would likely disturb and accelerate erosion of the cinder cone slopes on Lenox Crater and other areas of relatively pristine cinder deposits. Other unmapped, local geologic features, such as fumerole vents and spatter cones might also be impacted by specimen collection, breakage, and polishing of their surfaces. For these reasons, increased visitor use within the Extended Learning Zone would have long-term, minor impacts to large-scale

geologic features, but could have moderate adverse impacts to smaller, more unique geologic features unless they are fully mapped and inventoried, and use within the area is carefully planned.

### CUMULATIVE EFFECTS

The cumulative impacts upon geologic resources under Alternative 1 would likely be similar to those described for the No-Action Alternative, except for a minor reduction in off-road driving impacts within the proposed boundary expansion area.

### CONCLUSION

Alternative 1 would likely have no major impacts to geologic features within Sunset Crater Volcano National Monument. Many of the impacts associated with this alternative, including potential cumulative impacts, are very similar to those described for the No-Action Alternative. Increased visitor-use impacts within the proposed Extended Learning Zone between the Lava Flow Trail, Lenox Crater, and southern edge of the Bonito Lava Flow could result in long-term, minor adverse impacts to large-scale geologic features, such as cinder cones and lava flows, but could result in long-term, moderate adverse impacts to uninventoried, small, and unique geologic features. In addition to those mentioned, there would be other, less-severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

Under Alternative 2, the boundary of Sunset Crater Volcano National Monument would be expanded to approximately 6,700 acres. This would effectively double the area within the monument and encompass the a new visitor center-campground area to the south; the remainder of Lenox Crater at the southwest corner; the remainder of the cinder hills to the north; and all of Bonito Park to the west. The boundary expansion would also add a buffer around the south and east sides of the monument between the base of Sunset Crater and the existing Cinder Hills OHV Area boundary. Lastly, the boundary adjustment would allow the NPS to better control unauthorized driving on the O'Leary Peak Road. With the exception of the Bonito Park area, these adjustments would increase the level of protection for geologic features associated with the Sunset Volcano eruption, and reduce illegal OHV use outside of the existing Cinder Hills OHV Area boundary. This would have long-term, minor beneficial impacts to the integrity of geologic resources.

Under this alternative, as much as 8% of the expanded monument area would be used for road and trail corridors, NPS administrative and visitor support facilities, and visitor activities. The remaining 92% would be closed to protect sensitive geologic resources. Establishing a Resource Preservation Zone would have long-term, moderate beneficial impacts to the integrity of geologic resources.

Approximately 11/2 miles of FR545 on the east side and 2 miles of FR545 on the west side of the monument would be

abandoned. Segments of abandoned roadbed would be narrowed and converted to foot trails for visitor use, including the reach around the northwestern base of Sunset Crater cinder cone. Slumping and settling of the cinder slopes adjacent to the abandoned roadbed would likely continue as in the No-Action Alternative. The remaining reaches would be restored to original contours; however, many geologic features along the route were likely obliterated when the road was constructed and probably cannot be replaced. The abandonment of portions of the existing road would therefore have negligible impacts to geological resources. FR414, currently a primitive road through deep cinder deposits around the western flank of Lenox Crater, would be upgraded and paved, resulting in long-term, minor adverse impacts to large-scale geological features. The central portion of FR545 would be retained to connect FR414 to the Bonito Park and the Lava Flow Trail parking lots, and the impacts related to this reach would be the same as the No-Action Alternative.

A new visitor center and campground would be built south of Sunset Crater Volcano, in an area of deep cinder deposits. However, this area is close to the Cinder Hills OHV Area and a small cinder borrow pit on the Coconino National Forest, and is already heavily impacted by off-road driving impacts. Therefore, constructing new facilities at this location would result in negligible impacts to geologic resources. Some beneficial impact might result because proposed changes in visitor access would ensure visitors are informed of the fragility of the cinder cones and other unique volcanic features before encountering them.

The existing visitor center, NPS employee housing, maintenance facilities, and Bonito Campground would be removed. These facilities are located in an area of mature geologic terrain having deep soils and well-established forest vegetation, and this action would likely have negligible impacts to geologic resources. Relocating the campground from its current location would have a long-term, minor beneficial impact by eliminating casual unauthorized hiking and unplanned trail establishment between the campground and the western margin of the Bonito Lava Flow. These beneficial impacts could be entirely offset by visitor use around the newly proposed facilities south of Sunset Crater.

Under Alternative 2, visitor access and activity would be expanded considerably beyond existing conditions. Approximately 2 miles of the abandoned entrance road would be converted to trail corridors. A relatively large Extended Learning Zone would be established to encompass all of Lenox Crater, the southern margin of the Bonito Lava Flow, and the northwest base of Sunset Crater Volcano. Increased off-trail access along the trail corridors and within the Extended Learning Zone would likely result in increased disturbance to the cinder cone slopes on Lenox Crater and other areas of relatively pristine cinder deposits. Other unmapped, local geologic features, such as fumerole vents and spatter cones, might also be impacted by specimen collection, breakage, and polishing of their surfaces. For these reasons, increased visitor use within the Extended Learning Zone would have long-term, minor impacts to large-scale geologic features, but could have moderate impacts to smaller, more unique geologic features unless they are fully mapped and inventoried and use within the area carefully planned.

Under this alternative, a new trail would also be established around Bonito Park, which is in an area of geologically mature terrain having deep soils and well-established vegetation. The trail and associated visitor use in Bonito Park would

have negligible impacts to geologic resources within the area.

### CUMULATIVE EFFECTS

The cumulative impacts upon geologic resources under Alternative 2 would likely be similar to those identified for the No-Action Alternative, with the following exceptions: There would be minor beneficial impacts from reduced off-road driving impacts within the proposed boundary expansion area. Establishing an extensive trail system and relatively large Extended Learning Zone within the monument would likely result in increased adverse cumulative impacts to cinder cone volcano slopes, deep cinder deposits, and small-scale unique geologic features within the monument.

### CONCLUSION

Alternative 2 would cause no major impacts to geological features within Sunset Crater National Monument. The boundary of the monument would be expanded to approximately 6,700 acres, effectively doubling the area within the monument. As much as 8% of the expanded monument area would be used for road and trail access, visitor support and NPS administrative facilities, and visitor activities. The remaining 92% would be closed to protect sensitive geologic resources.

The new visitor center, campground facilities, and upgraded entrance road along FR414 would be constructed in a heavily impacted recreational use area and likely have negligible impacts to geologic resources. A new trail around Bonito Park would also likely have negligible impacts to geologic resources. Increased visitor use within the Extended Learning Zone and trails within the central monument area would have long-term, minor adverse impacts to large-scale geologic features, but could cause long-term, moderate adverse impacts to smaller, more unique geologic features unless they are fully mapped and inventoried, and use within the area carefully planned. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

The impacts from continued use of FR545 and Cinder Hills Overlook would remain the same as under the No-Action Alternative. The impacts from closure of the O'Leary Peak Road would remain the same as under the No-Action Alternative. The existing campground, housing, and maintenance facilities would be retained, and impacts would remain the same as identified for the No-Action Alternative. Although the existing visitor center would be adapted for educational activities, resulting impacts to geologic features would likely remain the same as described for the No-Action Alternative.

Under Alternative 3, the boundary of Sunset Crater National Monument would be expanded to approximately 11,600 acres. This would nearly quadruple the area within the monument. The proposed expansion area east of the existing

boundary would include significant features associated with the eruption and geologic story of the Sunset Crater Volcano, including the chain of related cinder cones, the Kana-A lava flow, and the volcanic vent at the opposite end of the fissure that fed magma to Sunset Crater Volcano and the Bonito Lava Flow. These features are currently being heavily impacted by OHV use within the Coconino National Forest. The impacted OHV area within the expanded boundary would be extensively restored and then allowed to continue recovering from vehicle impacts. The proposed expansion would also establish a large buffer area between the base of Sunset Crater and the Cinder Hills OHV Area. The inclusion of these geologic features within the monument would ensure the long-term preservation of the integrity of geological resources associated with the Sunset Crater Volcano, resulting in long-term, major beneficial impacts.

Under Alternative 3, much of FR776 would be closed to general public use within the expanded boundary area between FR545 and the southern monument boundary. The road would be retained in primitive condition for NPS administrative use. This would result in negligible impacts to geologic resources.

Under this alternative, as much as 12% of the expanded monument area would be used for roads and trails, visitor support facilities, and visitor use areas. Another 70% would be open to dispersed visitor hiking opportunities. The remaining 18% would be closed to protect sensitive geologic resources. Establishing a Resource Preservation Zone would have long-term, moderate beneficial impacts to the integrity of geologic resources.

The new visitor center facilities are proposed in a geologically mature area having deep soils and well-established vegetation, and construction would have a negligible impact to geologic resources within the area. For the same reason, additional visitor activities proposed in the vicinity of the new visitor center would also have negligible impacts to geologic resources.

Under Alternative 3, an existing, unplanned hiking trail linking the Bonito Campground, Lenox Crater, and Lava Flow Trail would be formalized. Increased visitor-use of the new trail would possibly be offset because the trail would concentrate visitor disturbance within a smaller area of deep cinder deposits along the route. This would result in negligible impacts to geologic resources along the trail route.

An Extended Learning Zone would be established in the vicinity of the Lava Flow Trail and Lenox Crater Trail. The zone would more than triple the area of visitor use around the Lava Flow Trail, Lenox Crater, and Bonito Lava Flow. Increased visitation would likely disturb and accelerate erosion of the cinder cone slopes on Lenox Crater, and disturb areas of relatively pristine cinder deposits. Other unmapped, local geologic features, such as fumerole vents and spatter cones might also be impacted by specimen collection, breakage, and polishing of their surfaces. For these reasons, increased visitor use within the Extended Learning Zone would have long-term, minor impacts to large-scale geologic features, but could have moderate impacts to smaller, more unique geologic features unless they are fully mapped and inventoried and use within the area is carefully planned.

Most of the area within the expanded park boundaries would be zoned for dispersed, guided hiking. A smaller area of cinder hills immediately south of Sunset Crater Volcano would be zoned for dispersed, unguided hiking. In addition, a new trail would be constructed to the base of Double Crater. Although these areas are already heavily impacted by off-road vehicle use, the impacts of proposed visitor activities are difficult to predict and would

depend upon the visitor numbers and the primary season of use. While large-scale geologic features, such as steep cinder cones and deep cinder deposits, would likely continue to recover from vehicle impacts, sustained dispersed visitor use would likely cause some long-term minor adverse impacts. Other unmapped, local geologic features, such as fumerole vents and spatter cones might also be impacted by specimen collection, breakage, and polishing of their surfaces. Sustained, dispersed visitor activity within the Guided Adventure Zone and Discovery Zone could have moderate impacts to smaller, more unique geologic features unless they are fully mapped and inventoried and use within the area is carefully planned.

### CUMULATIVE EFFECTS

Under Alternative 3, the cumulative impacts on geologic resources within the existing monument boundary would likely be similar to those described for the No-Action Alternative. The proposed boundary expansion would include significant geologic resources associated with the eruption of Sunset Crater Volcano. This action would prevent major, long-term adverse cumulative impacts to these resources by eliminating the cumulative impacts of increased OHV use in the future.

### CONCLUSION

Alternative 3 would likely have no major impacts to geologic features within Sunset Crater Volcano National Monument. Visitor use impacts to geologic resources within the original monument boundary are very similar to the No-Action Alternative. The boundary would be expanded to include significant geologic resources associated with the eruption of Sunset Crater Volcano. This action would ensure the long-term integrity of geologic resources by protecting them from increased off-road-driving impacts. Increased visitor use impacts within the proposed Extended Learning Zone between the Lava Flow Trail, Lenox Crater, and southern edge of the Bonito Lava Flow could result in long-term, minor adverse impacts to large-scale geologic features, such as cinder cones and lava flows, but could result in long-term, moderate adverse impacts to uninventoried, small, and unique geologic features. Dispersed guided and unguided hiking activity would be permitted within most of the boundary expansion area. Although this area is heavily impacted by off-road vehicle use, the impacts of sustained visitor use are difficult to predict, and would depend upon the visitor numbers and the primary season of use. While large-scale geologic features would likely continue to recover from vehicle impacts, dispersed hiking activity could cause long-term minor adverse impacts to these geologic features. In addition, dispersed hiking activity could cause long-term, moderate adverse impacts to smaller, more unique geologic features unless they are fully mapped and inventoried, and use within the area is carefully planned. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Irreversible/Irretrievable Commitments of Resources

The management alternatives all propose varying degrees of visitor access to large-

scale geologic resources, such as cinder cone volcanoes, lava flows, and expanses of deep cinder deposits. There are small-scale, unique volcanic features associated with this landscape that are irreplaceable, including spatter cones, fumerole vents, collapsed fissures, ice caves, lava tubes, and distinct lava surface features. These small-scale features would be permanently impacted to varying degrees by visitor activity, including trampling, breakage, polishing, collapse, specimen collection, and accelerated weathering.

### Loss in Long-Term Availability or Productivity of the Resource to Achieve Short-Term Gain

Under the various management alternatives, new facilities (other than trails) are generally proposed only in areas of geologically mature terrain, which have weathered to deep soils and are completely covered by vegetation, or areas that have been heavily impacted by off-road vehicle driving. None of the alternatives would result in the loss of long-term availability or productivity of geologic resources within Sunset Crater National Monument.

### Unavoidable Adverse Impacts

Sunset Crater Volcano has been impacted by past visitor use, resulting in deep scars eroded into the steep cinder cone slopes that are still visible today. Under the various management alternatives, road and trail corridors, parking lots, and visitor facilities would occupy as little as 5% or as much as 12% of the total landscape within the monument boundary. Roads would remain within previously disturbed areas, negating adverse impacts to existing geologic features. New visitor and NPS support facilities (other than trails) are only proposed in areas of geologically mature terrain or areas impacted by off-road vehicle driving, negating adverse impacts to existing geologic features. Visitor-use of new trails and within the proposed Extended Learning, Guided Adventure, and Discovery Zones would provide access to large-scale geologic resources, such as cinder cone volcanoes, lava flows, and expanses of deep cinder deposits. There are small-scale, unique volcanic features associated with this landscape that are irreplaceable, including spatter cones, fumerole vents, collapsed fissures, ice caves, lava tubes, and distinct lava surface features. These small-scale features would be permanently impacted to varying degrees by visitor activity, including trampling, breakage, polishing, collapse, specimen collection, and accelerated weathering. Recreational use of lands surrounding the monument is causing long-term moderate to major adverse impacts to the geologic features associated with the Sunset Crater Volcano eruption.

## ABILITY TO EXPERIENCE PARK RESOURCES

### Methodology

This topic includes analysis of the following broad areas: access to park resources by the general public and by visitors with disabilities; access to information provided by collections (ability to see the "real thing") and to a minimally altered environment; and the ability of the public to understand park resources and the regional context of the park. Also considered were the ability to exercise personal freedom during a park visit, the provision of traditional employee/visitor experiences (interpretation through personal services, and access to favorite sites), and the ability to participate in traditional recreational activities (biking, climbing, hiking, etc.).

Visitor surveys and personal observation of visitation patterns combined with assessment of what is available to visitors

under current management were used to estimate the effects of the actions in the various alternatives. The impact on the ability of the visitor to experience a full range of park resources was analyzed by examining resources identified in the park significance statement.

*Negligible:* The impact is barely detectable, and/or will affect few visitors.

*Minor:* The impact is slight, but detectable, and/or will affect some visitors.

*Moderate:* The impact is readily apparent and/or will affect many visitors.

*Major:* The impact is severely adverse or exceptionally beneficial and/or will affect the majority of visitors.

## Effects of the No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

#### Effects on Access to Park Resources by the General Public and by Visitors with Disabilities

Under this alternative, most visitors would continue to visit Sunset Crater Volcano as a drive-through experience in conjunction with Wupatki, via the 36-mile loop road (FR545) that connects the two parks. The typical visitor opportunity to experience park resources would remain a fairly linear encounter with the volcanic features visible along the road, on the Lava Flow Trail, and from an overlook or two. Geologic features crucial to an understanding of this larger story, including Lenox Crater, the Kana-A lava flow, and the Cinder Hills, lie partially or completely outside park boundaries; this creates challenges to understanding of the full Sunset Crater eruption story as a sequence of events along a 15-km fissure, involving successive lava flows, formation of other volcanic cones, cinder and ashfalls, and the "curtain of fire" activity.

Visitor satisfaction with the current park experience is high as measured by the Visitor Survey Card responses. (Machlis 2000) The 2000 survey showed that 98% of visitors were satisfied with opportunities for "learning about nature, history or culture" and 97% were satisfied with sightseeing opportunities. Eighty-four percent were satisfied with outdoor recreation (camping, bicycling, boating, hiking, etc.) opportunities. This indicates a major long-term beneficial impact.

Much of the existing Sunset Crater Volcano experience, including the visitor center, one loop of the Lava Flow Trail, and the trailhead rest rooms, would be available for visitors with physical and other challenges. Some of the volcanic landscape and major features are visible from the road and roadside pullouts and overlooks. Planned interpretive improvements would serve visitors with various impairments, but current exhibits have no special modifications. Written and Braille scripts would be available for the orientation audiovisual program in the visitor center. The beneficial impact is moderate to major and long term.

According to a recent visitor survey (Lee and Treadwell 1999), Sunset Crater Volcano visitors do not generally feel crowded. On a scale of 1.0 = not at all crowded to 9.0 = extremely crowded, the average response was 2.0.

Annual visitation at Sunset Crater Volcano has fluctuated widely in recent years, owing in part to changes in counting and reporting methods. The average is 194,245 visitors per year since 1997. If numbers increase in accordance with local and regional population growth, crowding will be inevitable within the lifetime of this plan. The perceived uncrowded atmosphere is a major benefit to today's visitors; deterioration of this quality would constitute a major adverse impact.

Visitor activities within the park are limited to established roads and trails. A variety of less-structured opportunities exist outside park boundaries, on USFS lands. However, the lack of opportunity for non-OHV users to safely explore volcanic features in the Cinder Hills area is a moderate adverse impact.

Traditional interpretive services would continue, including guided walks on the Lava Flow Trail and evening programs, in cooperation with the USFS, at Bonito Campground. Continuation of these activities would be a moderate benefit to visitors.

In this alternative, the Cinder Hills OHV Area is expected to continue operation, under USFS management, in accordance with guidelines and policies set forth in the FLEA Plan. OHV users are estimated by the USFS at approximately 30,000 per year, the equivalent of 15% of park visitation. Continuation of this use is a moderate benefit to this group, based on their numbers. Continued OHV use precludes use of this area by hikers and others wishing to explore its volcanic features, which are closely linked to the significance of the park.

Bicycling along FR545 would likely increase in popularity as the population of Flagstaff continues to grow.

### Effects on Access to Information Provided by Collections (Ability to See the "Real Thing") and to a Minimally Altered Environment

Volcanic rock specimens and other items would be displayed in the visitor center, and visitors would be allowed to handle representative specimens. Opportunities to see the "real thing" close up would continue via the Lava Flow self-guided trail at the base of the volcano. Approximately 83% of visitors walk this trail, where a variety of volcanic features can be seen adjacent to the trail, including two types of lava flows, lava tubes, and spatter cones. The Lenox Crater Trail would provide firsthand experience of hiking on a cinder cone as well as views of the volcanic terrain below.

The existing level of access is a major benefit to visitors interested in short walks and a general introduction to volcanic landforms. Visitors interested in longer explorations and more remote volcanic vistas suffer moderate adverse impacts.

Few archeological artifacts would be displayed, reflecting the lack of archeological data, sites, and specimens available within the park, rather than lack of concern for the human history of the area. This is a minor adverse impact, which would be mitigated through improved museum exhibits, cooperative efforts to interpret sites on USFS lands, and increased integration of the Sunset Crater Volcano and Wupatki interpretive programs.

To many visitors, the natural alterations to the landscape-lava flows, jagged rocks, sparse vegetation, and cinder fields-caused by the geologically recent eruption of Sunset Crater Volcano overwhelm the signs of human alterations. Upon closer inspection, there are many visual intrusions inside the park and within the viewshed, including roads and structures in the volcanic landscape, evidence of logging, fire suppression, farming, and an active pumice mine. Erosion, social trails, and trampled vegetation are evidence of heavy use in areas like the Lava Flow Trail. Prominent scars remain from the old trail to the summit of Sunset Crater Volcano, which has been closed since 1973. Such intrusions would be interpreted as illustrations of the fragility of this rocky landscape, but present a moderate adverse impact to those seeking a pristine environment. The Cinder Hills Off-Highway Vehicle (OHV) Area would continue to operate in a highly visible area near the park with some mitigating measures

through the FLEA plan. Visitors may continue to encounter impacts from the Cinder Hills Overlook and would continue the confusion over this apparently conflicting use. Impact on visitor experience is moderate, long-term and adverse.

Spectacular scenery is the most important reason for visiting the park (91% of visitors surveyed) (Lee and Treadwell 1999). Under this alternative, visitors would be afforded long vistas, with several significant volcanic structures and a broad variety of scenery in clear view. The obvious changes in vegetation and overall terrain along the drive from Sunset Crater to Wupatki would be available for visitors to see. A particularly attractive section of the lava flow, adjacent to the road, would continue to be almost impossible to view, because of sight distance and lack of pullouts. Hiking would be limited to two short trails within the monument; the O'Leary Peak Road could become a third option for hiking, following USFS plans to close it to vehicular traffic. Ability to enjoy scenery is highly important to visitors and constitutes a major long-term benefit. Lack of additional opportunities along hiking trails is a minor to moderate adverse impact.

The park would continue operation as a day-use area only with FR545 open 24 hours per day. Impacts of NPS activities on night skies would be limited to minor lighting at the visitor center and residence area across the road from the campground and would be of negligible impact.

Much of the existing park experience occurs within earshot of the road, and ability to hear natural sounds depends on the amount of vehicle traffic. Visitors at the Cinder Hills Overlook experience OHV noise at times, a minor adverse impact. Some parts of the Lava Flow Trail and the summit of Lenox Crater offer a greater opportunity to escape sounds of the road and parking lot. Closely related features located outside park boundaries offer a peaceful atmosphere with natural soundscapes; these include Bonito Park (between passing cars) and O'Leary Peak. Preservation of this aspect would be a major long-term benefit to visitors.

### Effects on Ability of Public to Understand Park Resources and the Regional Context of the Park

The existing visitor center would continue to be used. Museum exhibits are limited in scope and outdated. Neither these nor existing wayside exhibits convey an adequate understanding of the geological story, ecological processes, or changing plant communities visible along the road between Sunset Crater Volcano and Wupatki, and the interrelated archeological story is not apparent. A major planning effort is under way, concurrent with this general management plan, that will update museum and wayside exhibits and will result in a long-term major benefit for visitors.

## CUMULATIVE EFFECTS

The geographic area considered for cumulative effects for this alternative includes the Flagstaff Area National Monuments, the greater Flagstaff area, and the most adjacent portions of the Coconino National Forest.

In addition to the impacts described above, external forces and actions of other entities could affect visitor ability to experience park resources in this alternative. Primary sources of these additional impacts are the USFS, Grand Canyon National Park, Arizona Department of Transportation (ADOT), local developers, local residents, and resource-related industries.

Changes in visitor use patterns and transportation at Grand Canyon National Park could result in visitation increases at Sunset Crater Volcano, especially by those seeking the independent drive-through

experience no longer available at Grand Canyon.

Increased visitation and/or increased length of stay would impact uncrowded visitor experiences within the park, probably to a minor degree. Increased length of stay by visitors would also impact ability to understand park resources, since these visitors would probably devote more time to visitor center exhibits, wayside exhibits, interpretive programs, or otherwise learning about the park. In this alternative, a major benefit is expected from NPS actions. Increased visitation to the park could be mitigated by increased use of the forest by traditional park visitors.

Widening of US89 by ADOT will result in a four-lane highway north from Flagstaff to both Sunset Crater Volcano and Wupatki entrances, and this level of improvement will eventually extend to Page, Arizona. This could increase park visitation. Visitors might also be willing to spend more time exploring the park. Impact on uncrowded visitor experiences would be minor.

Development of Roden Crater and the subdivision of lots in Alpine Ranchos may increase traffic on FR545 and, incidentally, through the park. This increased traffic would only occasionally result in increased visitation to park resources and facilities, and impact on uncrowded visitor experiences would be negligible.

Increased growth of Flagstaff could increase park visitation by local residents, with the possibility of increased numbers of repeat visits and the use of the park for traditional recreational activities (biking, hiking, etc.) could increase.

Increased visitation would impact uncrowded visitor experiences to a moderate degree. Repeat visits could impact demand for traditional employee/visitor experiences and encourage more variety in interpretive programs offered. Addition of such activities would be of negligible impact.

## CONCLUSION

The No-Action Alternative would continue to provide major benefits to some visitors, particularly those wanting a brief introduction to the volcanic landscape, with emphasis on major features visible from the road or from short trails. Park facilities and many features would remain accessible; recent construction of an accessible paved loop on the Lava Flow Trail would provide access to representative volcanic features and views for visitors with physical disabilities and others whose time or abilities are not suited to the cinder surface of the longer trail loop. The ability to look at scenery, especially along FR545 en route to Wupatki, enjoy an uncrowded park setting, and listen to natural sounds would continue as major benefits, at least in the near future. Continuation of traditional interpretive programs, such as talks, guided walks, and campground programs would provide moderate benefits for visitors.

Distant views of some features would remain available from the Cinder Hills overlook, but would at times be impacted by the dust and noise from OHV activity on adjacent USFS lands. This impact would be minor depending on the time of the year. Continued presence of the OHV area would pose moderate adverse impacts, by effectively precluding access to the Cinder Hills by visitors wanting longer hikes, more remote landscapes, or the opportunity to see extensive volcanic features related to Sunset Crater Volcano.

Other visual intrusions would remain, both inside the park and within the viewshed. These range from NPS facilities to distant mines, but all present moderate adverse impacts to the ability to experience a minimally altered environment. The existing visitor center would continue in

use, limiting the space available for interpretive exhibits and contributing to incomplete visitor understanding of park resources-a moderate adverse impact. As park visitation increases, crowding in this small structure would further impact visitor experience. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

#### Effects on Access to Park Resources by the General Public and for Visitors with Disabilities

Under this alternative, a new visitor center, operated jointly by the National Park Service and USFS, would be constructed near the junction of US89 and FR545 (the loop road connecting Sunset Crater Volcano with Wupatki). This facility would provide orientation for both park and forest visitors before encountering sensitive resources, and they would be directed to areas best suited for their desired activities. By providing orientation to both NPS and USFS resources, this alternative would provide a major benefit to all visitors to the region. The existing visitor center would be retained for office space and use as an education center.

Existing trails would remain as described in the No-Action Alternative, and new trails would be provided to an overlook on the O'Leary Peak Road, and connecting Bonito Campground to the Lava Flow Trail. Public road access to O'Leary Peak would be eliminated, but access to other features along FR545 would be unchanged. Actual physical access to park resources, compared with the No-Action Alternative, would not be significantly changed.

The new visitor center would be fully accessible, as would the remodeled existing visitor center. All exhibits and interpretive programs, audiovisual programs, and other facilities in both locations would be designed to serve all visitors.

A portion of the USFS road to O'Leary Peak would be converted to a hiking trail. General public vehicular access to O'Leary Peak would no longer exist. Visitors with mobility impairments would be required to get permission from the USFS to drive to the view into Sunset Crater. This would be a minor adverse impact, based on the number of vehicles that have actually traveled this route in the past and could be mitigated for all visitors through photography and exhibits.

The views from O'Leary Peak would continue to provide hikers with a regional setting for the Sunset Crater story. It would be possible to walk from the campground to the existing Lava Flow Trail through a volcanically scenic area. Otherwise, this aspect would remain as described under the No-Action Alternative, and would be a moderate, long-term benefit to visitors.

#### Effects on Access to Information Provided by Collections (Ability to See the "Real Thing") and to a Minimally Altered Environment

The new visitor center would provide space for displays of park resources,

including various rocks, plants, and animals, and would increase visitors' ability to appreciate these tangible resources. Archeological artifacts and sites from throughout the region would be interpreted, to provide context for the Sunset Crater Volcano story and offset the lack of specific archeological data from within the park. This would be a major long-term benefit to visitors.

Because this alternative would preserve the drive-through experience described in the No-Action Alternative, it is expected that most visitors would avail themselves of new interpretive waysides along the main park road. This would constitute a major beneficial impact to visitors' understanding of the park and region.

The Lava Flow and Lenox Crater Trails would continue to provide visitors firsthand experience with volcanic features. Sunset Crater could be viewed from above from a trail viewpoint along the former O'Leary Peak Road. The new trail connecting the campground to the Lava Flow Trail trailhead would add the opportunity to walk along the edge of a particularly fresh-appearing section of the lava. This would be a moderate, long-term benefit.

The new visitor center building and associated traffic and human activity would intrude on an area impacted before only by the passing road. This would be a moderate adverse impact, which could be partially mitigated by design and landscaping.

The absence of vehicles on the former O'Leary Road would add to hikers' ability to experience a minimally altered environment, although the USFS fire tower would remain at the summit. The overall effect would be a minor long-term benefit.

Location of the visitor center near US89 and preservation of the drive-through experience would decrease visitors' ability to experience natural soundscapes and could decrease chances of seeing wildlife. OHV noise at Cinder Hills Overlook would continue much as described in the No-Action Alternative. There could be minor to moderate adverse impacts on the ability of visitors to experience the scenic resources and natural soundscapes. The addition of an overlook on the O'Leary Peak Road would result in minor benefit to the ability to experience a natural soundscape.

The new visitor center, serving a larger segment of the public and located more prominently near US89, would be designed to serve large numbers without crowding, but would potentially draw a greater number of visitors into Sunset Crater Volcano. Once inside the park, these larger numbers would encounter much the same array of parking areas, trails, roadside pullouts, and so on, as described in the No-Action Alternative. The Lava Flow Trail, already identified as one of the areas where visitors feel most crowded, would become more so.

The presence of Bonito Campground would continue to allow for an overnight stay on the boundary of the park, providing the chance to view night skies and encounter crepuscular and nocturnal wildlife. Expansion of the campground would result in an increase in the numbers of people using the campground and possibly the amount of night lighting. Impacts compared with the No-Action Alternative would be negligible.

### Effects on Ability of Public to Understand Park Resources and the Regional Context of the Park

Up-to-date, expanded exhibits in the new visitor center would provide thematic interpretation of all the park's major resources and their relationship to regional resources and issues. Visitors would also gain an understanding of the regional context of the park and have an

opportunity to learn about surrounding USFS lands. After their visitor center experience, visitors would have a better understanding of what they are seeing as they visit various features in the park. This would be a major long-term beneficial impact to park visitors, and probably to more visitors than present because more people would be expected to stop at this facility in its prominent location.

The conversion of the existing visitor center to an educational center would provide new in-depth learning opportunities for visitors, especially school groups. Under this action, school groups would have an opportunity to gather their classes indoors, receive programs in an appropriate setting, and be introduced to the park's resources and regional context before venturing into the park. Other visitors would have opportunities to participate in new educational programs and workshops presented by park staff and/or USFS and other cooperating entities. The building would also house special exhibits containing artifacts from the park, and specifically directed at school groups. This would have a moderate to major long-term beneficial impact on park visitors and on resources.

Traditional interpretive services would continue as described under the No-Action Alternative. Additional guided and/or self-guided opportunities would probably be added in the vicinity of the new visitor center. Campground plans would include an upgraded amphitheater and assembly space for group educational activities; these facilities might generate increased demand for interpretive programs to serve these groups. The overall effect would be moderately beneficial.

## CUMULATIVE EFFECTS

The geographic area considered for cumulative effects for this alternative includes the Flagstaff Area National Monuments, the greater Flagstaff area, and the most adjacent portions of the Coconino National Forest.

In addition to the impacts described above, external forces and actions of other entities could affect visitor ability to experience park resources in this alternative. Primary sources of these additional impacts are the USFS, Grand Canyon National Park, Arizona Department of Transportation (ADOT), local developers, local residents, and resource-related industries. Additional detail follows for each.

USFS management within the area of consideration could work in combination to increase total visitation to Sunset Crater Volcano. These include:

- forest closures and/or increasing restrictions, fire hazard closures, and similar changes could direct some visitors to the park.
- USFS "Company's Coming" program and campground expansion could increase interest in visiting nearby park facilities.
- Cooperative management of the multiagency visitor center could spread visitor use more evenly over facilities and features of both agencies.

Increased visitation for any of these reasons would impact uncrowded visitor experiences within the park, probably to a minor degree at any given time. Increased visitation to the park could be offset by increased use of the forest by traditional park visitors. In this alternative, a moderate adverse impact would be expected from NPS actions. The cumulative impact would remain moderate and adverse.

Changes in visitor use patterns and transportation at Grand Canyon National Park could result in visitation changes at Sunset Crater Volcano:

- visitation could increase, especially by those seeking the independent drive-

through experience no longer available at Grand Canyon.

- visitors arriving from Grand Canyon could have more time to spend, because of traffic management there.

Increased visitation and/or increased length of stay would impact uncrowded visitor experiences within the park, probably to a minor degree. In this alternative, a moderate adverse impact would be expected from NPS actions. The cumulative impact would remain major and adverse. Increased length of stay by visitors would also impact ability to understand park resources, since these visitors would probably devote more time to visitor center exhibits, wayside exhibits, interpretive programs, or otherwise learning about the park. In this alternative, a moderate to major benefit would be expected from NPS actions. The cumulative effect would be the same.

Widening of US89 by the Arizona Department of Transportation will result in a four-lane highway north from Flagstaff to both Sunset Crater Volcano and Wupatki entrances, and this level of improvement will eventually extend all the way to Page, Arizona. This could increase park visitation because of time saved en route on the improved highway, and/or because of visitors seeking a more scenic and leisurely route (FR545 through the two parks). Visitors might also be willing to spend more time exploring the park. Impact on uncrowded visitor experiences would be minor, and the cumulative effect would be major and adverse, as described above.

Development of Roden Crater and the subdivision of lots in Alpine Ranchos may increase traffic through the park. This increased traffic would only occasionally result in increased visitation to park resources and facilities, and impact on uncrowded visitor experiences would be negligible.

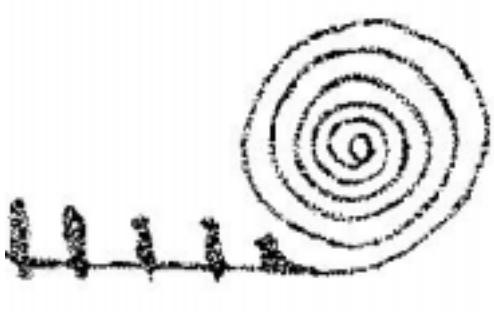
Increased growth of Flagstaff could increase park visitation by local residents, and the number of repeat visits could increase as residents return for more information and/or additional experiences. The use of park resources for traditional recreational activities (biking, hiking, etc.) could increase.

Increased visitation would impact uncrowded visitor experiences as described above, probably to a minor degree. Cumulative impact would be major and adverse. Repeat visits could impact demand for traditional employee/visitor experiences and encourage more variety in interpretive programs offered. In this alternative, this would be a moderate benefit to visitors. Cumulative impact would remain the same. In this alternative, for traditional recreational uses, impacts ranging from major adverse to minor beneficial are expected. Additional such activities would be of negligible impact. Cumulative impacts would remain the same.

Under this alternative, cumulative impacts of NPS and external actions would cause no measurable change to visitor ability to experience park resources.

## CONCLUSION

This alternative would provide major benefits to both park and forest visitors seeking comprehensive information on and interpretation of regional resources and recreational opportunities. Construction of a multiagency visitor center with new exhibits, conversion of the existing visitor center to an education center, and installation of new wayside exhibits would provide major benefits to visitor understanding of resources and the ability to see the "real thing." Benefits of accessibility would remain similar to those identified under the No-Action Alternative. Ability to experience scenery would be enhanced slightly and would remain a major benefit to visitors.



Traditional interpretive programs would continue as a moderate benefit, and new programs would be offered, using facilities of the new visitor center, education center, and expanded campground.

The types and degrees of impact by the OHV area would be unchanged from those described under the No-Action Alternative. Lack of opportunities to experience longer hikes and more remote volcanic vistas, natural soundscapes, and a minimally altered environment would remain moderate, adverse impacts.

The new visitor center, despite its major benefits to visitor understanding, would present the possibility of moderate adverse impacts on uncrowded visitor experiences, by funneling greater numbers into existing parking areas and trails. This effect would be accentuated at times by the presence of greater numbers and organized groups in the campground. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

#### Effects on Access to Park Resources by the General Public and Visitors with Disabilities

Under this alternative, visitors would experience many of the same resources of Sunset Crater Volcano as they do presently but in a markedly different way than they do under the No-Action Alternative. Entry to the park would be via a new road system using FR776; portions of the existing entrance road (FR545) would become dead-end spurs to Bonito Park and the Lava Flow Trail. Although visitors could rejoin FR545 east of the park and continue on to Wupatki, the visit would no longer be a drive-through experience; Sunset Crater Volcano would be a separate destination that would be closed at night. These changes would have a moderate beneficial impact on park visitors for those who were interested in Sunset Crater as a destination, and a moderate adverse impact for those who would include it as part of a trip itinerary.

A new visitor center, operated jointly by NPS and USFS, would be constructed south of the volcano, to provide an introduction to the resources of Coconino National Forest and of both Wupatki and Sunset Crater Volcano national monuments before visitors encounter them. Bonito Campground would be relocated nearby, and its existing location would be rehabilitated. The existing visitor center and related support facilities would be removed and their sites rehabilitated. Impacts would be moderate, long term, and beneficial to visitors and resources.

The Lava Flow and Lenox Crater Trails would remain as described under the No-Action Alternative, and a portion of the former O'Leary Peak Road would be open as a hiking trail. A portion of existing FR545 beyond the Lava Flow Trail would be converted to a hiking trail, providing lava flow vistas that cannot now be safely enjoyed because of road traffic. A new trail would be constructed in Bonito Park, providing access to Bonito Park itself, the ponderosa forest along its edge, and at least one unexcavated pithouse. Effects would be moderate, long term, and beneficial.

Much of the Sunset Crater Volcano experience would be available for visitors with physical and other impairments. The new visitor center would be fully accessible to visitors with all types of disabilities. All exhibits, interpretive programs, and audiovisual programs would be designed to serve all visitors, which would be a moderate long-term benefit.

Road access for the general public to O'Leary Peak would no longer exist. Visitors with mobility impairments would need permission from the USFS to drive to a view into Sunset Crater Volcano. This would be a negligible, long-term adverse impact, based on the number of vehicles that have actually traveled this route in the past, and might be mitigated for all visitors through photography and exhibits.

The conversion of road to trail beyond the Lava Flow Trail would be designed for full accessibility, as would the new Bonito Park trail.

Converting part of FR545 from road to trail would allow visitors to stop and see the beauty of a large segment of the lava flow and up-close views of the sides of the volcano in a way that is not possible under existing conditions. Excellent views would be available from the new Bonito Park Trail as well. Views from O'Leary Peak would provide hikers with a regional setting for the Sunset Crater Volcano story. Visitors continuing on FR545 to Wupatki would experience the same vistas, vegetation changes, and geologic features they do now. The impact of these changes would be a major, long-term benefit.

OHV users would be impacted by closure of the area north of FR776 to vehicle recreation and camping. Impact would be moderate and long term and could be partially mitigated by relocating these uses outside park boundaries. Continued OHV activity south of FR776 would preclude exploration of the cinder hills by hikers, and this would remain a moderate adverse impact them.

Depending on future visitation increases, this alternative would allow management of numbers entering the park, through a shuttle and/or reservation system. Should this occur, personal freedoms might be restricted at times, resulting in moderate to major impacts. (These impacts would be offset by continued benefits of uncrowded experiences described previously.)

This alternative would provide greater opportunities for hiking and biking than would the No-Action Alternative, which would be a moderate, long-term benefit to park visitors.

The campground would be moved to a new location. This would be a moderate adverse impact to some campers who use the existing site.

### Effects on Access to Information Provided by Collections (Ability to See the "Real Thing") and to a Minimally Altered Environment

The new visitor center would allow views of Sunset Crater Volcano and space for exhibits of park resources, including rocks, plants, and animals, and would increase visitors' ability to appreciate these tangible resources. Archeological artifacts and sites from throughout the region would be interpreted, to provide context for the

Sunset Crater Volcano and Wupatki stories and offset the lack of specific archeological data from within the park. This would be a major long-term benefit to visitors.

Elimination of vehicle traffic on FR545 beyond the Lava Flow Trail and conversion to a hiking trail would allow spectacular views of the flanks of the volcano and the Bonito Lava Flow that are unattainable under existing conditions. These views would illustrate the extent of the lava flow and demonstrate the return of life to the volcano and its environs. The Lava Flow and Lenox Crater Trails would continue to provide firsthand experience with volcanic features, and Sunset Crater Volcano could be viewed from above from the former O'Leary Peak Road. Additional experiences to explore resources would be provided at Bonito Park and in the vicinity of the new visitor center. Overall, these would be moderate benefits.

This alternative would remove administrative and visitor facilities from the heart of the park and provide for rehabilitation of impacted resources. Because the road would no longer cut through prime park resources, visitors would have enhanced opportunities to experience a more natural appearing condition, especially in Bonito Park, along portions of FR545 that would be converted to trail, and in all areas that would be rehabilitated to remove evidence of past use. Chances of viewing park wildlife would probably increase. This would be a moderate benefit to park visitors.

Rehabilitation of heavily used areas would remove some of the intrusions described in the No-Action Alternative, such as erosion damage, social trails, and trampled vegetation. Major scars would remain on the volcano and within the viewshed, including the old summit trail and evidence of logging, fire suppression, and mining. However, the overall effect of these remaining intrusions under this alternative would become a minor adverse impact to visitors.

The new visitor center building and associated traffic and human activity would intrude on an area that was formerly less impacted. This would be a moderate adverse impact, which could be partially mitigated by design and landscaping.

The absence of vehicles on the former O'Leary Peak Road would add to hikers' ability to experience a minimally altered environment, although the USFS fire tower would remain at the summit. The overall effect would be a minor benefit.

OHV use would be removed from the area north of FR776, in the vicinity of the new visitor center, and this area would be rehabilitated to lessen evidence of prior use. Abundant evidence of ongoing use would remain south of FR776 and, because of the proximity to a primary visitor use area, would be a more apparent part of the landscape than under the No-Action Alternative. The impact would be moderate, long term, and adverse.

Although some amount of OHV use would be removed, the most heavily used areas are south of FR776, and associated moderate long-term impacts would remain.

In this alternative, the park would probably feel less crowded, because of the elimination of the drive-through experience. Most visitor experiences would occur along dead-end spur roads and along trails, rather than along FR545. This would result in a moderate to major benefit to park visitors.

This alternative would have no effect on visibility of night skies within the park, because it would be closed and gated at night. The experience would be essentially unchanged for campers, although camping would be relocated from the existing Bonito Campground to the new

campground near the new visitor center. Impact would be negligible to none.

Elimination of through-traffic in the park would increase visitors' ability to experience natural soundscapes at almost all major features, which would be a major beneficial impact to park visitors. The new visitor center, however, would be noticeably noisier, owing to its proximity to the OHV area. This would probably be a minor impact, given normal parking lot noise and activity levels, and could be mitigated by design and landscaping.

Because the new campground would be near the OHV area, it would be a noisier place to camp than the existing Bonito Campground. This would be a minor adverse impact on visitors, because the majority of park visitors would not be camping.

### Effects on Ability of Public to Understand Park Resources and Regional Context

Up-to-date and expanded exhibits in the new visitor center would provide thematic interpretation of all of the park's major resources and their relationship to regional resources and issues. Visitors would also gain an understanding of the regional context of the park and have an opportunity to learn about surrounding USFS lands. After their visitor center experience, visitors would have a better understanding of what they are seeing and the extent to which eruptive events have changed the landscape of the area. They would be assisted by new wayside exhibits, which would provide new opportunities for learning about the park along the way. Since most visitors would probably rejoin FR545 and continue to Wupatki as they do now, new wayside exhibits would interpret the natural and culture resources that link the two parks. This would be a major beneficial impact to park visitors.

Traditional interpretive services would continue, including guided walks at major features and evening programs at the campground. Additional opportunities would exist for formal interpretive talks and other programs at the new visitor center, which would include indoor space to assemble groups. This would be a moderate benefit.

## CUMULATIVE EFFECTS

The geographic area considered for cumulative effects for this alternative includes the Flagstaff Area National Monuments, the greater Flagstaff area, and the most adjacent portions of the Coconino National Forest.

In addition to the impacts described above, external forces and actions of other entities could affect visitor ability to experience park resources in this alternative. Primary sources of these additional impacts are the USFS, Grand Canyon National Park, Arizona Department of Transportation (ADOT), local developers, local residents, and resource-related industries. Additional detail follows for each.

USFS management within the area of consideration could work in combination to increase total visitation to Sunset Crater Volcano. These include:

- forest closures and/or increasing restrictions, fire hazard closures, and similar changes could transfer some visitors to the park.
- USFS "Company's Coming" program and campground expansion could increase interest in visiting nearby park facilities.
- Cooperative management of the multiagency visitor center could spread visitor use more evenly over facilities and features of both agencies.

Increased visitation for any of these reasons would impact uncrowded visitor experiences within the park, probably to a

minor degree at any given time. Increased visitation to the park could be offset by increased use of the forest by traditional park visitors. In this alternative, a moderate to major benefit is expected from NPS actions. The cumulative impacts would remain the same.

Changes in visitor use patterns and transportation at Grand Canyon National Park could result in visitation changes at Sunset Crater Volcano:

- visitation could increase, especially by those seeking the independent drive-through experience no longer available at Grand Canyon.
- visitors arriving from Grand Canyon could have more time to spend, because of traffic management there (no stops at viewpoints).

Increased visitation and/or increased length of stay would impact uncrowded visitor experiences within the park, probably to a minor degree. In this alternative, a moderate to major benefit is expected from NPS actions. The cumulative impact would remain the same. Increased length of stay by visitors would also impact ability to understand park resources, since these visitors would probably devote more time to visitor center exhibits, wayside exhibits, interpretive programs, or otherwise learning about the park. In this alternative, a major benefit is expected from NPS actions. The cumulative effect would be the same.

Widening of US89 by ADOT will result in a four-lane highway north from Flagstaff to both Sunset Crater Volcano and Wupatki entrances, and this level of improvement will eventually extend all the way to Page, Arizona. This could increase park visitation because of time saved en route on the improved highway, and/or to visitors seeking a more scenic and leisurely route (FR545 through the two parks). Visitors might also be willing to spend more time exploring the park. Impact on uncrowded visitor experiences would be minor. The cumulative effect would be the same as described above.

Local development of Roden Crater and the subdivision of lots in Alpine Ranchos may increase traffic through the park. This increased traffic would only occasionally result in increased visitation to park resources and facilities, and impact on uncrowded visitor experiences would be negligible. The cumulative impact would be major and adverse, as described above.

Increased growth of Flagstaff could increase park visitation by local residents, and the number of repeat visits could increase as residents return for more information and/or additional experiences. The use of park resources for traditional recreational activities (biking, hiking, etc.) could increase.

Increased visitation would impact uncrowded visitor experiences as described above, probably to a minor degree. Cumulative impact would be major and adverse. Repeat visits could impact demand for traditional employee/visitor experiences and encourage more variety in interpretive programs offered. In this alternative, this would be a moderate benefit to visitors. Cumulative impact would remain the same. In this alternative, for traditional recreational uses, impacts ranging from minor adverse to moderate beneficial are expected. Additional such activities would be of negligible impact. Cumulative impacts would remain the same.

Under this alternative, cumulative impacts of NPS and external actions would cause no measurable change to visitor ability to experience park resources.

## CONCLUSION

This alternative would provide major benefits to both park and forest visitors seeking comprehensive information on and interpretation of regional resources

and recreational opportunities. It would be of particular benefit to park visitors wanting to experience resources in a quieter, more pristine environment, because facilities would be removed from the heart of the park, and the drive-through experience would be eliminated.

Construction of a new multiagency visitor center would provide major benefits to visitor understanding of resources and the ability to see the "real thing." Changes to the road system, rehabilitation of disturbed areas, and construction of new trails would provide access to a greater variety of natural and cultural resources, while enhancing ability to experience scenery and a less altered environment. In most areas of the park, natural soundscapes would be enhanced, because of the lack of passing traffic, and visitors would feel less crowded. These benefits would extend to visitors with disabilities, since facilities and most trails would be designed for full accessibility. Traditional interpretive programs would continue as a moderate benefit, with additional opportunities at the new visitor center and campground.

This alternative would result in moderate adverse impacts by continuing to limit access to volcanic resources closely related to park significance but located outside park boundaries. Types and degrees of OHV impact would remain similar to those described in the No-Action Alternative and would vary from minor to major at different times. Visitor awareness of OHV impacts would increase, because of the location of the new visitor center and campground nearby. There could be moderate adverse impacts on personal freedoms in the future, if reservation or shuttle systems were implemented to control numbers of visitors. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

#### Effects on Access to Park Resources by the General Public and Visitors with Disabilities

Under this alternative, a new visitor center, operated jointly by the National Park Service and USFS, would be constructed near the junction of US89 and FR545. This facility would provide orientation for both park and forest visitors, thus improving both awareness of and access to resources. Visitors would receive this information before encountering sensitive resources and would be directed to areas best suited for their desired activities. The existing visitor center would be converted to an education center. By providing improved orientation to both NPS and USFS resources, this alternative has a major benefit to visitors.

Existing trails would remain as described under the No-Action Alternative, and two new trails would be provided: the former road to O'Leary Peak would provide access to a viewpoint, and a trail would be built connecting Bonito Campground to the

Lava Flow Trail. Access to features along FR545 would be unchanged, and the drive-through experience would be retained. A Discovery Zone would be designated in which visitors could hike without a guide, with greater opportunities for natural quiet, solitude, and undisturbed scenery. The overall impact would be a moderate benefit to visitors.

OHV use would be eliminated from the Cinder Hills area within the expanded park boundary. The Cinder Hills contain highly significant resources related to the stories of geology and ecology at Sunset Crater Volcano, which would become available via new hiking trails. This would be a moderate long-term benefit to park visitors.

The new visitor center would be fully accessible to visitors with disabilities, as would the remodeled existing visitor center/education center. All exhibits, interpretive programs, audiovisual programs, and other facilities in both locations would be designed to serve all visitors.

Public road access to O'Leary Peak would no longer exist, and visitors with mobility impairments would require permission from the USFS to drive to a viewpoint overlooking Sunset Crater Volcano. This would be a negligible adverse impact, based on the number of vehicles that have actually traveled this route in the past, and could be mitigated for all visitors through photography and exhibits.

New trails would be constructed for accessibility to the extent possible. Because of terrain, trails into the Cinder Hills probably could not be made accessible; however, new wayside exhibits at the Cinder Hills Overlook would provide interpretation of the entire Sunset Crater volcanic chain, emphasizing features within the viewshed. This would be a minor, long-term benefit.

The presence of the new visitor center near the edge of Bonito Park would open new vistas to more of the visiting public. The views from the overlook on the former O'Leary Peak Road would provide hikers with a regional setting for the Sunset Crater Volcano story. It would be possible to walk from the campground to the existing Lava Flow Trail through a volcanically scenic area, which would constitute a minor benefit.

The scenic quality of Cinder Hills Overlook would be improved because of the removal of OHV use and associated dust. This would be a moderate long-term benefit.

The new visitor center, serving a larger segment of the public and located more prominently near US89, would be designed to serve large numbers without crowding, but would potentially draw a greater number of visitors into Sunset Crater Volcano. Once inside the park, these larger numbers would encounter much the same array of parking areas, trails, roadside pullouts, and so on, as described in the No-Action Alternative. The Lava Flow Trail, already identified as one of the areas where visitors feel most crowded, would become more so. New hiking trails into the Cinder Hills would disperse some of this use, especially for those seeking a longer, more challenging experience.

OHV users would be adversely impacted by closure of a large portion of the Cinder Hills OHV Area. Impact would be moderate, based on number of OHV users as a percentage of total park visitors. However, it would impact the majority of OHV users who have used this formally designated area. Many OHV users would probably seek other areas of the forest to relocate their recreational opportunities, which would remain subject to regulation by the USFS. For other park visitors, previously denied the opportunity to hike safely within the Cinder Hills, personal

freedom would be increased. This would be a moderate benefit.

Hiking opportunities would be greatly expanded in this alternative, providing moderate long-term benefits. Expansion of the campground would provide more people, and larger groups, the opportunity to camp near the park. Formalizing a trail from the campground to the Lava Flow Trail would expand recreational opportunities for hikers; especially those based in the campground. This would be a minor beneficial impact.

This alternative would have major, long-lasting effect on OHV recreational uses in the Cinder Hills area. Approximately 4,000 acres would be removed from the 15,000-acre OHV area and would become part of the park. This acreage contains some of the highest use areas of the Cinder Hills and includes the most challenging recreational experiences in the OHV area. This would be a minor impact based on number of OHV users; however, this action would impact the majority of OHV users of this designated area.

### Effects on Access to Information Provided by Collections (Ability to See the "Real Thing") and a Minimally Altered Environment

The new visitor center would provide space for displays of park resources, including various rocks, plants, and animals, and would increase visitors' ability to appreciate these tangible resources. Archeological artifacts and sites from throughout the region would be interpreted, to provide context for the Sunset Crater Volcano story and offset the lack of specific archeological data from within the park. This would be a major benefit to visitors.

Because this alternative would preserve the drive-through experience described in the No-Action Alternative, it is expected that most visitors would avail themselves of new interpretive waysides along the main park road. This would constitute a major beneficial impact to visitors' understanding of the park and region.

Lava Flow and Lenox Crater Trails would continue to provide firsthand experience with volcanic features, and Sunset Crater could be viewed from above from the new O'Leary Peak Trail. Depending on the selected route, the new trail connecting the campground to the Lava Flow Trail trailhead, could add the opportunity to walk along the edge of a particularly fresh-appearing section of the lava. Guided hikes would be considered for the Kana-A lava flow, where many significant lava flow structures are in evidence (delicate squeeze-ups, hornitos, lava bubbles, and pahoehoe lava). Here, visitors could experience the "real thing" and a minimally affected environment within a short distance of the main park road. Benefits would be moderate and long term.

Elimination of OHV use from the Cinder Hills within expanded park boundaries would allow park visitors a new opportunity to experience firsthand this significant part of the geological story of Sunset Crater. This would be a moderate benefit to park visitors.

Rehabilitation of the impacts on the Cinder Hills would eventually provide visitors with an opportunity to view areas in which succession is actively progressing and to witness a natural rate of erosion. The large landscape features that constitute a major portion of the Sunset Crater volcanic chain would be restored to a more natural appearance. Visitors could also view a minimally altered environment from the Cinder Hills Overlook. The overall impact would be a long-term moderate benefit to visitors.

The new visitor center building and associated traffic and human activity would intrude on an area previously impacted only by the passing road. This would be a moderate adverse impact, which could be partially mitigated by design and landscaping.

The absence of vehicles on the former O'Leary Peak Road would add to hikers' ability to experience a minimally altered environment, although the USFS fire tower would remain at the summit. The overall effect would be a negligible to minor benefit.

The presence of Bonito Campground would continue to allow for an overnight stay on the boundary of the park, providing the chance to view night skies and encounter crepuscular and nocturnal wildlife. Expansion of the campground would result in an increase in the numbers of people using the campground, and possibly the amount of night lighting. Impact compared with the No-Action Alternative would be negligible.

Location of the visitor center near US89 and preservation of the drive-through experience would decrease visitors' ability to experience natural soundscapes and could decrease chances of seeing wildlife. Conversion of the O'Leary Peak Road to a hiking trail would result in negligible to minor benefits in appreciation of the natural soundscape. Even as part of a guided group, visitors would find the Kana-A lava flow a very quiet section of the volcanic landscape; although only a short distance from FR545, road noise would be negligible. In areas designated as Discovery Zone, solitary hiking in natural soundscapes would predominate. Because of the elimination of OHV traffic, visitors' ability to experience natural soundscapes in the Cinder Hills area would increase significantly. This would be a moderate beneficial impact to park visitors both at the overlook and along hiking trails.

### Effects on Ability of Public to Understand Park Resources and Regional Context

Up-to-date exhibits in the new visitor center would provide thematic interpretation of all of the park's major resources and their relationship to regional resources and issues. Visitors would also gain an understanding of the regional context of the park and have an opportunity to learn about surrounding USFS lands. After their visitor center experience, visitors would have a better understanding of what they are seeing as they visit various features in the park. They would be assisted by new wayside exhibits, which would provide new opportunities for learning about the park along the way. This would be a major beneficial impact to park visitors and probably to more visitors, because more people would be expected to stop at this facility in its prominent location.

The conversion of the existing visitor center to an educational center would provide new in-depth learning opportunities for park visitors, especially school groups. Under this action, school groups would have an opportunity to gather their classes indoors, receive programs in an appropriate setting, and be introduced to the park's resources and regional context before venturing into the park. The building would also house special exhibits containing artifacts from the park and specifically directed at school groups. Other user groups could also benefit, because the building could be opened to general visitation and for interpretive programs as well. This would have a moderate beneficial impact on park visitors and on resources.

Visitors to the Cinder Hills Overlook, and those hiking in that area, would gain a more complete understanding of the events that constitute the Sunset Crater Volcano story, through opportunities to view intact cinder cones and a broad

volcanic scene. These elements of the landscape surrounding Sunset Crater constitute the beginning of Sunset Crater Volcano's story. This would be a moderate benefit.

## CUMULATIVE EFFECTS

The geographic area considered for cumulative effects for this alternative includes the Flagstaff Area National Monuments, the greater Flagstaff area, and the most adjacent portions of the Coconino National Forest.

In addition to the impacts described above, external forces and actions of other entities could affect visitor ability to experience park resources in this alternative. Primary sources of these additional impacts are the USFS, Grand Canyon National Park, Arizona Department of Transportation (ADOT), local developers, local residents, and resource-related industries. Additional detail follows for each.

USFS management within the area of consideration could work in combination to increase total visitation to Sunset Crater Volcano. These include:

- forest closures and/or increasing restrictions, fire hazard closures, and similar changes could transfer some visitors to the park.
- USFS "Company's Coming" program and campground expansion could increase interest in visiting nearby park facilities.
- Cooperative management of the multiagency visitor center could spread visitor use more evenly over facilities and features of both agencies.

Increased visitation for any of these reasons would impact uncrowded visitor experiences within the park, probably to a minor degree at any given time. Increased visitation to the park could be offset by increased use of the forest by traditional park visitors. In this alternative, a minor to moderate adverse impact is expected from NPS actions. The cumulative impact would remain the same.

Changes in visitor use patterns and transportation at Grand Canyon National Park could result in visitation changes at Sunset Crater Volcano:

- visitation could increase, especially by those seeking the independent drive-through experience no longer available at Grand Canyon.
- visitors arriving from Grand Canyon could have more time to spend, because of traffic management there (no stops at viewpoints).

Increased visitation and/or increased length of stay would impact uncrowded visitor experiences within the park, probably to a minor degree. In this alternative, a minor to moderate adverse impact is expected from NPS actions. The cumulative impact would remain the same. Increased length of stay by visitors would also impact ability to understand park resources, since these visitors would probably devote more time to visitor center exhibits, wayside exhibits, interpretive programs, or otherwise learning about the park. In this alternative, moderate and major benefits are expected from NPS actions. The cumulative effect would be the same.

Widening of US89 by ADOT will result in a four-lane highway north from Flagstaff to both Sunset Crater Volcano and Wupatki entrances, and this level of improvement will eventually extend all the way to Page, Arizona. This could increase park visitation because of time saved en route on the improved highway, and/or to visitors seeking a more scenic and leisurely route (FR545 through the two parks). Visitors might also be willing to spend more time exploring the park. Impact on uncrowded visitor experiences would be minor, and the cumulative effect would be the same as described above.

Local development of Roden Crater and the subdivision of lots in Alpine Ranchos may increase traffic through the park. This increased traffic would only occasionally result in increased visitation to park resources and facilities, and impact on uncrowded visitor experiences would be negligible. The cumulative impact would remain minor to moderate adverse.

Increased growth of Flagstaff could increase park visitation by local residents and the number of repeat visits could increase as residents return for more information and/or additional experiences. The use of park resources for traditional recreational activities (biking, hiking, etc.) could increase.

Increased visitation would impact uncrowded visitor experiences as described above, probably to a minor degree. Cumulative impact would be major and adverse. Repeat visits could impact demand for traditional employee/visitor experiences and encourage more variety in interpretive programs offered. In this alternative, this would be a moderate benefit to visitors. Cumulative impact would remain the same. In this alternative, for traditional recreational uses, impacts ranging from minor adverse to major beneficial are expected from NPS actions. Additional such activities would be of negligible impact. Cumulative impacts would remain the same.

Under this alternative, cumulative impacts of NPS and external actions would cause no measurable change to visitor ability to experience park resources.

## CONCLUSION

This alternative would result in major benefits to both park and forest visitors seeking comprehensive information on and interpretation of regional resources and recreational opportunities. It would be of particular benefit to park visitors wanting to explore the full range of volcanic features significant to the story of Sunset Crater Volcano.

Construction of a new multiagency visitor center, conversion of the existing visitor center to an education center, and installation of new wayside exhibits would provide major benefits to visitor understanding of resources and the ability to see the "real thing." New longer trails would provide access to a full range of features, including intact cinder cones, volcanic vents, lava bombs, and the broad volcanic scene within the Cinder Hills, which make up the beginning of the Sunset Crater Volcano story. Rehabilitation of resources damaged by OHV use would provide major long-term benefits to visitors' ability to experience a minimally altered environment, and natural sounds would prevail, both along trails and at the Cinder Hills Overlook. Traditional interpretive programs would continue as a moderate benefit, and new programs would be offered, using facilities of the new visitor center, education center, and campground. Additional guided hikes might be offered into the Kana-A lava flow, an area not available under the No-Action Alternative. Access for visitors with disabilities would be similar to that described for the No-Action Alternative. All facilities and existing trails would remain accessible, but, because of terrain, the Cinder Hills experience would probably be available only from the overlook.

This alternative would result in long-term adverse impacts to OHV recreational users. Approximately 25% of the designated OHV area would be removed from use, including some of the most heavily used routes. Impacts would be minor by definition (the number of OHV users represents approximately 15% of park visitation), but would affect the majority of those users.

The new visitor center, despite its major benefits to visitor understanding, would present the possibility of moderate

adverse impacts on uncrowded visitor experiences, by funneling greater numbers into the park. This effect would be accentuated at times by the presence of greater numbers and organized groups in the campground. However, the new access to the Cinder Hills would disperse some of this use from existing developed areas. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

Because there would be no major adverse impacts to resources whose conservation is (1) necessary to fulfill specific purposes in the establishing legislation or proclamation for Sunset Crater Volcano National Monument; (2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or (3) identified as a goal in relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

## Irreversible/Irretrievable Commitments of Resources

There would be no irreversible or irretrievable commitments of resources.

## Loss in Long-Term Availability or Productivity of the Resource to Achieve Short-Term Gain

There would be no short-term gains affecting long-term productivity.

## Unavoidable Adverse Impacts

The No-Action Alternative would result in major adverse impacts to visitor experience by continuing to limit access to volcanic resources closely related to park significance but located outside park boundaries. Distant views of some such features would remain available from the Cinder Hills Overlook, but would at times be impacted by the dust and noise from OHV activity on adjacent USFS lands. This impact would vary from minor to major at different times of the year. Continued presence of the OHV area would pose moderate adverse impacts, by effectively precluding access to the Cinder Hills by visitors wanting longer hikes, more remote landscapes, or the opportunity to see extensive volcanic features related to Sunset Crater Volcano.

Other visual intrusions would remain, both inside the park and within the viewshed. These range from NPS facilities to distant mines, but all present moderate adverse impacts to the ability to experience a minimally altered environment. The existing visitor center would continue in use, limiting the space available for interpretive exhibits and contributing to incomplete visitor understanding of park resources-a major adverse impact. As park visitation increases, crowding in this small structure would further impact visitor experience.

Alternative 1 would result in moderate adverse impacts to visitor experience by continuing to limit access to volcanic resources closely related to park significance but located outside park boundaries. The types and degrees of impact by the OHV area would be unchanged from those described in the No-Action Alternative. Lack of opportunities to experience longer hikes and more remote volcanic vistas, natural soundscapes, and a minimally altered environment would remain moderate adverse impacts. The new visitor center, despite its major benefits to visitor understanding, would present the possibility of moderate adverse impacts on uncrowded visitor experiences, by funneling greater numbers into existing parking areas and trails. This effect would be accentuated at times by the presence of greater numbers and organized groups in the campground.

Alternative 2 would result in major adverse impacts by continuing to limit

access to volcanic resources closely related to park significance but located outside park boundaries. Although the area available for OHV use would be modified somewhat, there would still be moderate adverse impacts to visitor ability to experience the volcanic features and remote vistas of the Cinder Hills. Types and degrees of OHV impact would remain similar to those described in the No-Action Alternative and would vary from minor to major at different times. Visitor awareness of OHV impacts would increase, owing to the location of the new visitor center and campground nearby.

Alternative 3 would result in moderate long-term adverse impacts to OHV recreational users. Approximately 25% of the designated OHV area would be removed from use, including some of the most heavily used routes. The new visitor center, despite its major benefits to visitor understanding, would present the possibility of moderate adverse impacts on uncrowded visitor experiences, by funneling greater numbers into the park. This effect would be accentuated at times by the presence of greater numbers of people and organized groups in the campground. However, the new access to the Cinder Hills would disperse some of this use from existing developed areas.

# PARK NEIGHBORS; LOCAL, STATE, AND TRIBAL LAND MANAGEMENT PLANS; AND LAND/RESOURCE MANAGING AGENCIES

## Methodology

Concerns covered by this section include effects on neighbors' access and emergency response, economic contribution of the park to local economies, access to culturally sensitive areas by traditional users, traditional land uses external to the boundary, and possible conflicts between the proposed action and local, state, or Indian tribal land use plans, policies, or controls. Levels of intensity of impacts on park neighbors are as follows.

Negligible: The impact is barely detectable and/or will affect few neighbors.

Minor: The impact is slight, but detectable, and/or will affect a minority of neighbors.

Moderate: The impact is readily apparent and/or will affect many neighbors.

Major: The impact is severely adverse or exceptionally beneficial and/or will affect the majority of neighbors.

## Effects of the No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

Many impacts resulting from this alternative would be of a beneficial nature to NPS neighbors and other land and resource managers. Maintaining FR545 as an always open road would have major, long-term benefits to forest users, to the residents living between the two monuments, and to those traveling to the Navajo Reservation via Wupatki National Monument.

Cooperative efforts with the Arizona Game and Fish Department are focused on preserving wildlife and habitat, which results in minor, long-term adverse impacts to that agency in terms of wildlife management workloads relative to cooperative field and administrative work with the NPS.

Cooperative efforts with the USFS have major, long-term, beneficial impacts on their campground operations by providing water and interpretive services. Cooperative law enforcement activities provide moderate, long-term beneficial impacts to the USFS. The NPS is available

to respond to wildfire situations in the immediate area pending the availability of USFS personnel, resulting in moderate, long-term, beneficial, impacts to that agency.

Visitor use of a portion of the O'Leary Peak Road to reach a viewpoint to see into the bowl of Sunset Crater would have minimal, long-term, adverse impacts on American Indian groups using the area for traditional, cultural purposes.

Although this alternative accommodates American Indian access to park resources, any increases in visitor numbers and activities in the monument and on adjacent forest lands could have minor, long-term, adverse impacts on tribal members because of increased contacts with others when accessing traditional use areas.

Occasionally, visitors are directed to areas of the Forest to pursue recreational activities not allowed in the monument, but provided for in nearby locations. This could result in minor, short-term adverse impacts to Forest Service workloads in terms of visitor use management activities.

The Forest Service is involved in a major planning effort for a large area adjacent to or surrounding the Flagstaff National Monuments. This plan, the Flagstaff Lake Mary Ecosystem Analysis (FLEA) is addressing several topics, including recreational opportunities, access, roads, off-highway vehicles, trails, forest health, camping, groups uses, special events, outfitter/guides, minerals withdrawals, snow play sites, motocross and commercial uses. The National Park Service is a participant in this planning activity and will represent concerns that arise from proposals that affect areas near the monuments. The National Park Service review and recommendations of the FLEA could result in minor, short-term impacts to Forest Service administrative and writing workloads. National Park Service input would be directed at resource preservation, land and resource uses, and appropriate visitor uses and recreational activities that do not result in adverse impacts to the monuments. Such input could result in moderate, long-term impacts to the Forest Service relative to FLEA elements that could address protection of park resources, vistas and natural sounds.

## CUMULATIVE EFFECTS

The geographic area considered in this alternative includes the city of Flagstaff on the south, the Coconino Plateau Natural Reserve Lands (CPNRL) on the north, US89 on the west, the Little Colorado River at Wupatki, the eastern limits of the Cinder Hills Off Highway Vehicle Recreation Area at Sunset Crater Volcano, and the lands generally enclosed by these landmarks.

Planning efforts by the Forest Service could result in both beneficial and adverse impacts to forest users in areas near the monument by restricting some uses and expanding others. Activities taken by the state in widening US89 also affect USFS activities in the area. Increasing population in Alpine Ranchos would increase pressure on USFS for demand for recreational opportunities for these nearby residents. Expansion of the city of Flagstaff would also increase recreational demand pressures. These actions would result in moderate, short- and long-term, adverse impacts to the USFS, as they have to accommodate increasing numbers of resource users.

The existing cooperative relationship between the NPS and the other land and resource managing agencies should result in short- and long-term beneficial impacts though shared visitor/user services and resource management.

Cooperative efforts with the Forest Service would continue to produce moderate, long-term, beneficial impacts in law enforcement, resource management,

wildfire management, protection, and visitor services. Parallel planning by the NPS and the Forest Service, and the involvement of each agency in the other's planning efforts will have minor, short-term, adverse impacts to the Forest Service workloads resulting from their participation in NPS planning, and their accommodation of NPS participation in their planning.

Arizona Game and Fish Department activities in the geographic area would consist of management actions to enhance forage available to game animals and to enhance the populations of those animals. Their actions would have minor, beneficial long-term impacts to other neighbors and land managers in the form of a healthier animal population; more productive game hunts, and increases in wildlife viewing opportunities.

Development of Roden Crater as a major tourist attraction would increase traffic and could create more congestion, increasing the commute time for Alpine Rancho residents. This would result in a minor, long-term adverse effect on those residents.

Expansion of Bonito Campground could introduce increased numbers of users in the Bonito Park and O'Leary Peak areas. That action, along with visitors hiking on a portion of the O'Leary Peak Road, could cause minor interruptions of American Indian uses of cultural properties resulting from increasing numbers of visitors and related traffic. The total action would result in moderate, long-term adverse impacts to American Indian tribes in the form of increased contacts with others during traditional uses.

Activities taken by the state in widening US89 also affect Forest Service activities in the area. Increasing population in Alpine Ranchos would increase pressure on the Forest Service for demand for recreational and woodcutting opportunities for these nearby residents. Expansion of the city of Flagstaff would also increase the demand for recreational opportunities.

The combined effects of the proposed actions by all land and resource management agencies would result in moderate impacts to one another and to park neighbors. The contribution to these impacts resulting from proposed NPS actions would be minor.

### CONCLUSION

Within existing conditions, the management actions of the NPS provide many beneficial impacts to other agencies and neighbors. Existing conditions result in only minor, long-term, adverse impacts to the workload of others in terms of additional administrative tasks, interpretive planning, agreement reviews, and joint planning efforts. There could be minor, long-term adverse impact to park neighbors in terms of increased congestion on FS545. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

This alternative would provide diverse opportunities both within and outside the monument boundaries. Partnerships with the USFS, affiliated tribes, and educational institutions would provide interpretation and consistent management of sites and features outside the park that are primary to park purpose.

A new visitor center and administrative complex would be constructed near the intersection of FR545 and US89 and would serve both the USFS and NPS visitor orientation needs. Potential impacts to monument neighbors would be negligible, as there would be no disruption of their access to, or through, the monument to

access forest lands, their residences, or the Navajo Reservation. The location of a shared facility in this area would enhance both the USFS and NPS ability to orient visitors prior to their entry to public lands. However, there would be moderate, short-term adverse impacts to the USFS in terms of facilities planning and construction, and moderate, long-term adverse impacts in staffing commitments.

Under this alternative, the existing Mission 66 visitor center would be retained and adaptively used, which would pose no impact to neighbors, tribes, or other land and resource managers.

A portion of the O'Leary Peak Road would take hikers to a viewpoint that allows them to see into the bowl of Sunset Crater resulting in minor, long-term, adverse impacts to the Forest Service in terms of added administrative and management workloads. This trail would remain part of the Forest Service administrative access to their facilities atop the peak.

This trail and viewpoint would result in minimal, long-term, adverse impacts to American Indians, as it would be a negligible intrusion in the sacred area of O'Leary Peak, and would not disrupt their cultural uses of the mountain.

Cooperative efforts with the Arizona Game and Fish Department would be the same as in the No-Action Alternative.

Cooperative efforts with the Forest Service would be the same as in the No-Action Alternative.

The implications of the FLEA planning process would be the same as in the No-Action Alternative.

Visitors would be occasionally directed to Forest Service areas as occurs under current conditions.

The implications of widening US89 and the growth of Flagstaff would be the same as in the No-Action Alternative.

Impacts to American Indian tribes would be the same as in the No-Action Alternative.

## CUMULATIVE EFFECTS

The geographic area considered in this alternative is the same as that in the No-Action Alternative.

Constructing a new shared facility and managing changes to the OHV area would have moderate short-term and long-term impacts to the USFS.

The implications of the Forest Service FLEA, NPS and Forest Service cooperative efforts, and relationships with other resource managers would be the same as in the No-Action Alternative.

Under Alternative 1, a portion of the O'Leary Peak Road would be used by hikers to gain a view into the bowl of Sunset Crater. Increased traffic congestion and construction activities would have minor, short-term impacts on park neighbors in Alpine Ranchos. In addition to these effects, subdivision of the Alpine Ranchos development would increase population in the area. Development of Roden Crater would increase traffic. All of these actions would result in a minor increase in traffic on the loop road. The increase in traffic on the loop road could create more congestion, increasing the commute time for Alpine Rancho residents. This would be an intermittent, long-term, minor effect on those residents.

Expansion of the campground could introduce increased numbers of users in the Bonito Park and O'Leary Peak areas.

Impacts to American Indians would be as in the No-Action Alternative.

The implications of the development of Roden Crater would be the same as in the No-Action Alternative.

Arizona Game and Fish activities in the geographic area would be the same as in the No-Action Alternative.

The combined effects of the proposed actions by all land and resource management agencies would result in major impacts to one another, and to park neighbors. The contribution to these impacts resulting from proposed NPS actions would be a moderate component, primarily resulting from the construction and operation of a new visitor orientation center, and expanded visitor use areas and activities.

### CONCLUSION

There would be minor to moderate, short- and long-term, adverse impacts to the Forest Service, resulting from their participation in the development and operation of a new visitor facility, including planning, construction, and staffing commitments, and resulting from changes to the OHV recreational area.

There could be a number of beneficial impacts such as those discussed in the No-Action Alternative.

Increased congestion and contact with others would have a moderate, long-term impact on American Indian tribes seeking traditional cultural uses.

The management actions of the NPS may result in minor to moderate, short and long-term, adverse impacts to the workload of others in terms of additional administrative tasks, interpretive planning, agreement reviews, and joint planning efforts. There could be minor adverse impact to park neighbors in terms of increased congestion on FR545.

In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

In this alternative, a new visitor center would be built on or near FR776, where no facilities currently exist. The new facility would be used primarily to orient visitors to the park/forest lands prior to their arrival and could be jointly operated by both the USFS and NPS. The existing Bonito Campground would be relocated to an area near the proposed new visitor center. Operation of the new visitor center would have moderate, long-term, adverse impacts to the Forest Service, as they would become partners with the NPS in construction, staffing, and maintaining the facility. However, USFS presence in the facility could have a moderate, long-term, beneficial impact on their ability to orient forest recreational users and minimize inappropriate activities. NPS administrative and maintenance facilities would also be relocated to this new developed area.

The closure of FR545 through the monument would result in moderate, long-term impacts to neighbors using the park road for commuting purposes or accessing USFS lands north of the monument. Such access and the commuting route would be redirected via FR776. Those users would experience moderate, intermittent impacts relative to seasonal traffic congestion along this road, which would also be the primary entrance to the Cinder Hills OHV Area, Alpine Ranchos, Wupatki National Monument, and the Navajo Reservation. Potential adverse impacts to resource/land management agencies would be moderate and long term; increased maintenance of FR776 would be required and possibly

shared among NPS, USFS, and/or Coconino County.

American Indians, who use resources for cultural and traditional purposes, could experience moderate, long-term adverse impacts to their ability to reach certain places in the monument previously accessed by FR545. They also could encounter congestion and crowded conditions during busy seasons of use, particularly around Bonito Park, and the O'Leary Peak Road.

Hiking around Bonito Park could result in minor, long-term impacts to American Indian tribes and resource managers. The Hopi consider Bonito Park a sacred site and prefer that visitor activities not occur in the open meadow area (however, a trail around the perimeter of Bonito Park might be acceptable). The Arizona Game and Fish Department (AGFD) monitors Bonito Park as a pronghorn fawning area and would prefer not to impact that wildlife process, although very few pronghorn use the area. Impacts to the wildlife could result in minor, long-term impacts to AGFD administrative workloads in managing wildlife.

Motorized sightseeing opportunities would be changed to include entry via FR776 and a realignment of FR414. Both routes would have to be improved and/or paved. The existing paved road (FR545) would terminate at Bonito Park and at the Lava Flow Trail; it would be obliterated beyond those two points. There would be moderate, long-term impacts to the Forest Service and/or Coconino County resulting from the relocation of the campground and supporting infrastructure and any increased responsibilities for maintenance and management of FR776. Some neighbors living near FR776 at the junction with US89 are concerned about any increase in congestion that would be caused by the rerouting of traffic. There would also likely be moderate, short-term impacts during the road-building phase, which could interrupt traffic, detour commuters and OHV area users, and temporarily restrict access to the OHV area. Neighbors are also concerned about changes in the OHV area that could push that use into areas closer to neighborhoods, which could create moderate, long-term adverse impacts to park neighbors in terms of noise, dust, traffic, and loss of viewshed. The feasibility (engineering) of paving FR776/FR414 has not been fully studied.

Also under Alternative 2, the park road would be gated at night, and, at some point in the future, visitation numbers could be controlled via shuttle or reservation. Any reduction in the numbers of visitors could result in a minor, long-term impact to the local community businesses.

Extended learning would be accomplished from the Lava Flow Trail to the north side of Sunset Crater as well as on portions of the existing entrance road, which would be reclaimed and become a trail. Potential adverse impacts to neighbors and other land/resource managers from the loss of this road would be moderate and long term.

Bonito Park would have a trail around it, incorporating part of an old roadbed. Introduction of visitors on foot into this area causes some concerns from managers from the NPS and other agencies relative to effects on wildlife populations, plant communities, and cultural resources. The USFS could experience minor, long-term adverse impacts in their administrative workload resulting from resource management activities and conducting interpretive programs as a partner in visitor services. AGFD could experience minor, long-term adverse impacts in their wildlife management in Bonito Park. There could be moderate, long-term adverse impacts to American Indian tribes who see Bonito Park as a sacred place, because their cultural uses could be impeded by

crowded conditions or heavy seasonal visitor use.

Hiking opportunities on a portion of the O'Leary Peak Road would be the same as in the No-Action Alternative.

Off-highway vehicle use would be limited to south of FR776. There could be minor, long-term adverse impacts to neighbors who might experience additional traffic in areas adjacent to the OHV area along with noise and dust. There would be minimal, long-term adverse impacts to the USFS in managing and restricting OHV uses to a slightly smaller area. The USFS would need to work with the OHV community and monitor and enforce use restrictions. Any action that further defines the boundary of the area would likely result in more efficient enforcement and better understanding by the users.

## CUMULATIVE EFFECTS

The geographic area considered in this alternative is the same as that in the No-Action Alternative.

Construction and operation of a new shared visitor facility, relocation of the campground, maintenance of FR776, and minor reductions in size and management requirements of the OHV area would result in major, long-term impacts to the Forest Service. Forest Service presence in the visitor center would result in a major, long-term, beneficial impact on USFS interaction with recreational users.

The introduction of a hiker trail around Bonito Park could result in moderate, long-term, adverse impacts to American Indian tribes.

The implications of the Forest Service FLEA planning process would be the same as those identified in the No-Action Alternative.

The implications of the activities of AGFD, ADOT widening US89, and the growth of the City of Flagstaff would be the same as in the No-Action Alternative.

Maintenance of FR776 could be a major, long-term impact to the Forest Service or Coconino County if either organization assumed shared responsibility for the road, requiring increased staff, equipment, and funding for maintenance operations.

The closure of FR545 through the monument, road reconstruction, increased congestion on FR776, expanded visitor activities, intrusion of OHV activities into viewsheds, and related dust and visible traffic would result in moderate to minor, short- and long-term adverse impacts to park neighbors.

Any reduction in numbers of visitors could result in a minor, long-term, adverse impact to the local hospitality industry by affecting extended or overnight stays in the community. Minor reductions in the size of the OHV area could have negligible, long-term adverse impacts to the local economy, resulting from fewer services needed from local OHV dealers, repair services, and service stations sales.

Visitor activities around Bonito Park could result in minor, long-term impacts in the Arizona Game and Fish Department's wildlife management program in Bonito Park.

Crowded conditions or heavy seasonal visitor use near Bonito Park could result in moderate, long-term impact to American Indian tribes who could experience congestion during time of traditional, cultural uses. The loss of access once provided by FR545 crossing through the monument could result in minor, long-term impacts to American Indian tribes by making access to some areas more difficult.

The combined effects of the proposed actions by all land and resource management agencies would result in major to minor adverse impacts to one

another, and to park neighbors. The contribution to these impacts resulting from proposed NPS actions would be a major component, primarily resulting from the desired relocation of the OHV area, construction and operation of a new visitor orientation center, elimination of FR545 as a through road, and expanded visitor use areas and activities.

### CONCLUSION

There would be major, short- and long-term adverse impacts to the Forest Service, resulting from their participation in the development and operation of a new visitor facility, including planning, construction, and staffing commitments, and resulting from reducing the size of the OHV recreational area.

There could be a number of beneficial impacts such as those discussed in the No-Action Alternative.

Visitor activities and hiking in new areas could have moderate, long-term impacts on American Indian tribes seeking traditional cultural uses.

The closure of FR545, increased traffic on FR766 and encroachment of OHV activities would have moderate, long-term impacts on some park neighbors.

Shared maintenance of FR766 and FR545 could have major, long-term impacts on the Forest Service and/or Coconino County.

The implications of development of Roden Crater would be the same as identified in the No-Action Alternative.

In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

This alternative proposes a significant expansion of the monument to include resources and features that were direct components of the eruption of Sunset Crater. A large portion of the Cinder Hills OHV Area would be transferred to the monument and existing OHV uses eliminated. OHV users would probably seek other such opportunities on forest lands, which would create major, long-term adverse impacts to the USFS in terms of designating new recreation areas, fulfilling compliance procedures, public meetings, planning, and future management. There could be moderate, long-term adverse impacts to park neighbors, resulting from displaced OHV uses relocating near their residences, along with related noises, dust, and intrusions on their viewsheds.

Some park neighbors who use FR776 for commuting to Flagstaff from the Navajo Reservation or from communities between Sunset and Wupatki, would have to use FR545 through the monument, or other routes. That would result in a minor, long-term adverse impact to those neighbors.

A new visitor center and administrative complex would be constructed near US89 and would serve both USFS and NPS visitor orientation needs. Impacts resulting from this action would be the same as in Alternative 1.

The beneficial implications of this alternative would be the same as those described for the No-Action Alternative.

There could be some minor, long-term adverse impacts to the AGFD in terms of

wildlife management and monitoring workloads in areas adjacent to new lands added to the monument. However, there would be moderate, long-term beneficial impacts in terms of wildlife health, numbers, hunting opportunities, and wildlife viewing opportunities.

The implications to the Arizona Game and Fish Department from the ADOT widening of US89, and from the growth of Flagstaff would be the same as in the No-Action Alternative.

Impacts to American Indian groups would be the same as in Alternative 1.

Public use of a trail on a portion of the O'Leary Peak Road would be the same as in Alternative 1.

Adverse impacts to neighbors commuting through the monument would be minimal, but long-term. Their access route would remain, but encounters with traffic and numbers of visitors could increase as monument visitation increases.

## CUMULATIVE EFFECTS

The geographic area considered in this alternative is the same as that in the No-Action Alternative.

Constructing a new, shared facility, providing access to hikers on the former O'Leary Peak Road, and management of a reduced OHV area would have major, short- and long-term impacts to the USFS.

The implications of the Forest Service planning (FLEA) would be the same as in the No-Action Alternative.

The removal of a large portion of the Cinder Hills OHV Area and the resulting displacement of many recreational users could have moderate, long-term adverse impacts to park neighbors, which would result from intrusions of this activity into their immediate neighborhoods, along with associated noises, dust, and vehicle congestion.

The implication of this alternative to American Indian groups would be the same as in Alternative 1.

The implications of development of Roden Crater would be the same as those described for the No-Action Alternative.

The combined effects of the proposed actions by all land and resource management agencies would result in major impacts to one another, and to park neighbors. The contribution to these impacts from proposed NPS actions would be a major component, primarily resulting from the expansion of the monument and resulting reduction of the OHV area, construction, and operation of a new visitor orientation center, and expanded visitor use areas and activities.

## CONCLUSION

There would be major, short- and long-term adverse impacts to the Forest Service, resulting from their participation in the development and operation of a new visitor facility, including planning, construction, and staffing commitments, and resulting from the reduction in size and potential relocation of the OHV recreational area. There could be a number of beneficial impacts as discussed in the No-Action Alternative.

Increased congestion and contact with others would have a moderate, long-term adverse impact on American Indian tribes seeking traditional cultural uses.

Alterations in the Cinder Hills OHV Area and the resulting displacement of many recreational users could have moderate, long-term adverse impacts to park neighbors, because of likely intrusions of this activity and associated noises, dust and congestion into their immediate neighborhoods. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

## Irreversible/Irretrievable Commitments of Resources

There would be no irreversible or irretrievable commitments of resources.

## Loss in Long-Term Availability or Productivity of the Resource to Achieve Short-Term Gain

There would be no short-term gains affecting long-term productivity.

## Unavoidable Adverse Impacts

Under the No-Action Alternative, there would be minor adverse impacts to the workload of park neighbors in terms of additional administrative tasks, interpretive planning, agreement reviews, and joint planning efforts.

Under Alternatives 1 and 3, there would be major, short- and long-term impacts to the Forest Service, resulting from their participation in the development and operation of a new visitor facility, including planning, construction, and staffing commitments. Similar impacts would result from Alternative 3, from the relocation of the OHV recreational area. Increased congestion and contact with others would have a major, long-term impact on American Indian tribes seeking traditional cultural uses.

In addition to those adverse effects identified for Alternative 1, under Alternative 2 the closure of FR545, increased traffic on FR766, and encroachment of OHV activities would have major, long-term impacts on some park neighbors. Maintenance of FR766 and FR545 could have major, long-term impacts on the Forest Service and/or Coconino County.

# OPERATIONAL EFFICIENCY

## Methodology

Operational efficiency, for the purpose of this analysis, refers to adequacy of the staffing levels and quality and effectiveness of the infrastructure used in the operation of the park in order to adequately protect and preserve vital park resources and provide for an effective visitor experience. This includes an analysis of existing and needed staffing levels and of the condition and usefulness of the facilities and developed features used to support the operations of the park. Facilities include the roads that are used to provide access to and within the park (both administrative and visitor use), housing used for staff required to work and live in the park, visitor orientation facilities (visitor centers, developed and interpreted sites, and other interpretive features), and the necessary administrative buildings (office and workspace for park staff), garages, shops, storage buildings, and yards used to house and store the equipment, tools, and materials used to maintain the constructed facilities, and features that support the operations of the park. This also includes the presence of utilities such as phones, sewer, water, and electric and other constructed features used to facilitate the operations of the park.

In addition to the above, discussion of impacts to park operations focuses on (1) employee and visitor health and safety, (2) ability to protect and preserve resources, (3) staff size, whether staffing needs to be increased or decreased, (4) existing and needed facilities, (5) communication (i.e., telephones, radio, computers, etc.), and (6) appropriate utilities (sewer, electric, water). Park staff knowledge was used to evaluate the impacts of each alternative and is based on the current description of park operations presented in the Affected Environment section of this document.

Definitions for levels of impacts to operational efficiency are as follows:

*Negligible:* changes would be so small that it would not be of any measurable or perceptible consequence.

*Minor:* changes would be small and, if measurable, the consequences would be small and localized.

*Moderate:* changes would be measurable and would have a consequence.

*Major:* changes would be measurable and would have substantial consequences.

## Effects of the No-Action Alternative: Existing Conditions

### IMPACT ANALYSIS

Under the No-Action Alternative operational efficiency would continue in approximately the same manner as it currently exists.

Partnerships with the USFS would have a minor to moderate effect on operational efficiency. This effect would be long-term and beneficial. The USFS would be regulating use and access, including the regulation of off-road driving, and the closure of a number of nonessential roads. Implementation of these actions would reduce the need for NPS patrols along the south boundary for resources protection purposes. If the use of this area were to increase, there would also likely be a need to provide 24-hour emergency response.

The installation of new wayside and museum exhibits would have long-term impacts that would moderately change operational efficiency in a beneficial manner. Increased information presented to the visiting public would afford a higher level of awareness of the significance of the resources in the park, and provide information regarding use and access restrictions. This in turn would increase the level of protection afforded park resources and reduce the need for law enforcement patrols.

The expansion of the USFS campground would have a minor adverse impact on operational efficiency. The NPS currently responds to law enforcement needs with the existing campground. The presence of the new unit, although catering to a different type of camper, would increase the law enforcement needs, including increased patrols and the need to respond to emergencies. Increased numbers of campers and increased size of groups would likely require an associated increase in after-hour call-outs of staff to the campground. This impact would be long term. There would, however, be a long-term beneficial effect resulting from increased information being presented to the visiting public, affording a higher level of awareness of the significance of the resources in the park, and of use and access restrictions. Construction of the group sites would increase the numbers of campers in proximity with primary park resources and would require additional staff time to mitigate visitor impacts through monitoring, education, and patrol. Having a facility capable of handling these groups would increase operational efficiency. Currently there is no safe, suitable place for school group orientation and activities.

Construction of a new curatorial facility and maintenance/resources management facility would have a long-term, major, beneficial impact on operational efficiency. The action would result in the removal and replacement of dilapidated, inappropriate, and nonfunctioning facilities that pose a number of health and safety and resource protection issues, and that are totally inadequate for employee safety and protection of investment in equipment and tools. It would result in the rehabilitation of extensively disturbed areas that contain significant cultural and natural resources, and would allow the

area to be protected and returned to more natural conditions and appearance.

The closure of the O'Leary Peak Road would have no impact on operational efficiency.

Increasing accessibility to facilities and natural and cultural features would have a negligible to minor impact on operational efficiency. The impact would be beneficial and long term. It would result in the development of the appropriate infrastructure that would make available certain areas of the park that are currently inaccessible to visitors with disabilities.

Addressing the existing health and safety issues is likely to have a moderate to major, beneficial impact on operational efficiency. Many of the existing deficiencies and health and safety needs in park facilities would be addressed and mitigated.

Formalization of the backcountry closure is expected to have a minor, long-term beneficial effect on operational efficiency. There would be an initial short-term minor, adverse impact due to the need to increase staff presence in order to effectively implement the change in use of the backcountry. Mostly this would consist of making contact with visitors who are unaware that they have entered an area that is closed to unguided access. This change in management would not be likely to affect a large number of visitors. This impact would be mitigated as the public becomes familiar with the change in management of the backcountry.

### Roadways and Access to the Park

Under the No-Action Alternative, Sunset Crater Volcano would continue to be visited via US89 and FR545. This would have a negligible to minor, adverse impact on park operations. Visitors and staff would continue to be exposed to dangerous situations while entering or exiting FR545 from US89. There is potential for this situation to increase, given the potential growth of the city of Flagstaff and the surrounding areas and the number of visitors likely to visit the Flagstaff area and the scenic destination points in the northern Arizona and Four Corners regions.

There would be minor to moderate adverse impact to park operations with the continued use of FR545. It is likely that there would be an increase in both visitor and commuter traffic, resulting in a likely increase in the number of accidents. Maintenance needs would increase. Given current staffing and funding levels, any increase in the use of FR545 would likely result in a worsening of the condition of the roadway.

The growth and development of the city of Flagstaff and the surrounding areas is likely to increase the use of USFS land immediately adjacent to the parks. This would have a minor to moderate adverse impact on park operations. Given the current inability to physically close any of the roads in the park, an increase in use of the associated roads would increase the difficulties that already exist in protecting park resources. This includes entry into areas of the park that are closed to visitation and intentional and unintentional damage to park resources. There would be an increase in staff demands to accomplish patrols and to provide 24-hour emergency response.

Use of most of the roads would continue to be unregulated, which would continue to make protection of park resources difficult. Issues of unauthorized entry into closed portions of the park and the impacts resulting from intentional and unintentional visitor damage to the park's park resources would be likely to increase. This would have a minor to moderate, adverse impact on operational efficiency.

### Visitor Use

Under the No-Action Alternative, visitor use of the park would continue as it exists currently, which should have a negligible, adverse impact on park operations. Most visitor uses are concentrated at the Sunset Crater visitor center and the Lava Flow Trail. There would continue to be an inability to provide immediate contact after visitors enter the park, and there would still be no staff present to provide orientation at any of the developed sites. Visitors to these developed areas would continue to be exposed to climatic extremes, poisonous wildlife, and uneven surfaces in and around the interpreted features.

### Facilities

Implementation of the No-Action Alternative would have a minor adverse impact on the park's facilities. The existing visitor center would remain inadequate and obsolete. Although some improvements would be made, it would still be in need of major upgrading and remodeling, including a number of changes that are required to ensure visitor and staff health and safety.

### Utilities

The No-Action Alternative would have a minor to moderate adverse impact on the utilities in the park. Without improvements, the park would continue to be subjected to repeated brown- and blackouts. Overall, this would have a constant and long-term adverse impact on the ability to conduct business and the quality of life of the employees that reside in the park.

### Staffing

Implementation of the No-Action Alternative would have a minor to moderate, adverse impact on staffing within the park. Given current staffing levels, a reasonable amount of staffing efficiency has been maintained. Existing staff levels are deficient, and there are serious limitations on the park's ability to provide adequate and acceptable levels of visitor services, resource protection and preservation, and maintenance of facilities.

Many of the existing deficiencies and health and safety needs in the park's facilities would remain and in fact would worsen if not addressed.

## CUMULATIVE EFFECTS

The geographic area of consideration in this alternative includes the city of Flagstaff on the south side, Wupatki National Monument on the north, the base of the San Francisco Peaks just beyond US89 on the west, US89 to the northwest, private, state, and federal land just beyond FR545 on the east, and the Navajo Reservation just across the Little Colorado River to the northwest.

Growth and development of the city of Flagstaff and the outlying communities would have a minor to moderate long-term, adverse effect on operational efficiency. The most significant effect would be an increase in the number of visitors coming to the park. Increased growth would also mean that commuter traffic from the outlying communities, such Alpine Ranchos and the Navajo Reservation, would increase, resulting in an increased need for law enforcement patrols and emergency response. Increased commuter traffic on FR545 would result in increased maintenance needs and an increased potential for accidents.

Increased growth of the surrounding communities would increase the interest and demand on Forest Service land surrounding the park. Because the two agencies have differing missions, the potential exists for inconsistent and incompatible uses to could occur adjacent to park boundaries. Such use could result in unregulated and unauthorized entry into closed areas of the park, resulting in

intentional and unintentional impacts to park resources, which could have moderate long-term adverse impacts to operational efficiency, through an increased need for law enforcement patrols to protect park resources.

The Forest Service will be considering use and access regulations, including the closure of a number of nonessential roads, regulation of off-road driving, and the development of definable trail systems. If successful, implementation of the actions would reduce the need for NPS patrols along the south boundary for resource protection purposes. This would have a long-term, minor beneficial impact on operational efficiency. As use of this area increases, there could also be a need to provide 24-hour emergency response. The effect of these actions would have long-term, minor adverse impacts on operational efficiency.

The Forest Service is also considering increased management use requirements on the OHV area immediately to the south and east of the park. If changes were implemented, this would have a long-term minor beneficial impact on operational efficiency. It should reduce many of the impacts that are occurring to park resources as a result of unauthorized entry into the park. Although the need for law enforcement patrols should be reduced, there would continue to be a need for 24-hour emergency response.

Increased mining activities could have long-term minor to moderate adverse impacts on operational efficiency. Haul trucks currently use a portion of the entrance road at the intersection of FR545 and US89. In addition to being incongruous and inconsistent with the purpose of the park, the mix of large vehicles with visitor traffic creates hazardous driving conditions. The potential exists for additional areas adjacent to the park to be exploited for mining purposes, which would result in an increase in the number of haul trucks using park roads, thereby increasing the potential for conflicts between haul trucks and visitors. The potential for increased accidents is great, and consequently there would be a need for increased law enforcement patrols. There would also be an increased need for roadway maintenance.

## CONCLUSION

The No-Action Alternative would result in no substantial change in the operations of the park from existing conditions. There would be long-term minor to major beneficial effects from the new waysides, new facility construction, accessibility, and health and safety improvements, and the backcountry closure. Most of the major roads providing access to the park would likely see an increase in visitor and commuter traffic, which would result in additional congestion and a likely increase in accidents. Maintenance needs would increase. Increased use of all roads leading to the park would increase the difficulties that already exist in protecting park resources, including entry into areas of the park that are closed to visitation and intentional and unintentional damage to resources.

The effects to facilities, utilities, and staffing would be long term and adverse, with small to measurable changes. Without improvement to the visitor center or utilities, conditions would worsen. Many improvements are needed to protect visitor and staff health and safety. Current staff levels have achieved a certain level of efficiency; however, limitations do exist that inhibit the park's ability to provide adequate levels of resource protection and preservation, maintenance of existing facilities, and visitor services. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

## Effects of Alternative 1 (Preferred): Focus on Extended Learning

### IMPACT ANALYSIS

The impacts resulting from 1) establishing partnerships with the USFS, 2) installation of new wayside and museum exhibits, 3) expansion of the USFS campground, 4) construction of a new curatorial facility and maintenance/resources management facility, 5) closure of O'Leary Peak Road, 6) increasing the park's ability to accommodate visitors with disabilities, 7) addressing health and safety issues, and 8) closure of the backcountry would be the same as those described in the No-Action Alternative.

Additional impacts to operational efficiency that would occur with the implementation of this alternative include the following:

### Roadways and Access to the Park

Vehicle access via FR545 would remain the same as it is now, and many of the impacts identified under the No-Action Alternative would continue to exist. There would be no changes to the forest roads surrounding the park, and there would still be a need for law enforcement patrols for resource protection purposes, resulting in negligible to minor long-term, adverse impacts to the park's operational efficiency.

FR546 leading to O'Leary Peak would be designated as Hiking Zone. Only the lower portion of the former road would be used. There would be no hiker access to the top of O'Leary Peak. Potential impacts to operational efficiency would be long term and adverse, but negligible. The most significant effect would be the need to respond to hiker emergencies along the trail.

### Visitor Use

A new hiking trail would be established between Bonito Campground and the Lava Flow Trail. Ground disturbances associated with the trail construction would require consultation, clearance, and/or mitigation of impacts to cultural and natural resources. Implementation of these actions would have moderate, short-term adverse impacts on operational efficiency. After completion of trail construction, this action would have a minor, long-term, adverse impact on operational efficiency, including the need for trail maintenance, resource monitoring, and law enforcement patrols

A broader range of resources would be interpreted and made accessible to the general public in the vicinity of the Lava Flow and Lenox Crater Trails. This action would have a minor, long-term, adverse impact on operational efficiency, including the need for trail maintenance, resource monitoring, and law enforcement patrols.

### Facilities

Under this alternative, a new visitor center and administrative complex would be constructed near US89 to serve both Forest Service and NPS visitor orientation needs. Potential impact to operational efficiency would be moderate, long term, and beneficial. Location of a complex in this area would enhance both the Forest Service's and NPS's ability to orient visitors prior to their entry to public lands. Joint staffing could allow greater freedom of NPS staff to patrol the park resources and could allow for greater control of fee collection compliance, particularly if the facility and its staffing allow for year-round presence on the entrance road. Ground disturbances associated with facility construction would require consultation, clearance, and/or mitigation of impacts to cultural and natural resources. Implementation of these actions would have a moderate, short-term,

adverse impact on operational efficiency. After the facility construction has been completed, this action would have a minor, long-term, adverse impact on operational efficiency, which would include facility maintenance and upkeep and law enforcement patrols.

The existing Mission 66 visitor center would be retained and adaptively used. Potential impacts to operational efficiency would be moderate and long term. This structure would become an administrative office facility as well as an educational center providing an orientation/activity area for educational groups. Operational efficiency would benefit by staff having adequate office and working space, but it would realize a slight adverse effect as a result of removing key staff from the visitor center.

### Staff

The actions of this alternative would have minor to moderate, adverse impacts on the overall staffing component of operational efficiency.

Administrative requirements, including purchasing and contracting for supplies, materials, and services, would increase, especially when construction is taking place. This would result in a major, short-term impact on operational efficiency.

Maintenance staff would have increased workloads on roads, trails, and facility issues, including the maintenance of new trails and an additional visitor center. This would have a long-term, moderate impact on operational efficiency.

As a result of the proposed new construction, resources staff would have increased workloads associated with consultation, compliance, and clearance of the proposed construction sites. This would have a moderate , short-term impact on operational efficiency. Minor long-term, adverse impacts would occur as a result of resource monitoring and preservation requirements associated with increased visitor use of the new trails.

As a result of the emphasis on providing a broader range of educational and interpretive programs using partnerships, affiliated tribes, organizations, institutions, and so on, and the need to review and administer programs to ensure compliance with NPS regulations and policy, there would be increased staff workloads. This would have a minor to moderate, adverse impact on operational efficiency. This impact, however, would be offset and the impact to operational efficiency would possibly be reduced somewhat, since NPS staff would not be needed to implement the expanded educational and interpretive programs.

### Boundary

This alternative would include a limited expansion of park boundaries to accommodate administrative needs, which would have a major beneficial effect on park operations. The most significant beneficial effect would be alignment of park boundaries logically along topographic features and elimination of some existing impacts associated with the management and maintenance of the existing boundary lines and delineating fencing. Boundaries would be more logically placed in areas that enhance the preservation of significant geologic features and would allow the placement of the required boundary delineations and fencing in less invasive and more manageable and maintainable locations. It would eliminate a number of forest roads that cross in and out of the park boundaries, and place them entirely within Forest Service ownership. Finally, it would increase the amount of protection and preservation of significant features along the existing south boundary from further adverse impacts caused by the adjacent OHV area.

### CUMULATIVE EFFECTS

Cumulative effects to operational efficiency under this alternative would be similar to those identified for the No-Action Alternative.

### CONCLUSION

Changes resulting from this alternative would have an overall benefit on operational efficiency. There would be long-term, minor to major beneficial effects from the new waysides, new facility construction, accessibility and health and safety improvements, and the backcountry closure. Improvements and additions would be made to facilities that would protect visitors and improve staff health and safety concerns. There would be moderate, adverse impacts resulting from the construction of the new visitor center, curatorial, and maintenance/resources management facility and the trails proposed to connect Bonito Campground to the Bonito Lava Flow. These actions would create moderate, short-term adverse impacts; however, following construction they would have minor to moderate impacts on operational efficiency. Most impacts would be in the form of increased maintenance needs for facilities and trail systems and increased resource protection and preservation needs. This alternative would not fully address road issues, which would continue to have minor to moderate adverse impacts on operational efficiency. This proposal would also include a limited expansion of park boundaries to accommodate administrative needs, which would have a major beneficial effect on operational efficiency. The most significant would be that the expansion would align park boundaries logically along topographic features. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

## Effects of Alternative 2: Emphasize Quiet Natural Setting while Providing Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

The impacts resulting from 1) establishing partnerships with the USFS, 2) installation of new wayside and museum exhibits, 3) closure of O'Leary Peak Road, 4) increasing the park's ability to accommodate visitors with disabilities, 5) addressing health and safety issues, and 6) closure of the backcountry would be the same as described in the no-action alternative.

The impacts that would occur as a result of removing the expanded USFS campground and the newly constructed curatorial facility and maintenance/resources management facility, would be short term. There would be initial, moderate adverse impacts as a result of the demolition and removal of these facilities. This action would require consultation, clearance, and/or mitigation of impacts to cultural (both prehistoric and historic structures) and natural resources. It would, however, result in the rehabilitation of extensively disturbed areas that contains significant cultural and natural resources and would allow these areas to be protected and returned to more natural conditions and appearance. After the facilities were removed, this action would have no impact on operational efficiency.

Additional impacts to operational efficiency that would occur with the implementation of this alternative include the following:

### Roadways and Access to the Park

Access to the park via FR545 would be extensively modified. A new entrance to the park would be created at the intersection of FR776, and FR414 would be realigned. The road would be paved and

would have a gate that would be locked at night. Visitors would arrive at the park entrance via FR776 (currently an improved dirt road, from either US89 or FR545. FR776 would be paved to accommodate this new use. FR545 would exist within the park only from the intersection of the O'Leary Peak Road to the Lava Flow Trail parking lot. This segment would remain paved, and vehicle access would be allowed. The truncated west end of FR545 from the O'Leary Peak Road to US89 would be removed and rehabilitated. The east segment of FR545 would be modified for use as a visitor foot trail from the Lava Flow Trail parking lot to the base of Sunset Crater. Beyond that point to the east boundary of the park, the road would be rehabilitated. A modified version of FR414 would be used as the new entrance to the park. Potential impact to operational efficiency would be major, long term, and beneficial.

Moderate adverse short-term impacts would be associated with the road construction, compliance, and mitigation of impacts to natural and cultural resources. There would be substantial initial costs for construction and long-term costs associated with maintenance. Following construction and rehabilitation of the abandoned road segments, these actions would have a negligible to minor, adverse impact on operational efficiency. The amount of time required to patrol these areas would be no different, or possibly less, than that required under existing conditions, possibly eliminating the need for 24-hour emergency response. The park road would be gated at night, and visitation numbers could be controlled via shuttle or reservation systems. The ability to close the park road at night would alleviate some after-hours calls, but this benefit would likely be cancelled out by increased calls on the new route. Additional time would be required to open and close gates each day and to deal with visitors who do not exit the park by closing time. Administration of a reservation or shuttle system would increase administrative duties. Road maintenance needs would still exist, but they would be reduced because of the elimination of 24-hour use. The use of the road by mining haul trucks would be eliminated. There would be increased maintenance requirements for the new paved FR776, although these responsibilities could be shared among NPS, USFS, and/or Coconino County. In addition, there would be a need for law enforcement patrols along this stretch of road for resource protection purposes. Because the Cinder Hills OHV Area would continue to exist on the opposite side of the road, the need for 24-hour emergency response would likely increase, resulting in a long-term, minor to moderate adverse impact on operational efficiency.

### Facilities

A new visitor center would be built on or near FR776, where no facilities currently exist, and Bonito Campground would be relocated to an area near the proposed new visitor center. Administrative and maintenance facilities would also be relocated to this new developed area. The facility would be used primarily to orient visitors to the park/forest lands and could be jointly operated by the USFS and the NPS. This could have a minor, adverse effect on operational efficiency, because with NPS staff being placed in closer proximity to the campground and OHV area, they could likely get additional requests for assistance from those users. The longer travel distance from the visitor center and offices to primary visitor use areas could adversely affect operational efficiency, however, this could be partially mitigated if the USFS were to provide staff support for the visitor center complex. There would be short-term, moderate, adverse impacts associated with the visitor center construction and the resulting compliance, and mitigation of impacts to

natural and cultural resources. There would be substantial initial costs for construction and long-term costs associated with maintenance. Following construction these actions would have a negligible to minor, adverse impact on operational efficiency.

### Visitor Use

Hiking opportunities would be increased via opportunities on the former O'Leary Peak Road, which would no longer have public motorized access, and a new trail that would use the remaining FR545 roadbed at the base of Sunset Crater Volcano. Potential impact to operational efficiency would be adverse but minor. An increase in hiking in this environment would undoubtedly result in increased EMS and other emergency service responses, which could include responding to visitors suffering from dehydration, or broken bones or sprains, resulting from traversing long, steep and rocky roads or trails. Limited maintenance would be needed for upkeep of both trails.

### Staff

The overall actions of this alternative would have minor to moderate, adverse impacts on the staffing component of operational efficiency. The construction of new facilities would have major, long-term beneficial impacts on the staff component of operational efficiency. Staff would have adequate, functional, facilities and would be working in a safe environment.

Administrative needs, including purchasing and contracting for supplies, materials, and services, would increase, especially while construction is ongoing. This would have a moderate, short-term, adverse impact on operational efficiency.

Maintenance staff would have increased workloads on roads, trails, and facilities, including the maintenance of new trails and the visitor center, which would have a long-term, minor, adverse impact on operational efficiency.

As a result of the proposed new construction, resources staff would have increased workloads associated with consultation, compliance, and clearance of the proposed construction and rehabilitation sites. This would have a moderate, adverse, short-term impact on operational efficiency. Minor long-term, adverse impacts would occur as a result of resource monitoring and preservation requirements associated with the increased visitor use of the new trail.

### Boundary Expansion

The alternative would expand the boundaries to include Bonito Park and land to the south to accommodate the new visitor center location. Both of these areas contain resources that contribute to the significance of the park and afford exceptional views of most of the primary resources of the park. This action would have a minor, long-term impact on operational efficiency.

## CUMULATIVE EFFECTS

Cumulative effects to operational efficiency under this alternative would be similar to those described for the No-Action Alternative.

## CONCLUSION

This alternative would have long-term, major benefits to the operational efficiency of the park. There would be long-term, minor to major beneficial effects from the new waysides, accessibility, and health and safety improvements, and the backcountry closure. Improvements and additions would be made to facilities that would protect visitors and improve staff health and safety concerns. Most of the issues regarding visitor access would be reduced or eliminated. Access to the park would be managed, which would increase the protection and preservation of park

resources and reduce the need for law enforcement patrols and the need for 24-hour emergency response. This alternative would dramatically improve the facilities that are used in park operations and provide staff with functional facilities and a safe working environment. Major costs would be associated with the proposed construction of new facilities, new paved roadways, and the rehabilitation of areas that would no longer be used for park operations. This would have moderate, short-term adverse impact on operational efficiency. Following construction, there would be a negligible to minor adverse impact on operational efficiency. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

## Effects of Alternative 3: Expand Park Boundaries to Preserve Park-Related Resources and Provide Diverse Opportunities for Visitor Use

### IMPACT ANALYSIS

The impacts resulting from 1) establishing partnerships with the USFS, 2) installation of new wayside and museum exhibits, 3) expansion of the USFS campground, 4) construction of a new curatorial facility and maintenance/resources management facility, 5) closure of O'Leary Peak Road, 6) increasing the park's ability to accommodate visitors with disabilities, 7) addressing health and safety issues, and 8) closure of the backcountry would be the same as described in the No-Action Alternative.

Additional impacts to operational efficiency that would occur with the implementation of this alternative include the following:

### Roadways and Access to the Park and Visitor Use

Vehicle access via FR545 would remain the same as it is now, and many of the impacts identified under the No-Action Alternative would continue. With the exception of FR776, there would be no changes to the forest roads surrounding the park. There would still be a need for law enforcement patrols for resources protection purposes. The actions would result in long-term, negligible to minor, adverse impacts to park operational efficiency.

Much of FR776 would be designated for administrative use and gated near the junction of FR545, and a trailhead would be constructed near this location. The western segment of FR776, extending from the intersection of US89 to the southwestern boundary of the park, would remain unchanged, but would terminate at the park boundary. This action would have long-term, minor, adverse impact to operation efficiency since the area that would require patrol and resource protection would increase substantially. There would be an initial short-term, moderate adverse impact due to the need to increase patrols in order to effectively implement this change. Mostly this would consist of making contact with visitors unaware of the change in land use and access. This impact would be mitigated as the public became familiar with the change in management.

The impact from designation of the former O'Leary Peak Road as a hiking trail would be the same that described for the No-Action Alternative and Alternative 1.

A trail would be established from the Bonito Campground to the Bonito Lava Flow. A new trail would be constructed in the fissure zone, providing access to Gyp and/or Double Crater. The trailhead would be located near the junction of FR776 and FR545.

Ground disturbances associated with trail construction would require consultation, clearance, and/or mitigation of impacts to cultural and natural resources. Implementation of these actions would have a short-term, major, adverse impact on operational efficiency. Following construction, this action would have a minor long-term adverse impact on operational efficiency, which would include trail maintenance, resource monitoring, and law enforcement patrols.

A broader range of resources would be interpreted and made available to the public in the vicinity of the Lava Flow and the Lenox Crater Trails and the Cinder Hills Overlook. This action would have a minor, long-term, adverse impact on operational efficiency, including the need for trail maintenance, resource monitoring, and law enforcement patrols.

### Facilities

Under this alternative, a new visitor center and administrative complex would be constructed near US89 to serve both Forest Service and NPS visitor orientation needs. Potential impacts to operational efficiency would be moderate, long term, and beneficial. Location of a complex in this area would enhance both the Forest Service and NPS ability to orient visitors prior to their entry into public lands. Joint staffing could allow greater freedom of NPS staff to patrol the park resources and could allow for greater control of fee collection compliance, particularly if the facility and its staffing allow for year-round presence on the entrance road. Ground disturbances associated with the facility construction would require consultation, clearance, and/or mitigation of impacts to cultural and natural resources. Implementation of these actions would have a moderate, short-term, adverse impact on operational efficiency. Following facility construction, this action would have a minor, long-term impact on operational efficiency, which would include facility maintenance and upkeep and law enforcement patrols.

The existing Mission 66 visitor center would be retained and adaptively used. Potential impact to operational efficiency would be moderate. This structure would become an administrative office facility as well as an educational center, which would provide an orientation/activity area for educational groups. Operational efficiency would benefit by staff having adequate office and working space, but it would realize a slight adverse effect as a result of removing key staff from the visitor center.

### Staff

The impacts to the staffing component of operational efficiency would be the same as those described for Alternative 2.

### Boundary

This proposal would call for the expansion of park boundaries to accommodate administrative needs and to ensure that natural resources contributing to the purpose and significance of the park are contained within park boundaries. This action would have a major beneficial effect on park operations, the most significant being that it would align park boundaries logically along topographic features and include features that contribute to the significance of the park.

Resources staff would need to direct their attention to a number of major natural resource management concerns and issues, including the rehabilitation of an area that has been subjected to extensive OHV use for a number of years. Rehabilitation would include unimproved roads, OHV off-loading areas, undesignated camp areas, and other OHV use areas. Substantial commitment of staff time and funding would be needed to inventory and evaluate the new lands. This would have a short-term, major adverse impact on operational efficiency. As these areas are

restored there would be a long-term, moderate adverse impact to operational efficiency as staff would continue to monitor and implement recovery and restoration efforts.

The Cinder Hills OHV Area would be relocated, potentially resulting in moderate, long-term impacts to operational efficiency. Patrol and monitoring of the revised boundary would be required.

### CUMULATIVE EFFECTS

Cumulative effects to operational efficiency under this alternative would be similar to those identified for the No-Action Alternative.

### CONCLUSION

Changes resulting from this alternative would have an overall long-term benefit on operational efficiency. There would be long-term, minor to major beneficial effects from the new waysides, new facility construction, accessibility and health and safety improvements, and the backcountry closure. There would be moderate adverse impacts resulting from construction of the proposed new visitor center and trails. Major long-term efforts would be needed to effect the rehabilitation of newly acquired land that has been substantially impacted by OHV use. These actions would create short-term, major, adverse impacts; however, following construction and rehabilitation activities, there would be minor to moderate adverse impacts to operational efficiency. Most impacts would be in the form of increased maintenance needs for facilities and trail systems and increased resource protection and preservation needs. Major long-term benefits would be realized with the expansion of park boundaries, which would include resources that contribute to the significance of the park. The alternative would align boundaries logically along topographic features, and would result in a reduction in impacts to the park's primary resources. Because the OHV is so heavily impacted, there would be a substantial commitment of resources and staff to rehabilitate and restore the area. In addition to those mentioned, there would be other, less severe effects as a result of implementing this alternative.

## Irreversible/Irretrievable Commitments of Resources

There would be no irreversible or irretrievable commitments of resources.

## Loss in Long-Term Availability or Productivity of the Resource to Achieve Short-Term Gain

There would be no short-term gains affecting long-term productivity.

## Unavoidable Adverse Impacts

The No-Action Alternative would result in no substantial change in the operations of the park. The effects of implementing the No-Action Alternative would be minor to moderate. Most of the major roads providing access to the park would see a likely increase in visitor and commuter traffic, which would result in additional congestion and a likely increase in accidents. Maintenance needs would increase. Increased use of all roads leading to the park would compound the difficulties that already exist in protecting park resources. This includes entry into areas of the park that are closed to visitation and intentional and unintentional damage to resources. The effects to facilities, utilities, and staffing would be minor to moderately adverse. Without improvement to visitor facilities or utilities, existing conditions would worsen. Many improvements are needed to protect visitor and staff health and safety. Current staff levels have achieved a certain level of efficiency; however, limitations do exist that inhibit the park's

ability to provide adequate levels of resource protection and preservation, maintenance of existing facilities, and visitor services.

Under Alternative 1, new facilities would be constructed. However, once constructed they would have minor to moderate adverse impacts on operational efficiency. Most impacts would be in the form of increased maintenance needs for facilities and trail systems and increased resource protection and preservation needs. This alternative would not fully address the needs of road access and resource protection issues, which would continue to have minor to moderate adverse impacts on operational efficiency.

New facilities would be constructed under Alternative 2. Major costs would occur with the proposed construction of new facilities, new paved roads, and the rehabilitation of areas that would no longer be used for park operations. This would have short-term, major adverse impacts on operational efficiency. Once this construction has been completed it would have a negligible to minor adverse impact on operational efficiency.

Changes resulting from Alternative 3 would be related to the construction of a new visitor center and new trails. Major long-term efforts would be needed to rehabilitate the new land, which has been substantially impacted by OHV use. These actions would create short-term, major adverse impacts. However, once the construction and rehabilitation have been completed, there would be minor to moderate impacts to operational efficiency. Most impacts would be in the form of increased maintenance needs for facilities and trail systems and increased resource protection and preservation needs. This alternative would not fully address the needs of road access and resource protection issues, which would continue to have minor to moderate adverse impacts on operational efficiency.

# CONSULTATION AND COORDINATION

## HISTORY OF PUBLIC INVOLVEMENT

The notice of intent (NOI) to prepare this EIS was published in the Federal Register May 19, 1997. The NOI indicated availability of newsletter #1, from which comments were accepted until June 30, 1997. The first newsletter described purpose and significance statements for all three parks, as well as identifying preliminary issues. A second newsletter, released February 1998, detailed public response to the first newsletter, described final purpose and significance statements, and explained the preliminary range of management zones. A third newsletter, issued November 1998, described the range of preliminary alternatives developed for all three monuments. The fourth newsletter in May 1999 described the decision to prepare a plan concurrently with the Forest Service Flagstaff Lake Mary Ecosystem Area planning process. All comments received through June 1999 were considered in this EIS. The Purpose of and Need for the Plan, Need for the GMP, and Description of Scoping Process sections describe the issues and concerns raised and sort the responses into several categories.

## AGENCIES CONSULTED

A number of meetings were held with staff from the U.S. Forest Service and Arizona Game and Fish Department. These meetings were held to discuss impacts that the alternatives might have on adjacent recreational activities and impacts to wildlife and their movement corridors and to try to ensure that NPS planning would be in support/harmony with their agency planning efforts. Several of these conversations explored the possibility of joint or comanagement of resources and visitor uses.

In keeping with its mandates for tribal consultation, NPS consulted with many American Indian tribes throughout the planning process. Based on ethnographic research efforts and previous consultations conducted for the Flagstaff Area national monuments during the last several years, ten tribes were identified as having potential traditional associations with park lands and resources. They are the Havasupai Tribe, Hopi Tribe, Hualupai Tribe, Navajo Nation, San Juan Southern Paiute Tribe, Tonto Apache Tribe, White Mountain Apache Tribe, Yavapai Apache Nation, Yavapai-Prescott Tribe, and Zuni Tribe. All ten tribes were contacted by letter and telephone, inviting them to attend an introductory meeting in October 1997. Six of the ten tribes participated in the October meeting, and four participated in a December 1997 consultation meeting. As of February 1998 participating tribes included Hopi, Hualupai, Navajo, White Mountain Apache, Yavapai Apache, Yavapai-Prescott, and Zuni.

At the first two consultation meetings the tribes discussed the purpose and significance statements and agreed on language for the final statements. They also discussed tribal involvement in identifying culturally significant and sensitive resources as well as plans for participation throughout the planning process. Early in 1998 the Hopi, Navajo, and Zuni Tribes agreed to conduct further NPS-sponsored research into tribal associations with park lands and identify particular sensitive resources and management concerns for the EIS. Representatives from three tribes attended the final tribal consultation meeting in

August 1998 and assisted with the development of alternatives. Early in 1999 the Hopi Tribe and Navajo Nation submitted to NPS reports identifying culturally sensitive resources and specific recommendations for the GMP.

All ten tribes originally identified continued to receive newsletters and invitations to consultation meetings throughout the planning process. Tribal interests and concerns were fully considered in the planning process and in the development of alternatives in the GMP.

## LIST OF RECIPIENTS

### Federal Agencies

Advisory Council on Historic Preservation

Department of Agriculture

Animal Damage Control

Natural Resource and Conservation Service

Animal and Plant Health Inspection Service

Forest Service
- Tonto NF
- Prescott NF
- USFS Regional Office
- Kaibab NF
- Coconino NF, Mormon Lake District
- Coconino NF, Peaks District

Department of Interior
- Fish and Wildlife Service
- Arizona Ecological Services
- Geological Survey
- National Biological Survey
- National Park Service
  - Canyon de Chelly NM
  - Glen Canyon NRA
  - Grand Canyon NP
  - Guadalupe Mountains NP
  - Hubbell Trading Post NHS
  - Montezuma Castle NM
  - Navajo NM
  - Organ Pipe Cactus NM
  - Petrified Forest NP
  - Pipe Springs NM
  - Rivers and Trails Conservation Assistance, Intermountain Support Office, Santa Fe
  - Southern Arizona Group
  - Tonto NM
  - Western Region

Department of the Army, Corps of Engineers

Department of Transportation, Federal Highway Administration

Environmental Protection Agency

U.S. Postal Service

### Indian Tribes

Havasupai Tribe

Hopi Tribe
- Cultural Preservation Office
- Water Rights Hydrologist

Hualapai Tribe

Navajo Nation
- Bodaway/Gap Chapter
- Cameron Chapter
- Leupp Chapter
- Tuba City Chapter
- Department of Agriculture
- Historic Preservation Department
- Forest Section
- Division of Economic Development
- Division of Natural Resources
- Lands Department
- Navajo Tribal Ranches

Pueblo of Zuni
- Heritage Historic Preservation

San Juan Southern Paiute Tribe

Tonto Apache Tribe

White Mountain Apache Tribe

Yavapai Apache Tribe
- Cultural Preservation

Yavapai Prescott Indian Tribe

### State Government

Department of Environmental Quality

Forest Service

Department of Mines and Minerals

Department of Public Safety

Department of Transportation
- Design Section
- Parkways and Historic Scenic Roads

Department of Water Resources

Game and Fish Department

Office of the Governor

State Historic Preservation Office
- Arizona State Parks

State Land Department
- Forestry Division
- Urban Planning Division

## Local Government

City of Flagstaff
- Chamber of Commerce
- City Council
- Convention and Visitor Bureau
- Fire Department
- Police Department
- Public Library
- Unified Public Schools
- Unified School District
- Utilities
- Visitor Center

Citizens Utilities

City of Sedona
- Public Library

Coconino County
- Attorney
- Board of Supervisors
- Department of Community Development
- Highway Department
- Parks and Recreation
- Sheriff's Department
- Supervisors

Doney Park
- Fire Department
- Water

Kachina Village Fire Department

Mountainaire Fire Department

Northern Arizona Council of Governments

Timberline-Fernwood Fire Department

## Organizations/Businesses

AandS Distributing
A.B.A.T.E.
A5 Adventures
Absolute Bikes
Access Fund
Affordable Housing Coalition
American Motorcyclist Association
Andy's Body Shop
Arizona 4WD Clubs
Arizona Archeological and Historical Society
Arizona Bowhunters
Arizona Cattlemen's Association
Arizona Riparian Council
Arizona Rough Riders Four-Wheel Drive Club
Arizona Snowbowl
Arizona Snowmobile Association
Arizona State Association of 4WD Clubs
Arizona Wildlife Federation
Arizona-Southern California Rocky Mountain Elk Foundation
Ascend Arizona
Aspen Sports
B A S S
Babbitt Ranches (Coconino Plateau Natural Reserve Lands)
Babbitt's Backcountry Outfitters
Bellemont Baha'i School
Big Joes Cycles
Book Nest
Canyon Country Outfitters
CCOEH
Central Arizona Grotto
CO Bar Livestock, LTD
Coconino Sportsmen
Cocopai RC and D
Colorado Plateau Forum
Dames and Moore
Darmstadt Elementary School
DBA Hart Ranch
Diablo Trust
DNA Legal Services
Doney Area Plan Committee
Doney Park Interest Groups
Ducks Unlimited Inc.
Earthlight
ENSR Consulting and Engineering
Environmental Action Coalition
Federal Land Exchange Inc.

First United
Flagstaff Film Commission
Flagstaff Hiking Club
Flagstaff Jeep Tours
Flagstaff KOA
Flagstaff Medical Center
Flagstaff Mountain Guides
Flagstaff Riding Club
Flagstaff RV Sales
Flying Heart Barn
Forest Conservation Council
Forest Guardians
Friends of Walnut Canyon
Grand Canyon Trust
Grand Canyon Wildlands Council
Greater Arizona Bicycling Association
Hanks Trading Post
Hart Prairie
Hart Ranch
High Desert Investments
Hitchin' Post Stables
Horse Trails Coalition
IMFAM Associates
Kampground Owners' Association
Karan English
Keep Sedona Beautiful Environmental Quality Committee
Lake Mary Fishing Boat Rentals
Lockett Ranch Inc.
Loose Spoke
Lowell Observatory
Manterola Sheep Company
Maricopa Audubon
McCoy Motors
Michelback Ranch
Monte Vista Marine
Mormon Lake Lodge
Morrison Brother's Ranch
Mountain Man Events
Mountain Mushers
Mountain Sports
Mountain View Pediatrics
Mountaintop Honey
Museum of Northern Arizona
NAHB
National Parks and Conservation Association
Native Plant and Seed
Northern Arizona University
- Arizona Historic Commission
- College of Engineering
- Department of Anthropology
- Department of Geography
- Department of Geology
- High Altitude Sports Training Complex
- Outdoors
- School of Forestry

Northern Arizona Association of Realtors
Northern Arizona Audubon Society
Northern Arizona Cattle Growers
Northern Arizona Flycasters
Northern Arizona Grotto
Northern Arizona Riding Club
Northern Arizona Trust Lands Inc.
Northland Yamaha-Kawasaki
Peace Surplus Outdoor Store
People for the West
Peterson Lumber Company
Ponderosa Outdoor/Sled Dog Inn
Popular Outdoor Outfitters
Precision Pine and Timber
Prescott Climbers Coalition
Prescott College Environmental Center
RMRS-Flagstaff
Rough Country Bowhunters
Ruff's Sporting Goods
S.E.C.
Salt River Project
Sanderson Ford
Sedona Westerners
Shapins Associates
Shriner's Club
Sierra Club
- Grand Canyon Chapter
- Legal Defense Fund
- Plateau Group

Sinagua Trading Post
Single Track Mountain Bikes
Sky Ranch Development, Inc.
Smith Contracting, Inc.
Southwest Center for Bio Diversity
Southwest Forest Alliance
Southwest Information
Southwest Parks and Monuments Association
SWCA, Inc.
Tametic Committee
Teton Mountain Bike Tours

The Arboretum at Flagstaff
The Edge
The Game Plan
The Nature Conservancy
The Wilderness Society
The Wilson Foundation
Total Timber
Trust for Public Land
University of Arizona College of Agriculture
Vertical Relief Rock Gym
Voters of Flagstaff
Wildlife Society
  Arizona Chapter
  Arizona State University Chapter
Windmill Ranch

## Individuals

There are more than 900 individuals to whom copies of the EIS were sent. A complete listing of these names is available from the Superintendent, Flagstaff Areas office, 6400 N. Hwy 89, Flagstaff, AZ 86004.

## APPENDIX A: LEGISLATION

**Public Law: 101-612 (11/16/90)**

SPONSOR: Sen McCain (introduced 05/02/90)
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•SHORT TITLE(S) AS ENACTED:
Smith River National Recreation Area Act
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STATUS: Floor Actions
11/16/90 Public Law 101-612
11/09/90 Measure presented to President
11/09/90 Measure enrolled in Senate
11/07/90 Measure enrolled in House
10/28/90 Senate agreed to House amendment
10/27/90 Measure passed House, amended
10/27/90 Measure considered in House
10/27/90 Measure called up by committee discharge in House
06/19/90 Referred to House Committee on Interior and Insular Affairs
06/14/90 Measure passed Senate
06/14/90 Measure considered in Senate
06/14/90 Call of calendar in Senate
06/07/90 Reported to Senate from the Committee on Energy and Natural Resources, S. Rept. 101-310

**S.2566**

Smith River National Recreation Area Act (Enrolled Bill (Sent to President))
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SEC. 11. STREAMSIDE PROTECTION ZONES.
SEC. 12. STATE AND LOCAL JURISDICTION AND ASSISTANCE.
SEC. 13. SAVING PROVISIONS.
SEC. 14. AUTHORIZATION OF APPROPRIATIONS.
SEC. 15. REDESIGNATION.

SEC. 15. REDESIGNATION.

The Sunset Crater National Monument, Arizona, shall, on and after the date of enactment of this Act, be known and designated as the `Sunset Crater Volcano National Monument'. Any reference to the Sunset Crater National Monument in any law, regulation, map, document, record, or other paper of the United States shall be considered to be a reference to the Sunset Crater Volcano National Monument.

Speaker of the House of Representatives.

Vice President of the United States and

President of the Senate.

# APPENDIX B: RESOURCE ATTRIBUTES

| Resource Experience Opportunity Areas | Size/Extent of Resource (%) | | Relative Commonness of Resource | | Ability of Resource to Conceal Use | Potential Interest of Resource to Visitor | Ability of Resource to Withstand Use | Relative Importance of Area to Purpose, Significance, and Interpretive Themes |
|---|---|---|---|---|---|---|---|---|
| | **Unit** | **Study Area** | **Unit** | **Region** | | | | |
| **Steep Timbered Hills** | 5 | 20 | 3 | 4 | 4 | 4 | 2 | 4 |
| **Lava Flow** | 35 | 20 | 5 | 4 | 2 | 5 | 5 | 5 |
| **Rolling Timbered Hills** | 2 | 25 | 2 | 4 | 4 | 3 | 3 | 2 |
| **Park** | 0 | 1 | 0 | 3 | 1 | 4 | 2 | 3 |
| **Pristine Black Dune** | 20 | 1 | 4 | 1 | 1 | 4 | 1 | 4 |
| **Crater** | 25 | 10 | 1 | 2 | 1 | 5 | 1 | 5 |
| **Cinder Hills** | 2 | 50 | 2 | 2 | 2 | 3 | 2 | 4 |
| **Timbered Cinder Hills** | 5 | 20 | 2 | 2 | 3 | 3 | 2 | 3 |
| | | | 1. Unique<br>2. Rare<br>3. Uncommon<br>4. Common<br>5. Abundant | | 1. Very Low<br>2. Low<br>3. Moderate<br>4. High<br>5. Very High | | | |

# APPENDIX C: CHOOSING BY ADVANTAGES AND COSTS

| Alternative #1 | | | |
|---|---|---|---|
| **Description** | **Qty.** | **Cost/ Unit** | **Net Cost** |
| New Visitor Center | 3500 | $265 | $927,500 |
| Utilities | | | $500,000 |
| Exhibits | | | $500,000 |
| New Parking / Orientation (40 cars, 5 RV's) | 40 | $2,200 | $88,000 |
| wayside | 3 | $10,000 | $30,000 |
| Rv's | 5 | $6400 | $32,000 |
| Adapt Visitor Center | 3500 | $100 | $350,000 |
| New Wayside (trails) | 10 | $5,000 | $50,000 |
| New Wayside (roads) | 10 | $10,000 | $100,000 |
| New Trail (road shoulder) | 1 | $26,500 | $26,500 |
| **TOTAL $2,604,000** | | | |

| Alternative #2 | | | |
|---|---|---|---|
| **Description** | **Qty.** | **Cost/ Unit** | **Net Cost** |
| New Visitor Center | 3500 | $265 | $927,500 |
| Utilities | | | $500,000 |
| Exhibits | | | $500,000 |
| New Parking / Orientation (40 cars, 5 RV's) | 40 | $2,200 | $88,000 |
| RV's | 5 | $6,400 | $32,000 |
| New Admin./ Maintenance | 3500 | $165 | $577,500 |
| New Road | 2 | $873,000 | $1,746,000 |
| Demolish Visitor Center & Museum Storage | 7500 | $15 | $112,500 |
| Site Rehabilitation | 12000 | $8 | $90,000 |
| New Wayside | 10 | $5,000 | $50,000 |
| Obliterate old road | 4 | $10,000 | $40,000 |
| New Campground 20 sites | 20 | $12,000 | $240,000 |
| rv sites | 5 | $21,000 | $105,000 |
| New Parking (Node sites) | 10 | $2,200 | $22,000 |
| Demolish Campground | | | $25,000 |
| New Trail (Bonito Park) | 3 | $26,500 | $79,500 |
| **TOTAL $ 5,055,500** | | | |

| Alternative #3 | | | |
|---|---|---|---|
| **Description** | **Qty.** | **Cost/ Unit** | **Net Cost** |
| New Visitor Center | 3500 | $265 | $927,500 |
| Utilities | | | $500,000 |
| Exhibits | | | $500,000 |
| New Parking / Orientation (40 cars, 5 RV) | 40 | $2,200 | $88,000 |
| RV's | 5 | $6,400 | $32,000 |
| Adapt Visitor Center | 3500 | $100 | $350,000 |
| New Wayside (trails) | 10 | $5,000 | $50,000 |
| New Wayside (roads) | 10 | $10,000 | $100,000 |
| New Trail (road shoulder) | 1 | $26,500 | $26,500 |
| New Trail (Double Crater) | 4 | $53,000 | $212,000 |
| Rehabilitate OHV tracks | 2000 | 7.5 | $15,000 |
| **TOTAL $2,801,000** | | | |

**Note: All estimates in FY 200 dollars.**

**Project/Location: Sunset Crater Volcano - General Management Plan**
5/31/00 (FY 2000 Dollars)
Subject: Functional Component
Description:
Project Life Cycle = 25 Years
Discount Rate = 7.00%
Present Time = Current Date

| | | | Alternative 1 | | Alternative 2 | | Alternative 3 | |
|---|---|---|---|---|---|---|---|---|
| **INITIAL COSTS** | **Quantity UM** | **Unit Price** | **Est.** | **PW** | **Est.** | **PW** | **Est.** | **PW** |
| Construction Costs | | | | | | | | |
| A. | | $0.00 | 2,604,000 | 2,604,000 | 5,055,500 | 5,055,500 | 2,801,000 | 2,801,000 |
| B. | | $0.00 | | 0 | | 0 | | 0 |
| C. | | $0.00 | | 0 | | 0 | | 0 |
| D. | | $0.00 | | 0 | | 0 | | 0 |
| E. | | $0.00 | | 0 | | 0 | | 0 |
| F. | | $0.00 | | 0 | | 0 | | 0 |
| G. | | | | 0 | | 0 | | 0 |
| **Total Initial Cost** | | | | **2,604,000** | | **5,055,500** | | **2,801,000** |
| **Initial Cost PW Savings (Compared to Alt. 1)** | | | | | | **(2,451,500)** | | **(197,000)** |
| **REPLACEMENT COST/ SALVAGE VALUE** | | | | | | | | |
| **Description** | **Year** | **PW Factor** | | | | | | |
| A. V.C. Replacement | 5 | 0.7130 | 180,000 | 128,337 | 180,000 | 128,337 | 180,000 | 128,337 |
| B. V.C. Replacement | 10 | 0.5083 | 180,000 | 91,502 | 180,000 | 91,502 | 180,000 | 91,502 |
| B. V.C. Replacement | 15 | 0.3624 | 180,000 | 65,240 | 180,000 | 65,240 | 180,000 | 65,240 |
| B. V.C. Replacement | 20 | 0.2584 | 180,000 | 46,515 | 180,000 | 46,515 | 180,000 | 46,515 |
| C. | 0 | 1.0000 | 0 | 0 | 0 | 0 | 0 | 0 |
| D. | 0 | 1.0000 | | 0 | | 0 | | 0 |
| E. | 0 | 1.0000 | | 0 | | 0 | | 0 |
| **Total Replacement/Salvage Costs** | | | | **331,594** | | **331,594** | | **331,594** |
| **ANNUAL COSTS** | | | | | | | | |
| **Description** | **Escl. %** | **PWA** | | | | | | |
| A. Maintenance - V.C. | 0.000% | 11.654 | | 0 | | 0 | | 0 |
| B. Operations | 0.000% | 11.654 | | 0 | | 0 | | 0 |
| C. Staffing | 0.000% | 11.654 | 0 | 0 | 0 | 0 | 106,000 | 1,235,280 |
| D. | 0.000% | 11.654 | 0 | 0 | 0 | 0 | | 0 |
| E. | 0.000% | 11.654 | 0 | 0 | | 0 | | 0 |
| F. | 0.000% | 11.654 | | 0 | | 0 | | 0 |
| **Total Annual Costs (Present Worth)** | | | | **0** | | **0** | | **1,235,280** |
| **Total Life Cycle Costs (Present Worth)** | | | | **2,935,594** | | **5,387,094** | | **4,367,874** |
| **Life Cycle Savings (Compared to Alt. 1)** | | | | | | **(2,451,500)** | | **(1,432,280)** |
| **Discounted Payback (Compared to Alt. 1)** | | **PP Factor** | | | **#DIV/0!** | **Years** | **-1.86** | **Years** |
| **Total Life Cycle Costs (Annualized)** | | **0.0858** | **251,905** | **Per Year** | **462,269** | **Per Year** | **374,810** | **Per Year** |

# GLOSSARY

**Advisory Council on Historic Preservation (ACHP).** An independent federal agency with statutory authority to review and comment on federal actions affecting properties listed in or eligible for listing in the National Register of Historic Places.

**air quality.** A measure of the health-related and visual characteristics of the air often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.

**air quality class II areas.** Regions in attainment areas where maintenance of existing good air quality is of high priority. Class II areas permit moderate deterioration of existing air quality.

**alternative.** One of at least two proposed means of accomplishing planning objectives.

**archeological resource.** Any material remains or physical evidence of past human life or activities that are of archeological interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research.

**backcountry.** All nondeveloped areas within the park. Generally considered to be all areas beyond developed facilities and visitor use areas, (operational areas, campgrounds, picnic areas, visitor centers, visitor contact stations), developed interpretive areas (view points, wayside orientation exhibits, developed archeological resources with designated trails), and designated trails, trailheads, and roads.

**cultural landscape.** A geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

**cultural landscape inventory (CLI).** The CLI is a computerized, evaluated inventory of all cultural landscapes in which NPS has or plans to acquire any legal interest. Its purpose is to identify cultural landscapes in the system and provide information on their location, historical development, character-defining features, and management. The CLI assists park managers in planning, programming, and recording treatment and management decisions. CLI forms, including maps, drawings, and photographs, are completed and maintained at the regional offices, with copies provided to the parks.

**cultural resources.** An aspect of a cultural system that is valued by or significantly representative of a culture or that contains significant information about a culture. A cultural resource can be a tangible entity or a cultural practice.

**cumulative effects.** The culmination of a proposed action when added to past, present, and reasonably foreseeable future actions; action can be taken by anyone and can occur inside or outside the park.

**ecosystem.** A system made up of a community of animals, plants, and bacteria and its interrelated physical and chemical environment.

**endangered species.** Any species that is in danger of extinction throughout all or a significant portion of its range [16 USC §1532(6)].

**environmental impact statement (EIS).** Required by the National Environmental

Policy Act to examine a range of federal actions and their potential effects on the human environment.

**ethnographic landscape.** Areas containing a variety of natural and cultural resources that associated people define as heritage resources.

**ethnographic resource.** A site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.

**floodplain.** A plain along a river, formed from sediment deposited by floods.

**four-wheel-drive.** Four-wheel-drive, differential transfer case disperses 50/50 front and rear displacement. Trucks, cars, buses, or sports utility vehicles with high clearance and the ability to operate off-pavement as well as on highways.

**front country.** Areas within the park that contain development for visitor use and park operations. Generally considered to be all areas with developed facilities and visitor use areas, (operational areas, campgrounds, picnic areas, visitor centers, visitor contact stations), developed interpretive areas (view points, wayside orientation exhibits, developed/stabilized archeological resources with designated trails), and designated trailheads, trails, and roads.

**full-time equivalents (FTEs).** Staff positions that include 40 hours of work per week all year.

**habitat.** A specific set of physical conditions in a geographic area that surrounds a single species, a group of species, or a large community. In wildlife management, the major components of habitat are food, water, cover, and living space.

integrity. The authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during its historic or prehistoric period; the extent to which a property retains its historic appearance.

**interpretation.** A communication process designed to reveal meanings and relationships of our cultural and natural heritage to the public through firsthand experiences with objects, artifacts, landscapes, or sites; facilitating a connection between the interests of the visitor and the meaning of the park by explaining the park's purpose and significance; usually a single contact with a group or individual.

**mitigating measures.** Constraints, requirements, or conditions imposed to reduce the significance of or eliminate an anticipated impact to environmental, socioeconomic, or other resource value from a proposed land use.

**National Register of Historic Places (NRHP).** The comprehensive list of districts, sites, buildings, structures, and objects of national, regional, state, and local significance in American history, architecture, archeology, engineering, and culture kept by NPS under authority of the National Historic Preservation Act of 1966.

**natural soundscapes.** The total ambient acoustic environment associated with a given environment (sonic environment) in an area such as a national park or the total ambient sound level for the park. In a national park setting, this soundscape is usually composed of both ambient sounds and a variety of human-made sounds. This sonic environment is an important resource of many parks; there can also be important relationships between how this environment is perceived and understood by individuals and society.

**riparian areas.** Zones of transition from aquatic to terrestrial ecosystems, dependent on surface and/or subsurface water for existence and which manifest the influence of that water.

**scoping.** Planning process that solicits people's opinions on the value of a park, issues facing a park, and the future of a park.

**sensitive species.** Those plant and animal species for which population viability is a concern.

**State Historic Preservation Officer (SHPO).** An official within each state appointed by the governor to administer the state historic preservation program and carry out certain responsibilities relating to federal undertakings within the state.

**threatened and endangered species.** Any species of fish, wildlife, or plant that is listed as threatened or endangered by the U.S. Fish and Wildlife Service.

**traditional cultural property (TCP).** A property associated with cultural practices or beliefs of a living community that are rooted in that community's history or are important in maintaining its cultural identity. Traditional cultural properties are ethnographic resources eligible for listing in the National Register of Historic Places.

**U.S.C.** United States Code. Contains the general and permanent laws of the United States.

**visitor use.** Visitor use of a resource for inspiration, stimulation, solitude, relaxation, education, pleasure, or satisfaction.

**wetlands.** Lands including swamps, marshes, bogs, and similar areas, such as wet meadows, river overflows, mud flats, and natural ponds.

**wilderness area.** An area officially designated as wilderness by Congress. Wilderness areas will be managed to preserve wilderness characteristics and shall be devoted to "the public purposes of recreation, scenic, scientific, educational, conservation, and historical use.

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