National Park Service
U.S. Department of Interior
Bandelier National Monument
New Mexico

BANDELIER
NATIONAL MONUMENT

Draft Ecological Restoration Plan
and
Environmental Impact Statement

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Bandelier National Monument

Los Alamos and Sandoval Counties, New Mexico

Fire has significantly shaped pre- European vegetation in Bandelier National Monument. Historic grazing beginning around 1880, followed by active fire suppression several decades later, effectively removed fire disturbance from many areas. Over one hundred years without fire resulted in major changes to plant communities (expansion of piñon- juniper woodlands at lower elevations; ponderosa pine and mixed conifer forests grew thicker at higher elevations). This increased the potential for crown fires in upper elevation ponderosa and mixed conifer forests and decreased herbaceous understory and fine fuels necessary to carry frequent, low intensity, surface fires in lower elevation ponderosa pine savanna and grasslands. Consequently, fire sensitive piñon and juniper invaded these lower elevation systems, eventually suppressing understory growth and enhancing widespread mortality of the ponderosa overstory during major droughts. The loss of herbaceous understory in these former grasslands and pine savannas created vast expanses of bare soil vulnerable to runoff and erosion throughout much of Bandelier's woodland. Accelerated soil erosion poses a significant threat to prehistoric cultural resources which can be washed away during thunderstorm events. Unchecked, this erosion will compromise the integrity of the unique archeological resources and values for which Bandelier was originally established.

This *Draft Ecological Restoration Plan and Environmental Impact Statement* (DEIS) evaluates two options for reversing the problems identified above, and includes the No Action alternative as a baseline for present management conditions. The specific goals for taking action include: re- establishing healthy, sustainable, grass dominated plant communities within the piñon- juniper woodland, which will help stabilize soils and cultural resources. Alternative B is the monument's preferred alternative. Alternative C also stabilizes soils and cultural resources and would promote healthy sustainable plant communities. Alternative C, however, would take up to 20 years to complete.

The National Park Services will accept comments on the DEIS from the public for 60 days from the date the Environmental Protection Agency publishes the Notice of Availability in the Federal Register. Mail comments to the name and address below or post online at http://parkplanning.nps.gov/. Our practice is to make comments available for public review. Before including your address, phone number, e- mail address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. Submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will always be made available for public review in their entirety.

Address written comments to: Ecological Restoration DEIS; ATTN: Darlene M. Koontz, Superintendent, Bandelier National Monument, 15 Entrance Road, Los Alamos, NM 87544.

When using the website (http://parkplanning.nps.gov/) for commenting, click on the link for "Plans/Documents Open for Comment," select the title of this document, and follow instructions for submitting electronic comments. Problems with the website should be directed to John Mack, Chief of Resource Management, at 505- 672- 3861, ext. 540.

Bandelier National Monument
United States Department of the Interior · National Park Service

EXECUTIVE SUMMARY

INTRODUCTION

The Bandelier National Monument *Draft Ecological Restoration Plan and Environmental Impact Statement* (EIS) establishes goals, objectives, and specific implementation actions needed to restore approximately 4,000 acres of degraded piñon- juniper woodland (woodland) to a more naturally functioning state over the next 15- 20 years. This EIS presents two alternatives for the restoration of piñon- juniper woodland, as well as a No Action alternative. Alternative B is the monument's preferred alternative at this time. The plan will determine both a policy direction for management of the park's woodland, as well as a process for integrating the results of monitoring and research into future management.

Restoration actions are expected to mitigate the accelerated soil erosion that threatens over 90% of archeological sites located within the woodland. Mitigating the erosion would also help in restoring understory vegetation and returning a more natural fire cycle to woodland at the monument. Management actions would be focused along mesa tops between 6,000 and 7,000 feet elevation where soil erosion issues are most critical. All 4,000 acres proposed for management actions are located in designated wilderness.

BACKGROUND

Bandelier National Monument (Bandelier, monument, park) is a unit of federal land administered by the National Park Service (NPS) and is located in north- central New Mexico approximately 10 miles southwest of Los Alamos and 50 miles northwest of Santa Fe, New Mexico. Bandelier is comprised of approximately 33,727 acres, of which 23,267 acres are designated wilderness.

In addition to several thousand cultural resources, Bandelier National Monument also contains diverse natural resources. These include a variety of vegetative communities such as juniper grassland communities, piñon- juniper woodland, ponderosa pine forests, mixed conifer forests, and mountain meadows. Associated wildlife includes elk, mule deer, black bear, mountain lion, and numerous bird and reptile species.

Ethnographic, scientific and educational values at Bandelier are articulated in the 1977 Bandelier *Master Plan* (NPS 1977), that also describes management of the monument and the preservation of the park's natural setting. The *Master Plan* was updated in 1990 via a *Statement for Management*, (NPS 1990).

Bandelier recently updated their goal statements for 2005- 2010, some of which address the protection of the monument's natural and cultural resources. Among others, these include:

Reducing soil erosion and promoting vegetative conditions that create a natural fire regime and protect cultural resource integrity within the landscape.

Maintaining prehistoric and historic resources in current or better condition to preserve cultural integrity and information potential.

SIGNIFICANCE OF BANDELIER NATIONAL MONUMENT

Bandelier was designated a National Monument in 1916 by President Wilson (Presidential Proclamation No. 1322: 39 Stat. 1794), largely because of its "tremendous ethnographic, scientific and educational" value. Bandelier National Monument contains approximately 2,900 recorded archeological sites ranging from the Paleoindian period (10,000 years ago) to the historic period. The monument includes ancient hunting camps, "cavate" structures (unique to the Bandelier area), 20 to 300+- room pueblos, small farming hamlets, and the remains of historic corrals and log cabins. In Frijoles Canyon, Bandelier has one of the largest collections of buildings constructed by the Civilian Conservation Corps (CCC) between 1933 and 1940. The Frijoles area was designated a National Historic Landmark in 1987 commemorating the accomplishments of the CCC.

PURPOSE AND NEED FOR ACTION

The purpose of the *Ecological Restoration Plan* is to re- establish healthy, sustainable vegetative conditions within the piñon- juniper woodland and to mitigate accelerated soil erosion that threatens the cultural resources. Protection of these cultural resources is identified in Bandelier National Monument's enabling legislation and this need is further explained below.

Prior to creation of the monument, historic land use, particularly grazing, resulted in changes in ecosystem processes that continue to adversely affect both natural and cultural resources inside Bandelier. The most detrimental of these changes is the accelerated rate of soil erosion and associated loss of archeological resources ongoing within the piñon- juniper woodland.

Continued rapid soil loss in already degraded piñon- juniper communities threatens the integrity of thousands of prehistoric cultural sites, which the monument was specifically set aside to preserve. Over 75% of the known prehistoric sites at Bandelier occur within piñon- juniper communities, and nearly 90% of these have experienced adverse effects related to erosion (Herhahn 2003; Powers and Orcutt 1999, unpublished data). Without management intervention to actively restore the herbaceous understory and stabilize soils in degraded woodland communities, an estimated 1,900 archeological sites are considered at risk of damage or loss from erosion (Herhahn 2003).

Plan Objectives

Objectives are more specific statements of the purpose of the plan, and they must be met to a large degree for the plan to be considered successful in resolving the needs for action identified above. The following are the objectives for Bandelier's *Ecological Restoration Plan*:

- Increase cover of native, perennial, herbaceous plants within degraded portions of the piñon- juniper woodland in order to reduce soil erosion, runoff, and loss of cultural resource integrity.
- Create conditions within degraded portions of the pion- juniper woodland that will support a surface fire regime within the natural range of variability (for example, sufficient to maintain restored grass- dominated communities).
- Manage degraded portions of the piñon- juniper community using information gained through an active program of research and monitoring.
- Build support for, and actively share information about, restoration actions and related research and monitoring efforts with government agencies, pueblos, and communities.

ALTERNATIVES

A combination of research results, internal (NPS) scoping and information obtained through two sets of public scoping sessions was used to create the range of reasonable alternatives. In deciding whether to carry alternatives forward for analysis, the criterion of reasonableness (as defined in the Council on Environmental Quality NEPA regulations, 40 CFR 1500 et seq.) was used as a guide. Reasonableness includes technical and economic feasibility, as well as "common sense." In this case, common sense included the application of research findings from studies and test plots at Bandelier and the scientific literature which have shown that successful treatment of the piñon- juniper woodland can be achieved through the cutting of selected trees and lop and scatter of their branches. Other techniques were either infeasible or would only be possible on a very small scale (Jacobs and Gatewood 1999). Therefore, only the thinning and slash mulch treatment is considered a reasonable approach for Bandelier, and it is the treatment method analyzed in both action alternatives.

Alternative A—No Action

Alternative A (No Action) is a summary of the existing management of resources. The No Action alternative serves as a baseline for comparison of the impacts of Alternatives B and C.

Current management of most resources in the piñon- juniper woodland at Bandelier is limited, with no active management of soils, vegetation, or wildlife beyond current research and monitoring activities. On- going research on soils and vegetation, as well as that for wildlife and special status species would continue in piñon- juniper woodland under this alternative. Current cultural resources research (e.g., current condition assessments/monitoring, recording of insufficiently documented sites, inventory of unsurveyed areas, resource stabilization, limited data recovery) would continue as funding permitted. Wildland and prescribed fire, as well as fire suppression, are allowed in piñon- juniper woodland though the likelihood of any of these occurring is low due to the sparse fuel conditions. Removal of trees considered threats to the integrity of archeological sites is allowed.

Wilderness would continue to be managed and maintained to provide a primitive and natural experience. Front and backcountry patrols would continue to emphasize visitor and employee safety, resource protection, fire prevention, and minor maintenance of trails.

Actions Common to all Action Alternatives

The action alternatives have several features in common, including:

- **Annual treatment plans**. Although this plan and EIS discuss as many of the site specific variables as are known at this time, they do discuss actions and impacts across the woodland and are considered “programmatic.” Therefore, each year the monument staff will prepare a site specific action plan for treating acreage. These annual site- specific treatment plans will be consistent with the Ecological Restoration Plan and EIS, and will flesh out the details of treatment within particular sub- basins to maximize the chances of success, minimize logistical problems, and avoid site specific impacts to cultural and natural resources. A minimum requirements analysis to re- evaluate whether intervention in these particular wilderness sites is needed and if so, to determine the minimum tool for conducting that intervention will be prepared to accompany the annual treatment plan.
- **Seasonal work restrictions**. No restoration work between June and August would occur so that impacts to monument visitors are minimized.
- **Wildlife mitigation (Special Status Species habitat).** Where appropriate, the use of hand tools, use of biological monitors, seasonal restriction for motorized activities, and or buffers would be used to minimize or mitigate impacts to special status wildlife species.
- **Archeological resources**. A variety of measures to protect archeological resources from impacts as a result of restoration activities including camp site location criteria, daily presence of archeologist in work areas, removal of dead trees and some live trees from structural elements of sites, and consultation with affiliated Pueblo tribes regarding sacred sites would be required.
- **Visitor experience**. Visitors would be informed of locations of on- going restoration work so that they can avoid these areas should they choose.
- **Wilderness**. Because all treatment would occur in designated wilderness, management actions in the piñon- juniper woodland would be subject to the minimum requirement analysis concept at the programmatic and project level to determine the appropriateness of intervention and of the use of hand and/or motorized tools and equipment.

- **Research and monitoring**. Controls would be established to assess ongoing erosion potential in other areas of the monument for comparison to treated areas. Following treatment, an area would be monitored annually, and the information used to modify future work as needed. Resources monitored would include soil and water, vegetation, wildlife, and cultural resources.
- **Education and consultation**. Field tours, public presentations of post- treatment response, articles in the park newsletter and local newspapers, annual reports on restoration efforts, and postings on the park and NPS websites are all means the monument anticipates using to educate and consult with interested and affected members of the public.

Alternative B—Operational Priority

Alternative B would maximize the efficiency of treatment and minimize impacts and the time (five years) to implement treatment. Geography and logistics would determine the location and timing of treatment. Crews would complete restoration in a wave- like fashion by working systematically across the monument from one end to the other (southwest to northeast). This alternative would require sequential funding for each season of treatment.

The piñon- juniper woodland would be divided into approximately equal combinations of sub- basins (approximately 800 acres) across the landscape. Field seasons would run generally from September to May. Up to two crews of six to ten personnel would be treating an estimated 50 acres per month, per crew. Locations of up to eight, one- acre backcountry camps would be based on a set of criteria related to proximity to work site and protection of natural/cultural resources. Establishment and supply of some camps would require helicopters or pack strings of four to six mules. Restricting helicopter flight routes and seasons of use would minimize adverse impacts to sensitive species. As work moves closer to monument headquarters, the use of pack strings would be emphasized and helicopter use may be eliminated.

Alternative C—Phased Approach

Alternative C treats sub- basins containing the highest priority cultural resource sites within piñon- juniper woodland. Specific cultural resource criteria which were weighted and averaged to determine a sub- basin's priority for treatment. These criteria included the significance of a cultural resource and the level of threat of its loss (e.g., imminent, permanent loss or less imminent).

One crew of up to six to ten people each would be working at any given time. This alternative treats prioritized sub- basins, many of which may be located far from the next highest sub- basin priority. With a single crew treating approximately 200- 300 acres/year, treatment of the 4,000 acre woodland is estimated to take up to 20 years.

Because of the increased demands caused by moving to prioritized sub- basins, one crew and a September to March field season was assumed for Alternative C for purposed of analysis. As in Alternative B, camps would be selected based on environmental and logistic criteria.

Environmentally Preferred Alternative

In the Council on Environmental Quality's (CEQ) implementing regulations, agencies are required to evaluate how each analyzed alternative meets certain policy statements set forth in Section 101(b) of the National Environmental Policy Act (NEPA) (40 CFR 1502.2d). The environmentally preferred alternative is defined as the alternative(s) that best meets the these criteria. The CEQ has also indicated in its regulations (1981 Forty Most Asked Questions Concerning CEQ's NEPA regulations) that the environmentally preferred alternative is the one that:

> … causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources.

Using both the CEQ's interpretations of the Section 101 criteria and the alternatives impact information provided in this document, it was determined that Alternative B (Operational Priority) is the environmentally preferred alternative. This is primarily due to its much shorter time frame and much quicker restoration. This means impacts would generally be less severe to cultural and natural resources over the course of treatment at the monument. In addition, the soil erosion that currently threatens vegetation and cultural resources would be slowed and the resources themselves protected to the greatest possible degree.

Preferred Alternative

Alternative B is also the monument's preferred alternative (e.g. the one it is most likely to select for implementation) for the reasons identified above. This option would slow erosion as quickly as possible, thereby preventing loss or degradation of additional cultural resources. Slowing erosion would also help protect and restore important natural resources, including the soils and more natural park vegetation. Eventually, treatment would allow the return of cooler ground fires, which would help in restoring vegetative structure and composition more typical of a sustainable piñon- juniper woodland and grassland.

Alternatives Dismissed From Further Analysis

The following alternatives were considered but not analyzed in detail as they were considered impractical or did not meet the purpose, need and objectives of the plan.

- Use of hand tools only.
- Widespread reseeding of native grasses to jump start regeneration in the piñon- juniper and hand scarifying to establish grasses.
- Reestablishment of beaver populations in Upper Frijoles Canyon.
- Moving the boundary of the park to include Capulin and Alamo watersheds.

- Hand removal of exotic vegetation.
- Allow drought and bark beetles to kill off trees instead of using human intervention.

Use only prescribed fire instead of motorized and hand tools.

ENVIRONMENTAL CONSEQUENCES

The order in which impact topics are addressed in this EIS is intentional, and sets out to progressively illustrate conditions that have led to the need for restoration described above. For example, for readers to understand why cultural resources at stake, they must first know about the human disturbances to vegetation and the resulting soil erosion that occurred. Therefore, vegetation and soils precede the discussion of cultural resources.

Vegetation

In Bandelier National Monument, the piñon- juniper woodland is dominated by one- seed juniper at lower elevations, and until recent drought mortality, by increasing dominance of Colorado piñon pine at higher elevations. Normally, the herbaceous understory is comprised principally of native, warm season grasses, with cool season grasses found beneath the protective canopy of trees.

The piñon- juniper dominated woodland occupies about 10,000 acres of Bandelier National Monument. Of that, about 4,000 acres in the monument are considered degraded and potentially responsive to treatment. Most of the degraded woodlands are found on low gradient, mesa top settings between 6,000 and 7,000 feet in elevation, and are where the soil erosion issues and associated impacts to cultural resources are most critical.

Although piñon and juniper are native to Bandelier, the ecology of the woodland and the distribution of these species have changed during the last century and have become overly abundant, increasing in both profusion and range. Evidence suggests the trees were common on hillsides and rocky slopes, but did not regularly occur in lower gradient, deeper soil settings such as the mesa tops in Bandelier (Albert, et al. 2004). In addition, the extent of the understory of grasses, herbs, and forbs that characterized much of the landscape decades ago has been greatly reduced or eliminated, primarily as a result of intensive historic livestock grazing.

The loss of understory, as well as deliberate fire suppression, has altered the important ecosystem processes of fire frequency and intensity. Frequent lower intensity surface fires at intervals of 15- 30 years generally do not take place in the monument's piñon- juniper woodland. Relatively “cool” lightning fires traditionally had reinvigorated annual and perennial grasses and forbs, while killing back piñon and juniper seedlings and restricting them to more “fireproof” rocky outcrops or shallow soil sites. The closing of the canopy with piñon and juniper trees in areas that had traditionally been more open and savanna- like furthered the loss of herbaceous understory plants and contributed to accelerated soil erosion and runoff.

If current management continues unchanged, as under the No Action alternative, the density and range of woodland tree cover would increase. This longer- term expansion would result in moderate decreases in both cover and diversity of perennial grasses, forbs, and shrubs. These ongoing losses in understory (cover and diversity) and associated negative effects on accelerated soil erosion would continue to yield major, long- term, adverse impacts to grass dominated vegetation communities within the woodland at Bandelier and may increase the potential for severe widespread crown fire, and subsequent weed invasion.

Treating degraded mesa top piñon- juniper under either of the action alternatives is expected to result in major beneficial impacts to the herbaceous understory across this vegetative type. While both action alternatives could potentially treat up to 4,000 acres, the actual number of acres treated under Alternative B would likely be higher than for Alternative C. This is because treatment takes four times as long in Alternative C as Alternative B.

Treatment in either Alternative B or C would increase fuel loading, resulting in moderate, adverse effects in the short term, and fine fuel continuity in the short and long term. This means more frequent, low severity fires would occur, with fewer adverse impacts on herbaceous vegetation and woodland trees than under the No Action alternative. In contrast, it is possible that increased fuel loading and encroachment of woody vegetation under the No Action alternative in combination with piñon die- off could result in increased potential for high severity wildfires over the long term.

Under both Alternatives B and C, the piñon- juniper forests themselves would be thinned, and so long- term, major adverse, effects on some smaller diameter (less than 10 inches) individual live (juniper) would occur. Thinning would also improve conditions for remaining trees by reducing competition for soil moisture.

During the five years of treatment, workers and pack animals would cause localized minor impacts to vegetation from trampling, compaction of soils, transport of weed seeds, and creation of unofficial trails. The more intense time frame of Alternative B means these impacts may be similarly more intense, although in both alternatives they would be considered minor.

Soil and Water Resources

Bare soil surfaces (i.e., without the protective cover of litter, slash, pumice, or vegetation) are subject to heaving by extremes of temperature and humidity, and are extremely vulnerable to erosion from surface runoff and wind. Exposed soil surfaces often exceed 80% in woodland intercanopy areas, and this large expanse of exposed soil can generate high- volume sediment yields during runoff triggered by intense summer thunderstorm events.

Summer precipitation is the dominant pattern throughout the woodland, and high intensity, short duration storm events during the summer can result in an average soil loss rate of about 3.25 mm/decade. Runoff and soil losses increase and become more focused as the slope gradient increases resulting gully formation.

Under the No Action alternative, runoff and erosion would continue at current accelerated or increased levels, causing long- term, minor adverse effects to water quality. Soil would be removed from some areas and redeposited downgradient during precipitation events. Ultimately this would reinforce woodland desertification processes, where continued soil loss means less effective herbaceous cover. Degradation of soil beyond its ability to recover would occur across a large portion of the woodland resulting in major, long- term adverse effects to Bandelier's soil. .

Treatment under either action alternative is expected to decrease average soil erosion rates across 4,000 acres of degraded woodland by at least two- to four- fold, a moderate to major beneficial effect on soil and water resources. In some locations, runoff and sediment production would fall as much as ten- fold, a moderate to major benefit. Benefits related to treatment may be more for Alternative B because Alternative C would take up to 20 years. It is likely that at least some areas would degrade beyond their ability to recover during this time frame.

Under both action alternatives, small- scale minor adverse effects on soil compaction and erosion caused by project activities (camps, treatment, etc.) would also occur. In addition, short- term, negligible, adverse effects on water quality are expected, associated with impacts created by temporary work camps.

Cultural Resources

A large proportion of the archeological sites in Bandelier relates to the Ancestral Pueblo occupation of the area (approximately A.D. 1175 to A.D. 1550), but earlier and later periods are also represented. About 97% of the project area has been inventoried and a wide array of archeological materials are present. Over half (about 1,600) of the monument's recorded archeological sites fall within the project area.

Currently, erosion (primarily sheetwash) is having a large- scale adverse effect on a majority of archeological resources by reducing their contextual integrity, a critical factor in making accurate inferences regarding ancient human behavior. This loss of context occurs when artifacts are moved out of their original locations by, in this case, overland flow and erosion. Extrapolations from a study in the Frijolito watershed (Maher, Hogan and Allen 2001) suggest that as many as five million artifacts could potentially be moved out of context over the piñon- juniper project area if no changes to current management are made. Erosion can also remove soil from underneath building stones, causing standing walls to topple. While erosion affects both scatters and structural sites, scatters are more mobile and vulnerable to damage.

The No Action alternative would continue current management and would result in the continued erosion and loss of integrity of hundreds of archeological sites. Current management is restricted to ad hoc treatment of individual archeological sites. While these small- scale actions would have major benefits on individual sites, effects to the overall cultural resource in the woodland would be negligible. The lack of a larger scale plan to mitigate the effects of erosional processes to the monument's cultural resources has the potential to have major adverse impacts on archeological resources throughout the project area. Bandelier's enabling legislation specifically cites the preservation of these unique archeological resources as the monument's purpose and the loss of integrity to these sites could result in impairment of park cultural resources. Impairment is defined as a major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of (park name); (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant National Park Service planning documents.

Current management practices could have negligible to minor adverse effects on ethnographic resources or traditional practices because of the presence and operation of backcountry camps.

Under Alternative B, vegetation treatment within the piñon and juniper woodland would occur over five years (approximately 800 acres/year), maximizing efficiency and minimizing impacts associated with the length of treatment. Treatment would stabilize soils and reduce erosion by a factor of two to ten. Major benefits to the archeological resources on the individual and landscape scales are anticipated as approximately 98% of recorded sites would be stabilized by the end of the five- year treatment period. Minor to major benefits are expected to individual archeological resources as a result of soil stabilization (slash mulching, etc.). Negligible to minor, adverse effects to cultural resources could occur from vegetation treatment methods. Because erosion would continue during treatment, some sites would degrade and lose integrity. Depending on the individual sites and the damage done, these residual impacts could range from minor to major in intensity, but is expected to be no more than minor on a landscape scale. In either action alternative, activities during treatment (use of helicopters, pack strings, camp operations/occupation, monitoring), along with proposed mitigation measures, could have negligible short-term effects to cultural resources.

Because Alternative C would take up to 20 years to complete, more resources are likely to experience erosion and loss of integrity and slightly fewer (approximately 94%) recorded sites would be stabilized. This alternative still produces a major benefit to cultural sites. Other effects to archeological resources under Alternative C are similar to that described for Alternative B with the exception that more sites could be degraded or lost during the 20 year treatment period.

Six New Mexico pueblos—the Pueblos of Santa Clara, Santo Domingo, San Ildefonso, San Felipe, Cochiti and Zuni are traditionally associated with ethnographic resources at Bandelier. Consultation among Bandelier and the six pueblos is guided by a Memorandum of Understanding requiring regular and active discussions regarding park management, fire planning, and operational decisions that affect subsistence activities, sacred materials or places, or other ethnographic resources. Consultations with the pueblos regarding the need to address the accelerated erosion and degradation of the piñon juniper woodland, as well as the impacts to cultural resources in Bandelier have been ongoing since 1998.

Under the No Action alternative, continued biological, ecological, and archeological research and monitoring and small- scale ad hoc treatment of archeological sites would occur. The lack of vegetation treatment would result in continuing erosion and there would be no associated increase in herbaceous plants that might be important for traditional uses. Negligible to minor, adverse impacts to ethnographic resources are likely for the short and long term under the No Action alternative. Cumulative impacts would be adverse and negligible to minor over the short and long term.

Under Alternatives B and C, short- and long- term, negligible to moderate beneficial impacts to ethnographic resources are expected because of the potential increased availability of culturally important plants and plant material resulting from vegetation treatment. Initial reduction of small diameter trees could result in short- term, negligible adverse impacts to traditional practices which used these resources. Under both action alternatives, most large diameter piñon and juniper trees would be retained, resulting in negligible impacts to potential traditional activities involving large trees (e.g. nut or seed gathering). The locations of backcountry camps and camp activities would result in short- term, negligible effects under Alternative B and potential long- term, major effects under Alternative C (due to its 20 year project period). Alternative C could result in moderate benefits to ethnographic resources in that its long project duration allows extended consultation time with neighboring Pueblos to identify and find protective measures for culturally important places, plants and plant material before treatment activities take place.

Cumulative effects to ethnographic resources under both action alternatives could range from negligible to minor resulting from fire management activities (adverse) and the increase in herbaceous plants/plant parts used in traditional practices (beneficial). The considerably longer project duration (20 years) under Alternative C could result in major adverse effects over time related to disruption in contemporary cultural practices and the potential for reduced ability to pass traditional cultural information to the next generation of practitioners.

Visitor Experience

Bandelier National Monument continues to rate highly with the public in visitor satisfaction and experience. The monument’s cultural resources are the primary reason for visitation. Most visits occur during the summer months. The overwhelming majority (over 90 percent) of visits are focused on the frontcountry where visitors enjoy, among other things, a visitor center, two campgrounds, hiking trails associated with cultural resources, and other facilities. The backcountry comprises the majority of the monument’s land and the lowest visitation rate (six percent). Park visitors using this area cite the scenery, peaceful quiet and solitude as reasons for visiting.

Under the No Action alternative, visitor satisfaction ratings and perceptions of their experience at the monument are expected to continue to remain relatively high, at least in the near term. Visitors would not be subject to the adverse effects of restoration activities (e.g., odors, view alterations, disrupted wildlife viewing opportunities), a minor benefit to their experience. Adverse effects to the park's soundscape related to existing noise in the monument would be negligible to minor. However, the park's cultural resource base is at greatest risk under this alternative because this resource is so highly rated with visitors, its degradation over the next few decades would result in long- term, possibly moderate, adverse effects on their experience.

Alternative B would provide the highest degree of stabilization for the cultural resource base, a moderate to major benefit to the visitor experience. At the same time, when compared to other alternatives, treatment activities would result in the most notable adverse effects (negligible to moderate) to the visitor experience (odors, wildlife viewing, view alterations) during and for a period after vegetation treatment. Increased mechanized noise from chainsaws and helicopters would result in negligible to moderate, short- term, adverse effects to the monument's soundscape. It should be noted that most effects would occur in the backcountry, the area with the lowest overall visitation. Negligible to minor benefits to wildlife viewing are possible from increased biological productivity. Ultimately, the accelerated stabilization of the cultural resources under this alternative would result in long- term benefits to the visitor experience when compared to the other two alternatives A or C.

Due to smaller annual vegetation treatment areas proposed under Alternative C, fewer and less intense (negligible to minor) adverse effects to the visitor experience (alteration of views, wildlife viewing opportunities, odors/emission) are expected when compared to Alternative B. Negligible to minor, adverse impacts to the monument's soundscape related to increased mechanized noise (chainsaws/helicopters) are also expected. Similar to alternative B, most effects would occur in the backcountry, the area of the monument with the lowest overall visitation. Negligible to minor benefits to wildlife viewing are possible from increased biological productivity. The increased loss of cultural resources would include minor to moderate, adverse effects to the visitor experience compared to Alternative B, however, stabilizing some cultural resources would result in minor, long- term benefits to the visitor experience when compared to No Action.

Visual Resources

Analysis of impacts to the visual resources of the monument includes issues of scenic quality and the sensitivity of the landscape to visual change. Scenic quality is a measure of the visual appeal of a landscape (e.g., landforms, vegetation, color, water features, adjacent scenery, etc.). The monument is characterized by a rugged landscape of canyons and mesas ranging in elevation from 5,300 to over 9,000 feet. Vegetation varies significantly throughout the monument from riparian elements (cottonwoods, alders) in canyon bottoms to piñon- juniper woodland along mesa tops where treatment is proposed. Canyon bottoms exhibit a diversity of visual elements, including water features, a variety of vegetation patterns, and interesting landforms. Much of the backcountry use of the park is on trails that follow along the stream courses in canyon bottoms.

Sensitivity is a measure of peoples' concern for the scenic quality of a landscape. It is a function of the numbers and activities of viewers, and locations and distance of the proposed project from sensitive viewing locations. The highest use area within the monument is Frijoles Canyon (Visitor Center and the Main Loop Trail) where views are limited to the canyon bottom and sidewalls. The piñon- juniper woodland proposed for treatment is generally not visible from the popular Frijoles Canyon area.

Under the No Action alternative, the existing, degraded condition of the piñon-juniper woodland would persist resulting in a landscape with little diversity in line, form, color or texture. Without active management, the scenic quality of the piñon-juniper woodland would continue to degrade, resulting in moderate adverse impacts to visual resources.

Proposed activities under Alternative B would result in the largest degree of visual modification. Visual changes in the landscape would depend on variables such as numbers of acres treated at any one time, the pattern of cut areas, etc. Annual treatment areas of approximately 800 acres would vary in their visual quality, with some likely to be perceived as patchy (treated areas interspersed with untreated areas) and some exhibiting very large cut areas, the latter attracting greater viewer attention. In the short term, visual changes in the character of the landscape (minor to moderate adverse impacts) would be more noticeable to viewers under this alternative. In the long term, successful revegetation by native herbaceous vegetation would improve the visual quality of the treated areas over the existing condition of the area, resulting in moderate benefits to visual resources. These benefits are expected to be similar under Alternative C; no such benefits are provided under the No Action alternative.

Under Alternative C the order of areas of treatment would not necessarily be organized by geographic location and could result in treatment of sub- basins quite distant from one another in any given year. Annual treatment areas of approximately 200- 300 acres would minimize the visual contrast between cut and uncut areas when compared to Alternative B. Under Alternative C, short- term visual impacts are considered adverse and minor, while long- term effects would be beneficial and moderate.

Wilderness

The Bandelier Wilderness was designated in 1976 by Congress (PL 94- 567). No language particular to the qualities of Bandelier's wilderness was included in the Act. Simply the number of acres—23,267—and the name "Bandelier Wilderness" were specified.

NPS policies indicate that environmental impact statements should evaluate both wilderness "character" and wilderness "values," including the primeval untrammeled character and influence of the wilderness; the preservation of natural conditions (including the lack of man- made noise); and assurances that there will be outstanding opportunities for solitude and the public will be provided with a primitive and unconfined type of recreational experience.

The Bandelier Wilderness "character" was not pristine when it was designated due to the history of Euro- American land use practices described above, including overgrazing and fire suppression over the past century. As a result, highly "unnatural" conditions, with unsustainable ecological processes, exist today. These unsustainable conditions would continue to desertify the landscape and reduce the park's biological productivity without human intervention. In other words, the requirement of the Wilderness Act to "preserve natural conditions" is unattainable without overt management. The ecological conditions described above have led to the degradation of many of the monument's archeological resources. Both the Organic Act and the Wilderness Act require actions to prevent this continued loss.

Wilderness values are the second component of wilderness. Studies (Hass, et al. 1986; Manning, et al. 1996; Loomis and Walsh, 1992) have found that the general public holds a wide range of values for wilderness, and even places value on the idea of wilderness, whether or not they ever visit (called "existence values"). The greatest values placed on wilderness were for its ability to help in protecting wildlife, water quality and air quality, and its value as a place that will always be available for future generations to enjoy the beauty of nature.

Researchers categorize values toward wilderness as "biocentric" and "anthropocentric". The biocentric includes things like existence of natural, ecologic conditions and protection of habitat, watersheds, and air quality. Anthropocentric values include experiential benefits from things like recreation, educational and scientific values, tourism revenue, aesthetic and spiritual values, and "existence" values.

Other researchers articulate values of a particular group, such as Native Americans or backcountry users. Ranchers, for example, most commonly identify with the "utilitarian" attitude towards the environment (value measured in terms of usefulness), while conservationists may have an "ecological" or "preservationist" view (Kellert 1976).

For many Native Puebloan people affiliated with Bandelier, wilderness is a link to the spiritual world. The wilderness is perceived as part of mother earth and is thought to be essential to the spiritual, cultural, and physical well- being of native peoples. Administrative or agency boundaries are meaningless. These relationships and beliefs have spanned the centuries, as native Puebloan peoples have lived in harmony with the ecology of the area for hundreds of years (Ortiz 1979).

The “conservation ethic” regarding wilderness restoration varies from being unable to improve upon nature (Turner, et al. 2003) to science- based action in an attempt to return the wild to a more natural state (Sanderson, et al. 2002).

Under the No Action alternative, the piñon- juniper woodland in Bandelier’s wilderness would continue to appear “trammeled” and degradation would worsen, with major adverse impacts to the naturalness aspect of wilderness character. However, because visitors may be unaware of the degraded ecological conditions, current management may only have a negligible or minor impact on visitors’ perception of the area offering a recreational experience defined by the Wilderness Act.

Those holding biocentric wilderness values would experience moderate or major impacts. Those with anthropocentric values would experience minor adverse to minor beneficial impacts, depending on how they value the recreational aspect of wilderness. For those who believe humans are part of the ecology or that intervention in wilderness is never warranted, the No Action alternative would have no adverse or beneficial impacts.

If either action alternative were implemented, minor to major, short- term, adverse impacts to the wilderness character from noise, the presence of crews and camps, and the unnatural appearance of treated areas would occur during and for a few years following treatment. Major long- term or even permanent benefits to the character of the Bandelier wilderness would result from restoration of the degraded and unnatural state of its piñon- juniper woodland. Although motorized equipment would adversely affect the wilderness character during treatment, better overall protection of wilderness values, cultural resources, soils and vegetation, would offset the short- term, adverse noise impacts. In the long term, restoring natural ecological processes to the piñon- juniper woodlands would have major beneficial impacts to those people with biocentric values and a range from moderate beneficial to moderate and adverse for those with anthropocentric values. For those believing that humans are part of the ecology, or for those believing that intervention is never warranted, minor to major adverse impacts from implementing either action alternative are possible. For the majority of Americans, including those who commented during scoping on this EIS, treatment of Bandelier piñon- juniper woodland would be consistent with the values they place on wilderness, and restoration would have major beneficial impacts.

Wildlife

Bandelier has a wide variety of wildlife that uses its many habitats. Several bird and mammal species occupy piñon- juniper woodland, as well as a few reptiles.

Under the No Action alternative, wildlife may be occasionally disturbed by researchers or cultural resource specialists applying treatment on an ad- hoc basis in the piñon- juniper woodland. No landscape treatment would occur, and the quality and extent of herbaceous habitat in the woodland would continue to decline. Short-term changes in herbaceous growth would be related to precipitation and soil moisture, with species dependent on moisture (invertebrates, for example and the reptiles that feed on them) experiencing temporary population increases. Compared to existing conditions, impacts to wildlife due to habitat change are anticipated to be indirect and negligible.

Treatment in either action alternative would involve the use of chainsaws and helicopters; either may result in temporary disturbance and even displacement of some animals. Animals with exclusively underground life habits would be less affected because of the insulating ability of soil and the less sensitive hearing these species tend to have. Mobile birds, mammals or reptiles that live above ground would likely disperse from the area in the short term, but return once the noise has stopped. Thus, the adverse impacts to wildlife from the use of chainsaws are anticipated to be short- term, direct, and negligible to minor. Although this would be true of both action alternatives, a shorter work season would likely mean fewer animals would be affected each year in Alternative C than if Alternative B were implemented. But the overall duration of impacts would be longer under Alternative C than B (20 years vs. five year treatment duration).

Restoration activities would thin piñon- juniper woodland and may cause changes to wildlife habitat in the project area, which may prove beneficial to some habitat generalist species (cottontails, rock squirrels, mule deer, many bird species) and adverse to more piñon- juniper habitat dependent species (piñon mice, black-throated gray warblers). Effects would be negligible to minor in intensity and range from short- to long- term. Alternative B or C would decrease piñon and junipers, and so may have an indirect adverse impact on black- throated gray warblers at Bandelier through the loss of forest insect prey. Coyote numbers would likely increase with the restoration treatments in response to an overall increase in available small mammal prey species. Impacts to reptiles from habitat changes under either action alternative are likely to be beneficial in both the short and long term.

Special Status Species

Treatment activities may affect the federally threatened Mexican spotted owl and bald eagle and the state threatened peregrine falcon.

Major canyons within Bandelier are thought to have suitable nesting and/or roosting habitat for the Mexican spotted owl and Bandelier has established two spotted owl management designations: suitable nesting areas (SNAs) and nesting/roosting zones (NRZs). Treatment may affect owl SNAs outside the study area through noise (chainsaws, helicopters, etc.) and so they are included as part of the analysis. Annual surveys for Mexican spotted owls have been conducted in the monument since 1995. No owls have been documented in the monument since 2002.

Bald eagles are only in the Bandelier area from approximately November 1 through February 28. Winter roosting and fishing habitats for bald eagles are located near canyon mouths and along the Rio Grande, respectively. The project area does not include any bald eagle roosting or fishing habitats. Most eagles typically leave these roosts in the Bandelier area as much as an hour before sunrise, and return late in the day near or after sunset. Piñon- juniper mesa tops may be used by bald eagles for occasional foraging during winter months. Winter surveys for bald eagles have been conducted in Bandelier since 1994. Data from 2003 shows approximately 11 eagles observed during winter counts over two consecutive days in January and February.

Four designated suitable nesting areas for peregrine falcons occur in or immediately adjacent to Bandelier. Foraging areas include primarily piñon- juniper woodland and ponderosa pine forests on the mesas of the Pajarito Plateau, with mixed conifer forests extending farther down the canyons from the northwest. The Peregrine Falcon Habitat Management plan (NPS2006c) identifies three management zones that surround suitable nesting ledges and commits to restrictions to prevent impacts particularly to breeding falcons. In northern New Mexico, occupancy of nesting habitat usually starts between March 1 and May 15. Between August 16 and October 15, mechanical activities are no threat to reproduction for the year, but adults will still be present and exhibit courtship behavior and defend the nesting habitat until migration. In most cases, no peregrine falcons will be present from October 16 to February 28. For the purposes of this EIS, chainsaw and helicopter use would be prohibited in zones near nest sites from March 1 to May 16 to prevent indirect impacts from noise to breeding peregrine falcons. The 2006 annual surveys have indicated the presence of an occupied nest in the park

Under Alternative A, sources of noise related to activity in the piñon- juniper woodland would be restricted to those from researchers, occasional treatment of cultural sites, and visitors. Habitat changes would be minimal as well. Impacts to all three special status species would be indirect and negligible.

Under Alternative B, negligible short- term impacts related to the noise of treatment activities may occur to bald eagles and spotted owls; negligible to minor effects of noise are possible to the peregrine falcon. The impacts would be mitigated through certain restrictions placed on treatment operations. For example, if owls are detected within the monument, flights or treatment may be confined to certain areas away from the owls. No helicopters would fly at night when occasional bald eagles may be roosting in trees along access areas to the treatment site. Helicopters would also be routed to avoid impacts from noise to peregrine falcons.

Under Alternative C, there would be no impacts to breeding Mexican spotted owls or peregrines from noise disturbance as the work season would conclude prior to the start of the breeding season. Impacts to bald eagles would be similar to those described in Alternative B

There may be indirect, short- and long- term, minor beneficial impacts to spotted owls and peregrine falcons due to increased prey availability from habitat changes associated with the treatment under either action alternative.

Air Quality

Recent monitoring data from areas surrounding the monument indicate air quality is generally good and within compliance levels of nearly all monitored pollutants. Several exceedances were due primarily to windblown dust and emissions from a gypsum mine located nearby (Wear 2006). Visibility, monitored at Bandelier National Monument since 1989, is generally very good (approximately 144 kilometers, NPS 2005).

Under the No Action alternative, only very occasional work in the piñon- juniper woodland related to research, treatment at cultural sites, and thinning would occur. These activities would have no detectable (negligible) impact on air quality, and good air quality and visibility within the monument and in the project area are expected to continue.

Under Alternative B, the operation of chainsaws and helicopters for approximately eight months a year over the five- year project would result in minimal emission levels not expected to exceed National Ambient Air Quality Standards (NAAQS). Commercial- grade chainsaw emissions would be low in temperature, occur near ground level and would disperse in the immediate area (negligible, adverse effect). Helicopters, used to transport and supply crews, are expected to release minimal emissions (would not exceed NAAQS) which occur high in the atmosphere and are quickly dispersed (negligible adverse effects). Compared to Alternative C, effects to air quality and visibility under this alternative are similar but occur over a considerably shorter project time period, a benefit to the monument's air quality.

Under Alternative C, the operation of chainsaws and helicopters for approximately six and a half months a year over the 15- 20- year project is expected to result in effects similar to that under Alternative B (negligible, adverse), though over a much longer time period. Despite similar effects to air quality and visibility, Because of the longer project length, slightly increasing negative effects to air quality under Alternative C might be expected compared to Alternative B.

Park Operations

Bandelier National Monument staff levels vary seasonally with approximately 69 permanent staff members and 40 additional seasonal and volunteer staff during summer months. The six divisions and/or programs include Administration; Fire Management; Interpretation and Visitor Services; Facility Management; Visitor and Resource Protection; and Resource Management. With the exception of the Fire

Management division, all division's workloads and/or budgets may be affected by the activities proposed.

Under Alternative A, most divisions would not be affected, but because accelerated soil erosion conditions would require mitigation efforts for affected resources (e.g., cultural resource stabilization), the Resource Management division might incur minor to moderate adverse impacts. This on- going situation would continue to redirect funding and staff duties for the long term, particularly when compared to Alternative B. Under Alternative B, negligible to minor adverse effects are possible to all affected divisions primarily during the five- year treatment period. These effects would result from project- related hiring/personnel management, budget tracking, providing visitor information, pack operations and field camp management, project implementation and monitoring, and human health and safety issues. As many of these impacts would cease once vegetation treatment is complete (5 years), it is expected that Alternative B would, in general, have fewer adverse effects on park operations than would the other two alternatives.

Impacts to park divisions under Alternative C would be, for the most part, similar to those described under Alternative B, though they would continue for 15- 20 years. For the Resource Management division, minor to moderate adverse effects are expected due to the extended project time frame and the demands on division staff. The much longer duration of adverse impacts to most park operations divisions under Alternative C, coupled with its greater intensity of effects to the Resource Management division, would result in slightly increased overall negative effects when compared to Alternative B.

Health and Safety

Health and safety issues addressed in this EIS are related only to park staff and/or contractors and are related to mechanized noise from helicopters, chainsaws and hand tools.

Under the No Action alternative, negligible to minor impacts from activities inside the monument, including car traffic and visitor activities, occur now in the study area. Additional temporary, minor impacts to the natural quiet of the area from aircraft overflights, LANL activities and construction also occur. No impacts related to the No Action alternative would add to these sources of noise.

Under Alternative B, negligible to minor noise impacts from existing activities inside the monument, including car traffic and visitor activities would continue. Minor to moderate adverse effects to workers related to noise exposure could result from the use of hand tools and chainsaws and proximity of workers to helicopters.

Under Alternative C, negligible to minor noise- related impacts from existing activities inside the monument, including car traffic and visitor activities would continue. Adverse effects to workers from noise related to the use of chainsaws and hand tools and proximity to helicopters are similar to those described under Alternative B (minor to moderate).

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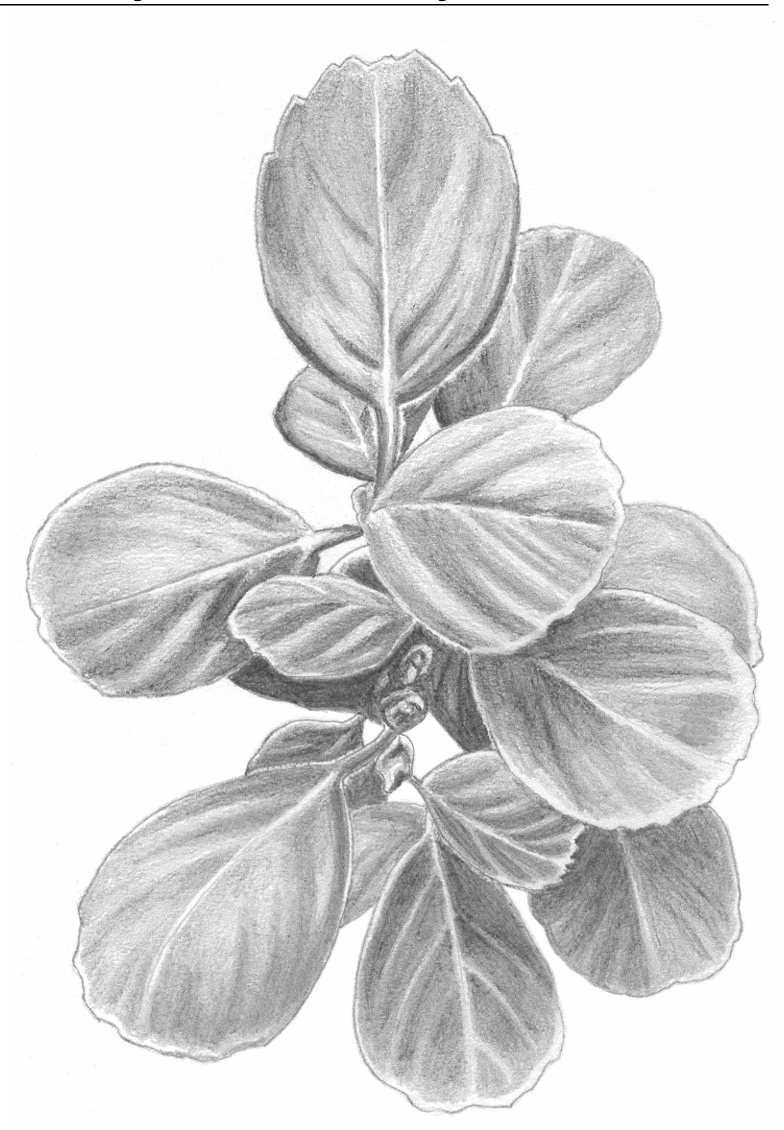

Mountain Mahogany,
Cercocarpus montanus

PURPOSE OF AND NEED FOR THE PLAN

INTRODUCTION

Bandelier National Monument ("Bandelier," "park," or "monument") is proposing to restore approximately 4,000 acres of degraded piñon- juniper woodland (woodland) in the monument (or 40% of the total 10,000- acre woodland area) to a more naturally functioning state. Vegetation has been altered by historic human land uses, and as a result important ecological characteristics such as the rate of soil erosion, and fire intensity and frequency are no longer within the natural rate of variability. Soil erosion also currently threatens over 90% of, or several thousand, archeological sites located within the woodland. Since nearly three- quarters of Bandelier's prehistoric cultural resources are located within the woodland, erosion effectively endangers the majority of the significant resource for which the monument was originally designated.

The monument explores two action alternatives for a restoration plan in this *Draft Ecological Restoration Plan and EIS*, as well as a No Action alternative. Alternative B is the monument's preferred alternative at this time. The plan/EIS is mostly programmatic in nature, which means it provides a framework for taking a range of management actions and a broad- scale discussion of impacts. The monument would decide more site- specific details for treatment each year based on soils, vegetation, cultural resources, and other factors. The plan will cover a 15- 20 year time frame and will determine both a policy direction for management of the park's piñon- juniper woodland, as well as a process for integrating the results of monitoring and research into future management.

PURPOSE OF AND NEED FOR ACTION

The *Purpose* section explains what the plan is intended to accomplish. The *Need for the Plan* section lays out the reasons why action is necessary at this time. Brief summaries of both purpose and need are presented here, but a great deal more information is available in the "Background" section.

Purpose

The purpose of the *Draft Ecological Restoration Plan* is to re- establish healthy, sustainable vegetative conditions within the piñon- juniper woodland and to mitigate accelerated soil erosion that threatens the cultural resources for which Bandelier National Monument was established.

Need for the Plan

Historic land use, particularly effects of grazing, in the general area of the monument before it became a unit of the National Park system, have resulted in changes in ecosystem processes that are adversely affecting both natural and cultural resources inside Bandelier. Most detrimental to fulfilling the congressionally designated purpose of the monument are accelerated rates of soil erosion and the associated losses of archeological resources within the piñon- juniper woodland. Rapid soil loss in degraded piñon- juniper communities threatens the integrity of thousands of prehistoric cultural sites, which the monument was specifically set aside to preserve. Over 75% of the known prehistoric sites at Bandelier are located within piñon- juniper communities, and nearly 90% of these have experienced adverse effects related to erosion (Herhahn 2003; Herhahn, et al. 2006). Without management intervention to actively restore herbaceous understories and stabilize soils in degraded woodland communities, an estimated 1,900 archeological sites are considered at risk of damage or loss from erosion (Herhahn 2003).

The relationship between historic human land use practices and changes in the function, structure, and processes of piñon- juniper woodland at Bandelier is explained in more detail in the *Background* section below. The remainder of this section describes the relevant legal, regulatory, and policy directives that the monument believes indicate that action in the form of an ecological management plan for piñon- juniper woodland is needed.

The National Park Service (NPS) is governed by a series of laws, regulations, and policies. The primary one of these laws is the Organic Act of 1916 (16 USC 1 et seq.) and its 1978 Redwood Amendment. The Organic Act speaks to the conservation and preservation of park resources and values as a high priority of the National Park Service and states that "the fundamental purpose of the said parks, monuments, and reservations . . . is to conserve the scenery and the natural and historic objects and the wild life 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."

The NPS has interpreted the Organic Act in its *Management Policies 2006* (NPS 2006a). These policies guide park management of both cultural and natural resources, as well as management of wilderness, visitor use, facilities, etc. Several sections of these policies direct parks to use tools available to them to try and preserve important cultural resources. For example, the policies state that parks must utilize the "most effective concepts, techniques, and equipment to protect cultural resources against . . . deterioration, environmental impacts, and other threats, without compromising the integrity of the resources" and "provide for the long- term preservation of . . . the features, materials, and qualities contributing to the significance of cultural resources." Archeological resources are to be preserved "in a stable condition to prevent degradation and loss" and those resources subject to "erosion, slumping, subsidence or other natural deterioration" are to be stabilized using methods that are not intrusive and that protect natural resources and natural processes. Cultural resources in wilderness may be an integral feature of the wilderness, and are to be "protected and maintained" according to all relevant laws and policies governing cultural resources (Sections 5.3.1, 5.3.5.1.1, 5.3.5.1.2 and 6.3.8).

In addition to the NPS Organic Act and current NPS policy, the enabling legislation for Bandelier National Monument speaks to the importance of the park's unique archeological resources and their preservation for future generations. The 1916 Presidential Proclamation (No. 1322: 39 Stat. 1794) that established Bandelier states: "Whereas, certain prehistoric aboriginal ruins . . . are of unusual ethnologic, scientific, and educational interest, and it appears that the public interests would be promoted by reserving these relics of a vanished people, with as much land as may be necessary for the proper protection thereof, as a National Monument."

With respect to natural resources, NPS *Management Policies 2006* (NPS 2006a) direct parks to intervene in natural biological or physical processes only "to restore natural ecosystem functioning that has been disrupted by past or ongoing human activities." This is true in wilderness as well, where most of the treatment of piñon- juniper woodland at Bandelier would take place if either of the action alternatives described in this environmental impact statement were implemented. Parks may manage wilderness ". . . to correct past mistakes, the impacts of human use, and influences originating outside of wilderness boundaries." The policies instruct park units to "seek to return human- disturbed areas to the natural conditions and processes characteristic of the ecological zone in which [they] are situated." Natural conditions are described as "the condition of resources that would occur in the absence of human dominance over the landscape." Further, landscapes may be manipulated to restore "natural processes and conditions to areas disturbed by human activities such as fire suppression." The policies specifically direct parks to prevent the "unnatural erosion, physical removal, or contamination of the soil or its contamination of other resources" and to prevent or minimize "adverse, potentially irretrievable impacts to soils" (Sections 4.1, 4.1.5, 4.4.2.4, 4.8.2.4, and 6.3.7).

The monument has also previously developed plans and policies which speak to the need to restore more natural ecological conditions, including its *Strategic Plan* (NPS 2000a) and *Fire Management Plan* (NPS 2005a). The relevant pieces of each are discussed in more detail in the *Background* and *Related Laws, Policies, and Plans* sections below.

The imbalance in the monument's resource conditions and the laws, policies, and plans that dictate their return to a more natural state are the reasons why action by the monument to re- establish sustainable vegetative conditions within the piñon- juniper woodland is needed. Doing so would both meet the requirements for natural resource management and help fulfill the obligation to protect the monument's unique cultural resources by slowing the soil erosion that threatens them.

Plan Objectives

Objectives are more specific statements of the purpose of the plan, and they must be met to a large degree for the plan to be considered successful in resolving the needs for action identified above. The following are the objectives for this plan:

1. Increase cover of native, perennial, herbaceous plants within degraded portions of the piñon- juniper woodland in order to reduce soil erosion, runoff, and loss of cultural resource integrity.
2. Create conditions within degraded portions of the piñon- juniper woodland that will support a surface fire regime within the natural range of variability (for example, sufficient to maintain restored grass- dominated communities).
3. Manage degraded portions of the piñon- juniper community using information gained through an active program of research and monitoring.
4. Build support for, and actively share information about, restoration actions and related research and monitoring efforts with government agencies, pueblos, and communities.

Desired Future Conditions for Piñon-juniper woodland

In addition to overall objectives for the plan, the monument has defined what it believes to be the functional state and ecological processes that would have characterized the now degraded portions of the piñon- juniper woodland. These are addressed in the "desired future conditions" (DFCs) of each subtype of piñon-juniper woodland in the park, and serve as specific and concrete objectives the monument will try to achieve in implementing the *Ecological Restoration Plan*.

Because European settlement has altered most of the forests of the western United States, DFCs are largely based on inferences from historic accounts, including oral and written histories, photographic records, and recent research (Allen 1989; Allen 2004; Swetnam, et al. 1999). Tree ring age class data can also provide additional information about the past structure of forests. Defining precise structural targets for vegetative communities in the monument is not appropriate because substantial spatial and temporal variability is inherent in plant communities (Allen, et al. 2002). Instead, process oriented, functional definitions for target conditions (historic fire frequency and fire behavior) are used, which provides a generalized DFC vegetation structure, since this acknowledges the inherent variability in natural systems (Allen, et al. 2002) and provides more realistic management goals.

PIÑON-JUNIPER WOODLAND

The piñon- juniper woodland is characterized by the presence of one- seed juniper at lower elevations, and until recent drought mortality, by increasing dominance of Colorado piñon pine at higher elevations. Historic grazing and associated loss of fire disturbance are thought to have allowed the expansion of piñon and juniper into former ponderosa pine savanna, and grass- or shrub- dominated communities.

The generally sparse herbaceous understory (<10% cover) is currently comprised principally of native, warm season grasses, including little bluestem, blue grama, and mountain muhly; these species are typically found in intercanopy spaces. Cool season grasses, including muttongrass, June grass, and littleseed ricegrass, are often found beneath the protective canopy of trees. A distinctive cool season grass of the intercanopy, Galleta was probably more common before grazing and woodland expansion. A great variety of perennial forbs, as well as annual and biennial forbs, can be found depending on local site conditions and weather patterns. Common shrubs include oak, rabbitbush, and sumac, with sub- shrubs such as wormwood, snakeweed, and pinque. Several genera of cacti are also present, with species of prickly pear dominating.

Desired future conditions in the piñon- juniper woodland in Bandelier would include a matrix of plant communities and structures, from more open grass or shrublands to pine savannas and including some dense patches of woodland. Understory species composition would include a mixture of native, perennial, warm and cool season grasses as noted above, largely reflecting what was present onsite or nearby prior to treatment; the major change would be increases of two- to four- fold in basal and canopy cover of grasses over pre- treatment conditions. Understory cover would be relatively greater on more productive sites, i.e., those with deeper soils, and total tree cover would generally increase with elevation (and precipitation). Recovery of a significant piñon component above 6,500' can be expected given current levels of seedlings remaining in woodland understories and subsequent production of seed crop by mature trees in 25- 50 years. The only exotic species of concern within the project area is cheat grass and experience suggests restoration treatment does not promote establishment of this species; rather treatment promotes recovery of a native herbaceous plant cover which can restrict invasion by exotic species. On the more productive sites, understory ground cover would be sufficient to stabilize soils and to carry low intensity surface fires at intervals of 15–30 years. Where older and denser patches of woodland occur, (typically on less productive, shallow or rocky substrates) surface fire disturbance would be uncommon, and fire would occur as patchy crown fires at intervals exceeding 250 years. Periodic drought and associated beetle mortality would occasionally thin existing woodland stands and, in addition to fire disturbance, restrict local woodland occurrence to rocky, shallow substrate sites.

General descriptions and desired future conditions for sub- components of the piñon- woodland are as follows:

JUNIPER-SHRUB GRASSLANDS

Juniper- shrub grasslands are currently characterized by the presence of a one- seed juniper overstory (not infrequently as a result of tree invasion since 1880) with an understory of various shrubs, grasses, and forbs as noted above. This type is found on the lower mesas and canyon slopes and on elevated benches along the Rio Grande corridor. In addition to relict juniper savanna communities, this type includes former shrub and grassland communities recently invaded by juniper.

Desired future conditions for this type include grass, forb, and shrub dominated communities with scattered mature trees (<5% cover) and herbaceous ground cover sufficient to stabilize soils and carry surface fire (at intervals of 5- 15 years). Isolated patches of juniper- dominated woodland (canopy cover >30%) may occur on shallow soil or rocky substrate sites (see piñon- juniper woodland DFC).

PIÑON-JUNIPER SAVANNA AND WOODLAND

This community is located at a higher elevation than juniper- shrub grasslands, but at a lower elevation than ponderosa pine forests, and is distinguished from the former by increased tree canopy cover and the presence of piñon pine. The overstory of piñon- juniper savanna and woodland types is comprised of Colorado piñon pine and/or one- seed juniper (and remnant living or dead Ponderosa pine components). The understory is characterized by a diverse array of shrubs, grasses, and forbs as noted above. Older growth woodlands are generally found on rocky, shallow soils, while younger savanna- like communities usually occur on deeper, more productive soils. Alligator juniper becomes an important component of woodland on steep rocky slopes in the southwestern portion of the monument, but these woodland types are not within the scope of the current proposal and constitute only a small percentage of total woodland area.

Desired future conditions for piñon- juniper savanna envision a community that maximizes a diverse shrub and grass- forb understory, with patches of piñon and juniper in varying proportions depending on local site conditions. Mature tree canopy coverage would average less than 15%, with herbaceous and/or shrub ground cover sufficient to stabilize soils and carry fire (at intervals of 15- 30 years). Piñon-juniper savanna would typically be located on deeper and more productive soil sites, where sufficient herbaceous cover can sustain frequent surface fire of intensity necessary to maintain open, or patchy, stand structure.

Desired future conditions for the piñon- juniper woodland envisions a community with canopy coverage generally exceeding 30%; herbaceous cover is generally sparse either due to shallow, rocky soils, or because canopy cover suppresses understory growth. Fire disturbance is uncommon, characterized by a patchy crown fire type behavior, and with intervals typically exceeding 250 years. Piñon- juniper woodland would typically be located on rocky, shallow soil sites which limit herbaceous productivity and potential for surface fires, thus promoting woody plant dominance and an infrequent, patchy crown fire regime.

PROJECT LOCATION

Bandelier National Monument is a unit of federal land administered by the National Park Service located on the southern portion of the Pajarito Plateau in the Jemez Mountains in north- central New Mexico. It is approximately 10 miles southwest of Los Alamos and 50 miles northwest of Santa Fe (Figure 1). Bandelier lies within the jurisdiction of Los Alamos, Sandoval, and Santa Fe counties, New Mexico. It is comprised of approximately 33,727 acres, of which 23,267 acres are designated wilderness.

Bandelier spans an elevational gradient from the Rio Grande at 5,300 feet (1,615 meters) to the summit of Cerro Grande at 10,199 feet (3,109 meters), an altitudinal range of 4,899 feet (1,493 meters). The monument's northern boundary is situated on the rim of a large volcano (now the Valles Caldera National Preserve) that collapsed approximately one million years ago after its enormous eruption. The area is now composed of volcanic ash and lava flows that have been eroded into deep canyons separated by narrow mesas. Modern drainages trend southeast on their way to the

Rio Grande. Modern tributary canyons within the monument, from north to south, include: Frijoles, Lummis, Alamo, Hondo, Capulin, Medio, and Sanchez.

The woodland across the Pajarito Plateau is characterized by cool, dry winters and warm, wet summers. Mean monthly temperatures range from 28° Fahrenheit (F) in January to 71.5° F in June. Mean minimum temperatures in January are around 12° F and mean maximum temperatures are around 89.7° F in June. Precipitation generally increases with elevation with considerable spatial and temporal variation (Hastings, et al. 2005). Mean annual precipitation (MAP) is about 16 inches (ranging from 15 to 16.5 inches depending on the 30- year period of record), and mean annual temperature (MAT) is about 50° F.

Normally a snow pack is formed during the winter months at the higher elevations, which yields peak base stream flows in most major canyons during the spring snow melt. Winter precipitation is generally followed by a distinct seasonal hot and dry period during the months of May and June. This dry period is defined as much by increased potential evapo- transpiration that accompanies increased day length, solar radiation, and temperatures, as by decreased precipitation. As a result, May and June are often the months of greatest fire potential given sufficient fuels and ignition; fire behavior during this time period can also be enhanced by strong wind patterns.

In late June/early July a monsoon pattern typically delivers 50- 60 percent of the annual precipitation between June and September. During this time, high intensity thunderstorms can account for large year- to- year variability in annual rainfall between localities (Hastings, et al. 2005). Over longer time scales, there are prolonged wet and dry cycles, lasting several years or more, which can have far reaching consequences in terms of plant mortality, establishment, and distribution.

The monument contains approximately 2,900 recorded archeological sites that span in time from the Paleoindian period (10,000 years ago) to the historic period (from 1600 to present). The monument also includes ancient hunting camps, "cavate" structures (rooms that have been carved into the soft tuff bedrock), 300- room pueblos, small farming hamlets, and the remains of historic corrals and log cabins as well as other cultural resources.

The elevational range, topographic aspects, climates, and soils mean the park has a variety of both plant and animal life. Bandelier contains moist canyon bottoms, juniper grassland communities, piñon- juniper woodland, ponderosa pine forests, mixed conifer forests, and mountain meadows and is home to 750 taxa of vascular plants, including many sensitive species. Associated wildlife includes elk, mule deer, black bear, mountain lion, and numerous bird and reptile species.

BACKGROUND

The purpose of this section is to describe in detail both the resource rationale for action and the administrative or legal reasons for action.

Historic and Prehistoric Land Use

This project focuses on the upland portions of the piñon- juniper woodland within Bandelier National Monument; this area comprises approximately one- third of the monuments' land area and can be generally circumscribed as mesa top settings between 6,000'- 7,000' elevation. Within this general setting, over three- quarters of Bandelier's prehistoric cultural resources are found. As noted above, desired future conditions of plant communities within the piñon- juniper woodland are based on inferences about the nature and status of these plant communities following prehistoric land use activities (ending around ca. 1600) and prior to historical land use patterns (beginning around 1880).

Aboriginal occupation of the Bandelier area for nearly 500 years (until ca. 1600) yielded a landscape strongly influenced by the needs of a pre- industrial civilization. In particular, fire frequency, tree density, and ungulate populations may have been significantly affected by prehistoric land use (in addition to the effects of prevailing climate). After abandonment in 1600, the system would have begun to adjust to the loss of the disturbance regime associated with a resident human population.

The vegetation of Bandelier was still recovering from the effects of prehistoric land use when historic land use activities began around 1800. Around 1880, these activities (i.e., fuel- wooding, grazing, and hunting) intensified and began to noticeably affect plant communities.

Fence posts and fuel wood were extracted from accessible woodland, animals were hunted (often to the point of local extirpation), herbaceous vegetation was intensively grazed by domestic livestock, and fires were indirectly suppressed by grazing activities. Beginning around 1916 when the monument was created, many of these consumptive activities ceased, although grazing continued through 1932 and a substantial population of feral burros was present in the monument until the mid-1980s.

Local plant communities were and continue to be strongly influenced by these historic land- use activities. Grazing removed herbaceous understory vegetation, and in combination with suppressing fires that normally removed piñon and juniper saplings from much of the landscape, gave way to increased tree dominance. Age class information from piñon- juniper study sites in Bandelier suggests an exponential increase in piñon- juniper stem densities in former pine savanna areas beginning around 1850 (Allen, personal communications, 2005.; Davenport, et al. 1996; Gottfried, et al. 1995; Julius 1999). Piñon and juniper also expanded their local distributions, invading upslope into ponderosa pine dominated forests and downslope into former shrub and grassland communities (Gottfried, et al. 1995).

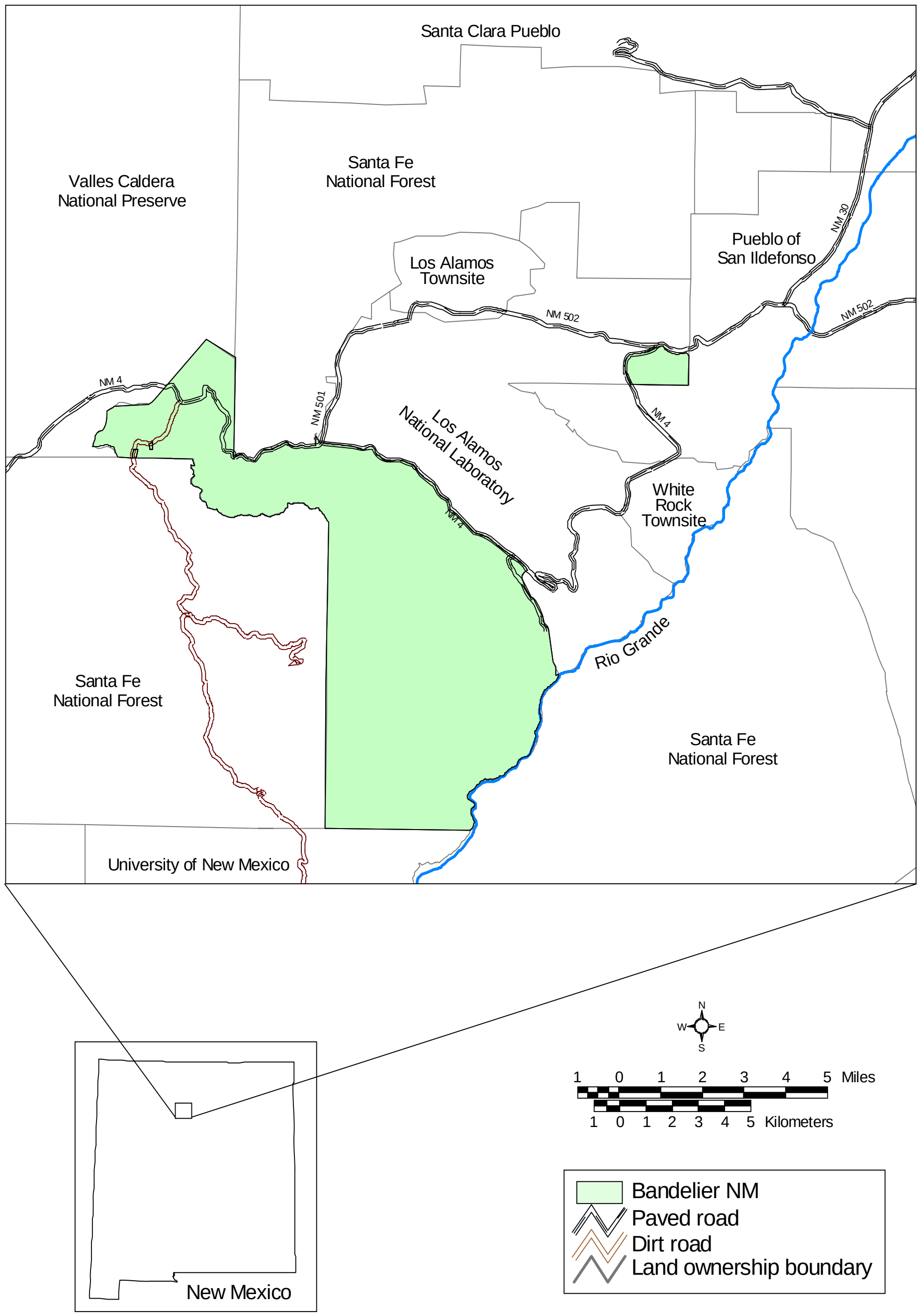

Figure 1. Locational Map of Bandelier National Monument.

Erosion

Changes in the degree and extent of woodland covering the landscape altered the balance of moisture shared by trees and understory herbaceous vegetation. Particularly under drought conditions, the increasingly sparse herbaceous vegetation that remained was unable to compete for limited soil moisture. Interspaces between woodland trees became increasingly characterized by little or no herbaceous cover (<10%) and the loss of the protective cover and fine roots necessary to capture runoff and hold soils.

Lacking an effective ground cover, many degraded piñon- juniper systems were unable to retain limited soil and water resources. These degraded communities began to yield unsustainable amounts of runoff and sediment, particularly from bare ground interspaces during high intensity summer thunderstorms (Wilcox, et al. 1996a,b). In addition, freeze- thaw action on exposed soils facilitated erosion, both by inhibiting new plants through root shear from becoming established and by creating light textured crusts vulnerable to the forces of wind and rain. Without sufficient water, or the nutrients these topsoils would normally provide, new herbaceous plants could not become established and degraded sites became increasingly desertified. These processes continue today in the piñon- juniper woodland of Bandelier and rapid soil erosion across much of the woodland has resulted. Degraded piñon- juniper woodland communities have grown to occupy thousands of hectares (ha) within the piñon- juniper woodland of Bandelier National Monument.

Active soil erosion on degraded piñon- juniper sites during the last fifty years is clearly evidenced by exposed soils and bedrock, soil pedestals, lobes of active sediment, and sediment accumulation behind fallen logs (Davenport, 1997). On the basis of sediment catchment data collected from 1995 to 2005 at multiple spatial scales, soil loss within degraded piñon- juniper communities at Bandelier at the scale of a hillslope can be can be conservatively estimated at approximately four millimeters (mm) per decade (Davenport, et al. 1996; Davenport, 1997; Davenport, et al. 1998; Wilcox, et al. 1996; Hastings, et al. 2004; Allen, et al. - - unpublished data). Higher rates have been measured in many individual years, on individual sites and certain time windows since 1995. Piñon- juniper woodland soils in Bandelier are at least tens of thousands of years old. Scientists know this because in these semiarid conditions it takes at least that long to develop the argillic (clay- rich) B- horizons found in most of these soils. This means that essentially the background or natural rate of net soil erosion for the Bandelier soil system has been zero for many thousands of years. Otherwise, the soils that the monument has today could not have formed and persisted (McFadden, personal communication 2002). Thus the current measured rates of soil erosion at Bandelier are extremely high, are unsustainable and reflect substantial degradation of soil resources. Although soil is now eroding in the piñon- juniper at a higher rate in some locations than others, assuming a range of soil depths from 15- 75 cm, an average four mm/decade erosion rate means that all soil would be lost in as little as 375 years or as many as 1875 years. Given their shallow depth (generally less than 25 centimeters on upland, non- pumice mesa areas), soils in the piñon- juniper woodland at Bandelier would be certain to be lost across the landscape in 625 years, and much sooner in some individual site locations.

As stated in the *Need for the Plan* section, rapid soil loss in degraded piñon- juniper communities threatens the integrity of thousands of prehistoric cultural sites which the monument was specifically set aside to preserve. Over 75 of the known prehistoric sites at Bandelier occur within piñon- juniper communities, and nearly 90% of these have experienced adverse effects related to erosion (Herhahn 2003; Powers and Orcutt 1999, unpublished data). Without management intervention to actively restore herbaceous understories and stabilize soils in degraded woodland communities, an estimated 1,900 archeological sites are considered at risk of damage or loss from erosion (Herhahn 2003).

RESEARCH AT BANDELIER

Natural Resources Research, Monitoring and Surveys

Staff at Bandelier National Monument have been conducting research and small-scale pilot treatments in piñon- juniper woodland for more than a decade. These experiments have included controls, and options such as plots protected from grazing by herbivore exclosures, seeding, girdling and herbicides, as well as thinning and slash treatment (Chong 1992; Potter 1985; Sydoriak, et al. 2001). To date, this research has found that cutting smaller piñon and juniper trees, and lopping and scattering the branches across the bare spaces between trees can increase both herbaceous ground cover and soil stability (Chong 1994; Jacobs and Gatewood 1999; Loftin 1999; Jacobs, et al. 2000). Studies at the monument also found that the highest potential for a successful response is on areas with deeper and more productive soils, which still support or have the capacity to support native understory communities that can carry periodic surface fires. These sites are also where it is most likely that former grassland, shrubland, or pine savanna occurred. These studies and other related research are described in more detail below.

Research in piñon- juniper woodland in Bandelier began in 1990, when a series of 300- meter vegetation line transects were established to quantify baseline conditions. While these transects are not a random or representative sample of woodland at Bandelier, they have been measured every couple years and provide meaningful monitoring data for park management. Associated with the vegetation line transects are a series of arthropod and mammal arrays, as well as photo points at different spatial scales; preliminary results of arthropod monitoring show large seasonal and annual fluctuations tracking temperature and moisture patterns, but without any apparent trends prior to onset of drought conditions in 2000 (Lightfoot, et al. 2000; Oertel 2004).

Transect data were useful in documenting changes in baseline conditions in piñon-juniper woodland that resulted from a recent regional drought. They indicated that tree canopy, litter, bare soil, and herbaceous plant basal coverage (coverage of the ground at the base of a plant) were fairly stable between 1990 and 2000, although there were often large fluctuations in aerial herbaceous plant cover (canopy cover of a plant) in response to annual precipitation patterns. With onset of drought conditions beginning around 2000, tree overstory patterns began to change dramatically; by 2004 there was a >90% decrease in live piñon canopy above 6,300 feet. Total tree cover was reduced from 35- 40% cover to around 15- 20%, and dominated by one- seed juniper. In addition, basal cover of some perennial grasses, like big blue stem, also declined dramatically. Subsequent to piñon mortality, and with sufficient growing season moisture, there were associated temporal increases in annual and biennial cover on and around piñon canopy litter mounds.

In 1993, a one hectare study area was established to characterize water and sediment budgets in degraded woodland at Bandelier. This intensive site has been monitored continuously, with an automated rain station, runoff flumes, and sediment catchments at meter, 0.1 hectare, and 1.0 hectare scales. Recent infrastructure additions include equipment designed to quantify wind erosion and suspended sediment. In addition, intensive mapping of soils and vegetation (with a complete census of trees) has been conducted. Several professional publications have resulted from data collected and these provide unique insights into the hydrologic dynamics of a degraded piñon- juniper woodland hillslope at multiple temporal and spatial scales (Allen, et al. in prep; Wilcox, et. al. 1996a,b; 2003).

A series of small- scale (i.e., less than several acres in size) efforts to develop and test restoration methodologies compatible with natural, cultural and wilderness values were initiated in 1991 (Chong 1993, 1994) and 1994 (Jacobs and Gatewood 1999). Based on promising results from these small- scale studies, paired watershed level studies were initiated in 1996, both to validate treatment response for a greater range of site conditions and across multiple biotic and abiotic parameters at functional ecosystem scales, as well as to educate the public about degraded systems and restoration options. Tree thinning and distribution of slash mulch onto bare soil surfaces stimulated herbaceous plant growth and reduced the erosional effects of summer monsoonal rainfall events. Results after three to five years post- treatment were highly significant with two- to seven- fold increases in total herbaceous cover relative to both control and pre- treatment conditions and reductions in sediment production (i.e., soil erosion) by several orders of magnitude (Jacobs, et al. 2002b). Due to funding constraints, only partial data have been collected since 2000; however, most of the paired watershed infrastructure is still intact and able to support future monitoring efforts with renewed support.

In addition to the core restoration treatment study, a number of related and supporting research and monitoring efforts were conducted within the scope of the watershed restoration study site. These are briefly summarized below:

- A first order soil survey, conducted in 1997 delineated 12 soil types units within the two watersheds and immediately adjacent area (Davenport 1997); this classification was simplified to four soil types using presence/absence of surficial pumice and an underlying argillic horizon (Julius 1999).
- An analysis of woodland age structure and understory composition across the three major soil types was conducted within the treated portion of the watershed study area (Julius 1999).

- Butterfly response to watershed restoration treatment, recorded as species abundance and diversity along established vegetation transects in each of two watersheds over three separate years, was recently published as a separate report (Kleintjes, et al. 2004).
- Avian response to watershed restoration, based on data from representative point counts in each of two watersheds across four sample years, is in preparation (Fettig 2006a).
- Sediment production data in response to watershed restoration treatment, measured in six sediment dams per watershed and analyzed as a function of soil type and rain event intensity, has also been recently published in a separate report (Hastings, et al. 2002).
- Surface runoff and suspended sediment production were documented for two 0.3 ha sites (one in each of the treatment and control watersheds) across a range of precipitation events, in partnership with the USGS- WRD (Myers 2004). This three year study was initiated in 2002, during the recent drought, and results were limited by a shortage of significant precipitation events.
- The use of fire as a tool for long- term maintenance of mechanically restored woodland savanna systems was also recently evaluated (Jacobs and Gatewood 2002).

Historical perspectives on woodland systems and the central roles of favorable moisture for plant establishment and periodic disturbances (i.e., fire and drought) in shaping these communities has been documented in the literature, including in several USGS –Biological Resources Division sponsored studies (Allen and Breshears 1998; Allen, personal communication, 2005). Two intensive woodland demography plots document episodes of pulsed establishment and mortality, with tree ring records extending back to ca. 1550. Several packrat middens dated at 3000 years ago suggest piñon- juniper woodland areas have been present at Bandelier for thousands of years (Betancourt, personal communication 1993) although these midden data are most representative of plant communities within foraging distance of the rocky cliff habitat where the middens are located.

Finally, the National Park Service Inventory and Monitoring program has recently completed a soil survey and a vegetation map of the monument, which includes coverage of the woodland . The vegetation map was based on two sets of aerial imagery taken both before and after the recent drought event, and provides high resolution documentation of changes in woodland canopy cover.

Cultural Resources Research, Monitoring and Surveys

Although Bandelier has a long history of archeological research and excavation, systematic survey and monitoring of sites located in the piñon- juniper woodland are more recent phenomena.

The Bandelier Archeological Survey (BAS), an inventory of cultural resources on 42% of park lands (13,986 acres), was conducted from 1987 to 1991 (Powers and Orcutt 1999). A total of 1,959 archeological sites were recorded by the project. An additional

61 sites were recorded in 1992 using the same procedures. As noted above under the Erosion, the background of natural rate of net soil erosion in Bandelier has been zero for many thousands of years. (McFadden, personal communication 2002). This means that under undegraded conditions, the cultural resources in the monument would have persisted indefinitely, or until weather and other factors resulted in the loss of their integrity. The data collected from 1988 to 1992, which included recording information regarding erosion impacts to sites, shows that 90% of sites in the piñon-juniper woodland are affected by erosion.

Following the BAS, a number of surveys to prepare for prescribed burns were carried out, but sites were not recorded beyond their location and general site type. Slightly more information was gathered via a survey in 1992 in the southwest corner of the monument. Good site documentation accompanied surveys conducted after the 1996 Dome Fire. Overall from 1992 to 1999, survey coverage increased by 6,320 acres and identified approximately 500 sites, but with varying degrees of documentation of sites discovered.

Starting in 2001, Bandelier began a systematic program to complete the archeological inventory of its lands with detailed documentation including detailed and accurate mapping, detailed in- field artifact analysis, and current condition information including impacts and threats from both natural and human forces. Since 2001, an additional 3,900 acres (approximately) have been inventoried and approximately 400 sites documented. As of August 2005, 72% of the monument is surveyed (24,209 acres), and the current site database stands at 2,909 recorded sites. Of newly recorded sites in the piñon- juniper woodland, approximately 90% show evidence of erosion.

In 2002, Bandelier received funding to assess the condition of 470 previously recorded archeological sites located on mesa tops within the piñon- juniper woodland (a 28% random sample), and to monitor a subset of these over the next two years. The assessment included systematic recording of erosion impacts to different aspects of each site, repeat photography, and estimation of herbaceous and tree cover on each site. These data also showed that 90% of sites revisited were impacted by erosion (Herhahn 2003). Thirty- two sites out of these 470 sites were selected for longer- term monitoring that includes repeat photography and estimation of herbaceous and tree cover on each site, as well as measuring the surface profile of the site along a transect over each site. These data are still being collected and analyzed.

Another related study indicates that water erosion has resulted in the loss of thousands of artifacts in relatively small areas of the monument, a trend expected to continue without management intervention (Maher, Hogan and Allen 2001). Exposed soil surfaces often exceed 80% cover in woodland intercanopy areas. These large expanses of exposed soil can generate considerable sediment yields during runoff events (Allen, unpublished data; Hastings, et. al. 2002;Wilcox, et al. 1993, 2003). The stabilization of vegetation and soils in the piñon- juniper areas will mitigate many of the current conditions contributing to the loss of archeological resources. Such actions are believed to have the potential to stabilize/protect a large percent of the vulnerable archeological sites in the monument's piñon- juniper areas (see soils and cultural resource discussions in Affected Environment for more detail on erosion and its effects to archeological resources).

Administrative History

SIGNIFICANCE OF BANDELIER NATIONAL MONUMENT

Bandelier was designated a National Monument in 1916 by President Wilson (Presidential Proclamation No. 1322: 39 Stat. 1794), largely because of its "tremendous ethnographic, scientific and educational" value. Ethnographic resources are defined as any "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" (NPS 2006a). Bandelier National Monument contains approximately 2,900 recorded archeological sites, ranging in date from the Paleoindian period (10,000 years ago) to the historic period. The monument includes ancient hunting camps, "cavate" structures (unique to Bandelier), 20 to 300+- room pueblos, small farming hamlets, and the remains of historic corrals and log cabins. Bandelier is also home to one of the largest collections of buildings from the Civilian Conservation Corps (CCC) era. Between 1933 and 1940, the Civilian Conservation Corps (CCC) operated a work camp in Frijoles Canyon at Bandelier and built almost every historic structure that currently exists. Because of its significance, the Frijoles area was designated a national historic landmark in 1987 commemorating the accomplishments of the CCC and its contributions to the history of the National Park Service.

The importance of "ethnographic, scientific and educational" values at Bandelier was further defined and articulated in the 1977 Bandelier *Master Plan* (NPS 1977). This plan is a policy document which governs management of resources and values across the monument. It called for the protection and interpretation of ruins in the monument, and the preservation of the park's natural setting. These twin goals were identified as the purposes of the monument.

The *Master Plan* was updated via a *Statement for Management* in 1990, a guide which includes both general and specific policies (NPS 1990). Stated objectives in the *Statement for Management* include the need for managing cultural and natural resources, providing for management- oriented scientific study of issues related to soils erosion on vegetation, and documenting changes resulting from human activities.

In 2000, the monument produced its *Strategic Plan* for governing the park for the next five years (2000- 2005) (NPS 2000a). In it, the purpose and significance of the monument was elaborated upon, and the mission statement and mission goals were identified. The pieces of the Strategic Plan relevant to this *ecological restoration effort* include the following:

The purpose of the monument is:

- To preserve, protect and manage cultural and natural resources to promote self-sustaining environmental conditions, and the information they represent, as existed prior to modern human influence (that is prior to landscape level livestock grazing and wildlife suppression and following Ancestral Puebloan occupation of the area).
- To provide the means and opportunity to study, understand and enjoy the resources of the monument without unduly compromising the resources or ethnographic values.

The primary significance of the monument relevant to this plan can be summarized as:

- A high concentration and wide variety of well- preserved archeological sites;
- The descendants of this prehistoric culture live in the area today and maintain their cultural and religious ties to the past through the area now encompassed by the park;
- The diverse ecological resources in this relatively small area support intact ecosystems, many vegetation types, associated fauna, and the Bandelier Wilderness, all of which are managed to enable the functioning of natural processes;
- Visitors experience the inspirational qualities of the past and present and the sense of solitude in an environmental rich in archeological sites and wilderness values and in relatively unaltered and scenic landscape;
- Outstanding natural and cultural research opportunities resulting from a relatively high integrity of resources and degree of resource protection.

The *Strategic Plan* also contains mission goals directly relevant to the *Ecological Restoration Plan*. One of these mission goals for Bandelier is to "preserve, protect and manage cultural and natural resources to promote self- sustaining environmental conditions and preserve the information- yielding potential they represent." The *Strategic Plan* goes on to describe accelerated erosion as the identified threat to achieving this goal.

Bandelier recently also updated their goal statements for 2005- 2010, some of which address the protection of the monument's natural and cultural resources. Among others, these include:

- Reducing soil erosion and promoting vegetative conditions that create a natural fire regime and protect cultural resource integrity within the landscape.
- Maintaining prehistoric and historic resources in current or better condition to preserve cultural integrity and information potential.

SCOPING PROCESS AND PUBLIC PARTICIPATION

Scoping is an early and open process to determine the breadth of environmental issues and alternatives to be addressed in an environmental impact statement. Bandelier National Monument has conducted both internal scoping with NPS staff and external scoping with the public and interested and affected groups and agencies.

Internal scoping was conducted by the staff at Bandelier. An interdisciplinary team (IDT) (see *Preparers and Contributors* section of the *Consultation and Coordination* section of this EIS) was formed early in the internal scoping process to define the purpose and need, identify action alternatives to address the purpose and need, determine what the likely issues and impact topics would be, and to identify the relationship, if any, of the proposed alternatives to other planning efforts at the monument.

Internal scoping efforts also included staff meetings with technical experts at both the Natural Resources Program Center and the Intermountain Region of the National Park Service.

External public scoping began with a notice of intent to prepare an environmental impact statement, which was published in the *Federal Register* on April 2, 2003. The monument then conducted four scoping open houses open to the public in Los Alamos and Santa Fe in June 2003 and November 2003. Additional information on public scoping meetings is presented in the *Consultation and Coordination* section of this EIS. The monument also continued ongoing consultation with affected Pueblo communities to ensure that they were fully informed of the proposal and that any suggestions regarding appropriate treatment of cultural sites or resources was fully considered.

ISSUES AND IMPACT TOPICS

Environmental issues are statements of problems or opportunities that might occur if the actions identified in the alternatives were implemented. The degree to which these become problems or advantages is analyzed as a set of impact topics in the *Environment Consequences* section. Issues listed here all have the potential to result in more than negligible changes.

Input from NPS specialists; other federal, state, and local agencies; non-governmental organizations; and the general public resulted in the identification of the following issues and impact topics, which are evaluated in detail in the *Environmental Consequences* section of this environmental impact statement.

Vegetation

Treatments are designed to restructure vegetative communities (by imposing vegetation composition and structure, and ecosystem processes as described above in the *Desired Future Conditions* section) within the woodland and thereby promote more sustainable ecological trajectories. Woodland areas on productive, deep soil sites would resemble savanna- like communities and promote the release of suppressed understory vegetation or remnant plant materials; these understory elements are expected to respond favorably to increased light and moisture conditions between fewer and more widely spaced tree canopies.

Creating camps and crews accessing treatment sites may result in the trampling, damage and/or loss of some vegetation during the treatment period.

Soils

With slash mulch application, and with recovery of a perennial herbaceous understory, soil erosion would be progressively slowed. During treatment, some localized increases in soil disturbance and compaction at the work or camp sites or along access routes would likely occur.

Water Resources and Water Quality

Accelerated erosion in upland settings can potentially lead to increased siltation along some reaches of the monument's perennial streams and river. In addition, woodification within the piñon- juniper has likely altered soil moisture balance dynamics, resulting in desertification of upland sites and increased runoff to lower gradient areas.

Cultural Resources

The NPS defines cultural resources as including archeological resources, historic and prehistoric structures, cultural landscapes, ethnographic resources, and museum collections (NPS 1998). No historic and prehistoric structures, cultural landscapes or museum collections would be affected by any of the alternatives analyzed. However, both archeological and ethnographic cultural resources might be affected in the short and long term by actions in the alternatives. As soils are stabilized, archeological resources would be less threatened with loss. Clearing vegetation away from cultural sites would help ensure their safety should a prescribed or wildland fire burn through the area, but it may also make the resource more visible and subject to damage or theft.

Pueblo Indian groups have a special relationship to Bandelier and treatment may affect elements of this relationship. The presence of crews or use of motorized equipment may temporarily restrict or affect access to ethnographically significant natural resources or places with which these groups are historically associated.

Currently, Bandelier National Monument has a Memorandum of Agreement (MOU) with the six pueblos that are most closely affiliated with Bandelier: Santa Clara, Santo Domingo, San Ildefonso, San Felipe, Zuni, and Cochiti. This MOU requires Bandelier to regularly and actively consult with these pueblos regarding monument activities, sacred materials or places, or other ethnographic resources with which they are historically associated. A Consultation Committee has been established consisting of tribal representatives from the six pueblos and serves to maintain an effective means of communication and consultation between Bandelier and Pueblo Indian communities that are traditionally associated with Bandelier National Monument.

Visitor Use and Experience

The noise associated with treatment (chainsaws, helicopters, etc.) may affect the visitor experience of some backcountry users. Visual changes in the landscape (see below) may also affect some visitors- - some visitors may find the changes in vegetation unattractive or undesirable, as they have become familiar with a more densely wooded landscape. Some visitors may find the cutting of trees offensive, but others may find the more open landscape appealing. There may be changes to visitor use patterns resulting from activity during treatment in certain areas.

Visual Quality

The landscape will look more open following treatment if one of the action alternatives is selected. Vistas that are obscured by trees may be opened. During treatment, visitors may see crews working in wilderness areas.

Wilderness

Most of the areas proposed for treatment are within designated wilderness. The values associated with wilderness include quiet, solitude, and a natural experience. Restoring vegetative communities and associated wildlife to within the natural range of variability would help restore wilderness values, but noise from motorized equipment, the presence of stumps and slash, and the presence of human activity during treatment may affect the wilderness experience for some visitors.

Some visitors may believe any human intervention in wilderness is inappropriate, regardless of the condition of its resources, as it violates the “untrammeled” nature of wilderness. Others believe intervention is warranted in some cases to return ecological or other values or to protect natural or cultural resources.

Wildlife

The alternatives considered in this document have the potential to affect and alter wildlife communities through the modification of wildlife habitat. The manipulation of vegetative communities may alter species composition and abundance and may influence habitat use inside and outside Bandelier’s boundaries. Noise from equipment and the presence of humans during treatment may disturb or displace wildlife.

Special Status Species

Actions associated with treatment, including the presence of human activity, use of motorized equipment and/or activities associated with supplying workers may disturb or disrupt special status wildlife. Restoration of ecologically sustainable conditions in piñon- juniper woodland may provide habitat for these or other special status species.

Air Quality

Air quality impacts related to treatment associated with this planning effort include temporary emissions from chainsaws and helicopters that may be used during treatment.

Park Operations

The use of staff or contractor time would be needed to conduct landscape- level treatments. To accomplish treatments, additional money and other resources may be required, or staff may need to be temporarily reassigned.

Health and Safety

Impacts of noise from chainsaws, helicopters and from the use of hand tools on worker's hearing may occur.

Impact Topics Dismissed from Further Analysis

These impact topics were considered by the interdisciplinary team, but dismissed from further analysis because they are either not relevant to the proposal, or impacts to these resources would be negligible; that is, barely detectable.

SOCIOECONOMIC ENVIRONMENT

The socioeconomic environment includes local and regional businesses and residents, the local and regional economy, and concessions at the monument. The economies of the surrounding communities of Los Alamos and White Rock function independently of Bandelier tourism, even though monument visitors often take advantage of local lodging and restaurants.

Implementation of an action alternative (Alternative B or C) may require hiring a small number of temporary contract workers. These workers may be local or regional residents, and they may utilize the surrounding communities in the short term. However, the number of new workers needed to implement action alternatives is expected to have negligible effects on the local and regional economy and monument concessioners. For these reasons, the socioeconomic environment has been dismissed as an impact topic.

ENVIRONMENTAL JUSTICE

Executive Order 12898, "General 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 if their programs and policies have effects on minority and low- income populations and communities. No disproportionate impacts to minority or low- income populations or communities, as defined in the U.S. Environmental Protection Agency's (EPA) guidelines for environmental justice concerns (EPA 1998) are expected; therefore, environmental justice has been dismissed as an impact topic.

WETLANDS AND FLOODPLAINS

Proposed treatment areas in Bandelier do not include wetlands or floodplains.

PRIME AND UNIQUE FARMLANDS

No prime or unique farmlands exist within Bandelier National Monument, and none would be affected by actions proposed in any of the alternatives.

PUBLIC HEALTH AND SAFETY

The alternatives being considered would primarily be implemented in backcountry areas and not near communities or public facilities. Most activities would be conducted during the off- season months (mid- August through mid- March) in order to minimize effects to visitors and the general public. Under all alternatives only negligible effects are expected to public health and safety; therefore, this topic is not analyzed further in this document.

WILD AND SCENIC RIVERS

The areas identified for treatment in this document do not contain any designated wild or scenic rivers.

INDIAN TRUST RESOURCES

Federal agencies are required to address environmental impacts of their proposed actions on Indian Trust Resources in any environmental document (Secretarial Order 3175 and ECM95- 2). Because no identified Indian Trust Resources exist in the monument, no impact would occur.

SACRED SITES

Sacred sites are defined as specific, discrete, narrowly delineated locations on Federal land identified by an Indian tribe or appropriate authoritative representative, as sacred by virtue of their established religious or ceremonial significance. The managing agency (in this case, the National Park Service) must be provided information on the existence of such sites (Executive Order 13007). Impacts to sacred sites would be avoided through consultation with potentially affected tribes.

CONFLICTS WITH OTHER AGENCY LAND USE PLANS

No land use plans or policies of other agencies (local, state, or Indian tribe) would be affected by actions proposed in any of the alternatives.

ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL

Under any alternative, the National Park Service would continue to implement its policies of reducing costs and conserving resources by using energy- efficient and cost- effective technology as required in *Management Policies 2006* (NPS 2006a), and would continue to look for energy- saving opportunities in all aspects of park operations. Consequently, the topic has been dismissed from further consideration in this EIS.

NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL

Under any alternative, the National Park Service would continue to strive to minimize short- and long- term environmental impacts of management actions through resource conservation, recycling, waste minimization, and the use of energy-efficient and ecologically responsible materials and techniques as required in *Management Policies 2006* (NPS 2006a). Consequently, the topic has been dismissed from further consideration in this EIS.

URBAN QUALITY, HISTORIC AND CULTURAL RESOURCES, AND DESIGN OF THE BUILT ENVIRONMENT

No alternatives have the potential to affect urban quality, historic and cultural resources (other than those covered in the impact topic "Cultural Resources"), and design of the built environment. Consequently, the topic has been dismissed from further consideration in this EIS.

RELATED LAWS, POLICIES AND PLANS

Laws and Policies

Organic Act and NPS Management Policies. As noted above, by enacting the National Park Service Organic Act of 1916 (Organic Act), Congress directed the U.S. Department of Interior and the NPS to manage units "to conserve the scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations" (16 USC. § 1). Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC § 1a- 1).

Despite these mandates, the Organic Act and its amendments afford the National Park Service latitude when making resource decisions that balance visitor recreation and resource preservation. By these acts Congress "empowered [the National Park Service] with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use" (*Bicycle Trails Council of Marin v. Babbitt,* 82 F.3d 1445, 1453 [9th Cir. 1996]).

Because conservation remains its predominant mandate, the National Park Service seeks to avoid or to minimize adverse impacts on park resources and values. Yet, the National Park Service has discretion to allow negative impacts when necessary (*Management Policies 2006*, sec. 1.4.3 [NPS 2006a]); however, while some actions and activities cause impacts, the National Park Service cannot allow an adverse impact that constitutes resource impairment (*Management Policies 2006,* sec. 1.4.3 [NPS 2006a]). The Organic Act prohibits actions that permanently impair park resources unless a law directly and specifically allows for the acts (16 USC 1a- 1). An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (*Management Policies 2006,* sec. 1.4.4 [NPS 2006a]). To determine impairment, the National Park Service must evaluate "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" (*Management Policies 2006,* sec. 1.4.4 [NPS 2006a]). The *Management Policies* require that these determinations, and

all planning decisions in the Service, be based on current scientific and scholarly understanding of park resources and ecosystems (sec 2.3.1.5).

Park units vary based on their enabling legislation, natural resources, cultural resources, and missions. Management activities appropriate for each unit and for areas within each unit vary as well. An action appropriate in one unit could impair resources in another unit.

As previously mentioned, Bandelier National Monument was established because of its significant "prehistoric aboriginal ruins" and their "unusual ethnologic, scientific and educational" values. An estimated 1,900 cultural resource sites in the monument's backcountry are at risk of damage or loss from accelerated soil erosion related to vegetative changes resulting from historic overgrazing and fire suppression, as described in the *Background* section. In addition to the threat to the monument's cultural resources, allowing existing conditions in these vegetative communities to continue could mean the loss of large areas of the park's vegetative and soil resources, as well as adverse and large- scale effects on native wildlife and wilderness values. This environmental impact statement will analyze the context, duration, and intensity of these impacts, and will be used by the NPS to determine the potential for impairment of park resources and values as required by *Director's Order 12: Conservation Planning, Environmental Impact Analysis and Decision- making* (DO 12)(NPS 2001).

Wilderness Act. As noted in other sections of this document, most of the piñon-juniper in Bandelier that would be treated if this plan were implemented is located in the 23,267- acre designated Bandelier Wilderness. Both the Wilderness Act and the NPS Organic Act require the National Park Service to administer wilderness areas "in such a manner as to leave them unimpaired for future use and enjoyment." While management actions are discouraged in wilderness where ecosystem processes are naturally functioning, they are allowed when needed to correct "past mistakes" or "the impacts of human use" (NPS 2006a, sec. 6.3.7). Section 4(c) of the Wilderness Act discourages motorized equipment in the wilderness to accomplish the tasks of preservation and protection, but does allow it if there is justifiable need and it has been found to be the "minimum requirement needed by management to achieve the purposes of the area as wilderness" (NPS 2006a, sec. 6.3.5). A minimum requirement and minimum tool analysis has been completed for this plan (see Appendix A) and has found that motorized equipment may be preferable to the use of hand tools because it substantially reduces the overall impact on wilderness resources and values.

Endangered Species Act. The Endangered Species Act of 1973, as amended, states that fish, wildlife and plant species are of esthetic, ecological, educational, historical, recreational, and scientific value to the nation. The Act's purpose is to conserve the ecosystems upon which these species depend, and generally, to increase populations and secure sufficient habitat to recover species to viable levels.

Under section 7(a)(2) of the Act, the National Park Service must ensure that any action that is authorized, funded, or carried out is not likely to jeopardize the continued existence of listed threatened or endangered species or to result in the destruction or adverse modification of designated critical habitat. The National Park Service is required to consult with the U.S. Fish and Wildlife Service (USFWS) if it is determined that an action may adversely affect listed threatened or endangered species or designated critical habitat. The Act also prohibits activities that would constitute an unauthorized "taking" of the protected species.

The National Park Service is required to control access to critical habitat for listed species, and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend. In addition, the *Management Policies 2006* require that all state and locally listed species be considered in planning activities (NPS 2006a, sec. 4.4.2.3).

National Historic Preservation Act. The National Historic Preservation Act of 1966, as amended, (NHPA) (16 U.S.C. 470 et seq.) is the principal legislative authority for the management of cultural resources associated with NPS projects. Section 106 of the Act requires all federal agencies to consider the effects of their actions on cultural resources (historic properties) determined eligible for listing in the National Register of Historic Places (register). In addition, the Act requires that federal agencies take actions to minimize harm to historic properties that would be adversely affected by a federal undertaking. Section 110 of the Act charges federal agencies with the responsibility for establishing preservation programs to identify, evaluate, and nominate historic properties to the register.

National Environmental Policy Act. The National Environmental Policy Act requires that federal decision- makers consider environmental impacts related to proposed actions ((such as implementing actions described in this *Draft Ecological Restoration Plan and EIS*) prior to implementation. This involves analyzing the potential effects and gathering public input as required by the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.). This EIS is being prepared to comply with the requirements of NEPA and the Council on Environmental Quality (CEQ), Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500–1508). In addition, this EIS will comply with NPS *Director's Order 12: Conservation Planning, Environmental Impact Analysis and*

Decision- making (NPS 2001), NPS *Management Policies 20061* (NPS 2006a), and any other NPS procedures or instructions regarding NEPA.

Please refer to the *Environmental Consequences* section for additional resource-specific laws, regulations and policies.

Park Plans

Master Plan. As noted above in the section on *Administrative History* of Bandelier, the purpose of the monument, as stated in the 1916 presidential proclamation establishing the monument, is the preservation and protection of "certain prehistoric aboriginal ruins . . . with as much land as may be necessary for the proper protection thereof." According to the 1977 *Master Plan,* the protection and interpretation of the ruins and the preservation of the natural setting have been and will continue to be the purpose of NPS management of the monument.

Statement for Management. The *Statement for Management* is also detailed above in the section on *Administrative History*. To summarize, this update of the park's *Master Plan* includes both general and specific policies relevant to proposed actions in this document (NPS 1990). Stated objectives include the need for managing cultural and natural resources, providing for management- oriented scientific study of issues related to soils erosion and effects of fire suppression on vegetation, and documenting changes resulting from human activities.

Strategic Plan. The relevant pieces of the Bandelier *Strategic Plan* are summarized above in the *Administrative History* section. Of note, one very specific goal of the *Strategic Plan* is to return 10% of the park to within the natural range of variability (including biologic diversity and processes) trending towards pre- 1880s conditions (NPS 2000a).

Fire Management Plan. The purpose of Bandelier's recently revised and updated *Fire Management Plan* (FMP) is to provide a framework for making fire and fuels management decisions and to describe fire and resource management goals and objectives (NPS 2005a). One goal relevant to this *Draft Ecological Restoration Plan and EIS* that the *Strategic Plan*, the *Resource Management Plan* for the monument, and the FMP (NPS 1995a, 2000a, 2005a) share is to:

> provide the means for staff and the public to preserve, protect, understand, and enjoy the cultural and natural resources of Bandelier National Monument through an integrated program where management activities support naturally functioning ecosystems consistent with cultural resource preservation needs.

The FMP supports this goal by prescribing actions and conditions under which actions would be implemented to achieve specific goals, including resource goals like the one identified above. The actions include fire suppression, prescribed fire, Wildland Fire Use (WFU), and manual and mechanical thinning. Wildland Fire Use is described in the FMP as the "practice of allowing a naturally ignited wildland fire to burn in a predefined geographic area, under specific prescription parameters, to accomplish fire and resource management goals and objectives" (NPS 2005a:20). In piñon- juniper woodland, the FMP allows the use of these tools, but because no or little herbaceous understory exists to carry wildland or prescribed fire, the need or planning for these activities or for fire suppression is minimal. Although manual and mechanical thinning are allowed, the locations, prescriptions and goals for doing so are different in the FMP than they would be in this plan. In addition, no lop and scattering of branches or attention to soil erosion would be included as part of the FMP activities. Rather, the alternatives in this *Draft Ecological Restoration Plan EIS* are intended to promote future ecological conditions that will enable the use of lightning- caused and prescribed fires managed under the FMP, so that fire becomes the primary ecological mechanism regulating and sustaining vegetative and soil conditions within the piñon- juniper woodland .

Tsankawi Management Plan. Tsankawi does contain areas dominated by piñon-juniper woodland experiencing accelerated soil erosion and in need of restoration treatment; however this section is addressed and managed according to the 2000 *Tsankawi Management Plan Environmental Assessment* (NPS 2000b) and Tsankawi is not part of this planning effort.

Wilderness and Backcountry Management Plans and Policies. Bandelier National Monument does not have an approved wilderness or backcountry management plan; however a substantial draft plan has been completed. In the absence of a more formalized plan, wilderness and backcountry are managed in accordance with the NPS *Management Policies 2006* (NPS 2006a).

Vegetation Management Plan. Bandelier National Monument has a *Vegetation Management Plan* which details routine and ongoing administrative actions relevant to vegetation, where impacts of management can generally be addressed through internal review. The plan outlines treatment options for ongoing vegetation management actions, such as exotic plant control (recently supplemented by an *Exotic Plant Management Plan*, 2006) and hazard tree management. Information from this plan, including descriptions of vegetation communities and complexes, and of desired future conditions for these communities is incorporated by reference and summarized where needed in this *Draft Ecological Restoration Plan and EIS*.

Chapter 2: Alternatives

June Grass
Koleria cristata

ALTERNATIVES

INTRODUCTION

This section describes the action alternatives developed during scoping that are considered technically, economically and otherwise feasible. Each action alternative would wholly or in large part resolve the stated need for action, and meet to a large degree the purpose and objectives described above in *Purpose of* and *Need for the Plan.*. The No Action alternative is also discussed as required by NEPA. This section also describes the environmentally preferred alternative, identifies the preferred alternative and briefly describes any alternatives considered but dismissed from analysis. It provides an alternative comparison matrix, an impact comparison matrix, and a description of mitigation measures for each action alternative.

STUDY AREA DEFINITION

The study area for impact analysis in this plan is the piñon- juniper woodland in Bandelier National Monument. Piñon and juniper dominated woodland occupies nearly a third of the monument, or approximately 10,000 acres, and extends from the lowest elevations along the Rio Grande (ca. 5,300') to around 7,500' at the interface with ponderosa pine savanna (Figure 2). While piñon- juniper woodland can be an important component of many canyon slope, lower ponderosa pine, and canyon bottom communities, the woodland system is best expressed on mesa top settings between 6,000 and 7,000 feet elevation. Mesa top settings are also where the soil erosion issues are most critical, and therefore the focus of treatment as described in this *Draft Ecological Restoration Plan and EIS*. About 4,000 acres of mesa top piñon-juniper woodland (or 40% of total woodland area) have been identified as degraded and in need of treatment.

Bandelier is situated on the Pajarito Plateau (Figure 3), and the same general pattern of resources and impacts to piñon- juniper vegetation, soil, cultural resources, etc. as described for the monument occurs throughout the plateau area. The Pajarito Plateau is a volcanic bench defining the eastern escarpment of the Jemez Volcanic field; it can be generally defined as extending from Cochiti Pueblo on the south to Santa Clara Pueblo on the north, with the Rio Grande generally delineating the eastern boundary. In addition to the plateau, the study area also includes basaltic upland areas with woodland cover east of White Rock Canyon (e.g., the Cerro del Rio area across the Rio Grande from Bandelier).

Prior to a recent drought, one- seed juniper dominated lower elevations across the Pajarito Plateau below 6,300 feet, with increasing dominance of Colorado piñon pine above 6,300 feet. However, the drought has killed off much of the Colorado piñon pine community, and most woodland areas across Bandelier and the Pajarito Plateau are now dominated by one- seed juniper regardless of elevation. Former piñon dominated woodland has essentially been converted to the more open juniper woodland and savannas typical of lower elevations. Despite the recent piñon mortality event, woodland (now dominated by juniper) is still the common vegetation type within the monument and across the Pajarito Plateau area. Several additional juniper tree species (Rocky Mountain and Alligator bark junipers) also occur within the monument and across the Pajarito Plateau, but generally are not found in areas with erosional issues or are of only minor importance in terms of actual land area occupied.

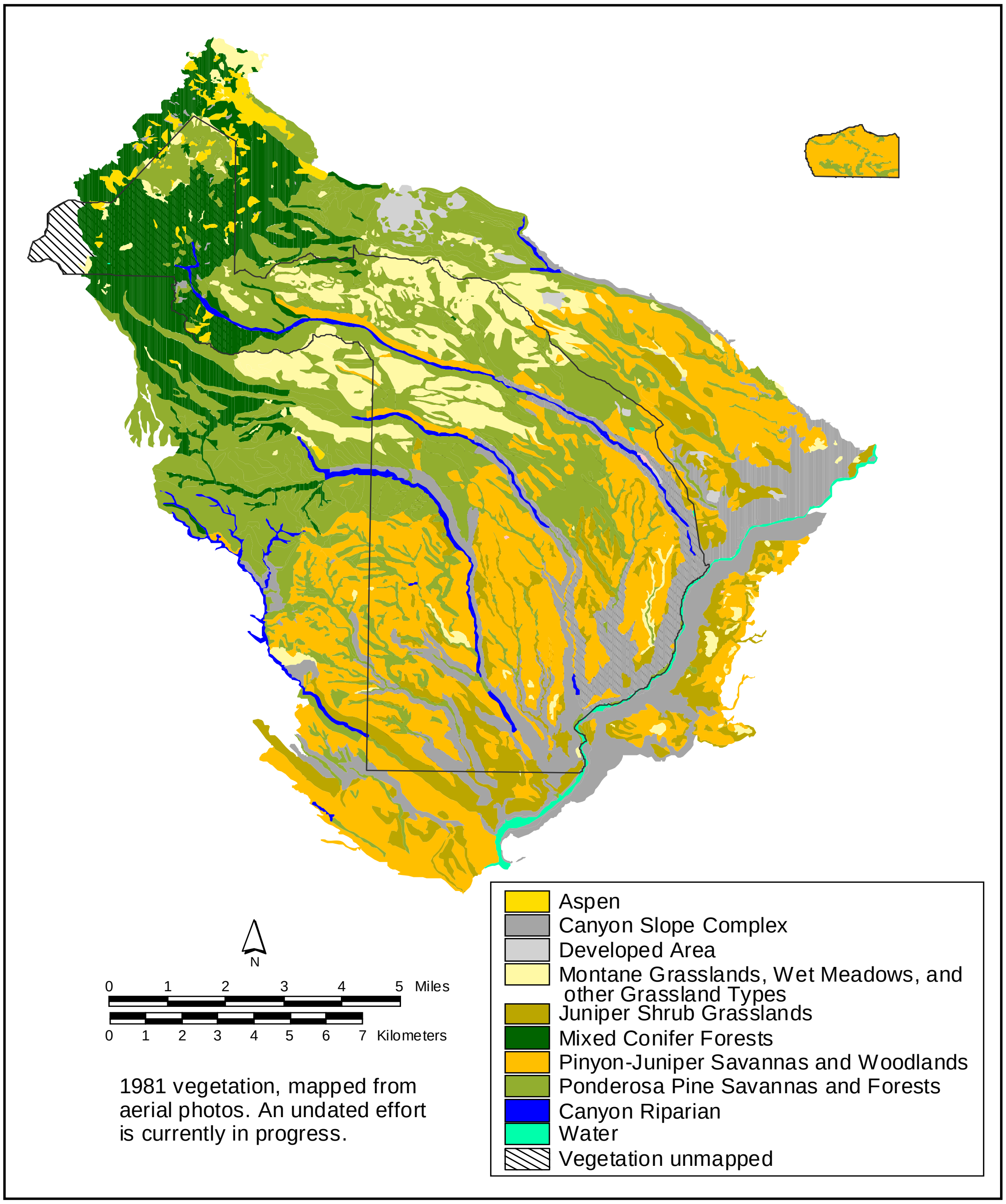

Figure 2. Vegetation of Bandelier National Monument.

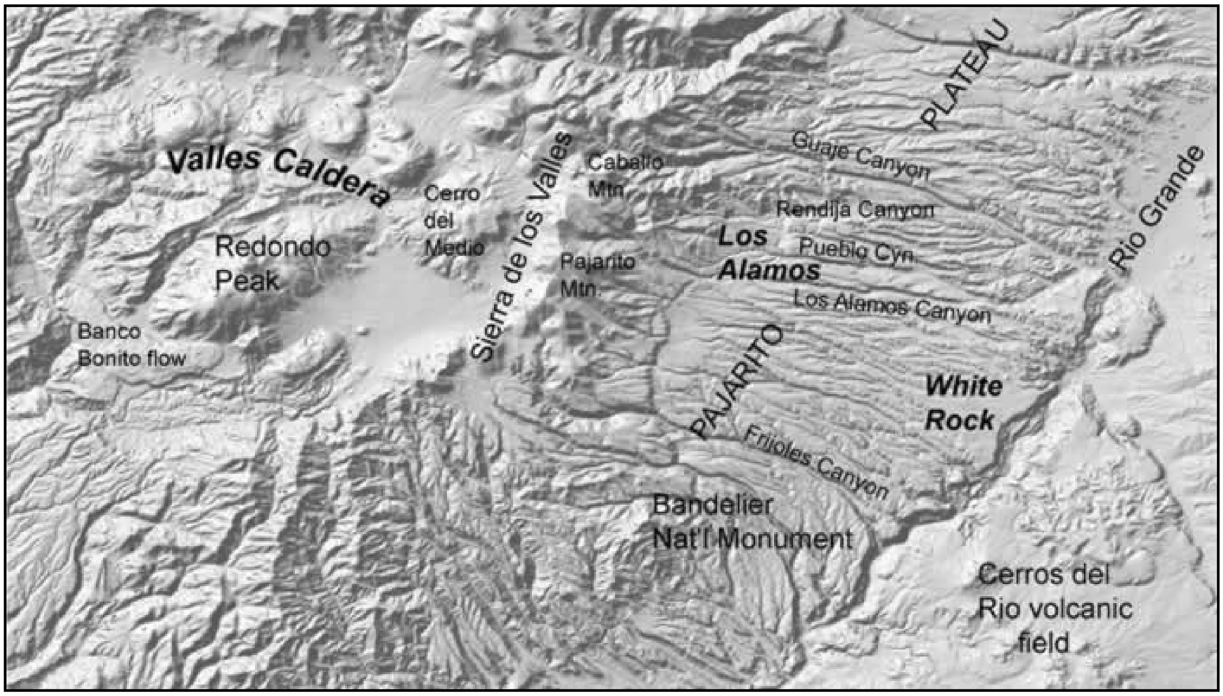

Figure 3. Pajarito Plateau and Bandelier National Monument

ALTERNATIVES DEVELOPMENT PROCESS

The appropriate range of alternatives includes those alternatives that would be reasonable, substantially meet the stated purpose, need, and objectives, and minimize environmental impacts. The purpose, need and objectives, impact topics, planning issues and constraints were developed through internal scoping by the interdisciplinary team of park, NPS and contracting personnel. Existing plans, policies, laws, results of ongoing research at the monument and in the scientific literature, as well as results from public scoping (see *Consultation and Coordination* section of this DEIS for more information) were integrated to define these factors. This information was also used in conjunction with the results of a second set of external scoping meetings to help in deciding whether an alternative was reasonable.

Research at the monument was critical in determining the range of reasonable alternatives. The results of test plots and other research at Bandelier (see *Research at Bandelier* section, above) and other literature have shown that successful treatment of the piñon- juniper woodland can be achieved through the removal of selected trees and lop and scatter of their branches. Removal of trees frees up limited soil moisture for herbaceous growth, while slash mulch improves conditions for herbaceous plant establishment by capturing runoff, enhancing infiltration, reducing evaporation, and providing protection from grazing (Jacobs and Gatewood 1999). Seeding, out-planting, irrigation, chaining, prescribed fire, and various agronomic approaches are either infeasible (prescribed fire, for example, would not burn without an herbaceous understory to carry it, and the combination of rugged terrain, wilderness, and cultural values preclude most agronomic techniques) or would only be possible on a very small scale (Jacobs and Gatewood 1999). Therefore, only the selected thinning and slash mulch treatment is considered as a reasonable approach for Bandelier, and it is the treatment method analyzed in both action alternatives.

Initially, the internal scoping team from the park included as part of this planning effort all vegetative types in Bandelier where ecological processes are outside the range of natural variability. The team also identified three action alternatives that varied in the amount of mechanized or motorized tool vs. hand tool use only, but relied on the same basic approach. This study area and set of alternatives was the one reviewed by the public during scoping sessions in 2003.

Since then, monument staff met with other specialists across the National Park Service and decided on several changes to the alternatives. First, because the focus of research to develop and evaluate restoration treatments for the mitigation of soil erosion and stabilizing of cultural resources was in piñon- juniper woodland, and because the means to restore other vegetative communities outside the piñon-juniper woodland involved tools more traditionally part of a fire management program, the scope of the project was limited to piñon- juniper woodland.

When NPS specialists evaluated the feasibility of treating 4,000+ acres of woodland in the monument exclusively with hand tools to address wilderness concerns, they found it would take more than 20 times as long as compared with using motorized tools such as chainsaws (NPS, unpublished data on file at Bandelier). Given that treatment of this large area with dedicated crews working eight months of the year with chainsaws would take about five years, a hand tool approach was considered both unreasonable and one that would result in significant losses of cultural resources, soil, and the ability to restore large areas of piñon- juniper woodland. An alternative that relied completely on mechanized equipment was also considered unrealistic, as hand tools might be useful in some situations, for instance to carefully remove vegetation around important cultural resources or perhaps in areas where the noise of chainsaws would disturb wildlife special status species. Therefore, the park team of specialists refocused its efforts on the appropriate range of options that used both hand and mechanized tools.

Two different approaches to treating the piñon- juniper woodland were created. The first would focus on efficiency, and assumes the project would be initially or annually fully funded as needed. Treatment would begin in one corner of the monument and proceed across the landscape treating the maximum amount (see *Definition of Sub-Basins* below) for the eight months when the park is least visited each year.

A second approach would focus on areas of the monument where important cultural resources are most at risk. The monument's cultural resources staff have completed an initial survey of most of the archeological and historic sites in the study area, and used a system of ranking (see *Cultural Resource Ranking* below) to define those areas in the piñon- juniper woodland where these resources have the most integrity, data potential, and are most threatened by accelerated soil erosion. Particularly if the treatment effort is funded more sporadically, this alternative would decrease the risk of losing these priority resources.

Minimum Requirement Results

Most of the piñon- juniper woodland at Bandelier is in designated wilderness. According to the NPS *Management Policies 2006* (NPS 2006a), any activities occurring in wilderness must be consistent with the minimum requirement concept. This concept is applied as a two- step process that determines:

- Whether the proposed management action is appropriate or necessary for the administration of the area as wilderness and does not pose a significant impact to wilderness resources and character; and
- The techniques and types of equipment needed to ensure that impact to wilderness resources and character is minimized.

The National Park Service utilizes the Arthur Carhart National Wilderness Training Center's *Minimum Requirements Decision Guide* (Arthur Carhart National Wilderness Training Center 2002) to apply the minimum requirement concept. The results of this process for Bandelier National Monument indicated that treatment of the area is critical to promote sustainable ecological conditions in the piñon- juniper woodland and to protect the high number of valuable cultural resources, for which the monument was created.

Further, the analysis indicated that motorized tools would be necessary to administer or manage the area based on the extent of treatment required in order to effectively restore piñon- juniper woodland and thus better protect cultural resources in the wilderness. The analysis showed that the speed with which the treatment would occur using motorized tools would result in better overall protection of wilderness values, cultural resources, soils and vegetation, and would offset the short- term adverse noise impacts to wilderness (Appendix A).

Should the plan be implemented, subsequent site- specific minimum requirement analysis would be completed on an annual or treatment area basis to determine whether intervention in designated sub- basins is needed, and to decide whether and to what extent mechanized or hand tools (see *Actions Common to All Action Alternatives* below).

Definition of Sub-basins

The project area was divided into 44 treatment areas of roughly 100 to 300 acres (Figure 4). These were based on mesa top hydrologic sub- basins modified to create hydrologically functioning work areas. Besides being hydrologically distinct, the sub-basins were useful in helping to define reasonably sized treatment areas where cultural resource priorities could be identified in Alternative C.

The methods used to divide the piñon- juniper woodland in Bandelier into sub- basins involved using an algorithm in the Geographic Information Systems (GIS) software ArcView 3.3 (ESRI 2002) that creates hydrologic units from 10- meter USGS digital elevation models (DEM) using the watershed command. The resulting ArcView shape file of the hydrologically functioning treatment basins was selected and clipped to the park boundary. Within each sub- basin, the acres and spatial distribution of soil types and vegetation type were quantified using GIS, which provided the number of treatable acres. For each soil complex, the total number of acres was reduced by the percentage of each complex that is untreatable (e.g., rock outcrops); this ranges between 10- 20% for both upper and lower soil complexes.

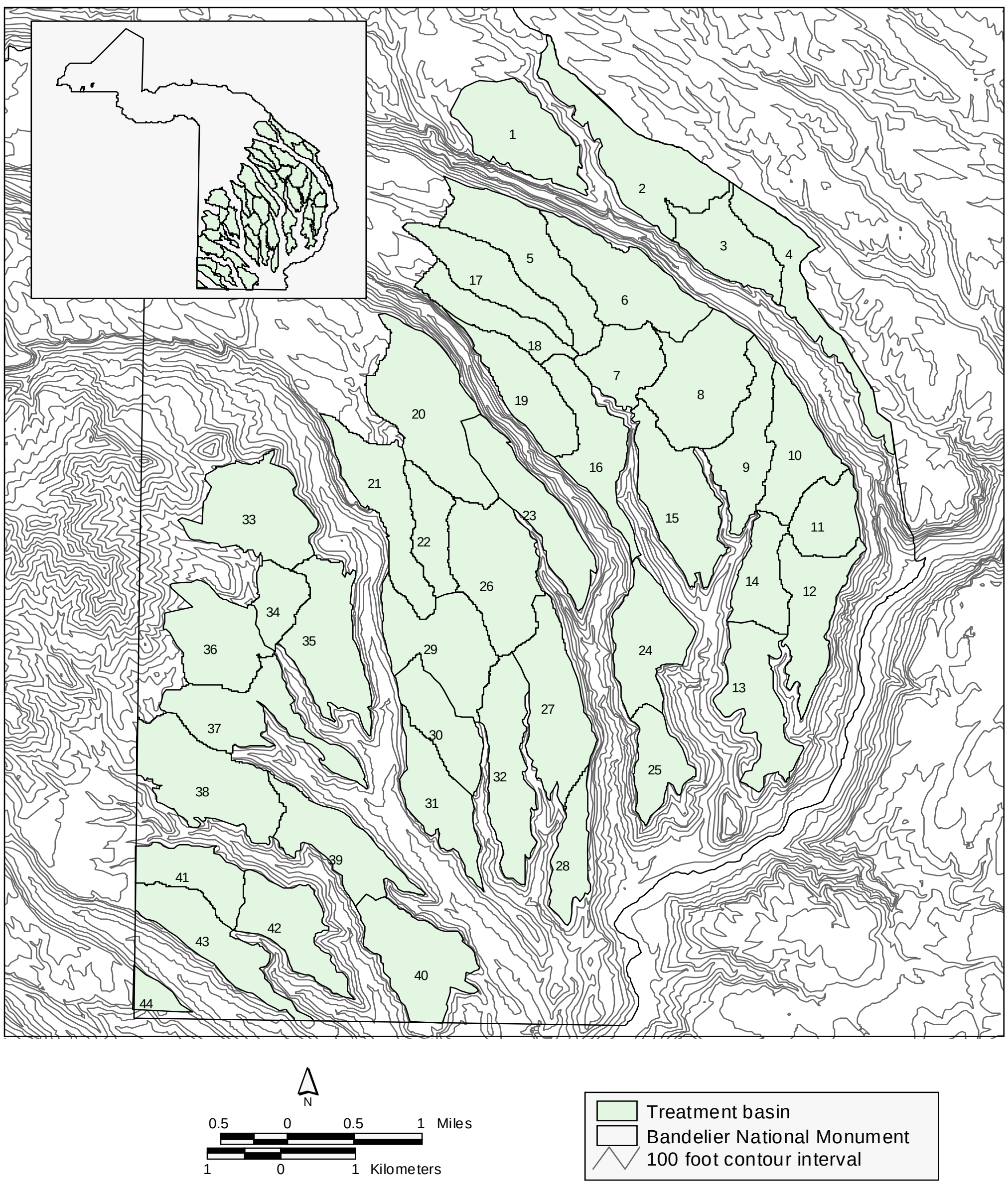

Figure 4. Hydrologic Sub-basins in Piñon-Juniper Woodland

Cultural Resource Ranking

Alternative C prioritizes sub- basins for treatment based on their ranking for important cultural resources. This section describes the variables evaluated and the process used to rank sub- basins. For each site, three variables were considered for prioritization. These variables included 1) data potential, 2) depositional integrity, and 3) threat timeframe. The first two variables were measured on an inverse ordinal scale, with sites with the highest data potential and depositional integrity were given a value of "1," and the sites with the lowest potential and integrity a value of "4." Time frame is also an ordinal scale variable, with the most immediately threatened sites given a value of "1" and the most stable a value of "4."

These values were assigned based on threat timeframe data collected during site condition assessments. Threat timeframe is an estimate of the number of years estimated to pass before identified threats will be realized and the site's integrity and data potential fall to a range that would undermine the site's eligibility for listing on the NRHP. The variable states were as follows:

1= Immediate to three years

2= Four to six years

3= Seven to 15 years

4= Twenty years or more

Using GIS (ArcView 3.3), sites were grouped by the treatment sub- unit in which they are located and treatment averages of site data potential, depositional integrity, and threat time frames were calculated. To obtain a single composite ranking variable for each treatment sub- unit, a weighted average of the three variables was obtained. Data potential and depositional integrity were each weighted at 40%, while timeframe was weighted at 20%. This scheme was designed to identify the most significant resources, while still taking into account the urgency of the threat to them. This single weighted average for each sub- unit was used to determine the order of treatment.

NPS PREFERRED ALTERNATIVE

Alternative B (Operational Priority) is the NPS preferred alternative. It is believed that action must occur to stabilize natural and cultural resources, and therefore that the No Action alternative is not reasonable. Alternative B would result in fewer adverse impacts, primarily due to the accelerated project schedule (five years vs. 20 years under Alternative C). While some effects may be more noticeable in the early phase of the project, impacts would be reduced over the lifetime of the project under Alternative B.

ALTERNATIVE A—NO ACTION

Alternative A is a summary of the existing management of resources that may change if one of the action alternatives (Alternative B or C) were implemented. It is also called the No Action alternative. The analysis of impacts of continuing existing management practices (in the *Environmental Consequences* section of this EIS) serve as a baseline for comparison of the impacts of either Alternative B or C.

Current management of most resources in piñon- juniper woodland at Bandelier is limited; there is no active management of soils, vegetation, or wildlife beyond ongoing research and monitoring activities. As noted above (see *Fire Management Plan* description), wildland and prescribed fire, as well as fire suppression, are allowed in piñon- juniper woodland, however the likelihood of any of these occurring is low given the generally sparse fuel conditions and minimal potential to affect park resources. No thinning or mechanical removal of trees except for occasional removal of heavy fuels from archeological sites at the request of cultural resource staff occurs under the *Fire Management Plan* in piñon- juniper woodland, although it and other fire management tools are likely to be used if piñon- juniper woodland is restored through treatment. Fuel breaks are created and hazard trees removed along right- of- ways in front country areas and along developed road corridors in piñon- juniper woodland (e.g., entrance road).

Research on soils and vegetation in piñon- juniper woodland is described above (see Research at Bandelier section). Monitoring activities on wildlife and special status species that would continue in or near piñon- juniper woodland under current management includes bird counts each summer and monitoring of listed species such as peregrine falcons, bald eagles, and Mexican spotted owls. Currently no research is being conducted on wildlife or special status species.

Ongoing research for cultural resources includes revisitation of sites lacking a current condition assessment, recording of insufficiently documented sites, inventory of unsurveyed areas, and limited data recovery through detailed surface recording or excavation. These activities are dependent upon funding.

Cultural resources have been initially surveyed throughout much of the piñon- juniper woodland over the past 15 years, and this work is expected to be complete within an additional five years. The condition of these resources is monitored, and stabilizing treatment in the form of lopping and scattering via hand tools has been taking place on a random basis for a few individual sites over the past few field seasons with funding assistance that ended in 2005. Emergency data recovery for sites that are in imminent danger of being lost from soil erosion occurs as park staff are able to detect and document these sites. However, as noted above, 1,900 sites in the piñon- juniper woodland are considered at risk and park staff are unable to continuously monitor all threatened cultural resources. Selected trees are also occasionally removed from cultural sites where deemed necessary by park archeologists to reduce the likelihood of damage to structures from root penetration, windthrow, or heat effects where prescribed fires are planned.

As mentioned in the *Purpose of* and *Need for the Plan* section, Bandelier National Monument currently has a Memorandum of Understanding (MOU) with the six pueblos that are most closely affiliated with Bandelier: Santa Clara, Santo Domingo, San Ildefonso, San Felipe, Zuni, and Cochiti. This MOU requires Bandelier to regularly and actively consult with these pueblos regarding monument activities, sacred materials or places, or other ethnographic resources with which they are historically associated. A Consultation Committee has been established consisting of tribal representatives from the six pueblos and serves to maintain an effective means of communication and consultation between Bandelier and Pueblo communities that are traditionally associated with Bandelier National Monument. This consultation is a key element in the identification and evaluation of any sensitive areas or resources (plants and minerals) that may be affected by a proposed action. Bandelier National Monument, through this MOU, is committed to maintaining an on- going, long- term relationship with these Pueblos to determine appropriate courses of action to minimize impacts to ethnographic resources and/or to provide maximum protection for these resources to ensure continued access and use by the Pueblo peoples for traditional purposes.

Wilderness is managed through issuing overnight backcountry use permits and following the precepts of the NPS *Management Policies 2006* (NPS 2006) that wilderness be maintained to provide a primitive and natural experience. Maximum group size per permit is 10 people. Camping in mid- Capulin and Frijoles Canyons is restricted to designated zones at the time the backcountry permit is issued. Camping is not allowed within one- quarter mile of major archeological sites, and within 250 feet of any other cultural resource. No fires are allowed in the wilderness. Visitors to the backcountry are not restricted to established trails and may travel to any part of the backcountry. Stock use is restricted to trails approved for that purpose, and is allowed by permit only. No overnight stays are allowed for public stock.

The front and backcountry areas are patrolled throughout the year, with particular attention to trails. With increased visitation in the late spring, summer, and fall seasons, patrol frequency shifts from the frontcountry zones to a split between the front and backcountry, or wilderness, areas. Patrol emphasis is on visitor and employee safety, resource protection—especially of sensitive cultural and archeological sites—fire prevention, and minor maintenance of trails. Patrols are primarily via foot, but may include horse work.

The following schedule is for the eight- month period treatment would occur, and assumes full staffing. Not all of these areas are in piñon- juniper woodland, but most include some areas of this vegetative type:

- In the Cerro Unit, patrols in the Alamo Headwaters area and Cerro Peak area occur weekly, and all others occur monthly.

- In the western area of the monument, patrols occur monthly or once per season in accessible areas.
- In the Dome Road area, Sawyer Mesa is patrolled twice per month and upper areas would be patrolled daily via road.
- Areas along Highway 4 are patrolled once or twice per month.
- The east boundary with the Department of Energy's (DOE) Los Alamos National Laboratory (LANL) is patrolled monthly.
- Interior and trail areas are patrolled monthly or more frequently weekly (Falls Trail, Mid- Alamo), several times per week (Falls Trail, Burnt Mesa), twice per month (Frijoles Canyon, Upper Alamo Trail, Turkey Springs) or monthly.

ACTIONS COMMON TO ALL ACTION ALTERNATIVES

Annual Treatment Plan

This *Draft Ecological Restoration Plan and EIS* is a programmatic guide for restoring vegetative communities in piñon- juniper woodland. This means it evaluates large-scale approaches to meeting the stated purpose, need, and objectives and that selecting an action alternative will set a certain direction for management of the piñon- juniper woodland. While it analyzes actions that are as specific as possible to identify at this scale, a myriad of site- specific sub- basin level details would need to be worked out before proceeding with each season of treatment. Therefore, both action alternatives include the use of annual site- specific treatment plans consistent with this programmatic plan to flesh out the details of treatment within particular sub- basins to maximize the chances of success, minimize logistical problems, avoid site specific impacts to cultural and natural resources, and to determine whether intervention in wilderness is needed and if so, the minimum tool for conducting that intervention (e.g., the "minimum requirement process" described above).

Identification of individual treatment areas within each sub- basin would be completed through analysis of soil suitability (i.e., soil type and depth), vegetation type, and status of cultural resource sites. The availability of woody biomass (i.e., tree density) would be used to further delineate treatment areas. For the upper soils approximately 75% of the area has sufficient woody biomass for treatment. Only approximately 60% of the lower soil complexes have sufficient biomass for treatment[1]. While these parameters would be emphasized in the implementation of the *Ecological Restoration Plan* at a site- specific level, it is recognized that fine- scale heterogeneity in soils, vegetation structure, and topography would be considered when annual treatment plans are developed.

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[1] 60% may underestimate the portion of the landscape with sufficient biomass for treatment, but this is likely to be compensated for by the overestimate of the percent of the land surface in the lower soil complexes with suitable soils (areas not covered by rock outcrop or other shallow soils).

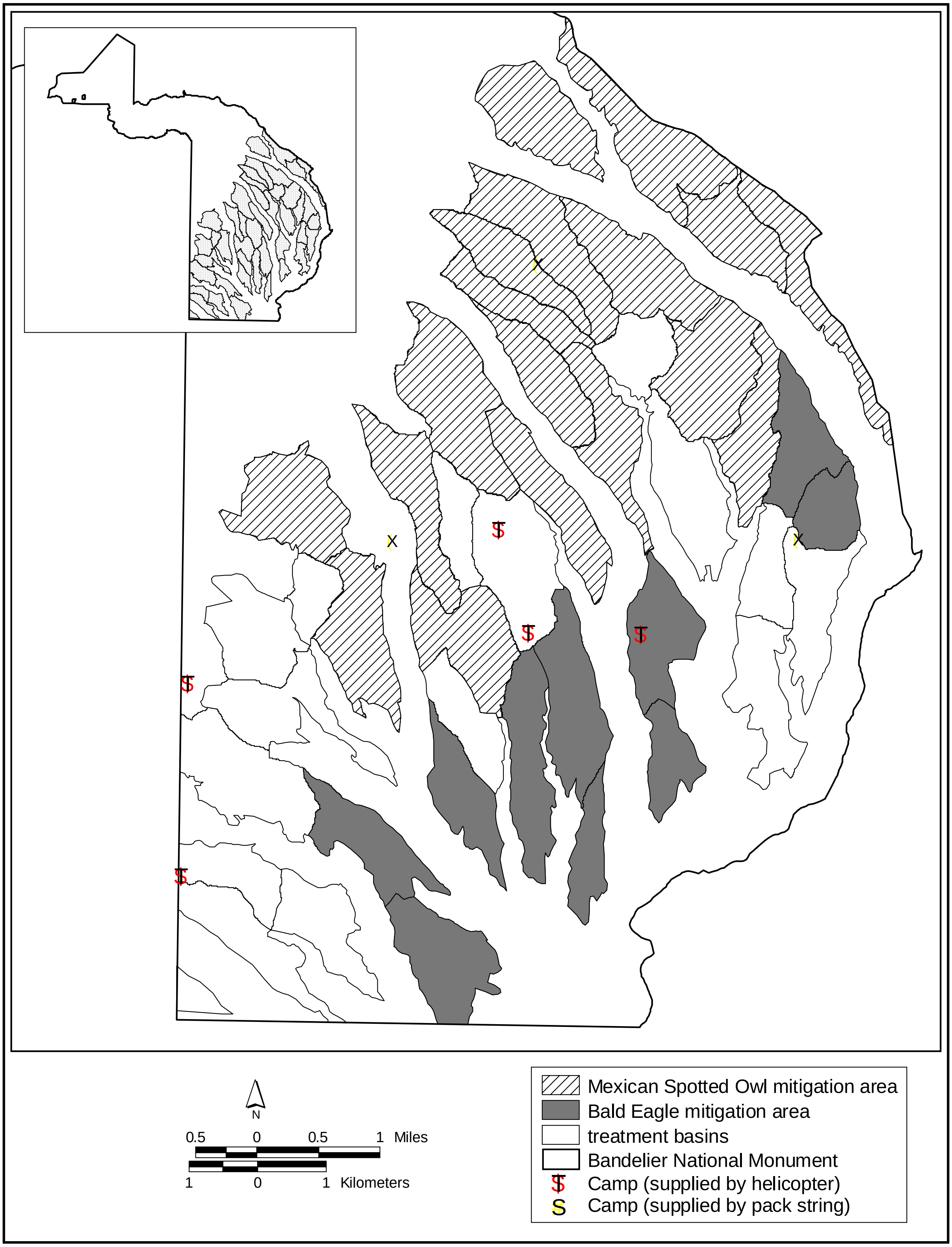

Figure 5. Helicopter and Chainsaw Restrictions for Mexican Spotted Owl and Bald Eagle, Based on Documented Areas of Habitat Use.

Annual treatment plans would include cultural survey and mitigation information (see *Impacts to Cultural Resources* section for Alternative B, for example) and would be reviewed and subject to approval by the New Mexico State Historic Preservation Officer.

Treatment of sub- basins would occur during a field season that generally runs from September to as long as May of the following year. In the description of alternatives, “season” is meant to define the period of field work within a given year of treatment and “year” to define the temporal range (or span) of implementation across the lifetime of the project.

Mitigation Measures

Restoration work would not take place during the summer months of June, July, and August to reduce the number of backcountry users exposed to the activities during peak visitation season, reduce trampling impacts to wet soils or actively growing vegetation, and limit exposures of work crews to adverse weather conditions (e.g., heat and lightning) which would limit productivity and pose safety issues.

WILDLIFE MITIGATION

Special Status Species

When treating piñon- juniper woodland near or in habitat that could be or is occupied by special status or federally listed species, hand tools might be the preferred method of treatment. The use of hand tools in select areas during the spring might allow crews to keep working while at the same time preventing impacts to these species. A biological monitor would be present during treatment to ensure no listed plant or animal species are disturbed, and to avoid or minimize impacts to other sensitive or unique species.

The following are species specific mitigations designed to reduce impacts to species and their potential habitat.

Mexican Spotted Owl (MSO)

At the start of the Mexican spotted owl breeding season (March 1), in order to mitigate any potential impacts to any nesting owls, occupancy surveys will be conducted to determine whether Mexican spotted owls are present in the monument and if so, their nesting status. If nesting MSOs are detected, the use of chainsaws and aircraft will not be allowed within 600 meters of an **occupied** suitable nesting area (SNA, described in *Affected Environment*) unless intervening topography attenuates the sound.

The following mitigation measures will also be implemented from March 1 to May 15 every year of treatment, regardless of surveys.

- Motorized activities on mesa tops will be prohibited within 100 meters of canyon rims within the shaded treatment basins shown in Figure 5 between March 1 and May 15.

- In general, helicopter flights will be avoided over the shaded treatment basins shown in Figure 5 between March 1 and May 15.

Bald Eagle

- No chainsaws will be utilized within 425 meters (0.26 miles) from fishing habitats and no helicopters will be flown within 1000 meters (0.62 miles) of fishing habitat along the Rio Grande from November 1 through February 28. .
- Helicopter and chainsaw activities will avoid the shaded basins shown in Figure 5 after 4:30 p.m. MST and before 8:00 a.m. MST from November 1 through February 28.

Peregrine Falcon

- In general, helicopter fights will be avoided over the basins indicated in Figure 6, which include peregrine falcon habitat management Zones A and B, from March 1 through May 15.
- Motorized activities in basins indicated in Figure 6 will be prohibited within 100 meters of canyon rims from March 1 through May 15.

ARCHEOLOGICAL RESOURCES MITIGATION

Mitigation measures specific to archeological resources include the following:

- Camp areas, helicopter drop zones, and pack train/human access trails will be located away from archeological sites.
- Prior to the start of work, the archeologist will instruct crews in identification of cultural materials and review federal and state laws protecting archeological sites and artifacts.
- Work crews (treatment and monitoring) will minimize walking over architectural and other features.
- All cultural sites within the treatment area will be identified and relocated by an archeologist.
- One archeological technician per work crew will be present on site during treatments to identify site components and supervise directional tree felling and placement of slash.

In addition, archeological sites within the treatment area will be treated following the prescription for the soil and vegetation type with the following modifications:

- All dead trees, regardless of species, will be removed from structural elements of sites. Non- structural elements of sites should be treated using the same prescription as the surrounding landscape.
- All 3- inch diameter and smaller trees will be removed. Cactus and other non- tree vegetation will be retained.
- Larger (>3- inch) diameter junipers growing in structures will be retained unless deemed by an archeologist to be detrimental to the stability or integrity of the structure.
- Larger (>5- inch) diameter ponderosa pines growing in structures that are deemed unstable will be removed.

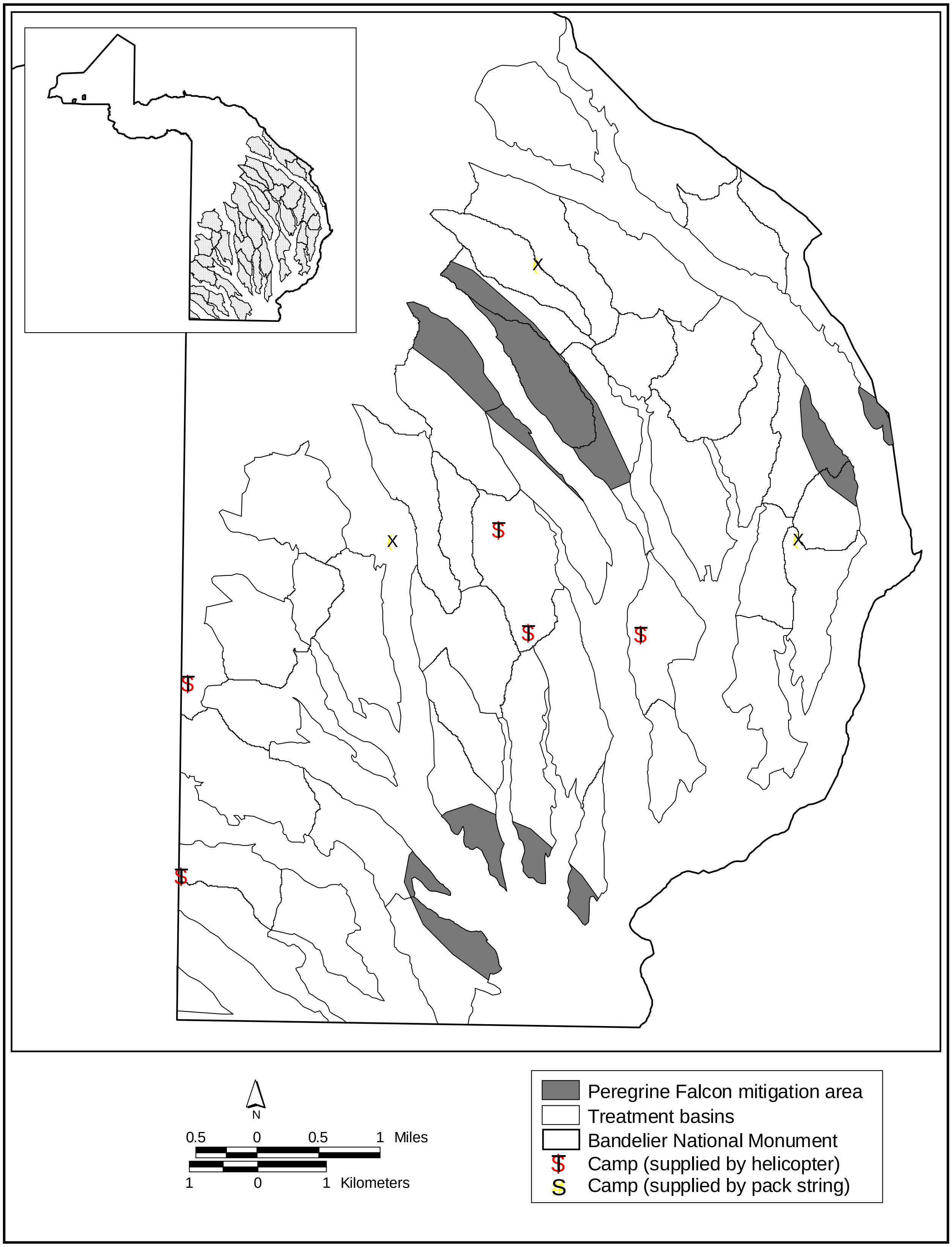

Figure 6. Helicopter and Chainsaw Restrictions for American Peregrine Falcon.

- Heavy fuels (and woody material greater than 3- inch diameter) will be hand carried off structural elements. Lighter slash can remain if deemed necessary by the on- site archeological technician.

Before treatment is initiated, NPS staff at the monument will consult with affiliated Pueblo tribes to determine the location and importance of sacred sites and how best to protect their integrity during treatment. This could include avoidance of an area if necessary, or the use of hand tools to treat woodland vegetation.

ETHNOGRAPHIC RESOURCES MITIGATION

Bandelier National Monument will continue to consult with the six affiliated pueblos identified above under the description of No Action. These consultations would identify treatment plans, site specific treatment maps, detailed archeological site maps, the need for tribal monitoring of treatment activities, proposed camp locations sites, and proposed mitigations for known ethnographic or culturally sensitive areas. The pueblos would be invited to identify potential Traditional Cultural Properties and express their concerns about any sensitive cultural or ethnographic resources or make their needs for access and use of traditional resources in the treatment area known. The monument intends to make the results of cultural resource field inventories available to the Pueblos, and will document consultation efforts and identify any proposed measures to avoid adverse effects to historic properties. Because of their sensitive nature, the locations of properties of traditional religious or cultural value will be kept confidential and unavailable to the general public. However, it will become part of a required submittal to the State Historic Preservation Officer under the National Historic Preservation Act. The required report will evaluate whether the selected alternative might adversely affect historic properties and if so, to what degree (pursuant to 36 CFR 800.4 and 800.5) If avoidance of adverse effects is not possible, Bandelier would work to mitigate them to the greatest possible degree with the SHPO and other appropriate parties in accordance with 36 CFR 800.6.

VISITOR EXPERIENCE MITIGATION

Backcountry permit applicants will be informed of locations of on- going restoration work (including locations of crew campsites). Visitor Center staff and rangers will be able to provide similar information to hikers requesting information. This information will allow visitors the opportunity to avoid restoration activities should they so choose.

Treatment Techniques

As stated above, annual treatment plans for work in piñon- juniper woodland implemented under this alternative would be prepared, and site specific treatment activities would be subject to minimum requirement analysis. If results of the analysis continue to demonstrate that motorized tools are the most appropriate tool treatment sites in specific sub- basins, chainsaws and other motorized equipment may be used within designated wilderness.

In areas where minimum requirements analyses indicate motorized tools should be used, small diameter piñon and juniper trees would be flush cut at their base using chainsaws. Limbs would be lopped and scattered over bare soil. Although seeding or erosion fabric generally would not be applied, it may be beneficial in select areas of high ecological value that would not otherwise respond to more typical treatments because of existing soil loss or other factors. In areas where the minimum requirements analysis indicates motorized tools would not be appropriate, hand tools (e.g., axes, crowbars, handsaws) would be used to cut and limb trees.

Within each sub- basin, monument experts would orient crews to a basic thinning/slash prescription. Primary emphasis for treatment would be placed on more productive sites with deeper soils and remnant herbaceous cover and/or dominated by smaller diameter or younger trees. Shallow, rocky, or otherwise low productivity sites within the watershed unit and/ or those dominated by larger diameter or older trees would generally receive little to no thinning. Monument staff would monitor treatment sites (see Appendix B) and use information gathered from the sites to modify future treatments, site selection or other factors if needed.

Monument research results suggest that while ground cover is sufficient to carry a light surface fire in only five to ten years after treatment, application of prescribed fire will not promote recovery of the herbaceous component until native, perennial grasses constitute at least 10% basal cover (Jacobs 2004; Jacobs and Gatewood 2002). Until this occurs, the current practice of suppressing fires in piñon - juniper woodland would remain in effect.

Research and Monitoring

Research activities would establish controls to assess ongoing erosion potential in other areas of the monument for comparison to treated areas. Following treatment, an area would be monitored annually, and the information used to modify future work as needed. Indicators of success would include the degree of change in herbaceous cover, sediment production, or erosion, and the relative reduction in threat to the integrity of cultural resources (see Appendix B).

SOIL AND WATER

Effects of proposed actions on soil and water resources would be monitored primarily using a single integrated metric which would be based on monthly (July-September) volumetric measurements of sediment production for discrete contributing areas (e.g., 0.1 to 1.0 hectares) located wholly within representative treatment and control areas. Comparable contributing areas within representative treatment and control areas would be instrumented with fabric sediment dams and sediment removed and measured on a monthly basis. Sediment production estimates would be adjusted using precipitation data obtained from rain gauges co- located with each sediment dam. Detailed procedures for measuring sediment production in relation to restoration treatments are detailed in supporting research by Hastings, et al. (2003). Supplemental information from repeat photography, erosion bridges, and vegetation cover may also be utilized to clarify system response.

VEGETATION

Effects of treatment on vegetation would be monitored on the basis of data collected annually from vegetation transects established located wholly within representative treatment and control areas. Two permanently marked, 100- meter vegetation line transects running downslope (perpendicular to contours) from the watershed divide and spaced at least 25 meters apart would be established within representative treatment and control areas. Vegetation and ground cover data (per species and ground cover type) would be collected at centimeter resolution during the early fall of each year, with basal and aerial cover intercepts recorded separately. Detailed procedures for measuring vegetation in relation to restoration treatments are detailed in supporting research in Jacobs, et al. (2000, 2002b). Supplemental information from repeat photography may also be utilized to clarify system response.

WILDLIFE, INCLUDING LISTED SPECIES

Monitoring occupancy of federally listed species, including the Mexican spotted owl and bald eagle, and the state- listed peregrine falcon, would continue as identified above under Alternative A—No Action. Although the state listed gray vireo breeds south of Bandelier in the Caja del Rio, it has not been documented in the monument and no information exists to suggest its presence in the project area. Breeding bird atlas field work conducted during 2002 throughout the piñon- juniper- dominated backcountry of the park did not detect any Gray Vireos after over 160 hours of observations. All proposed restoration treatments will be conducted outside of the breeding season for Gray Vireos (June through July based on data from Colorado National Monument, Colorado). Thus, there will be no direct effects on Gray Vireos from the proposed restoration work. If, during implementation of the project, gray vireos are found to be breeding in the park, surveys would be conducted. No additional monitoring specifically designed to measure the response of wildlife to treatment is planned. Pre- treatment surveys to determine the presence of the state- listed gray vireo in piñon- juniper woodland in the monument may be conducted.

CULTURAL RESOURCES

The effects of the two action alternatives on archeological resources would be monitored through qualitative data collection on the key variables of site condition, depositional integrity, and information potential, each of which relates to the eligibility of a site for listing on the National Register of Historic Places (NRHP). In addition, quantitative proxy measures of site stability would be monitored following an established protocol using Bandelier Archeological Site Condition Assessment and Monitoring forms. These forms record site condition, depositional integrity, data potential, detectable threats and disturbances from natural or human forces, presence of invasive species, site- wide and 2- by- 2- meter vegetation plot estimates of surface cover and sheetwash, repeat photography, and surface topography along a single transect across the site.

Monitoring would occur on a 10% representative sample of treated archeological sites one year after treatment, then every three to five years afterward, for a period up to 15 years. Data collection would occur from mid- August to mid- September, which is the end of the growing season. The purpose of the monitoring is to determine what, if any, changes are observed pre- and post- treatment, and in successive years following treatment. Collection of the full range of qualitative and quantitative data would provide the opportunity to identify unforeseen consequences (beneficial or detrimental) to treated archeological sites. Vegetation plots and site- wide estimates of ground cover provide a proxy measure of soil and site stabilization. Monitoring would be scheduled for the end of the summer growing season, which falls during the month of August.

In addition, research and monitoring on archeological sites will be a subject of consultation with the park's affiliated American Indian tribes. It is often the case that cultural resources (such as archeological sites) overlap with ethnographic resource values. On- going consultation with affected Pueblo communities will ensure that appropriate treatment of these sites or resources are fully considered.

Education and Consultation

Educational and collaborative activities common to all alternatives would include field tours, public presentations of post- treatment response, and articles in the park, local newspapers, and postings on the park and NPS websites. Visitors and interested and affected publics would be regularly informed through annual reports on the woodland restoration efforts including monitoring results, and would be asked to provide feedback about project related effects (e.g., on the park environment or visitor experience) that might require additional mitigation or adjustments in how treatment is implemented. The park staff would provide regular project updates to interested neighbors including federal, state, and local entities, as well as private landowners and affiliated Pueblo groups to inform and consult on planned restoration activities at Bandelier National Monument.

Cumulative Actions

Cumulative actions are those historic, current, or future planned actions and activities by agencies or private parties that would have a positive or negative additive effect on the same resources as described in this *Draft Ecological Restoration Plan and EIS*. Each resource affected (air, water, soils, etc.) may have a different set of cumulative actions that affect it and each may also cover a different geographic boundary.

SOILS AND VEGETATION

The soils that would be affected in the park are volcanic in origin and comparable to soils which are found on adjacent lands (i.e., Santa Fe National Forest [Caja del Rio], the Pueblo of Santa Clara, LANL, and Los Alamos County) on the Pajarito Plateau. The piñon- juniper woodland in the monument is also part of a larger expanse of comparable woodland that extends over the same general area. The historic land uses, including grazing and fire suppression, and climatic conditions that have changed vegetation and soil erosion rates have also affected these same resources across the Pajarito Plateau. In addition, building of homes, roads, Los Alamos National Laboratory, and commercial development have removed soils and vegetation in this region.

CULTURAL RESOURCES

The Pajarito Plateau is an appropriate cumulative boundary for the type of cultural resources found in the study area as well. The factors leading to soil erosion and loss of cultural resources have occurred across much of the plateau. In addition to these factors, visitor use in the park or neighboring forest may have resulted in removal of cultural resources. Neglect, surveying and data recovery, development, and other factors may have contributed beneficial or adverse impacts to these resources.

WILDLIFE

Wildlife may have experienced cumulative effects across the entire geographic boundary of a population. Peregrine falcons, for example, were historically affected by the use of pesticides whose residues may remain in the environment today. Obligate southwestern breeding birds may have experienced loss of habitat from development and human disturbance. Other wildlife species, such as grasshoppers or mammals, may also have been subject to cumulative actions resulting in habitat loss.

WILDERNESS

The geographic boundary for Bandelier wilderness includes the neighboring Dome wilderness in the Santa Fe National Forest (Figure 7). Actions that have affected this wilderness area include historic grazing, fire suppression and development. Because piñon- juniper is quite open, development of housing, Los Alamos National Laboratory facilities, etc. on the landscape outside of the wilderness boundaries is nonetheless visible and has a cumulative adverse effect on the natural, primitive experience wilderness is intended to provide.

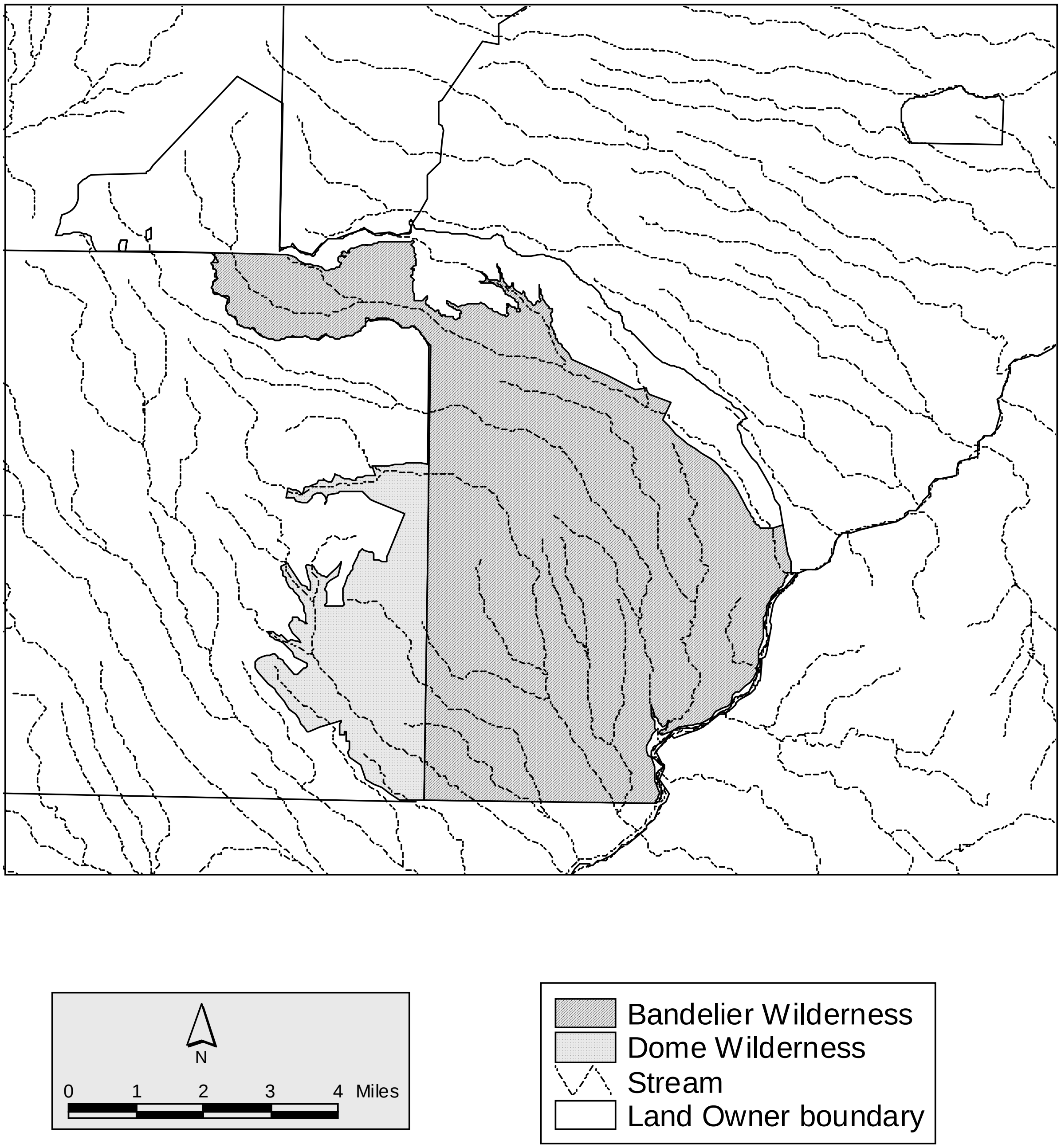

Figure 7. Bandelier and USFS Dome Wilderness Areas.

ALTERNATIVE B—OPERATIONAL PRIORITY

General Concept

Alternative B, the preferred alternative, would maximize the efficiency of treatment and minimize impacts associated with the amount of time treatment takes. Geography and logistics would determine the location and timing of treatment, and crews would complete restoration in a wave- like fashion by working systematically across the monument from one end to the other. This alternative would require either full funding initially, or full sequential funding for each season of treatment. For the purposes of the impact analysis of Alternative B in this EIS, implementation is assumed to take place over a period of five consecutive years, with the sequence of basin treatments shown in Figure 8. Basins scheduled for treatment may be switched from a given year to another, based on considerations such as presence of snow and inclement weather. However, although this may mean the year in which a particular sub- basin is treated might change, the impacts described in the *Environmental Consequences* section or those across the lifetime of the project would not change. Project costs over 5 years are estimated at $1,975,343 in nominal terms, $1,813,743 with a 3 percent discount rate applied, and $1,628,887 with a 7 percent discount rate applied (see Appendix E).

Proposed Management Program

TREATMENT PRIORITIES

Clusters of sub- basins prioritized for treatment each season would be those that are in close proximity or adjacent to one another. This would allow crews to treat as large an area as possible each season, and would minimize the number of camps and impacts of those camps. Up to two crews would be working at any one time, as this would be the maximum number of personnel that park natural and cultural resource monitors could adequately manage at any one time.

Piñon- juniper woodland would be divided into approximately equal combination of subunits across the landscape and treated in five successive years. About 4,000 acres of piñon- juniper woodland would be treated over this time period. It is anticipated that in year one, treatments would occur in the southwestern most unit and that over the remaining treatment years they would proceed in a northeasterly direction towards the main headquarters area and north of Frijoles Canyon. Contingency units, or those nearest headquarters and accessible by walking from developed areas, would be treated during inclement weather when access to more remote treatment units is deemed unsafe. All tools and activities described under *Actions Common to All Action Alternatives* would be used under Alternative B.

As stated above, an average of five years for treatment is assumed in Alternative B, and the acreages of scheduled for treatment in each of the five successive years are summarized in Table 1 and shown in Figure 8.

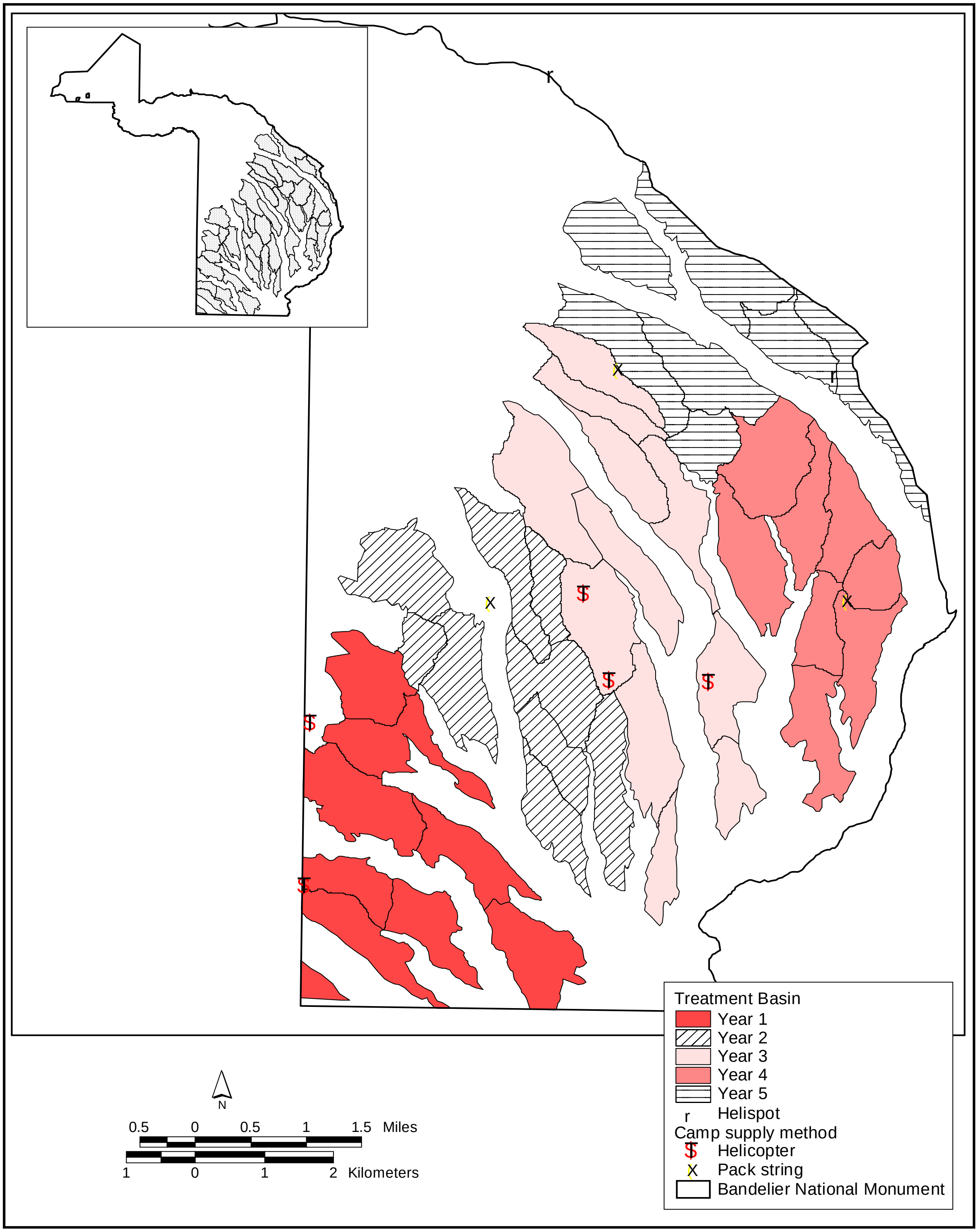

Figure 8. Treatment Areas, Alternative B.

Table 1: Treatable Acres for Each Project Season, Alternative B.

Treatment Year	Treatable Acres
1	792
2	780
3	877
4	857
5	745
Total	***4051***

CREWS AND CAMPS

Under Alternative B, up to two crews of six to ten personnel would be simultaneously implementing treatment activities each season. Optimally, the two crews would work at two different locations, often in adjacent or nearby sub- basins. Workers would walk to camps and mesas along existing trails if trails are available,, but would likely need to walk off trail to access treatment locations. Crews would work approximately eight to ten hours per day (depending on day length and sunlight) and eight to ten days per work session. Crews would treat a particular location, cutting an average estimate of 0.25 acres per day per person. This estimate includes time to walk to and from work locations, cutting, lopping, and scattering of branches, and other activities. For one 10- person crew, an estimated two and a half acres could be treated per day, with 50 acres treated per month (assuming crews work for an average 20 days per month). Using two 10- person crews simultaneously over the course of the eight-month season, approximately 800 acres could be treated each season.

Under Alternative B, a total of up to eight backcountry camp locations would be utilized over the five years of implementation. Both crews would camp at a central location near the work sites, i.e., 12–20 people would occupy the camp. A minimum of two camps would be required each season for the first and third years, as treatment would be conducted in the most remote areas of the monument. In the remaining other three years, it is anticipated that only one camp would be needed each season because crews would be able to hike each day to the treatment location as treatment moves closer to developed areas, or as in year two, is close to the Base Camp cabin in Capulin Canyon. The camps would be selected based on a series of criteria and would be located away from main trails. Each camp must also be within one and a half hours walking time from a work area, be located away from sensitive cultural or natural resource sites, and be situated such that it is accessible for helicopter drops or pack train support and so that it will accommodate the crew.

All crews would be briefed on emergency procedures and contact information (e.g. basic first aid, two- way radio protocol, cell numbers, after- hours contact numbers) to protect the health and safety of crew members or in the event of an emergency. In the event of an emergency in the backcountry, Bandelier protection rangers would likely be the first people contacted and based on the nature of the situation and their training, appropriate search and rescue procedures would be implemented (including the possibility of emergency helicopter transport).

The camp areas would be approximately one acre in size and would contain tent sites for up to 20 people, two kitchen tents, a paperwork/equipment storage tent, a dining canopy, and a portable self- contained latrine. Figure 8 shows the approximate location of proposed camp sites within treatment areas under Alternative B.

PACK STRING USE

A pack string of four to six mules would be used to establish and supply camps in areas that would not require supplies to be hauled in by helicopter, or that are located within three hours walking time to Bandelier headquarters (an estimated three camp locations across all five treatment years, as shown in Figure 8). Supplies, equipment, and water would be loaded into panniers carried by animals into camp locations. Camp locations would be located off main trails, so some off- trail travel by pack strings may occur. Under Alternative B, crews of 12–20 people may be camped at each location, necessitating several trips in and out by animals over the course of the season. It is estimated the supply trips by pack string would occur once every week during work sessions. Thus, pack strings would be utilized to set up and take down each of the three camps identified in Figure 8 and would return once to each camp location during each work session to deliver supplies to crews.

HELICOPTER USE

Where areas are not accessible by pack trains or where pack trains would be infeasible, helicopters would be used to establish and supply camps. In this alternative, a total of five camps would be supplied by helicopter over the five- year implementation period: two camps in year one, one camp in year two, and two camps in year three. Supplies, equipment, and water would be flown into camp locations using long line sling load techniques, which do not necessitate landing at the drop zone. The sling load would be placed on the ground and offloaded to the camp area. Since there are no proposed landings, the approximate number of helicopter trips is recorded as flight time (FT) per season over the five- year implementation period under Alternative B and is shown in Table 2 below. The results shown in the table include assumptions based on one hour of FT equal to approximately three round trips from the Bandelier heliport located at TA- 49 located along New Mexico Highway 4 (NM 4) or the helispot located along the Bandelier entrance road, as shown in Figure 8. An average of three hours FT (nine round trips) would be required per each camp set- up and each camp take down. In addition, one helicopter would be used to deliver supplies to the camps during the course of the season. It is estimated that the helicopter would deliver supplies to crews once per work session (three round trips per supply delivery for one hour of FT per work session). Based on two work sessions per month over an eight- month period, there would be an estimated eight supply deliveries (24 round trips, eight hours of total FT) completed per each camp, assuming camp occupancy duration of four months each, over the course of an eight- month season. Years one and three would have two helicopter supplied camps per season, with 42 round trips per camp (nine trips for set- up + nine trips for take- down + 24 trips for supplies), which equals 84 round trip flights per season This equates to 28 total hours of FT each for year one and year three, respectively. For year two, only one helicopter- supplied camp would be used, for a total of 42 round trips and 14 total FT hours.

Table 2. Approximate Flight Time (FT) to Set-up, Take-down, and Supply Camps by Helicopter for Implementation Years One through Three, Alternative B.

Implementation Year	Number of camps supplied by helicopter per year	Number of Round Trip Flights per Camp (set-up, take-down, and supplies)	Number of round trip flights year	Amount of total FT per year
1	2	42	84	28
2	1	42	42	14
3	2	42	84	28
Total over 5-year implementation	5	126	210	70

In this alternative, restoration work would generally be scheduled during the eight- month period from September to May to avoid the bulk of backcountry visitors to Bandelier. Flight routes and seasonal timing schedules discussed in wildlife mitigation measures (*Mitigation Measures* section above) would be implemented in order to avoid adverse impacts to sensitive species. In addition, as treatment moves closer to monument headquarters and pack strings become more feasible, helicopter use may be eliminated during the period from mid- March to May.

ALTERNATIVE C—PHASED APPROACH

General Concept

Alternative C focuses on treating sub- basins containing the highest priority cultural resource sites in piñon- juniper woodland to stabilize them first. As noted above under *Alternatives Development Process* above, three features of cultural resources were evaluated, weighted and averaged to determine a sub- basin's priority for treatment. For this alternative, work will occur over a 20- year time frame and project costs are estimated at $3,519,164 in nominal terms, $2,619,954 with a 3 percent discount rate applied, and $1,862,464 with a 7 percent discount rate applied (see Appendix E).

Proposed Management Program

TREATMENT PRIORITIES

As noted above, ranking methodology was used to determine the location and timing of treatment. Each sub- basin containing cultural sites was ranked based on criteria including the significance of and threat of losing cultural sites (e.g., imminent, permanent loss, or less than imminent). This methodology was used to prioritize sub- basins for treatment. However, in addition to the stabilization of cultural resources, factors described above under the *Annual Treatment Plan* section including the type of vegetation, soils, and woody biomass would be used to determine specifically where in the sub- basin treatment would occur. All specific locations in a particular sub- unit that require treatment would be treated before the crew moves to the next highest priority sub- basin.

All tools and activities described under the section *Actions Common to All Action Alternatives* would be used under Alternative C. One crew of six to ten people each would work throughout the field season. This alternative would target treatment in a particular sub- unit which may be located far from the section with the next highest cultural resources priority. Consequently, one crew would move around the monument more than in Alternative B, treatment of the 4,000+ acres of piñon-juniper woodland that are degraded would take longer, perhaps up to 20 years. The number of acres treated during each of the 20 seasons is shown in Table 3 below.

In addition, under Alternative C it is assumed the field season would last from September to March, instead of May as described in Alternative B. This abbreviated work year would avoid the bulk of backcountry visitors to Bandelier and the spring nesting season of sensitive bird species in the monument. If treatment in the spring would be located so that it either does not require the use of a helicopter for supplies, or so that a helicopter could supply the camp without disturbing nesting birds, treatment may continue through until the end of May. If so, the impacts of this scenario would be within the range analyzed in Alternative B. In summary, for the purposes of the impact analysis in this EIS, Alternative C would generally have a six-month field season from September to March and work with one field crew per season.

Table 3: Treatable Acres for Each Project Season, Alternative C.

Treatment Year	Treatable Acres
1	208
2	217
3	195
4	211
5	193
6	211
7	210
8	171
9	207
10	190
11	209
12	210
13	210
14	210
15	209
16	202
17	210
18	220
19	211
20	147
Total	**4051**

CREWS AND CAMPS

As described above, one crew per field season is assumed for Alternative C. Despite the reduction in field crews per season, a total of eight backcountry camp locations would still be utilized over the 20 years of implementation, which is the same as Alternative B. However, there may be fewer workers occupying the camps per occupation period due to only one crew working at any given time. The camp areas would be centrally located and be approximately one- acre in size and would contain tent sites for up to 12 people, two kitchen tents, a paperwork/equipment storage tent, a dining canopy, and a portable self- contained latrine.

It is anticipated that there would be one to three different camp locations utilized per season depending on the location of treatment units. Because of the more varied location of treatment areas, the duration for each camp would be shorter than in Alternative B and the same camp locations may be reused from year to year over the expected 20 years of implementation. As in Alternative B, camps would be selected based on environmental and logistic criteria. They would be sited away from sensitive cultural or natural resources, and be situated so that they are accessible to helicopter drops or pack train support. Figure 9 shows the approximate location of proposed camp sites within treatment areas under Alternative C.

As in Alternative B, workers would walk to mesas along existing trails if trails are available, but would likely need to walk off trail to access treatment locations. Crew members would be trained by NPS vegetation specialists and archeologists at Bandelier National Monument on how to cut trees, how best to avoid impacts to site- specific resources, and how to achieve maximum treatment results. As in Alternative B, crews would work approximately eight to ten hours per day, depending on sunlight conditions and eight to ten days per work session, over a period of 20 work days per month. Since the field season is shorter by two months in this alternative, less acreage would be treated per season.

Using the conservative estimate of 0.25 acre treated per day per person as used in Alternative B, one 10–person crew would be expected to treat approximately 50 acres per month, or approximately 200- 300 acres per year in this alternative.

PACK STRING USE

As in Alternative B, a pack string of four to six mules would be used to establish and supply camps that would not require water to be hauled in, or that are located within three hours walking time to Bandelier headquarters (approximately three camp locations over the course of the project). However, under Alternative C, camp locations would be reused from year to year over the duration of the 20- year implementation. This would result in a greater number of times each camp would have to be established, supplied, and packed back out. Based on a 20- year implementation plan, a total of nine backcountry camps requiring off- trail travel by pack strings would have to be established, supplied, and carried back out at the end of occupation. The greater number of trips to establish and carry out camps would be partially offset by fewer per camp supply trips required due to the smaller number pf people at each camp, but the overall number of back- and- forth trips is expected to be at least twice the number required by Alternative B.

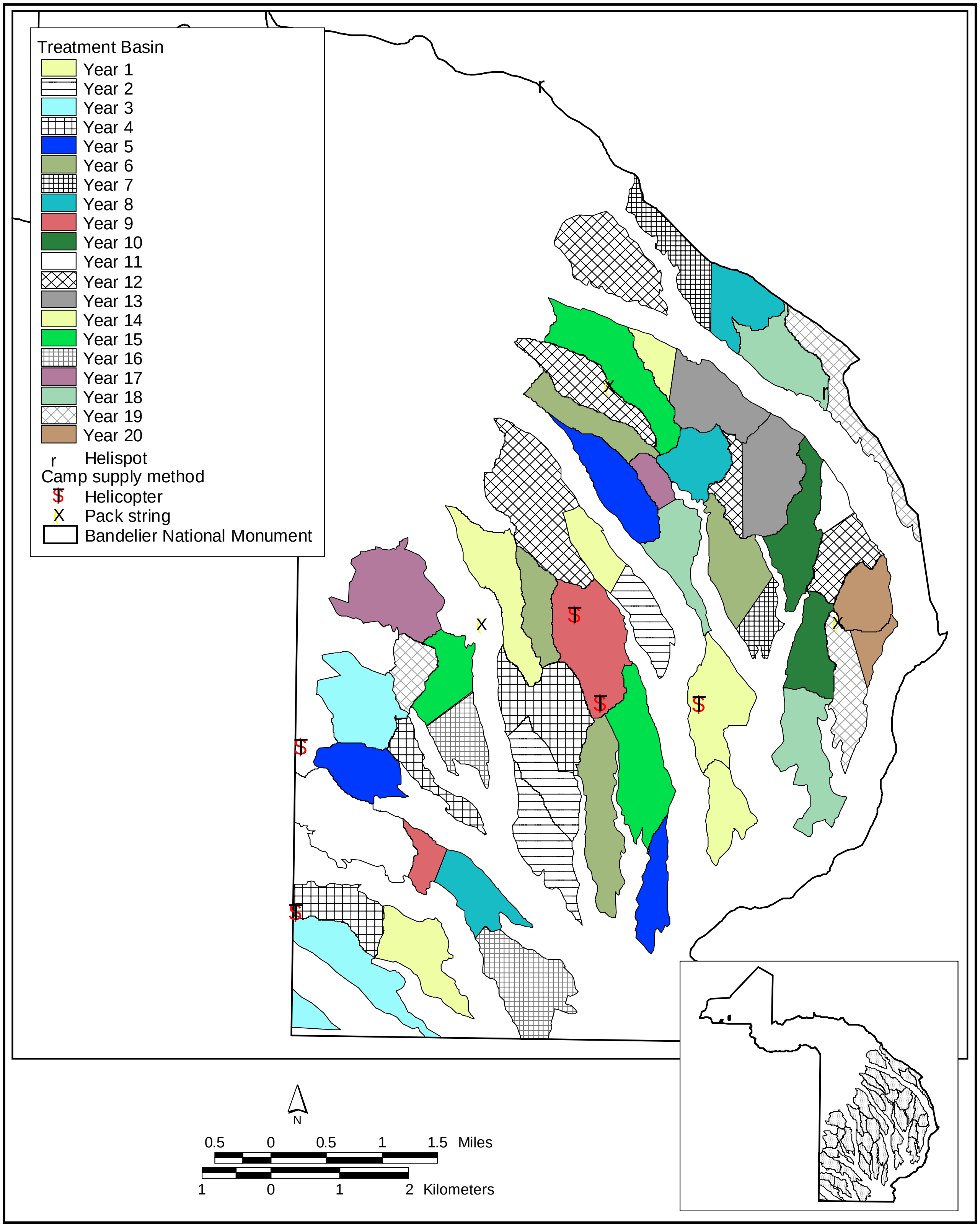

Figure 9. Treatment Areas, Alternative C

HELICOPTER USE

As described under Alternative B, helicopters would be used to establish and supply camps in areas not accessible by pack trains, and where pack trains would be unfeasible. Supplies, equipment, and water would be flown into camp locations using long line sling load techniques, which do not necessitate landing at the drop zone. The sling load would be placed on the ground and offloaded to the camp area. A total of 14 camps over 11 different field seasons would require helicopter support during the 20- year implementation period. Some camp locations would be reused from year to year over the duration of the project. Under Alternative C, the approximate number of helicopter trips required for the 14 camps is recorded as flight time per season over the 20- year implementation period and is shown in Table 4 below. The same assumptions applied under Alternative B are used here, with one hour of FT equal to approximately three round trips from the Bandelier heliport located at TA-49 along NM 4 or the helispot located along the Bandelier entrance road. However, because of the reduced crew size, the amount of required camp supplies would be less, thus reducing the number of round trips needed to supply one camp. It is estimated that six round trips (two hours of FT) would be needed per each camp set-up and each take- down. It is further estimated that helicopter supply trips per work session would be reduced to two round trips for each supply delivery (one delivery per work session), or 0.6 hours of FT. Thus, for years requiring two helicopter-supplied camps, there would be a total of 48 round trips flown for a total of 22.4 hours of FT. For years requiring only one helicopter- supplied camp, there would be a total of 24 round trips flown for a total of 15.2 hours of FT.

Table 4. Approximate Flight Time (FT) to Set-up, Take-down, and Supply Camps Requiring Helicopter Use for Each Year, Alternative C.

Implementation Year	Number of camps supplied by helicopter per year	Number of Round Trip Flights per Camp (set-up, take-down, and supplies)	Number of round trip flights per year	Amount of total FT per year (hours)
1	2	24	48	22.4
2	1	24	24	15.2
3	1	24	24	15.2
4	1	24	24	15.2
5	2	24	48	22.4
6	1	24	24	15.2
7	1	24	24	15.2
9	2	24	48	22.4
11	1	24	24	15.2
14	1	24	24	15.2
15	1	24	24	15.2
Total over 20-year implementation	14	264	336	188.8

Table 5 summarizes the elements of the alternatives analyzed in this EIS.

Table 5. Summary of Elements of Alternatives.

Action Categories	Alternative A No Action	Alternative B Operational Priority	Alternative C Phased Approach
Approach	No landscape treatment; continue individual removal at cultural sites, monitoring and small-scale research in piñon-juniper woodland.	Quick implementation to provide quickest means of slowing erosion, restoring vegetation and minimizing loss and degradation of cultural resources in project area.	Phased approach that identifies the most at-risk cultural resource sites and treating those first, regardless of efficiency of operations.
Implementation Period	Not applicable	5-year implementation period	20-year implementation period.
Actions	Hazard tree removal from cultural sites. Trees cut to create fuel breaks in sensitive areas. Ad hoc cultural site stabilization as funds allow. Monitoring and research of test plots.	Cut trees where soils are deeper or cultural resources require stabilization, and lop and scatter branches. Treat approximately 4,000 acres. Use minimum requirement analysis to determine motorized or hand tool use for project level implementation.	Same as Alternative B, except site specific cutting would include stabilizing cultural sites as top priority.
Crews	Research or individual cultural resource stabilization crews stay on or near roads; no supplies required	Two crews of six to ten walk to site from camp or developed area; camps set up by helicopter and supplied by helicopter in remote locations. Crews work eight months each season and cut a minimum of 0.25 acre per day per person (likely closer to one acre per day)	One crew of six to ten walks from camp or developed area to site; camps set up by helicopter and supplied by helicopter in remote locations. Assume crew works six months each season and cuts a minimum of 0.25 acre per day per person
Mitigations	No mitigation measures proposed.	Biological monitor on site Cultural monitor on site Crew training Trees removed from archeological sites No treatment May to	Same as Alternative B except: No treatment March to May to avoid visitor impacts and helicopter overflights in habitat occupied by nesting listed birds.

Action Categories	Alternative A No Action	Alternative B Operational Priority	Alternative C Phased Approach
		August to avoid high visitor use Hand tools in arch sites or near sensitive wildlife habitat. Some helicopter over flight restrictions and chainsaw use restrictions for listed species in certain areas.	Some helicopter overflight restrictions and chainsaw use restrictions for listed species in certain areas.
Research & Information Sharing	Share research results. Provide education through site tours of test plots; annually compile results of monitoring.	Same as the No Action alternative, and: provide wayside exhibits, visitor center exhibit, website stories, public involvement in accordance with the National Environmental Policy Act.	Same as Alternative B.
Tribal Consultation	Continue with tribal consultations per MOU.	Continue tribal consultations per MOU and meet with tribes annually to discuss treatment projects for the year to identify any issues or concerns.	Same as Alternative B.

ALTERNATIVES DISMISSED FROM FURTHER ANALYSIS

This section describes alternatives considered by NPS staff or suggested by the public during scoping but dismissed from further analysis. The reasons each was not considered further are also explained.

Hand tool only alternative—Quantitative data (NPS, unpublished data on file at Bandelier) documenting a minimum 20- fold increase in the amount of time required to cut down a juniper using hand tools versus a chainsaw demonstrates that a hand tool only alternative would not meet the plan objectives because the threat to the cultural resources would be realized before the treatment could be completed. To implement the treatment with hand tools over a shorter time frame using a greater number of sawyers, biological technicians, and archeological technicians would not be feasible or economically practical, and would impact the wilderness value of solitude to an unacceptable degree.

Widespread reseeding of native grasses to jump start regeneration in the piñon- juniper and hand scarifying in some areas to establish grasses—Two separate studies conducted at Bandelier suggest that reseeding with native grass by itself is not an effective restoration treatment in the absence of overstory reduction and slash mulch treatments (Chong 1994) and may not significantly enhance herbaceous response when applied as a supplement to mechanical treatments (Jacobs and Gatewood 1999). Under Alternatives B and C, limited supplemental seeding in high resource value areas may occur in areas where basic treatments do not produce acceptable results.

Reestablishment of beaver populations in Upper Frijoles Canyon—This action is beyond the scope and objectives of the plan as treatment activities described in this environmental impact statement would occur outside potential beaver habitat. In addition, adding this feature to alternatives would not help meet the stated objectives of restoring the physical and biotic natural range of variability to the piñon- juniper woodland of Bandelier..\

Move the boundary of the park to include Capulin and Alamo watersheds—This is also beyond the scope of the *Draft Ecological Restoration Plan and EIS*, which is focusing on restoring piñon- juniper woodland ecological processes. Congressional action would be required to change Bandelier's boundaries.

Hand remove exotic vegetation—The hand removal of exotic vegetation on a small scale is feasible; however, it does not meet the objectives of this plan to restore woodland ecological processes across the landscape. Action alternatives could involve some removal of exotics during implementation, but the extent would be small and incidental to the larger scale vegetation removal activities considered in this plan.

Allow drought and bark beetles to kill off trees instead of using human intervention—The current drought induced beetle mortality of piñon pine across much of Bandelier is being monitored to assess response of the understory community. In addition to extensive tree mortality, perennial herbaceous cover has also been significantly reduced by the drought. While herbaceous cover is expected to recover with a return to more normal moisture conditions and would likely exceed pre- drought levels in response to piñon overstory mortality, the level and pattern of increase (in herbaceous cover) would likely be insufficient in most areas to significantly reduce rates of soil erosion. However, monument staff intend to continue monitoring herbaceous response to overstory tree mortality and use this information to inform proposed or ongoing management actions, including making adjustments to restoration actions and priorities.

Use only prescribed fire instead of motorized and hand tools—As noted in the description of the monument's *Fire Management Plan*, prescribed fire is allowed in piñon- juniper woodland, but without the herbaceous understory to carry it, is not considered likely to burn. Also, for a period of at least 10- 15 years after treatment in either action alternative, fire would be actively suppressed within restored areas of the woodland, or until native, perennial grass cover achieves a minimum of 10% basal cover. When understory objectives are achieved and a ground fire is capable of burning, the treated areas may be further treated with prescribed fire.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The CEQ's implementing regulations requires that agencies evaluate how each of the analyzed alternative meets certain policy statements set forth in Section 101(b) of the National Environmental Policy Act (NEPA). The environmentally preferred alternative is defined as the alternative that best meets these criteria, as well as the one that (CEQ 40 Most Commonly Asked Questions):

> … causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources.

The section 101(b) criteria are as follows:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality if renewable resources and approach the maximum attainable recycling of depletable resources.

Based on an analysis of each alternative and its ability to meet relevant portions of these criteria and which "causes the least damage to the biological and physical environment" and best "protects, preserves, and enhances historic, cultural, and natural resources," Alternative B is the environmentally preferred alternative. Compared to the other two alternatives, Alternative B better protects important park resources, particularly vegetation, soils, water resources and cultural resources, without degradation. Because of its faster timeframe, the risk of ongoing degradation and loss of soil, vegetation and cultural resources would be lower than in Alternative C. Fewer sites would be so degraded as to be untreatable during the five- year treatement period in Alternative B than in Alternative C, and therefore more acres of piñon- juniper woodland and the resources in the woodland would be saved and restored. The ability to protect and preserve additional natural and cultural resources is pertinent to both CEQ's interpretation of the NEPA 101(b) criteria, as well as criterion four ("Preserve important historic, cultural, and natural aspects of our national heritage…) itself. In a similar vein, Alternative B also fares best on criterion one, because it will preserve more of the woodland for succeeding generations to appreciate.

Alternative B offers the best balance of protection of resources in the short- and long- term with fewer permanent adverse impacts, particularly to natural and cultural resources. Because the adverse effects take place over a shorter period of time, it causes the "least damage" to most elements of the biological and physical environment. In the case of air quality and health and safety, taking no action would result in the "least damage." However, for all other resources and values, any short-term impact from treatment is far outweighed by its beneficial effects.

Again because it accomplishes the same or greater restoration than Alternative C in a shorter period of time, Alternative B would also best assure safe, healthful, productive, and esthetically and culturally pleasing surroundings, as resources would be restored to a more natural or stabilized state and the impacts of treatment would be minimized by completing work quickly.

While both action alternatives would promote the quality of renewable resources (in this case, natural resources), Alternative B would accomplish this in a significantly shorter time period and so it environmentally preferred under this criterion (number six) as well.

Both Alternatives B and C were found to equally meet the criteria for achieving a balance between population and resource use and promoting health and safety.

DEGREE TO WHICH ALTERNATIVES MEET OBJECTIVES

As previously discussed, all action alternatives analyzed within this EIS must meet all objectives to a large degree, as well as address the stated purpose of taking action and resolving the need for action. Table 6 describes how effectively each of the alternatives meets the stated objectives.

SUMMARY OF IMPACTS OF EACH ALTERNATIVE

Table 7 summarizes the effects of each analyzed alternative, by resource. More detailed information on resource effects is provided in the *Environmental Consequences* section of this document.

Table 6. Degree to which Alternatives Meet Stated Objectives.

OBJECTIVE	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
Increase cover of native, perennial, herbaceous plants within degraded portions of the piñon-juniper woodland zone in order to reduce soil erosion, runoff, and loss of cultural resource integrity (possible impairment).	Does not meet objective. Degradation of the majority of the piñon- juniper woodland within the monument would continue (closed stands with dense needle litter mats beneath canopies and bare soil dominating intercanopy spaces). The continuing lack of herbaceous understory cover would, in many settings, yield irreversible loss/redistribution of upland soils and associated cultural resources.	Fully meets objective (five year implementation period). Actions are expected to result in re- establishment/maintenance of viable grass- dominated communities (understory) within the piñon- juniper woodland through reduced competition and enhanced site conditions. Runoff and sediment production will be considerably mitigated over current conditions, aiding in the stabilization of numerous cultural resources.	Meets objective to a large degree, but not as fully as under Alternative B due to the fact that some additional soils and cultural resources may be jeopardized because of the extended treatment time (20 years vs. five years in Alternative B).
Create conditions within degraded portions of the piñon-juniper woodland zone that will support a surface fire regime within the natural range of variability (for example, sufficient to maintain restored grass-dominated communities).	Does not meet objective. The on- going degraded condition of the piñon- juniper woodland is expected to continue to deteriorate, with increased potential for patchy, severe wildfire activity and subsequent weed invasion.	Fully meets objective. Herbaceous vegetation would have sufficient opportunity to recover to the point where surface fire regimes within the natural range of variability (e.g. frequency, intensity) could be supported. At the same time, potential for patchy, high severity fire and subsequent weed colonization would be minimized.	Fully meets objective as described in Alternative B; however, the time required to create conditions that would support a surface fire regime within the natural range of variability (20 year implementation period) would be considerably longer than under Alternative B (5 year implementation period).

OBJECTIVE	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
Manage degraded portions of the piñon-juniper community using information gained through an active program of research and monitoring.	Does not meet objective. Although research and monitoring would continue, the results would not be used to manage degraded piñon- juniper woodland.	Fully meets objective. In particular, vegetation, soils, water resources, and cultural resources will be systematically monitored to guide future project implementation work, on an annual basis.	Fully meets objectives as described under Alternative B.
Build support for, and actively share information about restoration actions and related research and monitoring efforts with government agencies, pueblos, and communities.	Partially meets objective. Information from research and monitoring is currently shared with interested agencies, pueblos and communities; however, no restoration would take place.	Fully meets objective. Objective would be met through providing project status information related to restoration efforts, including monitoring results, to interested and affected entities (public and private). Requests for feedback from interested and affected entities would be encouraged.	Fully meets objective as described under Alternative B.

Table 7. Summary of Environmental Consequences, by Alternative.

	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
VEGETATION	Soil erosion and loss, increase in extent of piñon- juniper woodland into former grassland would worsen with long- term, indirect, major, adverse impacts on herbaceous understory vegetation.	Long- term, major, beneficial impact to understory from treatment (reduced competition/enhanced site conditions)	Same as under Alternative B, possibly occurring across fewer total acres
	Long- term, indirect, minor, adverse impacts to individual piñon or juniper from competition and drought.	Long- term, major adverse impact to individual piñon or juniper trees from thinning, but reduced competition and short- term, minor benefits for those remaining.	Same as under Alternative B
	Minor to moderate, long- term adverse impacts from increased potential for wildfire from dying piñon pines and the potential for weed invasion.	Short- term, moderate, adverse impacts from increased potential for wildfire from thinned trees left on the ground. This would change to minor, long- term beneficial impacts from reduced potential for severe wildfires as understory returns.	Same as under Alternative B
		Treatment activities would result in short- term, minor, adverse impacts from trampling and soil compaction.	Same as Alternative B but impacts would occur over a longer duration (20 years vs. five years).
SOILS AND WATER RESOURCES	Continued erosion and desertification across the woodland beyond the ability to recover resulting in major, long- term adverse impacts.	Reduction in erosion rates averaging two to four times, with localized slowing of 10 times or more. Moderate to major, long- term, beneficial impact.	Moderate to major beneficial impact, but less than Alternative B because of longer treatment period and certainty that more soils would be irreparably lost as compared to Alternative B.

	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
SOILS AND WATER RESOURCES (cont.)		Treatment activities would result in short- term, minor, adverse impacts from trampling and soil compaction.	Same as Alternative B but impacts would occur over a longer duration (20 years vs. 5 years).
	Increased runoff would worsen with long- term, minor, adverse effects.	Moderate to major benefits to hydrologic function related to reduced runoff, sediment production, increased infiltration.	Moderate benefits to hydrologic function related to reduced runoff, increased infiltration.
		Short- term, negligible impacts to water quality possible from unintentional disposal of waste.	Same as Alternative B
CULTURAL RESOURCES			
Archeological Resources	Long- term direct and indirect major adverse impacts to most individual sites from no treatment due to loss of integrity.	Residual long- term, direct and indirect, minor to major, adverse effects to some individual sites due to loss of integrity of those sites not mitigated before NRHP eligibility is jeopardized.	Same as Alternative B but the integrity of more sites may be threatened due to the extended treatment time (20 years vs. five years in Alternative B).
	Long- term, direct and indirect, major, adverse impacts to cultural resources at the landscape scale due to the lack of plan to mitigate impacts related to soil erosion and potential loss of highly significant archeological resources. Impairment is possible.	Long- term, direct and indirect, minor, adverse effects to archeological resources at the landscape scale due to loss of integrity of sites not mitigated before NRHP eligibility is jeopardized.	Long term, direct and indirect, moderate, adverse effects to archeological resources at the landscape scale due to loss of integrity of sites not mitigated before NRHP eligibility is jeopardized. More sites may be jeopardized due the extended treatment time (20 years vs. five years in Alternative B).
	Short- and long- term, direct, localized, major benefits to a few	Long- and short- term, major, indirect and direct beneficial effects	Long- and short- term, major, indirect and direct beneficial effects

	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
CULTURAL RESOURCES (cont.)	individual sites from ad hoc treatment, but negligible landscape scale benefit	to individual sites and on the landscape scale through the stabilization of 98% of sites by end of five- year project.	to individual sites and on the landscape scale through the stabilization of 94% of sites by end of 20- year project.
		Long- term, direct, negligible to minor adverse effects to individual sites as a result of vegetation treatment methods (falling trees, cutting, lopping, etc.).	Same as Alternative B
		Short- and long- term, direct, minor to major benefits to individual archeological resources as a result of slash mulching (soil stabilization/ erosion reduction).	Same as Alternative B
Ethnographic Resources	Negligible to minor, adverse effects caused by biological, ecological and archeological research and management actions to mitigate erosion.	Short- to long- term, negligible to moderate benefits from increased availability of culturally important plants/plant parts.	Same as Alternative B
		Short- term, negligible adverse effects from loss of small piñon and juniper trees used in traditional practices.	Same as Alternative B
		Short- term, negligible effects from locations of camps and camp activities.	Long- term, major adverse effects from location of camps and camp activities over 20 year project period.

	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
			Short to long- term, moderate benefits related to extended time for consultation with appropriate Pueblos over the 20- year project period.
VISITOR EXPERIENCE	Continuing, long- term, site- specific to local, minor, benefits due to lack of disruptive vegetation management actions.	Short to long- term, negligible to moderate, site- specific to local, adverse impacts to views, wildlife viewing, and introduction of odors/emissions.	Short to long- term, negligible to minor, site- specific, adverse impacts to views, wildlife viewing, and introduction of odors/emissions.
		Long- term, negligible to minor benefits to wildlife viewing resulting from increased biological productivity.	Same as Alternative B
	Continuing, long- term, minor to moderate, local to regional, adverse effects due to lack of cultural resource stabilization (primary reason for visitation).	Long- term, moderate to major, local to regional, benefits resulting from vegetation treatment/cultural resource stabilization within five years.	Long- term, minor to moderate, local, adverse impacts from the loss of resources and general resource integrity due to slow rate (15- 20 years) of vegetation treatment/cultural resource stabilization; Long- term, minor, site- specific, benefits from stabilization of sites in areas of early treatment.
Soundscapes	Backcountry and Frontcountry—existing noise from overflights, autos, visitors results in negligible or minor, adverse, long- term effects.	Backcountry—short to long- term, minor to moderate, site- specific to local, adverse effects caused by noise from mechanized equipment (helicopters/chainsaws) over five year project period.	Backcountry—short- term, minor adverse, site- specific to local effects caused by noise from mechanized equipment (helicopters/chainsaws) over the 20- year project period.

	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
VISITOR EXPERIENCE (cont.)		Frontcountry—short to long- term, negligible to moderate, site- specific to local adverse effects caused by noise from mechanized equipment (helicopters/chainsaws) over five year project period.	Frontcountry—short to long- term, negligible to minor, adverse, site- specific to local effects caused by noise from mechanized equipment (helicopters/chainsaws) over the 20- year project period.
VISUAL RESOURCES	Long- term, moderate, adverse effects due to continuing degraded condition of visual quality of piñon- juniper woodland.	Short- term, minor to moderate, adverse effects due to visual effects of 800- acre treatment areas. Long- term, moderate, beneficial effects resulting from improved visual quality (successful revegetation/restoration of a more natural ecosystem).	Short- term, minor, adverse effects due to visual effects of 200- 300- acre treatment areas. Same as Alternative B, but impacts would last longer due to the 20 year duration of treatment.
WILDERNESS	Wilderness Character: Long- term, major, adverse (“trammeled” appearance) Negligible to minor adverse effects (recreational experience) Wilderness Values: Minor to major, adverse Minor beneficial (recreational issues)	Wilderness Character: Short- term, minor to major, adverse (noise, activity, landscape appearance) Long- term, major, beneficial (natural character returned) Wilderness Values: Minor to major, adverse Long- term, moderate to major, beneficial	Wilderness Character: Same as Alternative B but duration of adverse impacts would be longer (20 years vs. five years in Alternative B). Same as Alternative B Wilderness Values: Same as Alternative B but duration of adverse impacts would be longer (20 years vs. five years in Alternative B).

	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
WILDLIFE	Occasional disturbance from ongoing management and visitors; negligible and indirect	Negligible to minor, short- term, adverse impacts from treatment (temporary noise disturbance)	Same as Alternative B, although fewer animals may be disturbed during shorter season, but over a 20 year duration.
	Continued expansion of woodland would have negligible adverse impacts on most species.	Treatment and return of herbaceous vegetation would have indirect and direct, negligible to minor impacts to wildlife. For some species these would be long- term and beneficial and for piñon juniper dependent species, they would be adverse and long- term.	Same as Alternative B
SPECIAL STATUS SPECIES			
Mexican spotted owl	Occasional noise from researchers, visitors, and cultural resource specialists treating individual sites may have negligible, short- term impacts through noise.	Mitigation would prevent noise impacts from treatment (chainsaws, helicopters) from becoming more than negligible.	No impacts
	Long- term, negligible adverse impacts from continued expansion of woodland.	Minor, short- to long- term, beneficial impacts from increased prey availability as open savanna and understory are restored.	Same as Alternative B
Bald eagle	Occasional noise from researchers, visitors, and cultural resource specialists treating individual sites may have negligible, short- and long- term impacts through noise.	Mitigation would prevent noise impacts from treatment (chainsaws, helicopters) from becoming more than negligible.	Same as Alternative B
	Long- term, indirect, negligible	Same as Alternative A but short-	Same as Alternative B

	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
SPECIAL STATUS SPECIES (cont.)	effects from continued expansion of woodland.	term in duration.	
American peregrine falcon	Occasional noise from researchers, cultural resource specialists treating individual sites may have negligible, short- term impacts through noise.	Mitigation would prevent noise impacts from treatment (chainsaws, helicopters) from becoming more than minor (direct impacts to nesting peregrines would be avoided).	Same as Alternative B
	Negligible, long- term impacts from continued expansion of woodland.	Negligible to minor, long- term beneficial impacts from increased prey availability as open savanna and understory are restored.	Same as Alternative B
AIR QUALITY	Current management in woodland has negligible impacts on air quality. Good air quality and visibility would continue.	Short- term, negligible, adverse effects resulting from helicopter and chainsaw emissions over the five-year treatment period.	Short- term, negligible, adverse effects resulting from helicopter and chainsaw emissions over the 15- 20 year treatment period.
PARK OPERATIONS	Short and long- term, direct, minor to moderate, adverse effects to Resource Management by on-going need to mitigate effects of erosion on park resources (e.g., cultural resources).	Short and long- term, negligible to minor, direct, adverse effects to Resource Management related to project management/implementation, monitoring, etc. over the five- year treatment period.	Short to long- term, minor to moderate, adverse effects to Resource Management related to project management/implementation, monitoring, etc., over the 20- year treatment period.
		Short- term, direct, negligible, adverse impacts to Administration, Interpretation and Visitor Services, and Visitor & Resource Protection from project related tasks (human resources, budget, contracting, public information efforts, increased patrols, etc.) over a five- year period.	Same as under Alternative B but over a 20- year duration.

	ALTERNATIVE A NO ACTION	ALTERNATIVE B OPERATIONAL PRIORITY	ALTERNATIVE C PHASED APPROACH
PARK OPERATIONS (CONT.)		Short- term, negligible to minor, direct, adverse effects to Facility Management resulting from pack operations and camp set- up duties over a five year period.	Same as under Alternative B but over a 20- year duration.
HEALTH AND SAFETY	Ongoing management activities including research, selective treatment of cultural sites would have negligible to minor impacts to workers.	Chainsaws—moderate, adverse impacts to workers.	Chainsaws—moderate adverse impacts to workers, but less total dose to workers than in Alternative B.
		Hand tools may have short- term, minor to moderate, adverse impacts to workers.	Same as Alternative B.
		Helicopters—short- term, moderate, adverse impacts to workers.	Same as Alternative B, although total dose to workers likely to be lower.

Chapter 3: Affected Environment

Golden Ragweed
Bahia dissecta

AFFECTED ENVIRONMENT

This section describes resources that are either affected by existing management (No Action) or would be changed if one of the action alternatives is implemented.

The study area for impact analysis in this plan is the piñon- juniper woodland in Bandelier National Monument (see Figures 1 and 2). Piñon and juniper dominated woodland occupies nearly a third of the monument, or approximately 10,000 acres, and extends from the lowest elevations along the Rio Grande (ca. 5,300 feet) to around 7,500 feet at the interface with ponderosa pine savanna. While piñon- juniper woodland can be an important component of many canyon slope, lower ponderosa pine, and canyon bottom communities, the woodland system is best expressed on mesa top settings between 6,000 and 7,000 feet elevation. Mesa top settings are also where the soil erosion issues are most critical, and is therefore the focus of treatment as described in this *Draft Ecological Restoration Plan and EIS*. About 4,000 acres of mesa top piñon- juniper woodland (or 40% of total woodland area) have been identified as degraded and in need of treatment.

Bandelier is situated on the Pajarito Plateau (see Figure 3), and the same general pattern of resources and impacts to piñon- juniper vegetation, soil, cultural resources, etc. occurs throughout the plateau area as are described for the monument itself. The Pajarito Plateau is a volcanic bench defining the eastern escarpment of the Jemez Volcanic field. It can be considered as extending from Cochiti Pueblo on the south to Santa Clara Pueblo on the north, with the Rio Grande generally delineating the eastern boundary, but for purposes of this plan is considered to include basaltic upland areas with woodland cover east of White Rock Canyon (e.g., the Cerro del Rio area across the Rio Grande from Bandelier). The Pajarito Plateau is generally the geographic boundary for the discussion of cumulative impacts to natural and cultural resources in the *Environmental Consequences* section of this EIS.

VEGETATION

Piñon and juniper woodland of the American southwest covers about 76,000 square miles in six states. Although species assemblages vary across the region, piñon-juniper woodland is characterized by the presence of either singleleaf piñon or Colorado piñon, and by alligator juniper, one- seeded juniper, Utah juniper, or Rocky Mountain juniper. In north- central New Mexico, including in Bandelier National Monument, the piñon- juniper woodland is dominated by one- seed juniper at lower elevations, and until recent drought mortality, by increasing dominance of Colorado piñon pine at higher elevations. The herbaceous understory is comprised principally of native, warm season grasses, including little bluestem, blue grama, and mountain muhly; these species are typically found in intercanopy spaces. Cool season grasses, including muttongrass, June grass, and littleseed ricegrass, are often found beneath the protective canopy of trees. A great variety of perennial forbs, as well as annual and biennial forbs can be found depending on local site conditions and weather patterns.

Common shrubs include oak, rabbitbush, and sumac, with sub- shrubs such as wormwood, snakeweed, and pinque. Several genera of cacti are also present, with species of prickly pear dominating. A recent Vegetation Management Plan (NPS 2006b) provides an overview of plant community classification and vegetation issues at Bandelier.

Piñon- juniper dominated woodland occupies nearly a third of Bandelier National Monument or approximately 10,000 acres, and extends from the lowest elevations along the Rio Grande (ca. 5,300 feet) in White Rock Canyon to around 7,500 feet at the interface with the ponderosa pine zone (see Figure 2).

At a fine scale, and relative to soil type and topographic position, tree cover can vary from relatively open stands with established (herbaceous, sub- shrub, and shrub) understories, to nearly closed stands with dense needle litter mats beneath canopies and bare soil dominating the intercanopy spaces. While piñon- juniper can be an important component of canyon slope complex, lower Ponderosa pine savanna, and riparian canyon bottom communities, the woodland of interest for this plan is predominantly found on low gradient, mesa top settings between 6,000 and 7,000 feet elevation. These mesa top woodland areas are where most of the parks research and monitoring efforts have been focused, because this is where the soil erosion issues, and associated impacts to cultural resources, are most critical.

The same general pattern of piñon- juniper woodland (and associated soil erosion and cultural resource issues) occurs throughout the Pajarito Plateau area (Figure 10). Several additional juniper tree species (Rocky Mountain and Alligator bark) also occur within the monument and on the Pajarito Plateau, however these junipers are of relatively minor importance in terms of actual land area occupied. Thus the upland portion of the woodland within Bandelier is the focus of the plan, and the following affected environment discussions will largely address this setting within Bandelier, while referencing comparable adjacent lands on the Pajarito Plateau which constitute the regional context for evaluating cumulative impacts.

Although piñon and juniper are native to Bandelier, the ecology of the woodland and the distribution of these species have changed during the last century. Evidence suggests the trees were common on hillsides and rocky slopes, but did not regularly occur in lower gradient, deeper soil settings such as the mesa tops in Bandelier (Albert, et al. 2004). In the last century, however, piñon and juniper trees have become overly abundant. The expansion of piñon and juniper has taken two forms: it has increased in density in areas where it has always occurred, and it has spread out into lands that had previously been occupied by grasslands, shrublands or ponderosa pine forests. In addition, the extent of the understory of grasses, herbs, and forbs that characterized much of the landscape decades ago has been greatly reduced or eliminated. Fires are infrequent in the monument's piñon- juniper woodland because the understory is not in place to carry it between trees. The forces that resulted in these changes included livestock grazing, fire suppression, and drought, and the changes themselves occurred across a broader landscape than simply Bandelier National Monument.

Historic livestock grazing (cattle and sheep) during the last 150 years, and intensifying ca. 1850, has removed the grasses and forbs that acted as fine fuels to carry frequent lightning- strike fires across much of the southwest. These relatively “cool” fires traditionally had reinvigorated annual and perennial grasses and forbs, while killing back piñon and juniper seedlings and restricting them to more “fireproof” areas such as rocky outcrops or shallow soil sites. During this same period of time, wildfires were nearly totally suppressed, allowing the more drought- resistant piñon and juniper to invade ponderosa pine savannas.

Fire intervals averaging <25 years have been documented for adjacent Ponderosa savanna and grassland systems through unpublished fire history reconstructions (Figure 11) within Bandelier National Monument, including a site (i.e. South Mesa) within the piñon- juniper woodland zone encompassing the location of experimental restoration treatments (Allen, personnel communication, 2006).

Reduced understory vigor and loss of fire disturbance provided opportunities for piñon and juniper to expand in range. Expansion of woodland from traditional low productivity habitats (i.e., rocky, shallow soil sites) onto deeper soil or more productive sites (i.e., former grass dominated communities), as well as increasing densities within more open stands, further suppressed herbaceous and shrub components.

Although domestic livestock grazing inside the monument ended after 1940, continued grazing effects within the woodland have been experienced as a result of feral burros (through mid- 1980’s) and subsequently by resident deer. In addition, the loss of herbaceous understory from grazing triggered accelerated erosion (see Soil and Water Resources below), which aggravated the loss of this important vegetative community. The combination of the spread of trees where grasslands or savannas once stood and the loss of understory vegetation have meant that, although the monument’s Fire Management Plan allows for natural ignitions to burn in the piñon-juniper woodland, for the most part these fires are impossible because vegetation is not available to carry them.

More natural conditions in piñon- juniper woodland typical of that in Bandelier would likely include a matrix of plant communities and structures, from more open grass- or shrub- lands to pine savannas and including denser patches of woodland. Understory species composition would include a mixture of native, perennial, warm and cool season grasses but would cover two to four times as much ground in the woodland as they do now. Understory cover would be relatively greater on more productive sites, .ie., those with deeper soils, and total tree cover would generally increase with elevation (and precipitation). On the more productive sites, understory ground cover would be sufficient to stabilize soils and to carry low intensity surface fires at intervals of 15–30 years. Where older and denser patches of woodland occur, (typically on less productive, shallow or rocky substrates) surface fire disturbance

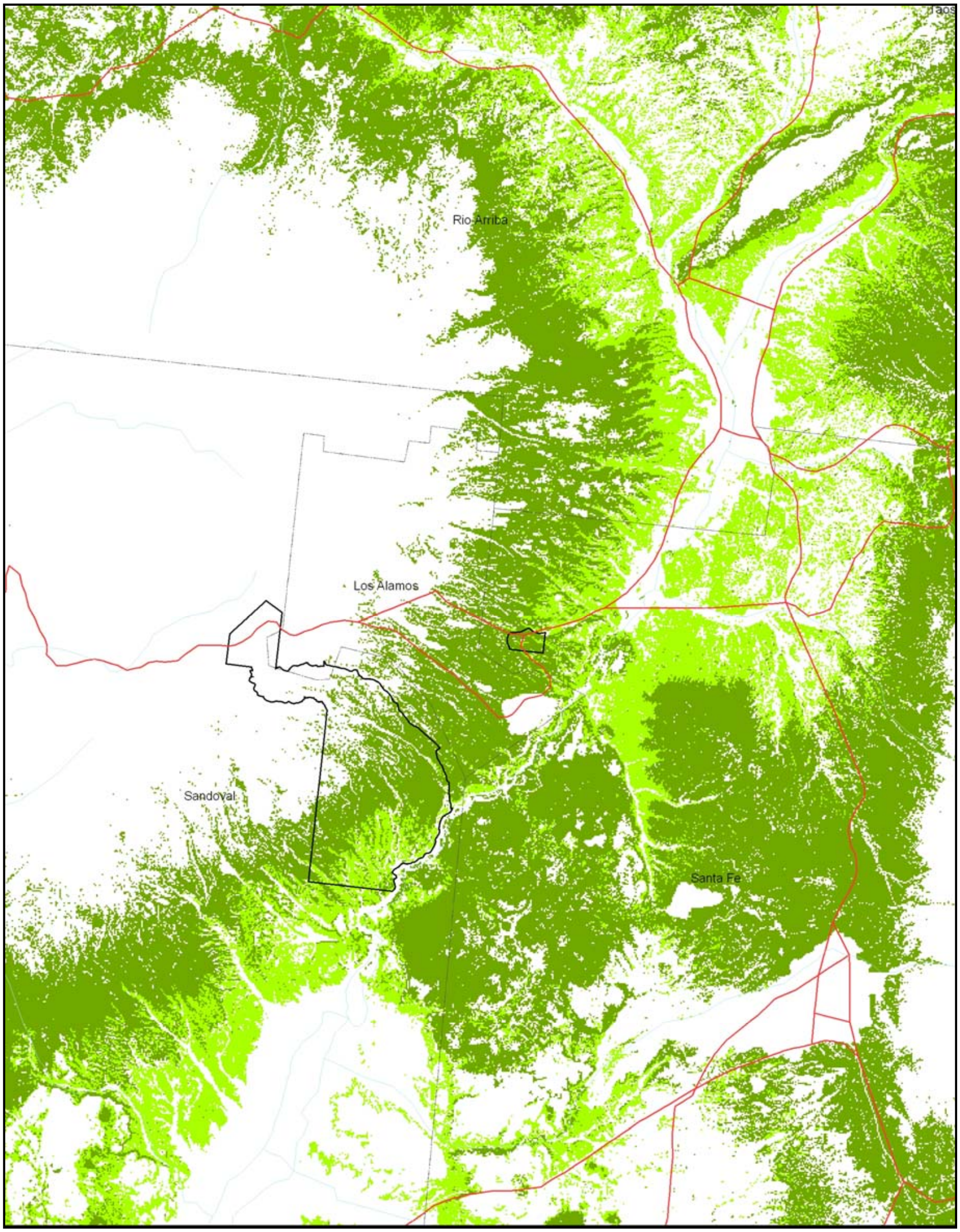

Figure10. Distribution of Woodland in Bandelier National Monument (indicated) and Surrounding Pajarito Plateau. (piñon-juniper in dark; juniper savanna in light) (modified from Southwest Regional GAP Analysis [Lowry, et al. 2005]).

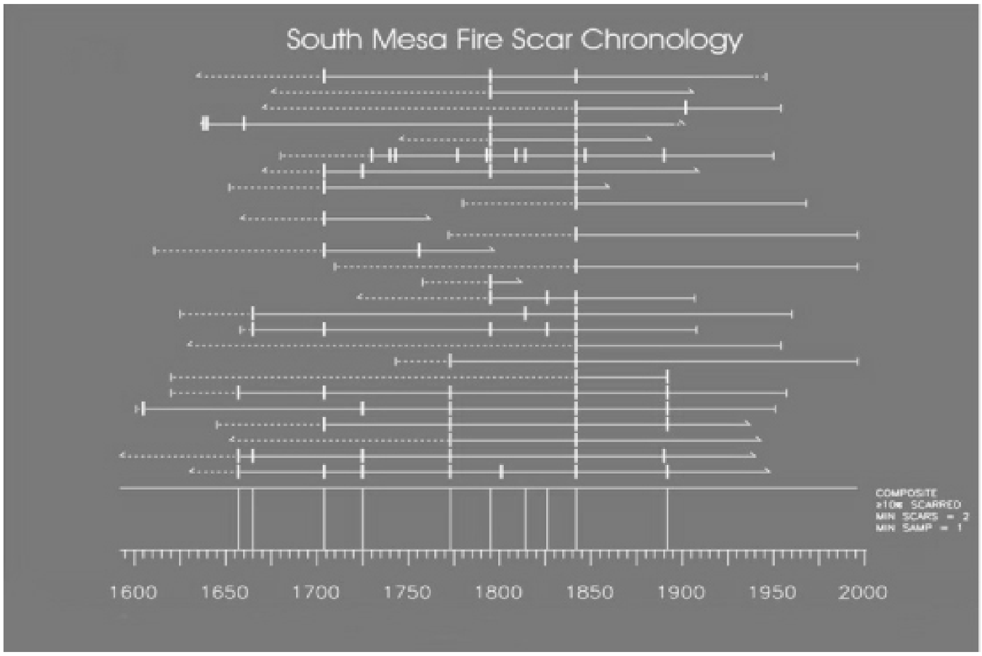

Figure 11. Fire Histories Based on Data Scars from Ponderosa Trees Located Within or Adjacent to Extant Woodlands on Deeper Soils Suggests Loss of Fire Process by Mid- to Late-1800s (Allen, personal communications 2006).

would be uncommon, and fire would occur as patchy crown fires at intervals exceeding 250 years. Periodic drought and associated beetle mortality would occasionally thin existing woodland stands and, in addition to fire disturbance, restrict local woodland occurrence to rocky, shallow substrate sites.

In juniper shrub grasslands that are now dominated by piñon and juniper, the more natural state would be open areas that have only scattered mature trees occupying less than about 5% of the ground cover and grasses, herbs and forbs occupying the remainder. Fire intervals in these grasslands took place at intervals of about every 5 to 15 years prior to the suppression actions associated with the historic land uses described above.

Recent and continuing drought conditions and associated losses to pine beetles have resulted in changes in the monument's piñon- juniper woodland. Prior to this time, one- seed juniper largely dominated lower elevation areas below 6,300 feet, with increasing dominance of Colorado piñon pine above 6,300 feet; this general elevational break between juniper savanna and piñon- juniper woodland can be seen on the vegetation map for Bandelier (see Figure 2).

Between 2000 and 2004, over 90% of the mature piñon pine across most of Bandelier and on the Pajarito Plateau were killed by a combination of drought stress and Ips beetle attack. As result of this widespread mortality of piñon pine, the piñon- juniper woodland across the Pajarito Plateau, including Bandelier, is now dominated by one-seed juniper; that is, former piñon co- dominated woodland has essentially converted to more open juniper woodland and savannas typical of lower elevations. Despite the recent piñon mortality event, woodland (currently dominated by one- seed juniper) is still the most common vegetation type within the monument and across the Pajarito Plateau area. While a few mature piñon are still present on the landscape, they occur mostly at upper elevations, or in moist, protected settings. The majority of surviving individuals are small seedlings scattered throughout former piñon- juniper woodland. The recent drought and beetle epidemic also resulted in near complete mortality of ponderosa pine stringers along drainages within the woodland.

Drought induced changes (whether temporary or long term, stochastic or directional) in plant communities are an infrequent, but important disturbance regime for southwestern woodland and forest systems. For example, considerable numbers of piñon and ponderosa pine snags and logs are scattered across portions of the woodland and provide evidence of earlier drought event during the mid- 1950s; these earlier events essentially converted what were then lower elevation piñon-juniper woodland to juniper savannas, and lower elevation ponderosa savanna (with a young woodland understory) to piñon- juniper woodland.

If the region's precipitation patterns returned to what they had averaged over the past average 30 years, piñon may recover co- dominance status above 6,300 feet after several hundred years. However, even with favorable moisture, recovery might be delayed by availability of seed (since trees only produce a seed crop every three to five years and the large edible seeds are both in great demand by wildlife and often short lived in the soil). Piñon seedlings would also need to compete with an established (and long lived) juniper overstory, but would benefit by having juniper as a nurse tree.

The dominance of piñon- juniper woodland resulting from historical land uses described above and the accelerated erosion and loss of archeological resources are all expected to persist regardless of the recent loss of piñon at the monument. For example, even though the loss of piñon overstory could theoretically result in some incremental increases in understory cover, these increases would not be large enough to significantly mitigate soil erosion rates or long- terms threats to cultural resource integrity. Also, the restoration treatment described in this environmental impact statement includes the felling of trees and scattering of branches. As dead piñon trees begin to fall across the landscape, their debris on bare soil surfaces might be expected to increasingly mimic this treatment; however, test plots indicate the presence of fresh needles to hold soil and clumpy distribution of felled trees and branches (i.e., mostly on and immediately adjacent to the old canopy mounds) is important in achieving success in restoring understory vegetation (and mitigation of runoff and soil erosion).

While the large- scale die- off of piñon in the region is unlikely to result in significant understory growth or stabilization of soils, it is likely to increase the potential for high- severity fire and extensive mortality of juniper in the woodland. This is because it will generate large amounts of woody piñon debris on the ground over several years. In a wet year, a bloom of weedy annual- biennial forbs might carry a fire between woody debris piles. Because it would be relatively hot and because piñon debris occurs over a large part of the woodland, a fire could affect large areas of juniper woodland, killing a large percentage of juniper trees and any recovering piñon or ponderosa pine. The aftermath of a high severity fire like this could yield a system dominated by extremely high rates of soil erosion, and subsequently vulnerable to widespread exotic plant establishment. Under almost any scenario, a post- fire woodland system would be severely degraded, with rates of soil erosion and threats to cultural resources expected to be much greater than what has been previously documented for woodland at Bandelier.

Implementation of restoration actions, therefore, might not only enhance herbaceous recovery in bare soil intercanopy areas, it could also be designed to mitigate potential threats to soils and to juniper posed by wildfire by redistributing slash in a more uniform pattern on bare soil and away from woodland patches. By moving dead piñon debris (i.e., fuels) onto bare soil areas, and supplementing this with fresh juniper slash, the monument can expect to both facilitate an effective understory recovery (i.e., capturing runoff and stabilizing soils), and preempt the potential for destructive wildfire behavior.

Sensitive Plant Species

Bandelier resource staff has identified several plant species which are considered locally sensitive. Because none of these species have special status (federal or state endangered or threatened) they are here rather than in the *Special Status Species* section. Of the four identified as occurring in the monument, only the grama grass cactus has the potential to occur in piñon-juniper woodland and be subject to impacts associated with restoration actions in either Alternative B or C.

GRAMA GRASS CACTUS

The grama grass cactus is a common, but cryptic species, often growing intermixed with blue gramma grass. Grama grass cactus has flattened and flexuous spines and they resemble the leaves of blue gramma grass. Grama grass cactus occurs at lower elevations, in relatively open and grassy piñon and juniper savannas on gentle slopes and upland areas, and usually in close proximity to canyon rims where basalt bedrock is exposed. This short- term perennial was documented for Bandelier in the Tsankawi Unit in the late 1980s, but a systematic survey in 1994 could not relocate this population. Suitable habitat for this species likely exists throughout the lower elevation woodland areas of Bandelier, but because of its cryptic nature and relatively short lifespan, it is difficult to monitor and may be generally more abundant than records suggest. The species has never been observed within the project area and has only a limited potential to occur, thus no specific mitigation procedures are identified. The dispersed foot traffic and slash disposal associated with the proposed restoration treatment poses little or no threat to this species.

MOUNTAIN LILY

The mountain lily is locally abundant in well watered, upper canyon areas, under relatively open mixed conifer forest canopies. This showy species is a perennial forb from a tuberous rhizome.

YELLOW LADY'S SLIPPER

The yellow lady slipper orchid is extremely rare in the Jemez Mountains and is known from only a few localities. It occurs in relatively open and grassy mixed conifer forests of upper elevation, mesic canyons, favoring well watered benches, seeps, and bogs on the north facing sides. This showy species is a perennial forb from a tuberous rhizome.

CERRO HAWTHORN

The hawthorn is an uncommon, but locally abundant, small tree of well watered upper canyon areas. It can form small thickets on moist flats, where its thorn like branchlets and red fruit make it a distinctive species.

SOIL AND WATER RESOURCES

Soils

Soils are a product of climate, geology, topography, and vegetation, and they in turn influence vegetation and hydrologic processes (i.e., runoff, infiltration, and sediment transport). Most of the soils on which woodland occur within Bandelier are derived from volcanic tuff, basalt, and pumice deposits, although typically from parent materials which have been secondarily transported and reworked by alluvial/colluvial (e.g. by water or gravity) action; in many cases, these locally derived sediments have been supplemented by eolian (wind) inputs. Upland tuff derived soils range from shallow, rocky, and poorly developed inceptisols, to older, deeper, and better developed entisols with clay- rich argillic horizons. Mollisols have formed locally on pumice patches, often with buried soil horizons at varying depths (see Figures 12 and 13). Bare soil surfaces (i.e., without the protective cover of litter, slash, pumice, or vegetation) are subject to heaving by extremes of temperature and humidity, and are extremely vulnerable to erosion from surface runoff and wind. Most soil heaving occurs when late spring snow melt saturated soil is repeatedly frozen by cold night temperatures and subsequently baked by warm afternoon sun, giving the soil surface a patterned and fluffy appearance. Exposed soil surfaces often exceed 80% cover in woodland intercanopy areas, and this large expanse of exposed soil can generate large sediment yields during runoff triggered by intense summer thunderstorm events.

Surface horizons range in texture from loam to sandy loam, with deeper horizons ranging from clay loam and silty- clay loam to sand. Soil depth can be highly variable across relatively short distances, although the deeper, more productive soils are generally alluvial deposits on lower slopes. Surficial pumice soils provide greater infiltration capacity while mitigating evaporative losses and physical heaving, however they can be relatively lacking in water storage capacity and organics. Nonpumice soils generally are more vulnerable to surface erosion given low infiltration capacity (i.e., high runoff and absence of vegetation) and susceptibility to frost/drought heaving. Presence of an argillic (clay) horizon can act as an impermeable layer which perches water at depth; the relative depth of the argillic horizon determines whether perched water is available to plants and whether more available to shallow rooted herbaceous plants (argillic horizon <120cm) or more deeply rooted woody plants.

Erosion is ubiquitous across all soil types within Bandelier (examples of this can be seen in Figures 30- 32 in the *Visual Resources* section). Intensive characterization of erosional processes in degraded piñon- juniper woodland at Bandelier suggest average losses ranging from 2,500- 4,000 kg/ha/year, most of it occurring during intense thunderstorm events typical of the summer monsoons (Allen, unpublished data; Hastings, et. al. 2002;Wilcox, et al. 1993, 2003). Active soil erosion on degraded piñon- juniper sites during the last fifty years is clearly evidenced by exposed soils and bedrock, soil pedestals, lobes of active sediment, and sediment accumulation behind fallen logs (Davenport 1997). On the basis of sediment catchment data collected from 1995 to 2005 at multiple spatial scales, soil loss within degraded piñon- juniper communities at Bandelier at the scale of a hillslope can be can be conservatively estimated at about four millimeters (mm) per decade (Davenport, et al. 1996; Davenport 1997; Davenport, et 1998; Wilcox, et al; 1996; Hastings, et al. 2004; Allen, et al. - - unpublished data). Higher rates have been measured in many individual years, on individual sites and certain time windows since 1995.

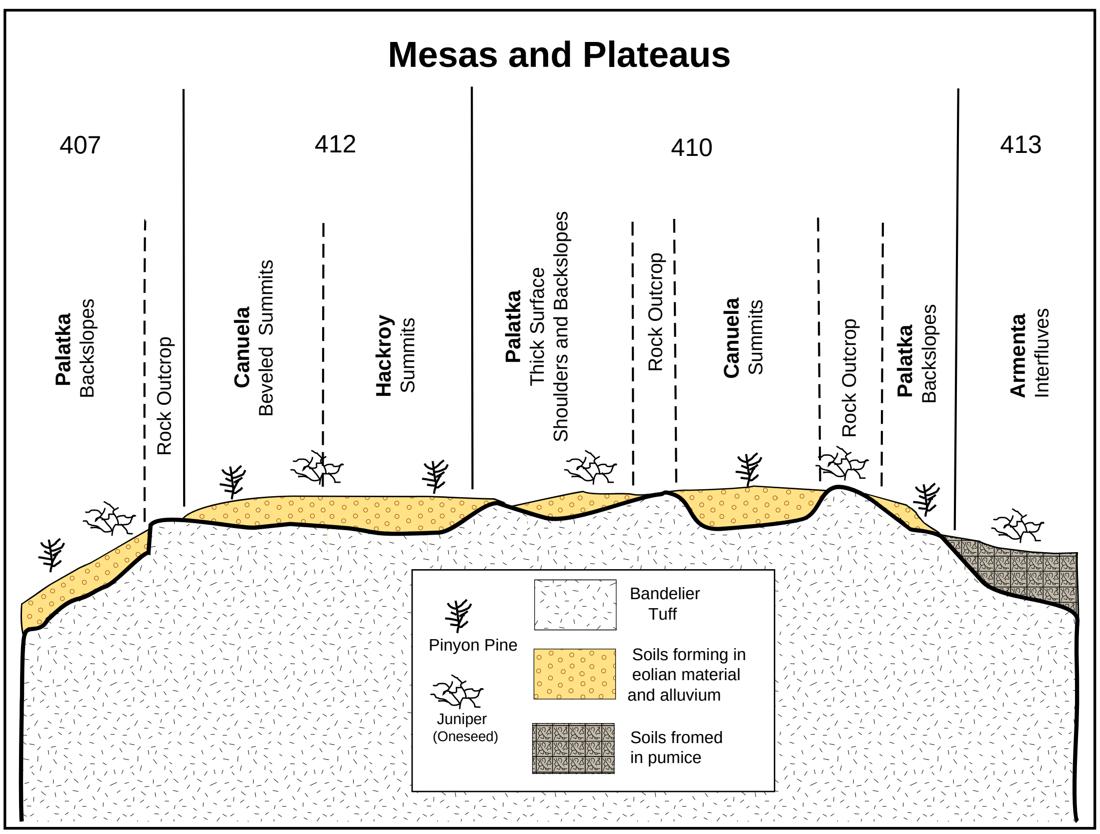

Figure 12. Soil Map Units Typical of Upland Woodland Areas.

Piñon- juniper woodland soils in Bandelier are at least tens of thousands of years old. Scientists know this because in these semiarid conditions it takes at least that long to develop the argillic B- horizons found in most of these soils. This means that the background or natural rate of net soil erosion for the Bandelier soil system has been essentially zero for many thousands of years. Otherwise, the soils that the monument has today could not have formed and persisted (McFadden, personal communication 2002). Thus the current measured rates of soil erosion at Bandelier are extremely high, are unsustainable and reflect substantial degradation of soil resources. Although soil is now eroding in the piñon- juniper at a higher rate in some locations than others, assuming a range of soil depths from 15- 75 cm, an average four mm/decade erosion rate means that all soil would be lost in as little as 375 years or as many as 1875 years. Given their shallow depth (generally less than 25 centimeters on upland, non- pumice mesa areas), soils in the piñon- juniper woodland at Bandelier would be certain to be lost across the landscape in 625 years, and much sooner in some individual site locations.

As noted, soil formation is strongly influenced by topographic and climatic setting, including aspect and elevation. In turn, these three factors in large part determine vegetation. Different soils may support different vegetation types, and conversely different vegetation types may influence soil development, soil properties, and hydrologic response. The vegetative response of a site to disturbances such as grazing, fire, drought, and restoration will depend on the nature, timing, and intensity of the disturbance in relation to the vegetation and soils present. Overgrazing as described above (see *Vegetation*) and the accelerated erosion, the loss of understory and desertification loop that resulted have altered the character and quantity of soils in the woodland. Now, although some woodland soils historically even supported dryland farming operations before they became parklands, intercanopy soils in piñon- juniper are generally poor and often lacking in organics (i.e., top soil), nutrients and water holding capacity. While soils of tree canopy mounds are often enriched relative to intercanopy locations, the general status of soils in the woodland are considered to be degraded. At lower elevations and at the southern end of the park, the soil and vegetation at many sites are probably already degraded beyond recovery using the restoration treatments proposed in this plan.

The most recent soil mapping of the monument was completed by the Natural Resource Conservation Service (NRCS) in 2004 (see Figure 13). In the NRCS survey, a map unit represents either an area dominated by one type of soil (typically with minor inclusions of different soils), or more commonly, an area dominated by a complex of several different soil types (i.e., the spatial patterns of individual soil types within a complex occur below the minimum mapping resolution for map unit) (for example see *Palatka- Canuela- Rock* complex pictured below).

The photos in Figures 14 through 17 show representative woodland areas and associated soils within Bandelier National Monument and are excerpted from the 2004 NRCS report prepared for the monument.

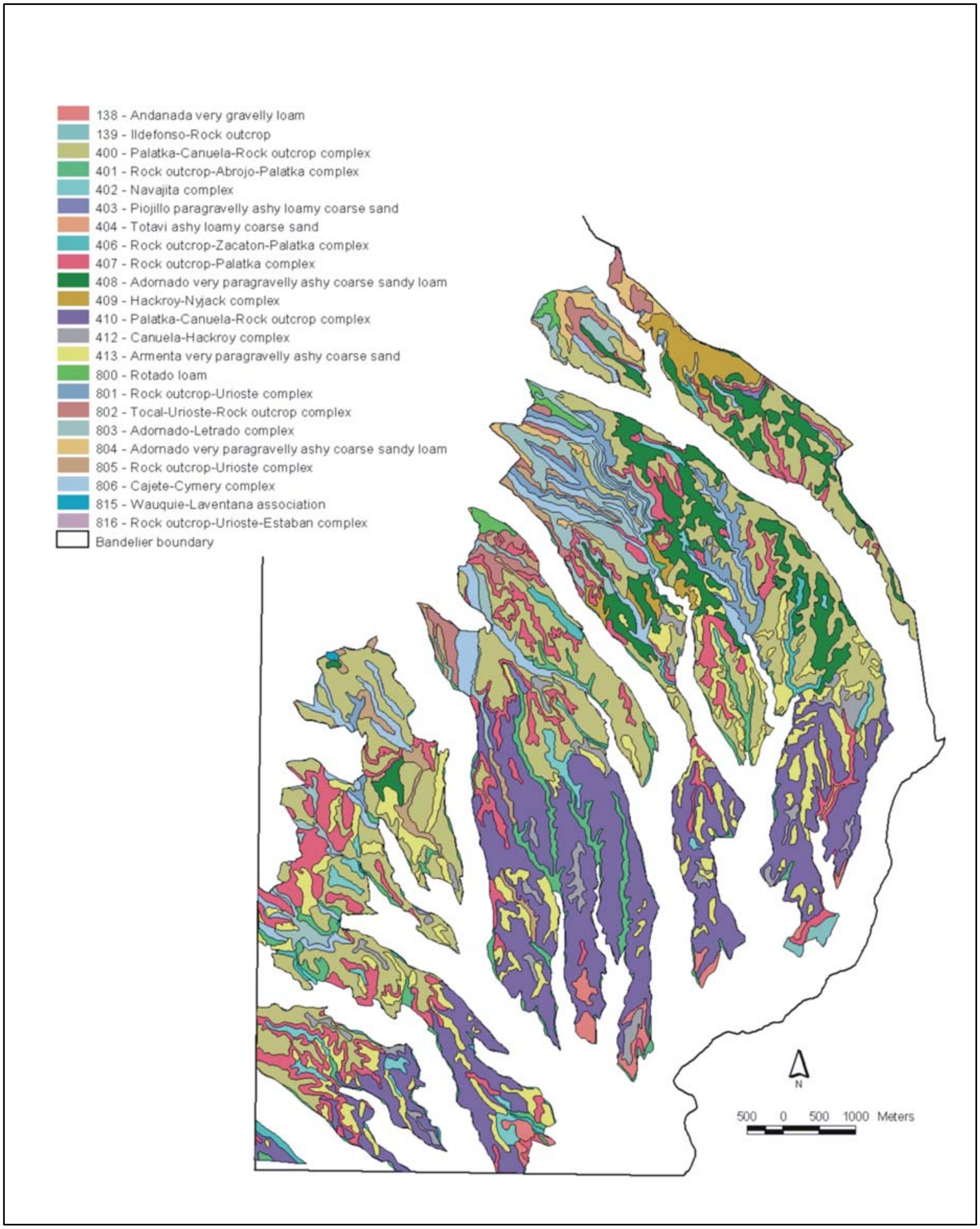

Figure 13. Soil Map of Bandelier National Monument (NPS 2004c).

Figure 14. Piñon-Juniper Savanna on Palatka-Canuela-Rock (shallow, rocky tuff derived) Soils.

Figure 15. Piñon-Juniper Woodland/Savanna on Armenta (deep pumice) Soils.

Figure 16. Piñon-Juniper Woodland on Hackroy-Nyjack (deep with clay rich argillic horizon) Soils.

Figure 17. Juniper Savanna on Canuela-Hackroy (shallow with clay rich argillic horizon) Soils.

Water Resources

Water resources within the upland (i.e., mesa top) portion of the piñon- juniper woodland are extremely limited; i.e., there is no permanent water (i.e., springs, seeps, or streams). This is a function of low mean annual precipitation, high evapo- transpiration, coarse, and well drained soils with little storage capacity (i.e., low clay and organics). The very deep volcanic deposits which compose the mesas ensure virtually no recharge of, or connection with, deep ground water resources. All water relevant to vegetation and soil erosion is derived from current precipitation.

Water from storms either runs off a site ("runoff"), runs on to another site ("runon"), infiltrates into the soil profile to be taken up by plants and transpired, and/or evaporated (the latter two are often combined and referred to as evapo- transpiration). In semi- arid areas like the woodland of the Pajarito Plateau, annual evapo- transpiration demands always exceed precipitation; thus soil conditions are normally dry with only intermittent wetting of the upper soil profiles. In most years, winter precipitation is insufficient to recharge soil moisture and promote spring growth; thus summer precipitation is the dominant pattern throughout the woodland (i.e., grass composition within the woodland is dominated by summer or "warm" season grasses).

In semi- arid climates, a summer dominated pattern of precipitation is generally thought to promote herbaceous dominance, because most of the available soil moisture is relatively shallow. However, on extremely well drained, shallow or coarse textured soils (and where water is focused by runon), water may infiltrate to greater depth and be available to support the usually deeper rooted woody plants (i.e., shrubs and trees). High intensity, short duration storm events typical of the summer monsoonal season tend to generate high amounts of runoff, runon, and sediment transport within bare soil intercanopy locations. Runoff and associated suspended sediment (i.e., turbidity) processes are episodic (i.e., a function of storm frequency/ intensity/ duration), and are generally localized (e.g., with runoff infiltrating and sediment depositing at gentle slope breaks within the upland context).

At Bandelier, soils are particularly vulnerable to erosion and loss during storm events for the reasons described above. This relationship between water resources and soil loss is illustrated by results from a paired watershed study. Over a two year period (2000- 2001), sediment production from this study area in the monument, as measured at a one- tenth hectare scale, showed average losses exceeding 2,500 kg/ha/year in sediment (Hastings, et al. 2002) during the summer monsoon period. Recent unpublished data from the nearby Frijolito watershed, for 1995- 2004, document even higher rates of soil erosion (3,990 kg/ha/year). Similar results from a third study (unpublished data on file at Bandelier) of the relationship between runoff and suspended sediment (i.e., fine sediment suspended in the water column) production in degraded woodland areas within a one- third hectare scale area instrumented with a flume and suspended sediment sampler for a 2003 storm are shown in Figure 18.

As noted above, woodland soils at Bandelier are eroding at an average rate of about four mm/decade. However, rather than an average loss across the landscape, runoff and soil loss increase and become more focused as the slope gradient increases, with resulting development of primarily drainage networks (i.e., gully formation). At larger spatial scales of several hectares however, runoff and soil loss are best interpreted as a local redistribution to lower gradient slope positions.

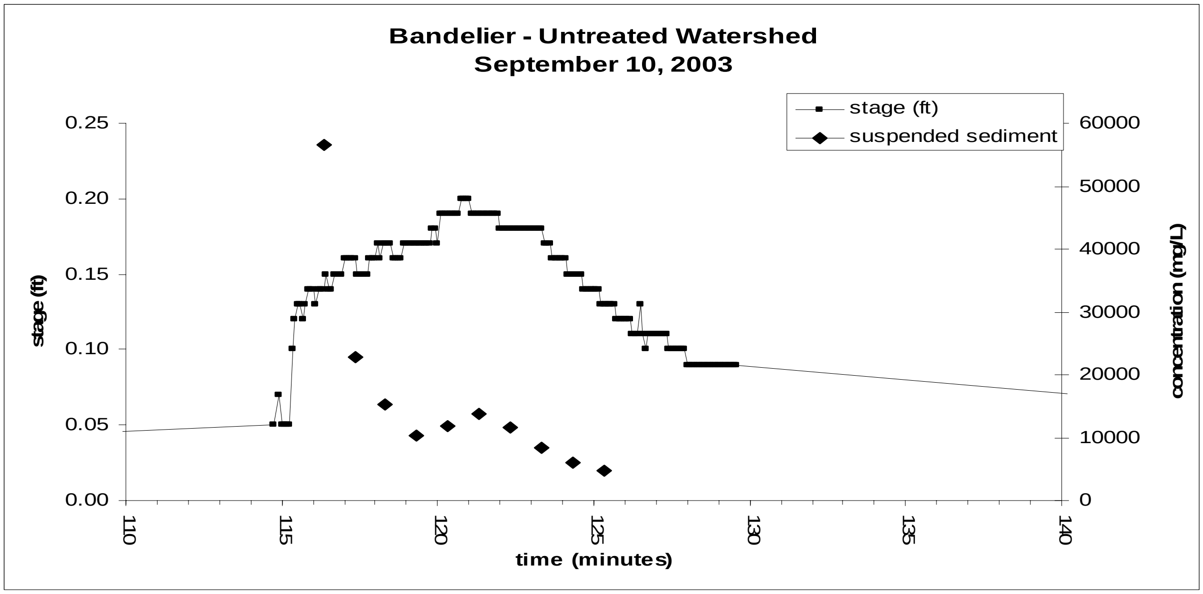

Figure 18. Soil loss during a 2003 thunderstorm at an untreated Bandelier watershed.

CULTURAL RESOURCES

Bandelier National Monument represents a Southwestern cultural heritage that spans from circa 10,000 B.C. to the present. Bandelier was created to protect its diverse array of cultural resources, which includes archeological, ethnographic, cultural landscape, and historical resources. Archeological sites are spatially finite areas containing physical remains of past human activity, and they are important for the information they can provide regarding prehistoric and historic lifeways. They are also important to people as a tangible link to the past. The NPS defines ethnographic resources as any "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" (NPS 2006). Cultural landscapes are reflections of human adaptation and use of natural resources and are often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. Historical resources are historic properties that retain some aspect of their original function, and are distinct from archeological resources. This EIS concerns only the piñon-juniper woodland on mesa tops, which encompasses approximately 12,000 acres of the monument. This “area of potential effect” or project area contains only archeological and ethnographic resources, and so this section details the existing conditions only for these cultural resources.

Archeological Resources

A large proportion of the sites in Bandelier relate to the Ancestral Pueblo occupation of the area dating from approximately A.D. 1175 to A.D. 1550, but sites pertaining to earlier and later periods are present as well. In earlier times, Bandelier was used primarily as a place to hunt and gather wild resources, leaving behind little aside from stone tools and stone tool manufacturing debris. The people living in Bandelier between 1175 and 1550 primarily lived in permanent above- ground dwellings or “pueblos” and subsisted by farming corn, beans, and squash, and by hunting wild game. They also built temporary “farmsteads” consisting of small, one- or two- room structures in or near their agricultural fields. These were only occupied during the summer growing season. They gathered and processed a variety of natural resources such as wood, minerals, wild plants, and stone for making cutting and grinding tools. People traversed the landscape to visit other villages, to farm, and to gather materials using trails etched into the bedrock. All of these activities have left behind material remains in the form of different kinds of archeological sites.

The prehistoric sites in the area of Bandelier where the action alternatives are proposed consist of a range of archeological materials including flaked and ground stone tools, waste from tool manufacture, broken pottery, food processing features, fire hearths, structural remains (rubble or standing walls), and rock art. Structural remains include more than 800 one to two room masonry structures, nearly 200 masonry or adobe pueblos containing six to 100 rooms, four masonry pueblos containing 100- 400 rooms, and more than 120 cavate structures and rock shelters. Cavates are rooms carved into the soft volcanic tuff of the cliff faces of the Pajarito Plateau.

Prehistoric non- structural sites include nearly 300 artifact scatters comprised of lithics, ceramics, groundstone, or fire- cracked rock. Ancestral Puebloan sites with structural remains are often found on rocky ridges that run down mesa tops within the piñon- juniper woodland, but are also commonly found on deeper soils away from the ridges. Cavates, although relatively rare within the project area, are found within the project area at cliff bases. Ceramic and lithic artifact scatters occur throughout the project area in a variety of topographic settings. Some sites consist of only one or several kinds of remains, such as lithic scatters, but others contain structural remains as well as artifact scatters. Of particular interest are several highly significant sites, including Yapashi Pueblo, which is the largest masonry pueblo in the monument; San Miguel Pueblo, Frijolito Ruin, and the Shrine of the Stone Lions.

In the years after A.D. 1550, Ancestral Pueblo people continued to use Bandelier as a place to hunt and gather wild resources and to herd sheep, and they continue today to revere it as the home of their ancestors.

Historic archeological sites provide important information not available in written records, such as cultural patterns typically omitted from historical literature (related to gender and ethnic groups), early building construction techniques, lifestyles of early settlers, trade and procurement of goods and materials, and interactions with native peoples. The project area contains a small number of historic period archeological sites primarily relating to sheep herding following the arrival of the railroads in New Mexico in 1889, which brought millions of head of livestock. The sites consist of two wooden corrals, 15 historic campsites, and two trails. Historic inscriptions are found at some campsites and associated with the trails. These sites occur in sheltered places on mesa tops, and along the edges of mesas.

The locations of all sites both prehistoric and historic are well documented within the project area. Excluding slopes with a grade steeper than 30%, 97% of the project area has been inventoried for archeological sites. The remaining 250 acres of unsurveyed land will be inventoried by August 2006. The monument as a whole contains 2,909 recorded archeological sites, 1,596 of which occur in the project area.

Surveys conducted over the past 20 years have documented that erosion is having a significant impact on archeological resources. All sites are held together and supported by the soil matrix into which they were deposited or constructed. This soil matrix is protected from erosion by vegetation cover, which has been reduced by historic land use practices (see *Purpose of and Need for Action* section). Vegetation cover also inhibits foot traffic through sites and unauthorized collection by reducing visibility.

Erosion at Bandelier is primarily water erosion in the form of sheetwash due to overland flow following summer thunderstorms or gully erosion where small drainages are incised further into the soil. Erosion damages archeological sites by undermining the contextual information contained within them. Archeological context refers to the spatial relationships among artifacts and other features of the situation in which they were deposited, which may be a house, a camp, or a rockshelter. Sheetwash damages archeological sites by moving artifacts out of their original location and essentially "smearing" the archeological record over the landscape. This process has been quantified for a one- hectare (approximately 2.5 acres) watershed in the piñon- juniper woodland in Bandelier. A limited study of the number of artifacts collected in sediment traps in the Frijolito watershed from 1995 to 1999 revealed that a total of 2,547 artifacts were lost from an area about the size of two football fields placed side by side (Maher, Hogan and Allen 2001). During 1995 alone, 1,109 artifacts were lost from that area from water erosion. When extrapolated to the piñon- juniper woodland as a whole, these data suggest that as many as five million artifacts may be moved out of context over the 10,000 acres of the project area.

In addition to the movement of large numbers of artifacts, erosion can also remove soil from underneath building stones, causing standing walls to topple. Gully erosion causes similar kind of damage, but it tends to be more restricted in space and more catastrophic in effect than sheetwash damage. In either, flowing water removes the soil matrix and many of the artifacts found in the matrix from the place of original deposition. This makes it difficult at best to make inferences regarding ancient human behavior based on archeological information, because erosion takes the material correlates of behavior and removes them from the context in which those behaviors occurred. An extreme example of an eroded Ancestral Pueblo site is shown in Figure 19.

Figure 19. Pedestalled Architectural Stone from an Ancestral Pueblo Small Masonry Structure Within the Project Area. (Erosion has removed the soil matrix from around the masonry, leaving only the soil protected by the overlying stones. The building stones are 40 to 60 centimeters long).

Data collected by the Bandelier Archeological Survey, which surveyed 42% of the monument, and 69% of the project area of this project, showed that 90% of the sites recorded during that project were impacted by erosion (Mozillo 1999; Powers and Orcutt 1999). A later study in 2002 of the condition of recorded archeological sites in the project area showed that 90% of the 446 sites revisited were impacted by erosion, primarily sheetwash as shown in qualitative and quantitative measures (Herhahn 2003). Erosion was also found to affect both scatters and structural sites, although because scatters are more mobile and vulnerable to damage from erosion than architectural remains, the impacts to these resources were more apparent. This does not mean the larger and less mobile features were unaffected, as wall alignments and other structural elements are subject to undercutting by erosion, which tends to cause catastrophic damage over a longer period of time. In addition to erosion, other impacts noted included rodent burrowing, unauthorized artifact collection, trails, and hazardous fuel buildup following the piñon die- off; these were identified as less damaging than erosion to archeological sites.

The data collected during the 2002 study were used in this EIS to develop alternatives, and to conduct impact analyses. The primary qualitative variables used in this EIS include data potential, depositional integrity, and threat timeframe estimated in years, which are described in detail below.

Data potential refers to the scientific research value of a site, specifically its ability to provide information important to understanding the prehistory or history of a region (NPS 2005b:53 *asmis data dictionary)*. This potential was determined by examination of site documentation that included a description of all features on a site, artifact analysis sheets, photographs, and a site map by an archeologist meeting the Secretary of Interior's standards (NPS 1998, Appendix E). Criteria for determining data potential included: 1) relative rarity of a particular site type or time period represented, 2) quantity and diversity of artifacts based on surface indications, and 3) whether the site relates to prehistoric or historic themes that are significant either nationally or regionally. A significance level (SL) value of "1" was assigned to unique site types (pueblos with more than 200 rooms) or sites dating to rare time periods (Paleoindian sites). A value of "2" was assigned to rare site types (pueblos with 100 to 200 rooms), sites relating to time periods underrepresented in the archeological record (Archaic sites), and sites with diverse artifact assemblages including items of long distance trade (Ancestral Pueblo sites with non- local pottery, lithic scatters with non- local raw materials). A value of "3" was assigned to sites that may not be significant on their own, but viewed in a larger context of other similar sites, provide important information. A value of "4" was assigned to sites that relate to historic themes that are not regionally or nationally significant, contain few artifacts, or exhibit no other features.

Depositional integrity refers to the degree or level of preservation of the site, its features and its contents (NPS 2005b:49). These data were directly recorded in the field by trained archeological technicians following a prescribed protocol using their professional judgment after observing evidence of disturbance to site features. They made experience- based estimates of the percentage of the site still intact using the following categories adapted from NPS (2005b:51): 100%, which was assigned to sites where virtually all deposits retain all their original archeological integrity; 76- 99%, assigned to sites which have suffered minor degradation, but all deposits are mostly intact; 51- 75%, assigned to sites that have clearly suffered degradation, but have lost only a minor portion of their original archeological integrity and most deposits are largely intact; 26- 50%, assigned to sites that have clearly suffered degradation and many deposits are relatively intact; 1- 25%, assigned to sites that have experienced severe disturbance, but a small portion is relatively intact; and 0%, assigned to sites that have lost all archeological value and lack information relevant to any current realms of archeological study that would warrant further investigation.

Threat timeframe is an estimate of the number of years estimated to pass before identified threats will be realized and the site's integrity and data potential fall to a range that would undermine the site's eligibility for listing on the National Register of

Historic Places. In contrast to the categories used in the prioritization of basins under Alternative C, the impact analysis used the values assigned in the field, which ranged from 1, 3, 5, 10, and 20 years were estimated based on the extent to which erosion was already impacting the site, the degree to which the area immediately around the site was eroding, and whether erosion was likely to negatively impact the site in an immediate, short, or long- term time frame. The archeological technician made a judgment based on professional experience regarding how much time could elapse assuming current climate patterns before the site would suffer loss of integrity.

Examination of the qualitative data collected for this study show a number of trends. The majority of the sites are of significance level 3, which are considered representative, but not particularly unique in the region. Many of the small field houses found all over the monument fall in this significance category. As shown in Table 8, a large percentage of these sites retain integrity, with only just over 10% with very low depositional integrity. The next most common is the significance level 4 category. These tend to include low density artifact scatters often lacking temporally diagnostic artifacts. These similarly retain some depositional integrity, although on the whole retain less. Significance level 2 sites are much less common than either significance level 3 or 4 sites, and tend to retain greater integrity. The number of significance level 2 sites retaining greater than 50% of their depositional integrity (depositional integrity levels 1 and 2) is highest of any of the significance level categories. The single significance level 1 site included in the 28% random sample does not retain a high degree of depositional integrity, but most of that is due to impacts other than erosion, including unauthorized artifact collection.

Table 8. The Number of Sites in the 28% Random Sample of each Significance Level, and the Percentage of Those Sites in Each Depositional Integrity Level Category.

Significance Level	Number of sites	Percentage of Sites within each Depositional Integrity Level			
		1	2	3	4
1	1	0%	0%	0%	100%
2	23	22%	48%	22%	9%
3	315	9%	49%	32%	11%
4	107	8%	40%	42%	9%

Another trend apparent in the data collected in 2002 is that a relatively low percentage of sites are threatened immediately, but many more are threatened within a relatively short time frame (three to ten years). These data are summarized in Table 9.

Table 9. Percentage of Sites in Each Significance Level Category Threatened in a 1, 3, 5, 10 or 20 Year or More Time Frame.

Significance Level	Number of sites	Percentage of Sites within each Threat Timeframe (estimated years)				
		1	3	5	10	20 or more
1	1	0%	100%	0%	0%	0%
2	23	9%	30%	43%	9%	9%
3	315	7%	15%	32%	24%	21%
4	107	6%	24%	28%	26%	16%

REGIONAL

The lands that are now Bandelier National Monument are part of a larger region used for similar purposes by Ancestral Puebloan people and later for livestock grazing. This is indicated in part by archeological resources on adjacent lands within the Pajarito Plateau, which are broadly similar in the types of sites present, site density, and the time periods represented as similar topographic and environmental settings within Bandelier. Other major landowners on the plateau include the University of New Mexico, the Santa Fe National Forest, the Valles Caldera National Preserve (VCNP), and Los Alamos National Laboratory (DOE)(see Figure 1). The condition of cultural resources on property owned by these agencies varies depending on historic use and ongoing management.

Sites on the Cañada de Cochiti land grant currently owned by the University of New Mexico are most similar to Bandelier sites in terms of the period of occupation and site type. They exhibit greater degree, extent, and severity of erosion due to historic and current livestock grazing. While the land is closed to the public, it is not actively patrolled for trespassers, which may foster higher rates of vandalism. However, due to the lack of patrol and monitoring, there are few data regarding the prevalence of vandalism. Past and current grazing has significantly affected sites on the Cañada de Cochiti through the same processes as seen at Bandelier and the Santa Fe National Forest, although the effects on native herbaceous understory is more pronounced at Cañada de Cochiti due to higher aridity associated with the lower elevation of the land grant. Very limited scientific archeological investigations have been carried out on a small scale, but no further excavations are planned for the foreseeable future. This parcel of land may be exchanged with the State Land Office within the next year, but it is unclear how this will affect management of the lands.

Sites on adjacent Santa Fe National Forest lands tend to be less well preserved than those in the monument due to vehicle and off- road vehicle access and less intensive patrol by law enforcement rangers. Continued grazing on National Forest lands has also contributed to greater impacts from erosion, as well as other grazing impacts such as artifact trampling and wall toppling. Catastrophic wildfire affects and has affected National Forest lands and Bandelier similarly. The effects of catastrophic wildfire on archeological sites include effects from fire suppression such as ground disturbance during line construction and mop- up, and from combustion, such as sooting, spalling, consumption, and oxidation. These effects have been extensively studied within Bandelier and on adjacent lands (Ruscavage- Barz 1999; Steffen 2002; Traylor, et al. 1990).

Sites on the VCNP have not been inventoried fully, but the restricted access due to formerly private ownership and current restrictions on public access since federal acquisition have kept archeological resources on the VCNP relatively well preserved, as far as is known. Major impacts stem from livestock grazing and vehicle traffic over dirt roads. The VCNP's cultural resource management plan has not been fully developed, but as the area is a national preserve, cultural resources can be expected to be given a high level of protection.

Because of restricted public access, sites on adjacent Department of Energy- Los Alamos National Laboratory lands are well protected from impacts due to vehicle access and unauthorized activities on sites, such as looting, vandalism, or unauthorized collection. However, LANL lands have a similar history of land use prior to around 1940, so the ecological conditions and soil erosion rates are roughly similar to those in the monument. In addition, Los Alamos National Laboratory lands have experienced a much greater degree of development (construction, utilities, testing, etc.) than in the monument and therefore greater impacts to archeological sites from ground disturbance. Because LANL is a federal agency subject to the requirements of NEPA and the National Historic Preservation Act, much of this damage has been mitigated by data recovery (excavation).

Ethnographic Resources

As noted above, the NPS defines ethnographic resources as any "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" (NPS 2006a). Many Native American pueblos and tribes continue their traditional cultural association on National Park Service lands. Of the 19 federally recognized pueblo Indian groups in New Mexico, six pueblos have the closest cultural affiliation with Bandelier—the Pueblos of Santa Clara, Santo Domingo, San Ildefonso, San Felipe, Cochiti and Zuni.

A current Memorandum of Understanding (MOU) regarding consultation between Bandelier and the six pueblos requires Bandelier to regularly and actively consult with these pueblos regarding park management, fire planning, and operational decisions that affect sacred materials or places, or other ethnographic resources with which they are historically associated. Communications with these pueblos occurs through a Consultation Committee consisting of tribal representatives from the six pueblos.

Consultations with the six affiliated pueblos regarding the need to address the accelerated erosion and degradation of the piñon juniper woodlands as well as the impacts to cultural resources in Bandelier have been ongoing since 1998. In the spring of 2003, Bandelier initiated discussions on a plan (e.g. this Ecological Restoration Plan) to address these issues. During consultation meetings in 2004 and 2005, further general discussions took place and feedback from the pueblos was received. Once the alternatives of the plan were developed in late 2005 and early 2006, the pueblos were again invited to comment and provide feedback on the plan prior to public release. Once the Draft Plan and EIS is released to the public, the pueblos will be provided a minimum 60- day review of the document and their comments will be considered in preparation for the Final EIS and Record of Decision.

ETHNOBOTANICAL RESOURCES

A review of existing literature focusing on the ethnobotany of the pueblos associated with Bandelier reveals an extensive list of plants and plant material use (O'Meara 2003). A database of plants used for cultural and/or subsistence purposes has been compiled which includes 514 entries. Each entry includes references to the source as well as brief descriptions of each plant species' use or importance to a specific pueblo or to pueblos. Two hundred and eight plants have been found to be culturally significant to Pueblo or Tewa people in general. This total number of plants consists of 42 botanical genera (e.g., Salix spp.), 163 specific plant species (e.g., Salix exigua) and three general categories (lichens, fungi, and mosses), some of which may be found in the project area.

Just as there are certain plant species that are more frequently documented, certain pueblo communities were more often the subject of observations and ethnographies by early researchers. Consequently, descriptions of ethnobotanical use by specific pueblos is somewhat uneven in the literature. Few specific references to San Felipe and Santo Domingo are included in the ethnobotanical database. However, some sources discuss plant use in broad terms, such as Robbins, et al. 1916 account of Tewa ethnobotany (in O'Meara 2003). As a result, documented botanical use in these generalized terms comprise not only the six culturally affiliated tribes of Bandelier but also the remaining Indian communities in the area. For example, "Tewa" plant use can be attributed to Santa Clara and San Ildefonso peoples as well as Nambe, Tesque, Pojoaque, San Juan, and Hano (Hopi) Pueblos, while the "Pueblo" category can be associated with all the Tewa, Tiwa, Towa, Keresan, Zuni and Hopi.

A broad summary of ethnobotanical database entries is reflected in Tables 10 and 11.

Table 10. Ethnobotanical References by Community or Group.

Name of Community or Group	Number of Database Entries
Zuni	100
Santa Clara	96
Tewa	90
San Ildefonso	77
Pueblo	70
Cochiti	68
San Felipe	8
Santo Domingo	5
Total	514

Table 11. Documented Plant Use by Community or Group.

Name of Community or Group	Number of Use Plants
Tewa	88
Zuni	82
Santa Clara	74
Pueblo	68
San Ildefonso	65
Cochiti	54
San Felipe	8
Santo Domingo	5

The details of specific plant use and a cross- reference of these uses with specific tribal community is available in O'Meara (2003: 5- 15).

The O'Meara report makes the important point that findings from existing literature reviews should not be taken as the final word on puebloan plant use as the literature can be contradictory and incomplete. It is possible that inconsistencies in the published record reflect the sensitivities and complexities in sharing cultural and esoteric botanical knowledge within tribal groups or with outsiders. In some instances, interviews and data collection may not have been conducted during the correct season, place, or community event when it would be suitable or acceptable to talk about a specific plant and its uses.

Knowledge of more subsistence oriented plants, such as those used in material manufacture, is often held by many community members and is typically not a sensitive conversation topic. However, puebloan plant usages, particularly those for medicinal or ceremonial purposes, can be highly guarded. The detailed information regarding the appropriate ways to approach and use medicinal plants is often earned and obtained in a ceremonial context with specific tribal specialists. Consequently, it is likely the case that not all members of a pueblo community have access to specific ethnobotanical information.

ETHNOGEOLOGICAL RESOURCES

Similar to the ethnobotanical information discussed above, information on culturally significant minerals has been gathered from existing published literature. Ethnogeological data presented here has been extrapolated from a range of sources, including original ethnographies, historical records, and journal records, among other documents. Due to a lack of specific references to Pueblo use of geological resources the data presented here is drawn from broad range of sources. In total, 50 documents were found and reviewed. A review of these sources resulted in 38 documents being used to present ethnogeological resources data.

Ninety- six geological resources have been found to be used by either Pueblo or Tewa people in general, or by a specific pueblo. Standard geological classification has been used to organize this information. These classifications include:

Elements:	Geological entities that cannot be divided into smaller constituencies. Example: copper.
Minerals:	Compounds of elements that have occurred through geological processes. Minerals are subdivided into several categories reflecting the chief elements in their compositions. Example: turquoise
Rocks:	Solid compounds of minerals that have formed through processes such as volcanism or erosion. Example: basalt
Sediments:	Compounds of rock or minerals. Sediments lack the density of rocks. Example: sand.
Unclassifiable:	Materials in this group are derived from vague or ambiguous references, and cannot be further classified. This group also includes several references from Robbins, et al. (1916) to undefined Tewa terms. Example: "yellow stone."

Specific references to geological resources vary in frequency, depending on factors such as cultural importance, their visibility to observers, and their availability in the region. For example, clay, a recurrently cited resource, is culturally valued by pueblo people, is highly visible to outsiders as pottery, and is locally available. However, the frequency of references to a specific geological feature or resource does not necessarily reflect its cultural significance, given that certain resources such as those used in ceremonies, are seldom cited. Table 12 lists the 10 most frequently cited geological resources, in order of frequency of reference.

Table 12. Most Frequently Cited Ethnogeological Resources.

Name of Resource	Number of References	Number of Pueblos
Clay	17	7
Turquoise	15	7
Basalt	15	5
Obsidian	9	4
Gypsum	8	5
Rock Crystal	8	5
Salt	7	4
Mica	6	5
Sandstone	6	5
Hematite	6	4

Table 13 reflects the number of references to use of ethnogeological materials for each Pueblo associated with Bandelier. Also reflected are number of references related to the general categories of "Pueblo" and "Tewa."

Table 13. Documented References of Ethnogeological Material Use, by Pueblo.

Name of Group	Number of References
Pueblo	49
Tewa	40
Santa Clara	21
Zuni	20
Cochiti	12
Santo Domingo	12
San Ildefonso	8
San Felipe	2

These two tables reflect general information on ethnogeological data drawn from existing literature. More detailed information of geological materials and their specific use by specific Pueblo communities is found in Dumbauld 2003.

TRADITIONAL CULTURAL PROPERTIES

There are, at present, no places within Bandelier listed on the National Register of Historic Properties as Traditional Cultural Properties (TCP). The National Park Service defines a TCP as a place that qualifies for listing on the National Register due to its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (Parker and King n.d.). This does not mean there are no places within the monument that meet these criteria. Indeed, past consultation with associated pueblos has clearly revealed places of cultural significance. These consultations also reveal that the pueblos with on- going interest in specific places within the monument do not want them to be revealed to the general public. Consequently, for purposes of this environmental impact statement, Bandelier will rely on continued consultation with the associated pueblos to keep them fully informed of any proposed actions resulting from the proposed alternative – and to seek their advice and recommendations on how to minimize any and all impacts to the integrity of these important places. Bandelier honors the requests by these communities to minimize publishing or otherwise making public the location and character of these sites. The monument, and the NPS as a whole, is committed to working closely with these and other tribal communities with similar concerns regarding the protection of these places used since time immemorial to preserve a traditional way of life.

VISITOR EXPERIENCE

While most of the acreage at Bandelier is in backcountry wilderness, most visitations at the monument occur in the frontcountry. The backcountry is either designated wilderness or lands managed as wilderness, and permits are required for overnight use where it is allowed. The frontcountry includes all other park lands, and most notably Frijoles Canyon where a developed visitor center, campground and associated trails and facilities exist (Figure 20).

An estimated 264,125 visitors spent time at Bandelier in 2004 (Table 14). Approximately 50% of the visitation occurred between the months of May and August, with an average of approximately 32,900 visitors/month. Visitation is at its lowest between the months of November and February, dropping to an average of around 8,950 visitors/month. The months of March, April, September and October reflect an average of about 23,980 visitors/month.

Visitor Use

Although recent data are not available, the monument completed a visitor study in July 1995 in which interviews were conducted and questionnaires distributed to a sample of visitors in the main parking lot (NPS 1995b). Results of this study are utilized here with the caution that the data reflect visitors' views and use for that specific time period and location only and may not apply to visitors during other times of the year or in different parts of the monument.

The 1995 study indicates that 94% of monument visitors live within the U.S. with approximately 47% residing in New Mexico, Texas and California. Approximately 87% of visitors reported their stays at Bandelier to be less than a day (24 hours), with the majority of visits (55%) averaging three to four hours. Of those visitors spending more than 24 hours at Bandelier (approximately 13%), 79% of the stays ranged between three and four days.

Seventy- three percent of visitors were visiting Bandelier for the first time, 18% had visited two to four times, and 9% had visited at least five times or more (NPS 1995b:10- 11). Forty- two percent of respondents visited Bandelier in groups of two; 21% visited in groups of four. Forty- one to 45 year olds comprised the largest adult visitor group (12%), while 44% of all visitors ranged in age from 36- 55. Twelve percent of visitors were 10 years old or younger (NPS 1995b:5).

The most frequently used visitor services included the visitor center (94% of visitors), the Ruins Trail guide (73%), museum exhibits (68%), information desk services (56%), park personnel (53%) and trail exhibits (49%). The most frequently used park facilities included the restrooms (94%), the Ruins Trail (92%), Ceremonial Cave (61%), park signs (46%), the gift shop (43%), and the snack bar (39%). Nearly all of these services and facilities are located in the frontcountry (Figure 20). By contrast, use of backcountry trail facilities represented only 6% of visitor use (NPS 1995b:15- 16).

The cultural resources of Bandelier, representing human use of the area from approximately 10,000 years ago to historic times, are the primary reason for visitation. Ninety- six percent of the visitors surveyed in 1995 reported they had visited the prehistoric ruins, while 70% had viewed cultural museum exhibits (NPS 1995b:14). In a recent visitor study conducted by the Los Alamos Meeting and Visitor Bureau (LAMVB), about 45% of visitors cited "nearby Indian cultural attractions/pueblos" as a reason associated with visiting the city (LAMVB 2005:11). Approximately 57% of the recorded cultural resources are located within the piñon- juniper woodland areas of the monument (163 sites in the frontcountry, 1468 sites in the backcountry) for which restoration efforts are proposed.

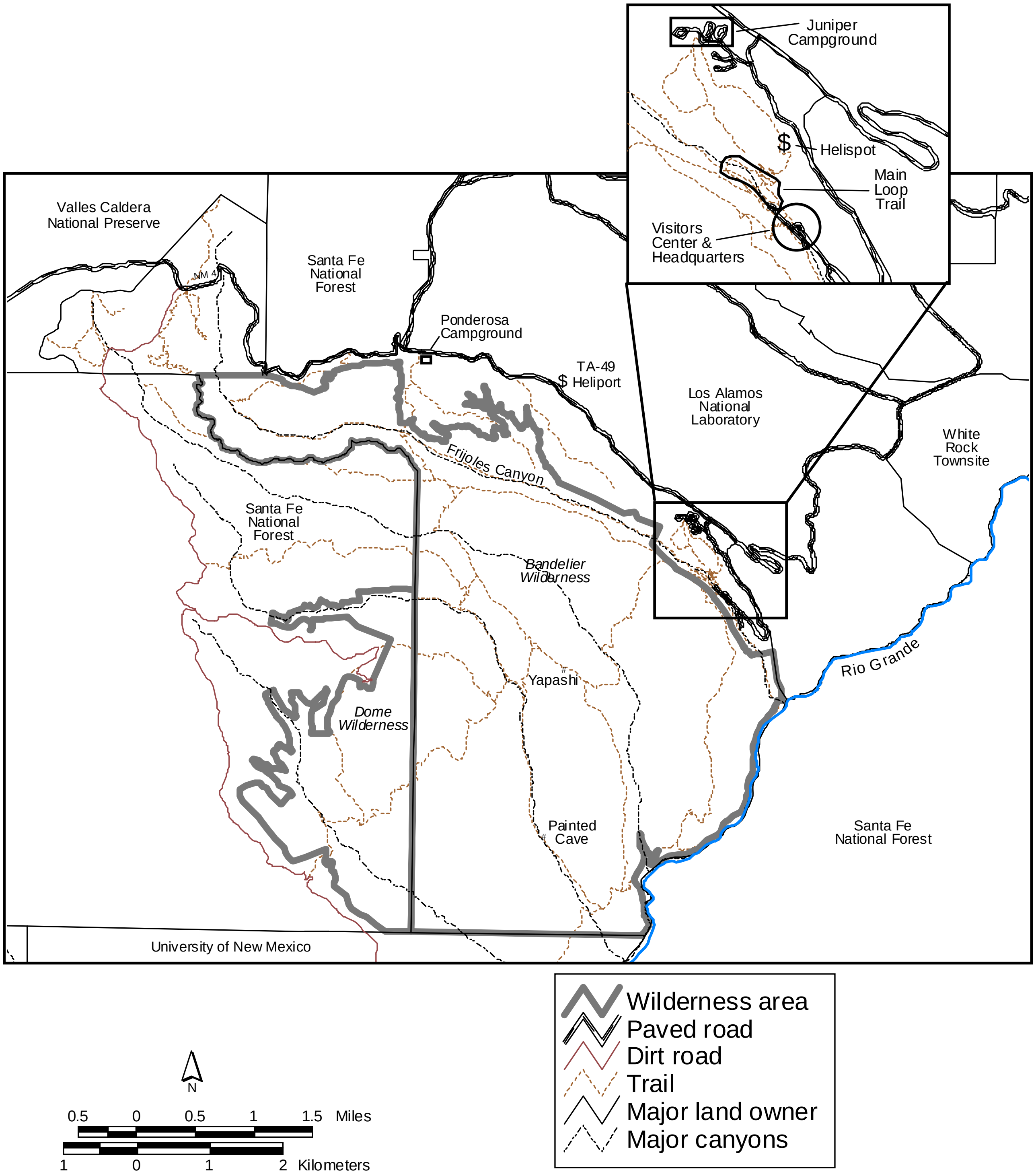

Figure 20. Map of Bandelier National Monument

Table 14. Recreational Visits by Month for 2004, Bandelier National Monument (http://www2.nature.nps.gov/mpur/index.cfm).

MONTH	NUMBERS OF VISITORS
January	8623
February	6529
March	21329
April	23440
May	33244
June	30715
July	35,063
August	32556
September	23752
October	27381
November	12476
December	8177
TOTAL	**264,125**

The 1995 NPS study also showed that approximately 40- 45% of visitors engaged in frontcountry day hikes, shopping, and viewing slide programs. Other visitor activities included picnicking (24%), camping in the frontcountry (13%), campfire programs (8%), and backcountry use (7%) etc. (NPS 1995b:14).

The variety of natural resources within Bandelier also attracts visitors to Bandelier for such activities as wildlife viewing and interpretive/educational activities. Thirty-eight percent of visitors reported they had taken part in wildlife viewing and nature studies (NPS 1995b:14). The LAMVB study indicates that about 13% of the visitors to the City of Los Alamos come to this town because of Bandelier National Monument, while about 20% mention the scenic beauty of the area as a reason to visit (LAMVB 2005:11).

Hiking of the approximately 75 miles of monument trails is primarily a day- use activity and is concentrated in those frontcountry areas associated with pueblo sites, cavate structures and other cultural resources north of the visitor center, as well as a trail accessing the Frijoles Falls area located south of the visitor center. Ninety- six percent of visitors surveyed had visited the ruins along these trails; 17% of visitors utilized the falls trail (NPS 1995b:14).

Camping opportunities at Bandelier include two fee- based campgrounds in the frontcountry (Juniper and Ponderosa). Approximately 13% of visitors used these facilities in 1995 (NPS 1995b). Ponderosa, a group campground located outside restoration boundaries in the northwestern portion of the monument, is open from mid- Spring to mid- Autumn. Juniper Campground, located within the restoration area, is open year- round, weather permitting, with camping levels being the highest during the summer months when restoration work would not occur. Camping at Juniper varied with only about 50 campers a month between December and February, and about 1300 campers in May and September. In October, November, April, March, camper numbers at Juniper fluctuated between approximately 325 and 725 (NPS n.d., http://www2.nature.nps.gov/mpur/index.cfm).

Expansive views of the Bandelier landscape (see *Visual Resources* for more information) and the surrounding areas exist from several vantage points within and outside the monument, including mesa tops, the summit of Cerro Grande to the north, the Valles Caldera National Preserve to the northwest, and certain areas to the west in Santa Fe National Forest (SFNF)(Coker, personal communications 2006). The Tyuonyi Overlook (Frijoles Canyon) and certain areas along the park entrance road and State Highway 4 (north park boundary) also offer views into the park. Existing visual intrusions include facilities related to the Department of Energy's Los Alamos National Laboratory(e.g., antennas, towers, smoke plumes, other lab- related structures). In addition, Bandelier's *Fire Management Plan* calls for certain management activities (e.g., prescribed burns) that result in smoke, reduced visibility and possible viewshed disruptions (NPS 2005a).

Backcountry Visitor Use and Experience

Most backcountry use is concentrated in the eastern half of the park, between the visitor center and the Yapashi area (Figure 20), most of which is accessed via three trailheads located near the visitor center parking lot area. Fewer visitors use the west side of Bandelier's backcountry due to more difficult access. Recent estimates of backcountry day use gauged the numbers of non- camping hikers in the backcountry between October and April to be approximately 20- 30 people a day, with variations depending on weather (King, personal communications 2005).

Free camping in the backcountry requires a park- issued permit and constituted about 2% of visitor use in 1995 (NPS 1995b). Visitors are allowed to camp in certain backcountry zones which have specific group size limits (typically six people). There are no designated campsites and open fires are not allowed. According to permitting information, the backcountry areas most visited are Painted Cave and Yapashi (Dominy, personal communications 2005). Visitor- perceived importance of this activity was difficult to determine in the 1995 study due to low response numbers. In the past five years, an annual average of about 532 visitors camped in the backcountry between the months of October and May. During the same time period, 14 permits were issued for backcountry users with horses (King, personal communication 2005). In 2004, backcountry camping varied throughout the year with lowest frequencies occurring between November and February with an average of 16 campers/month (NPS n.d., http://www2.nature.nps.gov/mpur/index.cfm). This equates to less than 1% of visitors using the backcountry during these months.

When compared to the frontcountry, the 1995 study reflects a considerably smaller number of backcountry users (5%) (NPS 1995b:14). "Visitor likes" mentioned in the study include "beautiful scenery," "peaceful quiet," "solitude," and "spiritual nature of park" (NPS 1995b:57). Most (about 30,000 acres) of the monument's 33,727 acres are either designated wilderness or managed as wilderness.

Soundscape

Alternatives analyzed in this EIS are likely to change noise levels in the backcountry, and may affect several resources, including the visitor's experience of the monument's soundscape, the visitor's wilderness experience, wildlife, species of special concern, and staff and contractor health and safety. The bulk of the impact analysis of changes in noise levels is included in this *Soundscape* portion of environmental consequences to *Visitor Experience*, but is referenced in each of these other sections as well. Because the impact analysis is part of the *Visitor Experience* section, the description of current noise levels is included in this section of the *Affected Environment*.

The natural ambient sound is defined as "the environment of sound that exists in the absence of human- caused noise." It includes the sound of wind, water and animals, and is considered the baseline condition for national park units and the standard against which current conditions in a soundscape are measured and evaluated. As noted above, natural ambient sound (or "natural sound") is often highly valued by visitors, and an integral part of the backcountry or wilderness areas of national park units. Noise is a psychological evaluation of sound, and is sometimes defined as "unwanted sound."

Very little information exists about current sources of noise at Bandelier, but road traffic, aircraft overhead and visitor activities appear to be the primary sources of human- generated noise. Limited sampling in Los Alamos County conducted by the Department of Energy (see DOE 2003, for example) indicate background sound levels at the entrance of the monument average from 31 to 35 decibels or dBA. (The A- weighted sound level, or dBA, gives greater weight to the frequencies of sound to which the human ear is most sensitive.) This is extremely quiet and below quiet urban daytime noise levels, rural daytime outdoors noise levels, and even the threshold of human hearing. When cars are idling at the monument entrance station, noise levels at or near the station are higher, and can be on the order of 65- 70 dBA at close range (100 feet).

Visitors activities generate noise, from talking (60 dBA), and from moving equipment, cooking and other activities in the monument's campgrounds and campsites.

Sources of noise outside the monument but in the immediate area include non- park traffic, commercial airliner overflights, military training and monitoring, and activities at Los Alamos National Laboratory facilities. Background noise in six canyons within Los Alamos County was measured in 1998 (DOE 1998). The primary source of noise above 55 dBA in the canyons was vehicular traffic. A clap of thunder provided the highest recorded noise level at 76 dBA. In general the level of noise, once away from highways and parking lots, was well below 60 dBA.

The detonation of high explosives generated by LANL operations represents peak noise levels in the area. The primary sources of these detonations reported in 2002 are the high explosives experiments conducted at LANL's pulsed high- energy radiation machine emitting X- rays facility (PHERMEX)(DOE 2002), although a Dual Axis Radiographic Hydrodynamic Test Facility was named as an additional future source of noise that would be soon built and functional. Measured noise at 750 feet from the detonation of a typical blast at PHERMEX in 1995 found sound levels in the range of 140- 148 dBA. Measurements at the entrance station of the monument of these blast 2.6 miles away indicate noise levels were about 60 dBA (similar to conversation) and 71 dBA at the closest public approach on Highway 4, 1.3 miles away. (Note that noise levels do not drop off arithmetically with distance, but logarithmically. Also, topography and even wind and climate affect how sound travels). Construction of LANL facilities such as the Dual Axis Radiographic Hydrodynamic Test Facility also generates noise in the range of 81- 85 dBA. Because sound rapidly decreases with distance, it is unlikely that monument visitors are able to distinguish noise from construction. However, visitors or monument staff may hear blasts from LANL testing, and in particular the rangers in residence in the park may experience periodic increases in noise levels under some weather conditions (DOE 1995).

Los Alamos County restricts noise levels through the use of a local ordinance to a maximum of 65 dBA during the hours of 7 a.m. to 9 p.m. and 53 dBA during nighttime hours. Noise levels during the daytime may be increased to 75 dBA (comparable to a vacuum cleaner or coffee grinder) for 10 minutes in any one hour without a special permit. As of 2002, Los Alamos had not required a special permit for LANL activities. According to DOE (DOE 2002), this is because "noise related to explosives testing is not prolonged, nor is it considered unusual to the Los Alamos community."

Aircraft flying over Bandelier is another source of noise in the monument. An unpublished study of aircraft noise in the monument during 1999 and 2000 (NPS 1999a, 2000d) found that aircraft was audible for more than one- third of the daylight hours during which sounds were recorded. Aircraft noise was particularly audible on calm weekday mornings from what the studies concluded must be commuter traffic. The average duration of quiet between noticeable aircraft sound was only four to six minutes. In a study of noise in national parks (NPS 1994) monument managers were characterized as "extremely concerned" about aircraft noise. At least part of this concern was for the impacts noise might have on a protected species, the peregrine falcon.

Military training or surveying helicopters may also be flying in the Bandelier area along the Rio Grande (Coker, personal communication, 2005), but the traditional training space for Kirtland Air Force Base lies well west of the monument (Air Education and Training Command 2005). Park staff report commuter flights between Albuquerque and Los Alamos regularly fly over or very near the Rio Grand at relatively close distance (Fettig, personal communication 2006b). Commercial helicopter touring companies fly over Valles Caldera National Preserve and other tourist sites in the area, but are currently asked to refrain from flying any closer than a half- mile from Bandelier until the monument produces a flight management plan (ABQ Journal, June 9, 2004).

Visitation on Adjacent Public Lands

Visitor experience on adjacent lands has the potential to be influenced by the restoration project within Bandelier. Recreational opportunities for visitors to the area are available on Santa Fe National Forest lands immediately adjacent to the monument (west, north, east)(Figure 20). With the exception of the Dome Wilderness lands immediately west of Bandelier, uses in much of this area tend to be less restrictive than those allowed within the monument. Such activities include, among other things, motorized traffic, open fires/campsites, timber harvesting, and hunting. The topography and elevation of the areas offers views into Bandelier from certain vantage points west and north of the monument. Several hiking trails connect the monument with US Forest Service lands, creating the potential for recreational users of the Santa Fe National Forest to also be affected by the restoration project. The Dome Wilderness area of Santa Fe National Forest is contiguous with the Bandelier Wilderness on the west side of the monument. Access into the Dome Wilderness is difficult in the winter months as Dome Road is closed.

The Valles Caldera National Preserve is located immediately to the north/northwest of Bandelier National Monument. This 89,000- acre preserve protects the historic Baca Ranch and offers numerous activities to the public, including hiking, horseback riding, motorized/guided tours, hunting, fishing, and wildlife viewing. Self- guided and guided backcountry hikes are available, most of which require advance reservations/fees.

VISUAL RESOURCES

The visual resources of the park can be described by evaluating the scenic quality and the sensitivity of the landscape to visual change. Scenic quality is a measure of the visual appeal of a landscape, based on several factors, including landforms, vegetation, color, water features, adjacent scenery, and cultural modifications. Sensitivity is a measure of peoples' concern for the scenic quality of a landscape, and is a function of number of viewers, activities of viewers, and locations and distance of the proposed project from sensitive viewing locations.

Figure 21. Mesas Showing Piñon-Juniper Woodland.

Scenic Quality

The monument is located on the Pajarito Plateau, at the south end of the Southern Rocky Mountains physiographic province (Fenneman 1931). Within the monument, the plateau has a gentle northwest to southeast slope, and is a rugged landscape of canyons and mesas. The landscape character is influenced primarily by topography, elevation and vegetation communities. Elevation ranges from about 5,300 feet at the southeast edge of the park near the Rio Grande to over 9,000 feet on the northwest. In canyon bottoms, scenery includes a riparian element that can consist of cottonwoods, alders, birches, and other types of shrubs and grasses. The canyon bottom outside of the riparian zone includes vegetation such as ponderosa and piñon pines, and a variety of shrubs. The canyon wall forms a backdrop and encloses the views from within the canyon, and is typically a steep wall of tan- orange- colored tuff. The canyon bottoms tend to be the most scenic areas within the monument, and have a diversity of visual elements, including water features, a variety of vegetation patterns, and interesting landforms. Much of the backcountry use of the park is on trails that follow along the stream courses in canyon bottoms.

The canyon walls lead up to the mesa tops, where, between about 6,000 to 7,000 feet, the vegetation community is characterized as the piñon- juniper woodland. Figure 21 shows an overview of mesas tops that are dominated by the piñon- juniper woodland, which is the vegetation community where the proposed restoration activities would occur. Recent drought has decimated the population of piñon pine in the monument, leaving juniper as the primary tree species. The scenery within this landscape is characterized by homogenous vegetation and a relatively level landform. Past activities in this vegetation type, such as grazing and fire suppression, has reduced the herbaceous and shrub understory, resulting in a woodland that has, in places, little diversity in vegetation, color, or form. There are opportunities on the mesas to view the surrounding landscape, which adds to the scenic quality. The adjacent scenery includes the San Miguel and Jemez mountains to the west and north. St. Peters Dome and Boundary Peak on the west boundary of the monument are highly visible from the mesas, as is Cerro Grande, located on the very north edge of the monument. These mountains are eroded remnants of volcanic domes whose scale and form add to the character of the landscape when viewed from locations within Bandelier.

At the higher elevations on the north end of the monument, the scenery changes to a landscape characterized by more coniferous vegetation, including ponderosa pine, Douglas Fir, limber pine, Engleman spruce and white fir. There are also scattered areas of aspens and montane grasslands. Topography is more varied, with areas of mountains interspersed with higher elevation canyons. The variety of tree and shrub species, the varied terrain, and a wetter environment creates a landscape with more diversity and visual interest.

Sensitivity

Visitors to the monument are generally sensitive to the quality and integrity of the visual environment. Protection of visual values is important especially for areas that are seen and used by large number of visitors, and for special view points within the monument. Also, any areas that have special management objectives require special consideration for protection of visual resources.

By far the highest use areas within the monument are the Visitor Center and the Main Loop Trail, which starts at the Visitor Center and leads through excavated archeological sites. The best known and most visited sites in the monument are located in Frijoles Canyon. Views from the Visitor Center and the nearby archeological sites are limited to the canyon bottom and sidewalls—the large expanse of mesa tops and the piñon- juniper woodland areas are generally not visible from Frijoles Canyon where the Visitor Center and the popular archeological sites are located.

Much of the monument is designated wilderness, and is an area where natural appearing scenery is an important component of a visitor's experience. Use of the backcountry is primarily limited to trails, with the trails in Capulin and Frijoles canyons receiving the most use. Although to a casual visitor the wilderness area seems generally free of visual intrusions and evidence of humans, there has been significant effect of human occupation that has changed the appearance of the landscape. As noted above, the scenery in the piñon- juniper woodland has particularly been affected by past human activities, primarily grazing of livestock and fire suppression. These activities have combined to create a landscape where the piñon- juniper vegetation has increased significantly in densities and extent, and the understory vegetation has been reduced or eliminated, resulting in a somewhat unnaturally homogenous landscape. As described in the vegetation section, the natural condition of the landscape would likely be characterized by a more patchy distribution of trees, and localized to the steeper, rockier sites, with a greater cover of shrubs and grasses between tree patches on lower gradient areas.

Other visually sensitive areas within the monument include campgrounds, picnic areas and overlooks. The Ponderosa Group Camp/Picnic area is located on the north end of the monument just off of U.S. Highway 4. The Juniper Campground is located near the monument entrance. A fire lookout, located on the east side of the monument, has a panoramic view of the monument and the adjacent San Miguel and

Jemez Mountains. The highest point in the park, at the summit of Cerro Grande (10,199 feet) offers the most complete view across the park, from north to south.

WILDERNESS

The Wilderness Act

The Wilderness Act, passed on September 3, 1964, "provides a degree of protection to the resources of the National Park System that the NPS Organic Act does not." The House Report accompanying the Act, which helps to clarify congressional intent in passing legislation, states that its purpose is to establish a National Wilderness Preservation System made up of designated wilderness areas "because of the undeveloped character of their lands and the need to protect and manage them in order to preserve, as far as possible, the natural conditions that now prevail" (House Report No. 1538, 88th Congress, 2nd session, July 2, 1964).

The Wilderness Act includes a lengthy definition of wilderness, including phrases such as:

- An area where earth and its community of life are untrammeled by man.
- An area where man himself is a visitor who does not remain.
- An area of underdeveloped land retaining its primeval character and influence.
- An area protected and managed to preserve its natural conditions.
- An area that generally appears to have been affected primarily by the forces of nature.
- An area with the imprint of man's work substantially unnoticeable.
- An area with outstanding opportunities for solitude or a primitive and unconfined type of recreation.

The ambiguous terms in these phrases such as wilderness character, untrammeled, primeval, natural, primitive and unconfined recreation are left undefined by congress and so they are open to interpretation. Understandably, agencies and authors have disagreed about their meaning in the literature and in agency policy. A recent NPS document (NPS 2005c) defined wilderness character as consisting of multiple components, including a state of naturalness and an "untrammeled" state, as well as conditions for solitude, primitive and unconfined experiences, personal challenge, self sufficiency, and an escape from the reminders of our modern society. As well as a state, wilderness character denotes an intention and a commitment to the spirit of an intangible.

Much of the disagreement centers on the proper definition and context of the word "untrammeled." While some authors believe untrammeled is about the human experience in wilderness, and so is synonymous with words like "unconfined," "unfettered," and "unrestrained" (Cole 2005), others believe congress originally saw untrammeled as a state where signs of external human influence were not present, i.e., synonymous with a natural state. The National Wilderness Steering Committee

(2003), for example, says untrammeled refers to the lack of "intentional control or manipulation." Landres, et al. (2000) point out that the Wilderness Act links untrammeled and natural, and that these two words were "undoubtedly intended to be complementary because untrammeled areas were certainly natural."

What the Wilderness Act apparently did not anticipate was a condition where lands were either not in a natural state when they were designated as wilderness or where large- scale changes in environmental conditions (invasion of exotic species, acid rainfall, etc.) occurred such that the natural state was altered. When either of these conditions occurs, intervention in the form of "intentional control or manipulation" may be required. Although this is perhaps "trammeling" in that human, rather than "natural" activities are conducted, it also returns the wilderness to an "untrammeled" or "natural" pre- impact state in the long term.

Landres, et al. (2000) has summarized much of the debate as a conflict between the degree of "wildness" and the degree of "naturalness" a wilderness should retain. Wildness connotes a sense of an area free from human control, development or manipulation, whereas naturalness captures the ecological sense of wilderness.

National Park Service Wilderness

The NPS National Wilderness Steering Committee has addressed several wilderness issues facing parks that are pertinent to the proposed actions analyzed in this environmental impact statement, including appropriate management in wilderness and cultural resources management in wilderness. Because the Wilderness Act uses the terms discussed above such as "primarily affected by the forces of nature" and "untrammeled by man" to characterize wilderness, the Committee addressed the question of whether historic structures and other cultural resources, which represent occupation by man, need to be removed to protect or restore wilderness values. The Committee noted that the Act includes important modifiers, such as "generally" appears, affected "primarily" by the forces of nature, and where the imprint of humans is "substantially" unnoticeable. A landscape, such as Bandelier, "can have hundreds of prehistoric and historic archeological sites on it and still appear to have been affected primarily by the forces of nature." That is, it can still qualify as wilderness (NPS 2003).

The NPS has also interpreted section 4(a)(3) of the Act, which says in part that "... *the designation of any...unit of the national park system as a wilderness area shall in no manner lower the standards evolved for the use and preservation of such park, monument or other unit of the national park system*." The Organic Act and Redwood Act prevent impairment of any park resource or value, and in particular those resources and values for which the park unit was created. In a 1967 opinion, the Department of the Interior Solicitor wrote, "it is obvious that Congress could only have intended by the Wilderness Act that wilderness designation of national park system lands should, if anything, result in a higher, rather than a lower, standard of unimpaired preservation." Because Bandelier was set aside for its unique cultural resources, and because continuing with the current policy of no management of the large- scale soil erosion that threatens thousands of the monument's archeological sites, impairment is a possibility. The monument has interpreted this section of the Act as not only allowing intervention in the wilderness to comply with the standards of the Organic Act and Redwood Act, but requiring it.

Bandelier Wilderness

The Bandelier Wilderness was designated along with wilderness in many other units of the National Park Service, in 1976 by Congress (PL 94- 567). No language particular to the qualities of Bandelier's wilderness was included in the Act. Simply the number of acres—23,267—and the name "Bandelier Wilderness" were specified. Additional wilderness- quality lands were added to the park in 1977, so that today approximately 71% of the park, or 30,000 acres, is managed as wilderness.

According to a summary of the history of Bandelier (Rothman 1988), the NPS did not initially propose designating any wilderness when the national Wilderness Act was passed, at least in part because it believed that cultural resources research and management could be severely constrained (Sydoriak, et al. 2001). However, the "powerful environmental community" believed not doing so would result in degradation of the Bandelier backcountry. According to Rothman, the environmental community was in part reacting to development in Bandelier to accommodate visitors, development generally in the area and the unsuccessful attempt by earlier conservationists to create a much larger national park on the Pajarito Plateau.

The Bandelier Wilderness is adjacent to a much smaller piece of designated wilderness managed by the U.S. Forest Service called the Dome Wilderness (see Figure 7). The Dome Wilderness was designated by congress in 1980 and is now 5,200 acres. Elevations in this wilderness range from 5,800 feet in Sanchez Canyon to 8,200 feet near Saint Peters Dome.

Wilderness Character

NPS policies indicate that environmental impact statements should evaluate wilderness character and values, including the primeval untrammeled character and influence of the wilderness; the preservation of natural conditions (including the lack of man- made noise); and assurances that there will be outstanding opportunities for solitude and the public will be provided with a primitive and unconfined type of recreational experience.

As noted above, wilderness character has multiple components, including naturalness, wildness, the lack of man- made noise, and conditions for a specific kind of visitor experience where people are able to find solitude, a primitive and unconfining environment, and an escape from the modern day world.

The recreational character of the Bandelier Wilderness is described in more detail in the visitor experience and visual sections of this EIS. However, for the most part, visitors to the backcountry can usually expect few encounters with other visitors and natural quiet.

Like most wilderness areas in the National Wilderness Preservation System, the Bandelier Wilderness was not pristine when it was designated due to the history of Euro- American land use practices described in the *Background* section of this EIS, including overgrazing and fire suppression over the past century. As a result, highly "unnatural" conditions, including a degraded ecosystem with unsustainable ecological processes, exist today. These processes include the loss of organic topsoils, decreases in available soil moisture, extreme soil surface temperatures and freeze-thaw activities that characterize Bandelier's piñon- juniper woodland. Because scientific evidence indicates ecological thresholds have been crossed, these conditions will continue irreversibly to desertify the landscape and reduce the park's biological productivity without human intervention. In other words, the requirement of the Wilderness Act to "preserve natural conditions" is unattainable without overt management.

In addition to the monument's inability to meet its obligations to provide a wilderness whose character is such that is "appears to have been affected primarily by the forces of nature," the ecological conditions described above have led to the degradation of many of the monument's archeological resources. As noted above, both the Organic Act and the Wilderness Act require actions to prevent this continued loss.

Wilderness Values

Both people who use wilderness and those that do not have opinions about why it is valuable. These perceptions of people about the benefits wilderness offers are referred to as "wilderness values," and change from person to person and from wilderness to wilderness.

No surveys of wilderness users at Bandelier have been conducted, and even anecdotal information on the particular values it has is lacking. Therefore it is unknown what particular values visitors ascribe to the Bandelier Wilderness. Instead, this section describes values users have placed on wilderness generally.

The values applied to wilderness are wide- ranging, and have been grouped into biocentric and anthropocentric categories. The biocentric includes the existence of natural, ecologic conditions. These include protecting natural ecological processes, wildlife habitat, habitat for rare and endangered or unique plants and animals, protecting watersheds and water quality, and protecting air quality.

Anthropocentric values include experiential benefits from recreating in wilderness, educational and scientific values, generating tourism revenue for adjacent or nearby gateway communities, aesthetic and spiritual values, the knowledge that wilderness areas exist and will exist in the future, and intrinsic or symbolic values.

Wilderness Restoration Values

Agencies, academics, recreational users and the general public may also hold strong and varying opinions about whether intervention in a wilderness to restore its naturalness is warranted or advisable. Because this is a debate central to the proposed action in this EIS, it is explored it in detail.

The literature suggests that most people typically hold more than one attitude towards an issue and react differently in different situations. Nonetheless, it is possible to identify in most people predominant characteristics of a primary attitude toward an issue. For example, ranchers tend to have a utilitarian attitude towards the environment (value measured in terms of usefulness), while conservationists may have an ecological or preservationist view (Kellert 1976). The use of lands that are now Bandelier National Monument for sheep grazing for over one hundred years is an example of the utilitarian ideal at work in the study area.

The utilitarian ethic began to be challenged at the turn of the century, when lands that are now in the monument were noticed by preservationist constituencies and Native Americans for their unusual archeological resources. A presidential proclamation codified this change in values by designating Bandelier National Monument in 1916 and identifying its tremendous "ethnographic, scientific and educational" value as the primary resource that the monument would protect. In subsequent years, although the cultural or "ethnographic" and "archeological" value of the monument remained a major emphasis, the "scientific" and "educational" merits of Bandelier were also explored. For example, the Baca Location #1, the Valle Grande, and areas north and west of Frijoles Canyon emphasized the geological attributes of the region. The monument's 1977 *Master Plan* called for not only the protection and interpretation of ruins in the monument, but the preservation of the park's natural setting (NPS 1977). These twin goals were identified as the purposes of the monument. In addition, the unusual language in the presidential proclamation ".... with enough land as may be necessary for the proper protection thereof" regarding Bandelier's cultural resources was explored and emphasized.

NATIVE AMERICANS

Native Puebloan peoples may have particular values toward wilderness generally, and many have held strong beliefs toward the land and resources located within the present- day monument long before its designation. These values and tribal traditions are different for each pueblo, though some can be generalized. Wilderness embodies the social values of many native Puebloan peoples. The wilderness is a link to the spiritual world; many tribes connect their cultural and spiritual identity through the land. The wilderness is perceived as part of mother earth as is thought to be essential to the spiritual, cultural, and physical well- being of native peoples. Wilderness is also thought of as something that is without boundaries, making the administrative or property boundaries between agencies or between public and private land meaningless. These relationships and beliefs have spanned the centuries, as native Puebloan peoples have lived in harmony with the ecology of the area for hundreds of years (Ortiz 1979).

Bandelier National Monument's six culturally affiliated New Mexico pueblo tribes are: the Keres pueblos of Cochiti, Santo Domingo, and San Felipe; the Tewa pueblos of San Ildefonso and Santa Clara; and Zuni Pueblo. The Pueblo of Jemez may also have certain ties to Bandelier resources. While each of these pueblo tribes has distinct values regarding the archeological, historic, and ethnographic resources within Bandelier National Monument, the following may provide some insight:

> The tribes define and honor spiritual values relative to the lands and waters, which many traditionalists believe should remain undisturbed. Despite economic difficulties on the reservation, many tribal members adhere to and wish to preserve traditional philosophies and ways of life. They believe their intratribal cultural issues are intensely personal and private, and must be resolved within each tribe (Farhar and Dunlevy 2003).

CONSERVATIONISTS

As with other groups, it is impossible to define a single "conservation ethic" regarding wilderness restoration. Some conservationists may argue that people cannot improve upon nature, regardless of the state of the resources or natural systems, and that therefore any management is a conflict with their personal values (Turner, et al. 2003). Turner et al., for example, argue that "wild" precludes intentional human intervention. Alternatively, others argue that the wild is no longer in a position to manage itself (Sanderson, et al. 2002), and value action, usually science- based, in an attempt to return the wild to a more natural state. For example, Landres (2004) writes that our current "biological diversity crisis" demands that we manipulate wilderness to restore natural conditions.

As discussed above, researchers have noted that conservationists tend to hold preservationist or ecological views about wilderness. Recently, however, Landres, et al. (2000) identified two overarching philosophical views in addition to the utilitarian philosophy regarding the relationship between humans and resources, either of which might characterize conservationists now. These are the preservationist and the "organic" perspective. The preservation perspective is that nature exists "in spite of" human culture, and generally needs to be protected from the influences of humanity. The preservationists view is perhaps best illustrated by the phrase in the Wilderness Act that defines wilderness as ". . . a place where man himself is a visitor who does not remain." Wilderness management has helped to solidify this perspective by distinguishing between natural and human- caused influences. For example, a human- caused fire would be suppressed but a lighting ignition would be allowed to burn. Bare ground may be allowed to remain if attributed to the behavior of native species, but would be remediated if the result of livestock. An example of this more traditional preservationist view by a conservation organization near the monument is the Valley Caldera Coalition, a group of more than 35 organizations and individuals interested in management of the Valles Caldera National Preserve, located adjacent to Bandelier National Monument. The coalition advocates for ecologically sound and sustainable stewardship of the preserve, and states its goal as ensuring that management decisions enhance the ecological, scenic, and cultural resources of the preserve and surrounding lands for future generations.

The organic perspective is that the natural and human worlds are integrated and even inseparable. Humans are acknowledged as part of nature and wilderness, and society is given the responsibility to determine how extensive that role in wilderness should be. An example of a western conservation organization with an integrated view of wilderness management is the Quivira Coalition, which states as its mission as "to foster ecological, economic, and social health on Western landscapes through education, innovation, collaboration, and progressive public, and private land stewardship." The Quivira Coalition proposes an approach it terms *The New Ranch*, which includes progressive ranch management, scientifically- guided riparian and upland restoration, land health assessment and monitoring, and bridge- building among ranchers, environmentalists, federal and state agency personnel, and members of the public, is the way to increase ecological, economic, and social health of western landscapes.

BACKCOUNTRY USERS

After the establishment of the Bandelier Wilderness in 1976, the number of backcountry users increased ten- fold (Rothman 1988). Viewing and photographing wildlife, viewing and photographing birds, and day hiking are the most popular of activities that typically occur in backcountry settings. These are also among the fastest growing of outdoor activities. People who like to view and photograph nature often disapprove of any signs of human impact or alteration of the landscape. Similarly, backcountry users seeking solitude or a refuge from areas where human activities dominate are also likely to perceive conflicts arising from motorized users. Actions that would require the use of chainsaws and leave clear signs of human presence would most likely conflict with the social values of backcountry users.

Some representative opinions of backcountry users include:

> One of the main reasons I go into the wilderness is for escape: escape from busy highways, escape from crowded shops, and escape from time. I enjoy knowing that the only thing I have to accomplish in the wilderness is to let my mind run free (Johnson 2005).
>
> The more people that get outside in the wilderness the more people will like it, I can guarantee that. There is a need among the folks who do journey outside the city…(Lozer 2005).

DAY HIKERS AND CAMPERS

Because no surveys of day hikers or backcountry visitors are available for Bandelier, the values these groups place on it is unknown. However, it is likely that day hikers and campers, like backcountry users, value the natural setting associated with the monument, as well as the ability to partake in outdoor recreation activities or to view the significant cultural resources of Bandelier's frontcountry.

THE AMERICAN PUBLIC

Studies of large numbers of wilderness visitors and non- visitors (Hass, et al. 1986; Manning, et al. 1996; Loomis and Walsh 1992) have found that the general public holds a wide range of values for wilderness, and even places value on the idea of wilderness, whether or not they ever visit (called "existence values"). The greatest values those interviewed placed on wilderness were not for its recreational or visitor use values, but rather on its ability to help in protecting wildlife, water quality and air quality, and its value as a place that will always be available for future generations to enjoy the beauty of nature. One study (Parker and Koesler 1998) of urban residents found that respondents believe wilderness contributes to the quality of the United States and that it should be set aside to prevent development by people. Even more abstract values have been ascribed to wilderness by the public in other studies. One found that nearly 70% of day or overnight Desolation Wilderness users acknowledged spiritual and intrinsic values of wilderness (Trainer and Norgaard 1999). Some visitors described going to wilderness areas as similar to going to church. This same study attempted to assess the willingness to pay fees for wilderness use, but respondents indicated this was an inadequate expression of the values they held for wilderness, leading the authors to conclude "economic and non- economic values of wilderness may be incommensurable." Loomis, et al. (1992) found that onside recreation use of wilderness accounts for less than half its total economic value, and that people who never intended to visit still believed it held great value simply by virtue of existing now and in the future.

These results suggest that perception of wilderness and the values Americans place on it have changed over the years. Early American wilderness values were based on the existence of a frontier and included independent thought, freedom, primitivism and simplicity (Roggenbuck 1990). Later, transcendental American philosophers emphasized inspiration and spiritualism, while others emphasized nationalism, utilitarian values, virile sport, humility and mental health. Roggenbuck suggests that, given the results of recent interviews with members of the public, the future wilderness values will be spiritual, preservationist, land stewardship and connections with the world wilderness community.

Two public scoping sessions held in conjunction with the production of this EIS found that most (91%) of those commenting believed the Bandelier Wilderness required intervention. Of those who indicated a preference for the use of mechanized equipment or hand tools only, 72% indicated mechanized equipment is preferable because it would overall reduce impacts to the wilderness. Only 11% indicated mechanical means would not be preferred or asked for additional justification for using them instead of hand tools, citing noise and the presence of human activity and their impact on wilderness character.

WILDLIFE

Bandelier supports a wide variety of wildlife species, including approximately 1,000 known arthropods, five amphibians, 14 reptiles, and 44 mammals (including 15 species of bats). In addition, about 115 bird species and 90 species of ants have been recorded in and around the monument (Allen 1984, 1989).

Wildlife presence and habitat use are closely associated with vegetation types and elevations. A variety of wildlife species are associated with piñon- juniper vegetation during part of the year. The populations of many of these species in the monument fluctuates between seasons and years. This is particularly so for small mammals such as piñon mouse and rock squirrel as these species respond directly to the availability of plant foods, which can vary greatly with annual precipitation. Survey work for reptiles and amphibians in recent dry years suggest these taxonomic groups also fluctuate with annual precipitation.

A variety of birds use the project area at a variety of times with some breeding and some not breeding in piñon- juniper habitats. For example black- throated gray warbler, juniper

titmouse, and gray flycatcher are present in the project area only in summer and breed only in piñon- juniper habitats of the monument. Common nighthawk, house finch, Cassin's kingbird, plumbeous vireo, and Bewick's wren are also present in the project area only in summer but also found in non- piñon- juniper habitats. Violet-green swallow is primarily in piñon- juniper during summer, but typically breeds in taller trees than piñons or junipers. Western bluebird, Townsend's solitaire, American robin, and mountain chickadee are primarily found in the project area during the winter and seldom breeding in piñon- juniper habitats. Northern flicker, western scrub- jay, and bushtit can be found in the project area year round.

In December 2002, the U.S. Fish and Wildlife Service issued a report "Birds of Conservation Concern, 2002" (USFWS 2002) which superseded a 1995 report. The 2002 report complies with a 1988 law that requires the U. S. Fish and Wildlife Service to identify species, subspecies, and population of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973. The 2002 report deems black- throated gray warbler, along with other species, as a priority for conservation actions in the Southern Rockies/Colorado Plateau Bird Conservation Region (BCR 16).

In January 2004, Partners in Flight issue the North American Landbird Conservation Plan (Rich, et al. 2004) listing both the black- throated gray warbler and the gray flycatcher as Stewardship Species of continental importance. The report defines Stewardship Species as having a high proportion of their global population within a particular regional area. In this case, both black- throated gray warbler and gray flycatcher breed primarily in the intermountain west and southwest of the United States.

SPECIAL STATUS SPECIES

Special status species include: 1) species federally listed as threatened or endangered under the Endangered Species Act of 1973, as amended (ESA); 2) species that are proposed or are candidates for listing under ESA or federal species of concern that are not protected pursuant to ESA but are monitored for conservation status; and 3) State of New Mexico listed threatened or endangered species.

Table 15 lists federal and state listed threatened, endangered, proposed, and candidate species and species of concern that may occur within Los Alamos and Sandoval Counties, New Mexico. This list was created using information obtained from the U.S. Fish and Wildlife Service (USFWS) for Los Alamos, Santa Fe, and Sandoval Counties, New Mexico on February 28, 2005 and the New Mexico Natural Heritage Program Biological and Conservation Data System (NMNHP 2006). Table 15 also lists the potential for occurrence within the project area based on species habitat associations, life histories, and historical documented occurrences. Only those species likely to occur and possibly be affected by activities described in this EIS are described further. These are the Mexican spotted owl, bald eagle, and peregrine falcon.

Federal Threatened and Endangered Species

BALD EAGLE (THREATENED)

Winter surveys for bald eagles have been conducted in Bandelier since 1994. The latest data available, from 2003, shows approximately 11 eagles observed during winter counts over two consecutive days in the monument in January and February. Specific counts over a longer period of time or trend data regarding the use by bald eagles of the potentially affected piñon- juniper woodland are not available. Biologists on elk survey flights (approximately 60- to 90- minute duration) during the late 1990s noted occasional observations of some bald eagles in the vicinity of mesa tops in Bandelier. Mid- winter counts outside the project area above Cochiti Lake during the 1990s suggest that bald eagle numbers may be highest when winter temperatures are near their seasonal lows.

In general, bald eagles inhabit coastal areas, estuaries, unfrozen inland waters, and some arid areas of the western interior and southwestern portion of the U.S. (New Mexico Department of Game and Fish [NMDGF] 2004). They prefer areas near waters containing abundant fish and with unimpeded views both horizontally and vertically, but will also make use of carrion in dry upland settings. Wintering habitat typically has an adequate food supply with access to open water such as river rapids, impoundments, dam spillways, lakes, and estuaries. Communal roosts are generally comprised of several individuals and are common in the winter months in areas that provide protection from adverse weather conditions (NMDGF 2004).

Bald eagles are only in the Bandelier area from approximately November 1 through February 28. They select their winter habitat near canyon mouths and along the Rio Grande, respectively, and do not roost or fish anywhere in the project area. Rather, they make use of tall, large ponderosa pines in deep canyons for roosting and protection from winter storms. Most eagles typically leave winter roosts in the Bandelier area each day at first light to fish and forage, often as much as an hour before sunrise, and return late in the day near or after sunset. They have been observed to occasionally feed on carrion on mesas during the winter in the

Table 15. Special Status Species that may Occur in Sandoval County.

Common Name	Scientific Name	Federal Status[1]	State Status[2]	Potential to occur in Project area
American Peregrine Falcon	Falco peregrinus anatum	SC	T	Likely
Arctic Peregrine Falcon	Falco peregrinus tundrius	SC		Unlikely
Baird's Sparrow	Ammodramus bairdii	SC	T	Unlikely
Bald Eagle	Haliaeetus leucocephalis	LE	T	Likely
Gray Vireo	Vireo vicinior		T	Unlikely
Mexican Spotted Owl	Strix occidentalis lucida	LT		Likely
Mountain Plover	Charadrius montanus	SC		Unlikely
Northern Goshawk	Accipter gentiles	SC		Unlikely
Southwestern Willow Flycatcher	Empidonax traillii extimus	LE		Unlikely
Western Burrowing Owl	Athene cunicularia hypugea	SC		Unlikely
Whooping Crane	Grus americana	LE		Unlikely
Yellow-billed Cuckoo	Coccyzus americanus	C		Unlikely
Black Footed Ferret	Mustela nigripes	E		Unlikely
Goat Peak Pika	Ochotona princes nigrescens	SC		Unlikely
New Mexican Meadow Jumping Mouse	Zapus hudsonius lutues	SC	T	Unlikely
Spotted Bat	Euderma maculatum		T	Unlikely
Townsend's Big-eared Bat	Corynorhinus townsendii	SC		Unlikely
Jemez Mountains Salamander	Plethodon neomexicanus	SC	E	Unlikely
New Mexico Silverspot Butterfly	Speyeria nokomis nitocris	SC		Unlikely
Rio Grande Cutthroat Trout	Oncorhynchus clarki virginalis	SC		Unlikely
Rio Grande Silvery Minnow	Hybognathus amarus	LE	E	Unlikely
Rio Grande Sucker	Catostomus plebeius	SC		Unlikely
San Ysidro Tiger Beetle	Cicindela willistoni funaroi	SC		Unlikely
William Lar's Tiger Beetle	Cicindela fulgida williamslarsi	SC		Unlikely

1 Federal status under the ESA: LE = Endangered; LT = Threatened; C = Candidate for listing; SC = Species of Concern.
[2] State status: E = Endangered; T= Threatened.
[3] Potential for occurrence includes both resident and migratory.

monument's piñon- juniper woodland during these forays from their roosting sites. For this reason, the following mitigation measures would apply:

- No chainsaws would be utilized within 425 meters (0.26 miles) from fishing habitats and no helicopters would be flown within 1000 meters (0.62 miles) of fishing habitat along the Rio Grande from November 1 through February 28.
- Helicopter and chainsaw activities would avoid the shaded basins shown in Figure 5 during roosting (e.g. after 4:30 p.m. MST and before 8:00 a.m. MST) from November 1 through February 28.

MEXICAN SPOTTED OWL (THREATENED)

Annual surveys for Mexican spotted owls have been conducted in the monument since 1995. No owls have been documented in the monument since 2002. However, since suitable habitat exists for the species within the canyons and mixed- conifer forests of Bandelier, annual surveys continue to be conducted to determine occupancy status and identify any potential management concerns.

Mexican spotted owls nest, roost, and forage in a diverse assemblage of vegetation communities. Mixed- conifer forests are commonly used throughout most of the range (USFWS 1995). In general, these communities are dominated by Douglas fir and/or white fir, with co- dominant species including southwestern white pine, limber pine, and ponderosa pine (Brown, et al. 1980). In addition to these species, the understory often contains broadleaved species such as Gambel oak, maples, box elder, and New Mexico locust (USFWS 1995).

Three classes of habitat have been recognized for Mexican spotted owls: nesting, roosting, and foraging. The breeding and nesting season for Mexican spotted owls is March 1 through August 31. Nesting habitat typically consists of closed- canopy forests or rock canyons (USFWS 1995, 2005). Forests preferred by nesting spotted owls often contain mature or old- growth stands with complex structure and are typically uneven- aged, multi- storied, and have high canopy closure (USFSW 1995). In the northern range of this species (including southern Utah, southern Colorado, and far northern Arizona and New Mexico), owls may nest in caves or on cliff ledges in steep walled canyons that provide situations for cool microsites (USFWS 1995, 2005). For roosting, spotted owls will utilize small and large trees, scattered across the landscape, but they still maintain a preference for closed- canopy forest conditions. Spotted owls generally use a wider variety of forest conditions for foraging. Little is known about the pattern of use by foraging owls, but the habitat appears to be primarily defined by its proximity to nesting or roosting habitat and its ability to provide vulnerable prey (USFWS 1995).

Major canyons within Bandelier are thought to have suitable nesting and/or roosting habitat for the Mexican spotted owl. As such, Bandelier has established two spotted owl management designations: suitable nesting areas (SNAs) and nesting/roosting zones (NRZs). The nesting/roosting zones include all suitable nesting areas as well as additional important habitat for the owls. SNAs include all known historic spotted owl nests and regular roost areas, plus other areas that are known to have similar habitat characteristics, such as cliff areas and forest stands that exhibit the physical characteristics described above. The NRZs contain all nesting habitat (and therefore all SNAs) and nearly all roosting habitat, but may also contain areas that are not suitable nesting or roosting, such as foraging habitat for example. The U.S. Fish and Wildlife Service (2005) recognizes the Bandelier habitat designations, although it uses different terms (the SNA is called a protected activity center or PAC and the term NRZ is referred to as a restricted habitat, as defined in the 1995 Mexican Spotted Owl Recovery Plan (USFWS 1995).

Bandelier National Monument is also within Mexican spotted owl critical habitat unit SRM- NM- 4 (69 CFR 53182). This unit is located in the Jemez Mountains, south of Los Alamos, in north- central New Mexico. The US Fish and Wildlife Service indicates that habitat within this area that is suitable for the spotted owl is composed of steep slopes (greater than 40% slope), canyons incised into volcanic rock, rocky outcroppings with dense, and mixed- coniferous forest. Based on these criteria, lands within the project area, while within Bandelier and the SRM- NM- 4 unit, do not meet the criteria for critical habitat.

No SNAs or overnight roosting habitat exists in the piñon- juniper woodland in Bandelier, although there are patches of designated NRZs on the tops of mesas considered suitable for foraging. It is unknown but possible that Mexican spotted owls may occasionally use these NRZs for nighttime foraging. In addition, owls outside the woodland may be affected by noise if helicopters fly nearby or even from chainsaw activity if it is close. Therefore, the following mitigation measures would apply:

At the start of the Mexican spotted owl breeding season (March 1), in order to mitigate any potential impacts to any nesting owls, occupancy surveys will be conducted to determine whether Mexican spotted owls are present in the monument and if so, their nesting status. If nesting MSOs are detected, the use of chainsaws and aircraft will not be allowed within 600 meters of an **occupied** suitable nesting area (SNA, described in *Affected Environment*) unless intervening topography attenuates the sound.

The following mitigation measures will also be implemented from March 1 to May 15 every year of treatment, regardless of surveys.

- Motorized activities on mesa tops will be prohibited within 100 meters of canyon rims within the shaded treatment basins shown in Figure 5 between March 1 and May 15.
- In general, helicopter flights will be avoided over the shaded treatment basins shown in Figure 5 between March 1 and May 15.

State Listed Species

PEREGRINE FALCON

Annual surveys for peregrine falcons have been conducted in Bandelier since 1995. A nesting bird was documented in Bandelier this year (2006), and before this, most recently in 2003. Management actions in peregrine nesting habitat are dictated by its

Peregrine Falcon Habitat Management Plan in Bandelier National Monument (NPS 2006c).

Peregrine falcons are known to utilize cliffs for nesting and prefer canyons that contain mixed conifer, ponderosa pine, Chihuahua/Apache pine, bristlecone/limber pine, and piñon- juniper communities for foraging. In New Mexico, the breeding territories of peregrine falcons center on cliffs that are in wooded/forested habitats, with large "gulfs" of air nearby in which these predators can forage (Hubbard 1985).

Four areas that the Bandelier *Peregrine Falcon Habitat Management Plan* has defined as likely peregrine nesting habitat (canyon cliffs with suitable nest ledges) occur in or immediately adjacent to the monument. Additional foraging areas include primarily piñon- juniper woodland and ponderosa pine forests on the mesas of the Pajarito Plateau, with mixed conifer forests extending farther down the canyons from the northwest.

The *Peregrine Falcon Habitat Management Plan* delineates three increasingly large zones around each suitable nesting ledge, and dictates what types of activities are acceptable and when they can be conducted (seasonally) so as to avoid impacts to nesting birds. These "zones" and the types of activities allowed in each are based on flight response thresholds of peregrine falcons to disturbance, as documented in *Response Thresholds of Breeding Peregrine Falcons* (Johnson 1993). As an example, the largest zone, zone C, extends to a line- of sight distance of approximately 2,200 meters from nesting habitat, and less when topographic or vegetative screening or regular background activities intervene. The season of concern for peregrines is between March 1 and October 15, as this is when they are occupying nests (March 1 to May 15), laying and incubating eggs and fledging young (May 16 to August 15) and when adults remain on the nest to defend their territory (August 16 to October 15). Peregrines are most sensitive to disturbance and likely to be displaced by noise of human activities during the initial occupation period of March 1 to May 15. Between May 16 and August 15, nest abandonment is unlikely because of the presence of eggs or young in the nest, but sound disturbance can cause nesting failure in other ways. In most cases, no peregrine falcons will be present from October 16 to February 28.

According to the *Peregrine Falcon Habitat Management Plan*, all human activities in zone A, which extends from 400 meters to 900 meters around the nest site, should be discouraged from March 1 to August 15 each year (Johnson 1993; NPS 2006c). Within zone B, which extends to a line- of- sight distance of 1,400 meters from the nest, human activity should be discouraged from March 1 to May 15 and mechanical activities should produce no more than a stimulus of 20 db below that required to cause a breeding peregrine to respond by flying. Zone C extends to a line- of- sight distance of 2,200 meters and allows small- to medium- sized groups of people, with restrictions on machinery and aircraft. When observations determine no falcon activity within potential breeding habitat as of May 15, activities and noise levels are unrestricted.

Measures the monument will take in either alternative to ensure compliance with the *Peregrine Falcon Habitat Management* Plan include the following:

- Helicopter fights will be avoided over the stippled areas shown in Figure 6, which include, at a minimum, peregrine falcon habitat management zones A, B, and a portion of zone C from March 1 through May 15, and
- Motorized activities in stippled areas shown in Figure 6 will be prohibited within 100 meters of canyon rims from March 1 through May 15.

Project activities outside of zone B will not be restricted. The stippled basins shown in Figure 6 were identified using GIS by mapping the boundary of zone B (containing zone A) and selecting the treatment basins that are located within or adjacent to the boundary for zone B. In some instances, the shaded treatment basins shown in Figure 6 are much larger than zone B, and thus contain acreage within zone C.

AIR QUALITY

Bandelier National Monument is located in Sandoval and Los Alamos Counties, New Mexico. These counties are in attainment with the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants [carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter with a diameter of 10 micrometers or less (PM_{10}), particulate matter with at diameter of 2.5 or less ($PM_{2.5}$), oxides of nitrogen (NO_x), ozone (O_3) and lead (Pb)] (EPA 2005a). The primary and secondary NAAQS are listed in Table 16. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings (EPA 2005b).

Air quality monitoring is not conducted at Bandelier National Monument. The nearest air quality monitors are located at Zia Pueblo, Jemez Pueblo, Bernalillo, and Rio Rancho, New Mexico, approximately 25 miles, 25 miles, 35 miles, and 40 miles from the park respectively (EPA 2005b). Parameters monitored at these locations are indicated in Table 17.

Monitoring data from the past five years for these sites show that air quality is generally good. Data showed compliance with the NAAQS at all locations for all pollutants monitored, with the exception of the Jemez Pueblo monitor, which indicated three exceedances of the 24 hour PM_{10} NAAQS in 2004, and exceedance of the annual PM_{10} NAAQS in 2004 and 2005. The PM_{10} exceedances at Jemez Pueblo are due primarily to windblown dust and emissions from a gypsum mine located approximately 5 miles away (Wear 2006).

Visibility at Bandelier National Monument is generally very good. Visibility has been monitored since 1989 and is approximately 144 kilometers (Visibility Information Exchange Web System 2005).

Table 16. National Ambient Air Quality Standards.

POLLUTANT	PRIMARY STANDARDS	AVERAGING TIMES	SECONDARY STANDARDS
Carbon Monoxide	9 ppm ($10\ mg/m^3$)	8-hour	None
	35 ppm ($40\ mg/m^3$)	1-hour	None
Lead	$1.5\ \mu g/m^3$	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm ($100\ \mu g/m^3$)	Annual (Arithmetic Mean)	Same as Primary
Particulate Matter (PM_{10})	$50\ \mu g/m^3$	Annual (Arithmetic Mean)	Same as Primary
	$150\ ug/m^3$	24-hour	
Particulate Matter ($PM_{2.5}$)	$15.0\ \mu g/m^3$	Annual (Arithmetic Mean)	Same as Primary
	$65\ ug/m^3$	24-hour	
Ozone	0.08 ppm	8-hour	Same as Primary
Sulfur Oxides	0.03 ppm	Annual (Arithmetic Mean)	-------
	0.14 ppm	24-hour	-------
	-------	3-hour	0.5 ppm ($1300\ ug/m^3$)

Table 17. Air Quality Parameters Monitored at Locations near Bandelier National Monument.

Location	Parameters Monitored
Zia Pueblo	$PM_{2.5}$
Jemez Pueblo	CO, O_3, PM_{10}, $PM_{2.5}$
Bernalillo	O_3, PM_{10}, Pb
Rio Rancho	CO, NO_2, O_3, $PM_{2.5}$, Pb

Figure 22 shows the average visibility extinction for Bandelier in megameters (Mm- 1) from 1989 through 2004. Lower visibility extinction indicates betters visibility (Visibility Information Exchange Web System 2005). The data indicate extinction is constant or trending slightly downward. This indicates visibility is generally remaining constant or improving slightly.

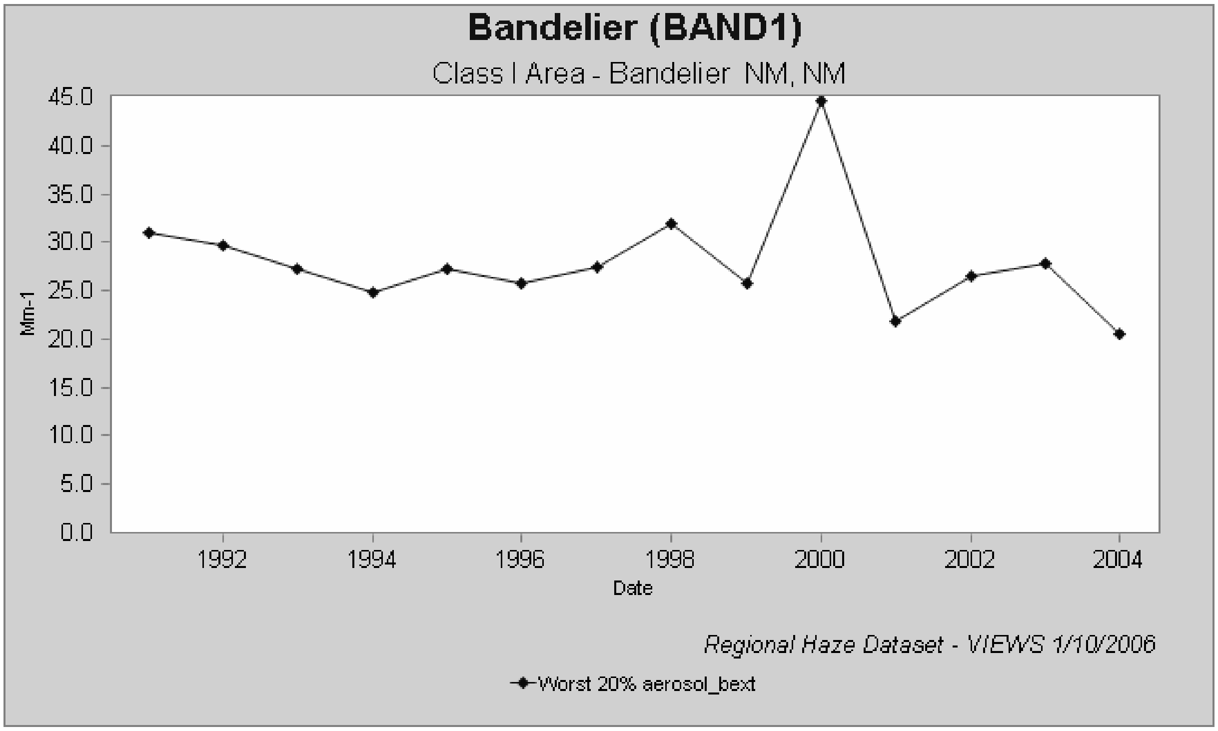

Figure 22. Average Visibility Extinction for Bandelier from 1989 to 2004.

PARK OPERATIONS

Bandelier National Monument staff levels vary seasonally, with 69 permanent year-round staff members and 40 additional seasonal and volunteer staff during summer months. The staff is separated into six divisions and/or programs with different functions and responsibilities: Administration, Fire Management, Interpretation and Visitor Services, Facility Management, Visitor and Resource Protection, and Resource Management. With the exception of Fire Management, all divisions may be affected by the activities described in the alternatives with regard to personnel workloads and division budgets. A brief description of the functions and responsibilities and approximated percentage of Bandelier base operations budget allocated for each affected division is provided below:

Administration Division: Staff in this area direct numerous administrative functions to facilitate rewarding visitor experiences and the protection of park resources. Activities include budgeting and finance, procurement, human resources management, property management, strategic planning, and information technology. The percentage of base operations budget allocated to this division in fiscal year (FY) 2005 was 15%.

For activities proposed under the alternatives, this division would be responsible for recruitment and hiring of seasonal field crews, contract procurement and administration (if necessary), any information technology needs of Bandelier staff and field crews, and property management.

Interpretation and Visitor Services Division: This division is responsible for interpretive and educational programs at the monument. This includes operation of the visitor center, conducting information and orientation programs, providing curriculum- based educational programs, and providing interpretive media. The percentage of Bandelier base operations budget allocated to the Interpretation and Visitor Services Division in FY2005 was 15%.

Currently, this division provides visitor information on the backcountry trails and camping areas in the project area. A map of the trails and rules and regulations is distributed at the visitor center and is available at most wayside exhibits throughout the park. During project implementation, the interpretation staff at the visitor center would inform visitors of the project and current treatment locations in the backcountry, and would provide educational information to visitors regarding the ongoing ecological restoration effort.

Facility Management Division: This division is responsible for providing a safe, sanitary, environmentally protective, and esthetically pleasing environment for monument visitors and employees; protection of the physical integrity of monument facilities; and preservation and maintenance of facilities in their optimum sustainable condition to the greatest extent possible. This includes maintenance and upkeep of all monument facilities, including the CCC Historic District at monument headquarters, trail maintenance, road maintenance, and vehicle maintenance. The percentage of the Bandelier base operations budget allocated to this division in FY2005 was 23%.

The Facility Management staff workload does not currently emphasize lands in the project area. There are no standing buildings or facilities located within the area. However, the Facility Management staff is responsible for some trail maintenance work in lieu of a trails maintenance crew and management of housing units in the monument for seasonal crews. In addition, the maintenance staff also directs and operates all NPS stock use for field work.

For activities described in the alternatives, this division would provide and manage stock for pack strings to deliver crew camp supplies and equipment, as well as manage all park housing for seasonal staff.

Visitor and Resource Protection Division: This division is responsible for visitor and resource protection aspects of the monument. Law enforcement is a major component of this division. The objectives of the law enforcement program are the prevention of criminal activities through resource education, public safety efforts, and deterrence, as well as the detection and investigation of criminal activity and apprehension and successful prosecution of criminal violators. This division also operates the Fee Collection Station at the entrance to Bandelier. The percentage of Bandelier base operations budget allocated to this division in FY2005 was 14%.

The Bandelier protection staff patrols all developed and non- developed areas in the monument daily throughout the year. With increased visitation in the late spring, late summer and fall seasons, patrol frequency shifts from the frontcountry zones to backcountry, wilderness, and non- developed areas. Vehicle patrols are conducted on all monument roads. Trail and off- trail patrols are primarily on foot, but may include horse work. Patrol emphasis is on visitor and employee safety, resource protection—especially of sensitive cultural and archeological sites, fire prevention, and minor maintenance of trails within guidelines. Currently, the trails within the project area are patrolled on a weekly basis (see the description of the No Action alternative for more information).

For activities described in the alternatives, this division may provide assistance with field operations, as well as health and safety training of field crews. This division will also inform visitors to the park about the project activities that may affect their stay.

Resource Management Division: The overriding goals of this division are to 1) preserve, protect, interpret, and manage the cultural and natural resources of the monument within naturally functioning ecosystems, consistent with cultural resource preservation; and 2) provide the means and opportunity for people to study, understand, and enjoy the resources of the monument without unduly compromising the resources or ethnographic values. The percentage of Bandelier base operations budget allocated to the Resource Management Division in FY2005 was 26%. It has the highest number of employees of any division at Bandelier.

The Resource Management Division currently conducts ecological research in the project area which is addressed in the *Purpose of and Need for Action* section. For activities described under the alternatives, Resources Management staff may be impacted. Funding for the project would not come from the base operations budget of the monument but rather from separate project- specific funding sources managed under this division. Several permanent staff would be temporarily redirected to manage project funds, field operations, and project implementation. All seasonal staff would be hired and managed under this division.

HEALTH AND SAFETY

The monument has no particular set of people from whom it plans to draw contracted workers to complete treatment in either alternative. However, it is likely that they have experience with chainsaws working with helicopter sling loads, etc. If so, they may have already been exposed to noise levels from these mechanical sources, vibrations from equipment and the potential for accidents during operation.

No health or safety concerns to visitors are anticipated, and so this section deals only with effects to park staff or contracted workers treating sites. In addition, although workers may experience safety hazards or the effects of vibration from chain saws, the primary health and safety issue analyzed in this document is from noise. A summary of current sources of noise is available in the *Soundscapes* subsection of *Visitor Experience*.

Chapter 4:
Environmental Consequences

Deer vetch
Lotus wrightii

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

The *Environmental Consequences* section analyzes both beneficial and adverse impacts that could result from implementing any of the alternatives. In addition, this section includes a summary of laws and policies relevant to each impact topic, definitions of impact "thresholds" (for example, negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative effects. As required by the Council on Environmental Quality regulations implementing the National Environmental Policy Act, a summary of the environmental consequences for each alternative is provided in Table 7 which can be found in the *Alternatives* section. The resource topics presented in this section, and the organization of the topics, correspond to the resource discussions contained in the *Affected Environment* section.

SUMMARY OF LAWS AND POLICIES

Three overarching environmental protection laws and policies guide the actions of the National Park Service in the management of the parks and their resources—the National Park Service Organic Act; the National Environmental Policy Act, and its implementing regulations; and the National Parks Omnibus Management Act. These guiding regulations are described in brief below.

The National Park Service Organic Act of 1916 (16 USC 1) commits the National Park Service to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

The National Environmental Policy Act of 1969 is implemented through regulations of the Council on Environmental Quality (CEQ) (40 CFR 1500–1508). The National Park Service has, in turn, adopted procedures to comply with NEPA and CEQ regulations, as found in Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision- making (NPS 2001a), and its accompanying handbook.

The National Parks Omnibus Management Act (16 USC 5901 et seq.) underscores the National Environmental Policy Act in that both are fundamental to park management decisions. Both acts provide direction for connecting resource management decisions to the analysis of impacts and communicating the impacts of these decisions for the public using appropriate technical and scientific information. Both acts also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case.

The Omnibus Act directs the National Park Service to obtain scientific and technical information for analysis. The NPS handbook for Director's Order 12 states that if "such information cannot be obtained due to excessive cost or technical impossibility, the proposed alternative for decision will be modified to eliminate the action causing the unknown or uncertain impact or other alternatives will be selected" (NPS 2001, section 4.4).

Section 4.5 of Director's Order 12 adds to this guidance by stating "when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well- reasoned decision, the National Park Service will follow the provisions of the CEQ regulations (40 CFR 1502.22)." In summary, the National Park Service must state in an environmental impact statement: (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community.

Collectively, these guiding regulations provide a framework and process for evaluating the impacts of the proposed alternatives for ecological restoration of Bandelier's piñon- juniper woodland.

GENERAL METHODOLOGY FOR ESTABLISHING IMPACT

Thresholds and Measuring Effects by Resource

The general approach for establishing impact thresholds and measuring the effects of the alternatives on each resource includes the following elements:

- General analysis methods as described in guiding regulations.
- Basic assumptions used to formulate the specific methods used in this analysis.
- Thresholds used to define the level of impact resulting from each alternative.
- Methods used to evaluate the cumulative effects of each alternative in combination with unrelated factors or actions affecting park resources.
- Methods and thresholds used to determine if impairment of specific resources would occur under any alternative.

These five elements are described in the following sections.

General Analysis Methods

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures. One hallmark of this analysis is the application of results of the scientific research conducted in Bandelier National Monument, along with other best available scientific literature applicable to the region and setting, the resources being evaluated, and the actions being considered in the alternatives. A substantial amount of research has been conducted in Bandelier in the last 10 years aimed at answering many of the key questions of impacts on the monument's resources and how best to address them.

The National Park Service created an interdisciplinary planning team comprised of monument and regional staff and consultants assisting the park service with preparation of this document (see list of Preparers and Contributors in the Consultation and Coordination section of this EIS). In addition, the monument obtained technical review, advise and assistance from personnel from the regional and Washington offices of the National Park Service. The core team of park and contracted staff met periodically to discuss the scope of the analysis, to review thresholds and methodologies, to refine alternatives, and to conduct and review the analysis of impacts. A list of preparers and contributors is provided in the Consultation and Coordination section of this document.

Assumptions

Several guiding assumptions were made to provide context for this analysis. These assumptions are described below.

Analysis Period

This *Draft Ecological Restoration Plan and EIS* establishes goals, objectives, and specific implementation actions needed to manage piñon- juniper woodland at Bandelier for the next 20 years; therefore, the analysis period used for assessing impacts is 20 years. The impacts analysis for each alternative is based on the principles of adaptive management, which will allow the National Park Service to change management actions as new information emerges through monitoring of management actions and ongoing research throughout the life of the plan.

Analysis Area

The geographic study area for this *Draft Ecological Restoration Plan and EIS* includes portions of the piñon- juniper woodland that can be restored inside Bandelier National Monument. Of the 10,000 acres of piñon- juniper at Bandelier, about 4,000 acres are both in need of restoration and have not progressed so far as to be unable to be restored. All 4,000 acres are in designated wilderness.

Duration and Type of Impacts

This EIS considers and defines "short- term" and "long- term" impacts to each resource. While the definition of these terms may vary depending on the resource, if no definition is provided, the following should be assumed:

Short- term impacts: Those occurring from actions related to ecological restoration within a short period of time would no longer be detectable, as the resource is returned to its pre- disturbance condition or appearance in less than 10 years.

Long- term impacts: Those occurring from actions related to ecological restoration that would cause a change in a resource or its condition so that it does not return to pre- disturbance conditions or appearance within 10 years.

Impact Thresholds

Determining impact thresholds is a key component of the NPS Management Policies 2006 (NPS 2006) and the Director's Order 12 handbook (NPS 2001). These thresholds provide the reader with an idea of the intensity of a given impact on a specific topic. Determining the impact threshold is sometimes done by comparing the impact to a relevant standard from state or federal regulations or scientific research, although standards are often unavailable for resources (wilderness, visual quality, etc.). In this case, threshold definitions are created by assessing available data, the scientific literature, and using best professional judgment. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. The following intensity definitions are used throughout this analysis: negligible, minor, moderate and major. In addition, the NPS uses the information to determine whether impairment of natural or cultural resources is possible (see below).

In addition to intensity, agencies are required to consider an impact in relevant contexts. This is usually interpreted to mean geographic or temporal context. For example, an alternative may result in a severe localized impact that would be barely detectable over the entire piñon- juniper woodland. This effect is characterized two ways then, as having a site- specific major adverse impact, and a negligible adverse landscape scale effect.

Cumulative Impacts Analysis Method

The CEQ regulations to implement the National Environmental Policy Act require the assessment of cumulative impacts in the decision- making process for federal projects. Cumulative impacts are defined as "the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are presented and considered for each impact topic analyzed for all alternatives, including the No Action alternative. Evaluation of intensity and context of cumulative impacts is topic- specific and dependent on impact threshold definitions presented for each impact topic. For instance, the effects of a specific action could result in minor, cumulative, adverse effects to one resource while creating major, cumulative, adverse effects to another."

For each impact topic, an appropriate geographic and temporal boundary for cumulative effects was defined. This is because the extent of a resource does not usually stop at the monument boundary, but rather extends to some natural geographic boundary independent of land ownership. In addition to actions inside all of the piñon- juniper woodland at Bandelier, these boundaries most often included the Pajarito Plateau. Soils, cultural resources and many wildlife species across remaining open areas on the plateau are part of complexes and so are evaluated together in the cumulative impact sections. Wilderness inside Bandelier is immediately adjacent to the smaller Dome Wilderness in the adjacent Santa Fe National Forest and so cumulative impacts may extend across both, for example.

Temporal boundaries used for analysis also change with the resource, but again, the impacts to many were similar and extended back to the time of European occupation. As noted in several sections of this EIS, impacts to vegetation, soils, erosion and archeological resources in the monument and across the geographic boundaries identified above for these resources began at this time.

Cumulative actions that have affected resources inside those boundaries, are affecting them now, and would continue to affect them in the same period of future time as the alternatives evaluated in this EIS are then identified, and an attempt is made to assess the intensity of this combined impact. As an example, in addition to the past actions of overgrazing, fire suppression and resulting loss of soils that affect buried cultural resources across the monument and Pajarito Plateau, building in the Los Alamos area, access to cultural sites in the monument, adjacent forest and on other public lands, and removal of artifacts have also contributed impact, and so are considered cumulative actions with combined or additive effects.

Impairment Analysis Method

The NPS Management Policies 2006 (NPS 2006a) require an analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, as 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, adversely impacting 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 a park system unit, that discretion is limited by the statutory requirement that the agency 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 NPS manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute impairment, but an impact would be more likely to constitute impairment to the extent that it has a major or severe adverse effect upon 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
- identified as a goal in the park's General Management Plan or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park.

The following process was used to determine whether the alternatives had the potential to impair park resources and values:

- The park's enabling legislation, *Strategic Plan, Vegetation Management Plan*, and other relevant planning documents were reviewed to ascertain the park's purpose and significance, resource values, and resource management goals or desired future conditions.
- Thresholds were established for each resource of concern to determine the context, intensity, and duration of impacts, as defined above.
- An analysis was conducted to determine if the magnitude of impact reached the level of "impairment," as defined by NPS *Management Policies 2006*.

For those impact topics for which impairment analysis is required, findings of impairment to park resources and values for each of the management alternatives are included.

VEGETATION

Attributes of vegetation resources relevant to the current planning document were previously addressed under *Affected Environment*. This section discusses the potential effects or impacts to vegetation.

Laws, Regulations and Policies

Native vegetation is a fundamental natural resource component whose integrity is addressed within the scope of numerous NPS policies and guidelines, specifically Chapter 4, Biological Resource Management, Section 4.4 (e.g., Plants) in NPS *Management Policies 2006* (2006a). Section 4.4.2.4 of the NPS *Management Policies* states "Landscape and vegetation conditions altered by human activity may be manipulated where the park management plan provides for restoring the lands to a natural condition. Management activities to restore human- altered landscapes may include: restoring natural processes and conditions to areas disturbed by human activities such as (grazing) fire suppression, as well as maintaining open areas (savannas) and meadows in situations in which they were formerly maintained by natural processes that now are altered by human activities." Section 4.1.5 of the NPS *Management Policies 2006* (Restoration of Natural Systems) provides guidance for management of vegetation resources within the context of the current planning document (NPS 2006)(see *Need for the Plan* section of this EIS for more information).

Methodology

The assessment of impacts uses the general methodology described above and the resource specific information presented here. The area of analysis includes the monument and, for cumulative impact purposes, the Pajarito Plateau. The primary sources of information used to evaluate potential for adverse or beneficial effects on vegetation include results from long- term monitoring and experimental studies conducted at the monument, as well as input from researchers with expertise in woodland ecology, pertinent scientific literature, and the professional judgment of monument resource specialists.

Effects on vegetation are relative to treatment and expected treatment response, where restoration treatment decreases tree cover, and expected response is an increase in native, perennial understory (i.e., grass, forb, and shrub) cover and diversity.

Short- term impacts would occur within five to ten years and long- term impacts would remain after 10 years.

The intensity of impacts to vegetation is defined by the following thresholds.

Negligible: The effect on vegetation is at or below the lowest levels of detection with neither adverse nor beneficial consequences. Measured differences in vegetation cover and diversity between treatment and control areas, (estimated from vegetation line transects) or for post-treatment relative to pre- treatment (adjusted for climatic effects), are not apparent even to a skilled observer.

Minor: The effects of the proposed action on vegetation are slight, and not readily apparent to a skilled observer. Measured changes in herbaceous cover and diversity, native understory cover and diversity, or in tree cover, on treatment versus control areas, (estimated from vegetation line transects) or for post- treatment relative to pre- treatment (adjusted for climatic effects) are one- to two- fold.

Moderate: The effects of the proposed action on vegetation are readily apparent to a skilled observer. Measured changes in herbaceous cover and diversity, in native understory cover and diversity, or in tree cover, on treatment versus control areas, (estimated from vegetation line transects) or for post- treatment relative to pre- treatment (adjusted for climatic effects) are two- to three- fold.

Major: The effects of the proposed action on vegetation are severe or of exceptional benefit. Measured changes in herbaceous cover and diversity, in native understory cover and diversity, or in tree cover, on treatment versus control areas, (estimated from vegetation line transects) or for post- treatment relative to pre- treatment (adjusted for climatic effects) are four- fold or more.

Impairment: An impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is: 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative A—No Action

The No Action alternative is defined in planning efforts as "no change" from current management. The description of current management is in the *Alternatives* section, whereas this section evaluates the impacts on continuing with current management over the planning horizon (i.e., 20 years).

As noted in Affected Environment, conditions in the piñon- juniper woodland at Bandelier have changed over the last 100 to 150 years as a result of European settlement and land use practices. For example, livestock grazing removed grasses and forbs that had acted as fine fuels to carry frequent lightning- strike fires across much of the southwest. These relatively "cool" fires traditionally had reinvigorated annual and perennial grasses and forbs, while killing back piñon and juniper seedlings and restricting them to more "fireproof" areas such as rocky outcrops or shallow soil sites. During this same period of time, wildfires were nearly totally suppressed, allowing the more drought- resistant piñon and juniper to invade ponderosa pine (Pinus ponderosa) savannas. Reduced understory vigor and loss of fire disturbance provided opportunities for piñon and juniper to expand in range. Expansion of woodland from traditional low productivity habitats (i.e., rocky, shallow soil sites) onto deeper soil or more productive sites (i.e., former grass dominated communities), as well as increasing densities within more open stands, further suppressed herbaceous and shrub components. Loss of herbaceous cover triggered accelerated erosion and runoff, resulting in further degradation of the understory (as well as impacts to upland watersheds, downstream riparian zones, and embedded cultural resources).

Recent and dramatic changes in the monument's piñon- juniper woodland have taken place as a result of drought and beetle induced mortality during the years 2000 to 2004. Prior to this time, one- seed juniper largely dominated lower elevation areas below 6,300 feet, with increasing dominance of Colorado piñon pine above 6,300 feet. The piñon and/or juniper woodland within Bandelier ranged in canopy cover from 10- 15% at lower elevations and drier aspects to 35- 40% cover at higher and more mesic locations. Within the elevational zone above 6,300 feet, where piñon was co- dominant with juniper, average canopy closure was about 35% with piñon constituting ca. one- half (i.e., 15- 20%) of the total (Jacobs, et al. 2002b). Understory cover was often <10%, with intercanopy spaces dominated by exposed soils (Jacobs, et al. 2002b). Since 2000, the woodland system has experienced a significant decrease in tree cover from drought and insect induced mortality of piñon pine (exceeding 90% parkwide) and one- seed juniper (less than 10% and localized)(see *Affected Environment*).

More natural conditions in piñon- juniper woodland typical of that in Bandelier before European occupation would resemble a savanna like system with a matrix of trees and tree patches interspersed with open areas dominated by grasses, forbs, and shrubs. Herbaceous understories would be characterized by native, perennial grasses, forbs and shrubs with cover exceeding 30% (two to three times the current levels). This would provide sufficient understory cover to mitigate runoff and soil erosion and allow periodic surface fire to maintain grass, forb and shrub dominated openings.

If current management continues unchanged (as it would under this alternative) woodland tree cover would trend higher (from 2005 levels) as piñon and juniper trees continue to grow. Piñon would increase primarily from residual seedlings which have survived the multi- year drought as the seedbank is essentially depleted, while juniper would increase across all size classes and from seed. The expansion of tree cover (from 2005 levels) would result in minor adverse effects on woodland trees through increased competition for water and nutrients. Increasing tree cover would continue to limit growth and establishment of perennial understory cover, with expected moderate decreases in both cover and diversity of perennial grasses, forbs, and shrubs longer- term. These ongoing losses in understory (cover and diversity) and associated negative effects on soils would continue to yield and worsen existing major, long- term, adverse impacts to grass dominated vegetation communities within the piñon- juniper woodland at Bandelier.

At a smaller scale, short- term pulses in available soil moisture and nutrients associated with the piñon die- off might become available to native, perennial grasses, forbs and shrubs, which could stimulate a sustained increase in their cover, particularly when normal precipitation patterns resume. However, the immediate herbaceous response to recent piñon tree mortality is likely to be dominated during the short term by the growth of weedy (native and non- native) annual/biennial plants. This was borne out by the results of recent monitoring data from drought impacted woodland areas within the park. Increases of up to 30% of herbaceous cover were noted in response to increased precipitation during 2005, but vegetation was dominated by annual and biennial species, which last only one to two years. Herbaceous ground cover at this study site will likely return to its pre- response levels of ~10% cover (based on moisture response patterns in understory previously observed), but with smaller incremental, but more sustainable, increases in perennial understory cover (i.e., 2- 5%) possible over longer time periods (i.e., five to ten years) due to the effects of extensive piñon mortality. These relatively modest, longer- term increases of several percent cover in perennial understory cover would be unlikely to mitigate runoff and stabilize soils within the woodland or occur at levels sufficient to protect cultural resources. In contrast, comparable reductions in live tree canopy using restoration treatment methods, and broadcast of live slash onto bare intercanopy soils, produced sustainable, perennial, understory responses of nearly 30%, at three years post- treatment (Jacobs, et al. 2002b), with continued increases in herbaceous cover projected for four through ten years post- treatment, and erosion rates reduced by several orders of magnitude (Hastings, et al. 2002).

Future climate, insect, and fire patterns, including recent drought effects and anticipated vegetation response over time, may have unpredictable effects that cannot be fully anticipated or modeled. This is the reason why some adaptive management based on the results of monitoring and changing site conditions is required in the action alternatives.

Potential for future active fire management activities is expected to be somewhat limited by the inherent discontinuity of fuels in the absence of any restoration treatments and slash management; however, even under the No Action alternative, fire management in the woodland would evolve from a policy of complete suppression to a passive, prescribed natural fire policy, as continued drought and beetle induced tree thinning promote more continuity in live and dead fuel components. Depending largely on future fuel structures in drought impacted woodland systems, various types of fire behavior are possible, but one potential outcome could be an increase in the frequency and size of high, although still patchy, severity fire, and subsequent invasion of these high severity burn patches by invasive weeds (primarily cheat grass which is present within the park). Although hypothetical, increased potential for high severity fire and subsequent colonization of the burn patches by noxious weeds be considered to present minor to moderate, long- term, adverse effects.

Recent, large- scale piñon mortality may contribute to an increase in patchy and heavy fuel loading, resulting from accumulations of piñon litter, branches, logs, snags, along with pulsed, weedy herbaceous growth on nutrient rich former piñon (canopy mound) sites. While this provides a potential for increased wildfire activity, fires would be spotty with high severity burns localized to existing and former woodland patches, with discontinuous fuels between patches which would be expected to limit fire spread. Areas burned under these conditions would be expected to recover to some mixture of grass, forbs, and shrub cover depending on actual burn severity and pre- burn community composition, although severely burned areas and/or those with limited perennial understory cover may become susceptible to exotic weed invasion.

As noted above, the NPS is required to assess whether the degree of impact to a particular natural or cultural resource under each alternative considered has the potential to impair it. An impact to any park resource would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is: 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents. Based on a conservative extrapolation of recent monitoring data into the future, implementation of a No Action alternative has, and would continue to, result in long- term degradation of understory vegetation resources (i.e., cover and diversity of native, perennial, grass, forb, and shrub dominated communities within upland portions of the woodland) across an entire landscape, creating major, long- term impacts.

However, while open canopies and healthy perennial understory vegetation are key ingredients in the piñon- juniper woodland ecosystem at Bandelier, these resources are not named in the presidential proclamation that created the national monument and their restoration is not specifically spelled out as a goal in a Bandelier general management plan. Therefore, no impairment of park vegetation is anticipated.

CUMULATIVE IMPACTS

As noted above, cumulative impacts are additive, adverse or beneficial, impacts on the same resource that would be affected by the continuation of current management inside the monument. While cumulative effects as considered here are primarily human caused impacts, natural disturbances have also had, and will continue to have, large influences on the composition and structure of woodland vegetation in Bandelier and on the Pajarito Plateau.

The major historical effect within Bandelier and on the Pajarito Plateau on woodland vegetation has been grazing by domestic livestock (i.e., cattle and sheep) beginning with Euro- American settlement and intensifying ca. 1850. Sustained grazing pressure is thought to have reduced grass competition and allowed woodland trees to successfully establish into intercanopy spaces, savanna openings, and adjacent communities. Although domestic livestock grazing inside the monument ended after 1940, continued grazing effects within the woodland have been experienced as a result of feral burros (through mid- 1980s) and subsequently by resident deer. Grazing is thought to have reduced fine fuels and the potential for fire disturbance which formerly maintained openings by periodically eliminating successful tree reproduction. Conversely, periodic drought, and associated beetle mortality can act to reduce tree cover across the woodland, and these natural disturbances may set the stage for temporary increases in fuel load and continuity which could increase frequency and severity of any fire.

Much of the Pajarito Plateau woodland has a similar history to Bandelier and is in a comparable degraded state; however, there can often be great variability in observed or potential effects on vegetation due to small differences in site conditions. Continuing current management (e.g., No Action) within Bandelier would mirror current and future management on most lands within the larger Pajarito Plateau woodland. Openings dominated by native perennial grasses, forbs, and shrubs within the woodland are currently infrequent and with continued tree encroachment these openings and associated plant communities could become relatively rare on the regional landscape. Moreover, progressive loss of soil and remnant plant materials are expected to reduce future opportunities for successful restoration. Only limited management activities within the larger regional landscape are currently planned that would materially affect vegetation within the woodland. These efforts include active woodland thinning to promote grass recovery, ongoing or proposed hazard fuel reductions, and other range improvement treatments on adjacent lands (i.e., Caja del Rio on Santa Fe National Forest and Los Alamos National Laboratory). These actions could act to maintain viable, although small and scattered, patches of grass dominated communities within the larger woodland, and could help preserve seed sources if some future events remove tree cover and make sites available to recolonization by grasses. This does not change the fact that sustained woodland dominance would (in many settings) yield irreversible losses of soil and site productivity. In general, it is anticipated the woodland understory vegetation would continue to slowly degrade, or in some locations stabilize at current degraded levels, as tree dominance continues and facilitates ongoing system desertification.

CONCLUSION

In summary, the No Action alternative would result in long- term, indirect, major, adverse effects on the perennial understory cover through continued competition with overstory trees, while runoff and soil erosion processes associated with high density woodland would continue to degrade site conditions necessary to support an effective herbaceous cover. There may also be long- term, indirect, minor, adverse effects on woodland trees through increased competition for water and nutrients, while intercanopy site conditions continue to deteriorate, and long- term, indirect, minor to moderate, adverse effects on woodland through increased potential for patchy, severe, wildfire activity and subsequent weed invasion.

Alternative B—Operational Priority

Treating degraded mesa top piñon- juniper under either of the action alternatives is expected to result in major long- term or permanent beneficial impacts to the herbaceous understory across this vegetative type in the monument. Expected effects of the proposed restoration treatment on vegetation resources have been well documented by field trials conducted at multiple spatial scales and over time periods of three through ten years post- treatment (Jacobs, et al. 2002b; Hastings, et al. 2002). These expectations for desired future conditions in treated portions of the woodland are based in large part on conservative extrapolation of actual vegetative response documented within the monument's restoration study sites. An example of the type and degree of response to treatment is shown in Figure 23.

While recent drought mortality has dramatically changed overstory composition in woodland above 6,300 feet, results from past experimental restoration efforts are still applicable, and mechanical treatment is necessary to meet the stated objectives of this plan, including to "increase cover of native, perennial, herbaceous plants within degraded portions of the piñon- juniper woodland in order to reduce soil erosion, runoff, and loss of cultural resource integrity" and to "support a surface fire regime within the natural range of variability." The long- term, beneficial effects of restoration treatment on woodland vegetation would not be materially different between the two action alternatives, especially given the large scale of the project (see Figure 23). However, as noted below and in the analysis of Alternative C, the period required for treating woodland vegetation at the monument is shorter by a factor of four in this alternative (Alternative B). Because degradation would continue to occur during the treatment period and some piñon- juniper sites would be eroded beyond the ability of treatment to restore, it is likely that overall more vegetation would be treated in Alternative B than Alternative C.

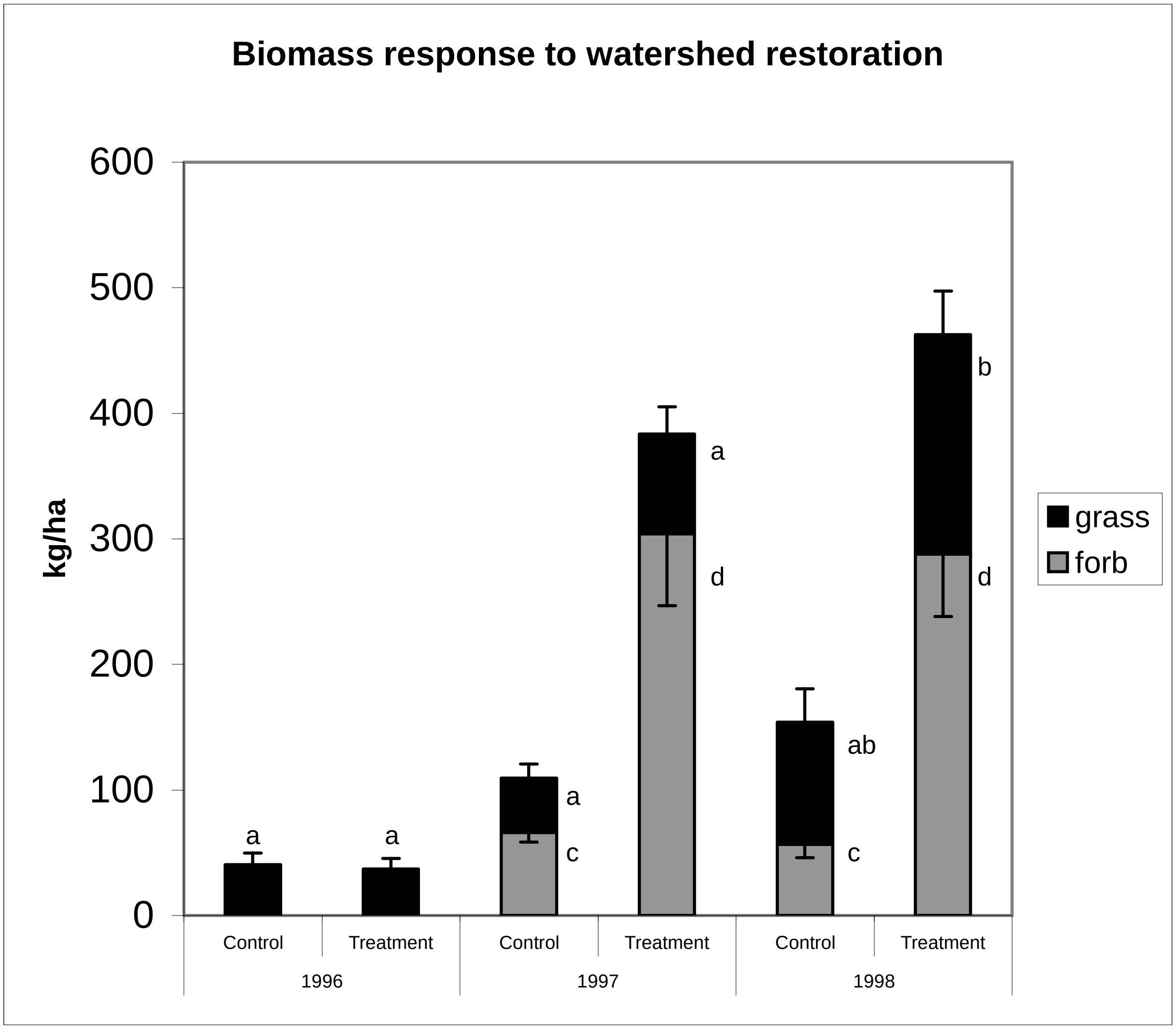

Figure. 23. Cumulative Mean Biomass (kg/ha) Across the Control and Treatment Watersheds (n=20) from 1996 (pre-treatment) to 1998 (two years of treatment) (Jacobs, et al. 2002b).

The relative impacts to vegetation of treatment in both Alternatives B and C on trees are determined by the restoration prescription and existing woodland stand structure (i.e., density of stems per size class). The general restoration treatment approach involves thinning out younger juniper and dead piñon and broadcasting the slash onto bare soil intercanopy areas. The basic prescription would remove live juniper less than eight inches (individual stem diameter) and dead piñon smaller than 10 inches (diameter at chest height); all remaining live piñon would be left. Thus the thinning that is part of the restoration prescription would have long- term, major adverse, effects on standing live juniper of <8" individual stem diameter and dead piñon of <10"diameter breast height (dbh). However, thinning would also likely produce short- term, minor, beneficial effects on remaining live woodland trees (piñon and juniper) due to reduced competition for water and nutrients from other trees, and from enhanced site conditions (e.g., retention of more precipitation inputs).

In addition to thinning, trees are lopped and distributed as a slash mulch to protect exposed soils, slow erosion, and promote understory growth. The degree of beneficial effects that treatment offers to understory vegetation (i.e., grasses, forbs, and shrubs) at a given site depends primarily on three factors: 1) pre- treatment herbaceous groundcover and composition, 2) soil resources, including structure, texture, organics, and seed, and 3) the density of smaller diameter trees available to provide slash for mulch. An acceptable understory response to restoration treatment can be expected on sites where: 1) sufficient slash mulch is available to evenly blanket exposed soils (i.e., covering >50% of bare soil intercanopy areas), 2) soils still retain sufficient structure and texture for retaining water and nutrient resources, and there is some seed available for germination in the soil seed bank, and 3) pre- treatment, perennial, herbaceous (i.e., grasses and forbs) understory exceeds 5% cover (Jacobs et al., 2002). Restoration treatment is expected to produce long- term, major, landscape- scale beneficial effects on understory (grasses, forbs, and shrubs) cover and diversity from reduced competition for water and enhanced site conditions.

On the basis of coarse scale soil and topographic data, it is estimated that a total of ~4,000 acres (out of total 8,000- 10,000 acres of woodland at Bandelier) are potentially treatable using mechanical thinning and slash mulch methods. However, prior to any actual treatment, all proposed restoration project areas would be evaluated onsite using the criteria outlined above. Areas lacking in any of the three basic criteria (i.e., herbaceous cover, soil characteristics, and young tree density) where sufficient slash mulch cannot be generated; perennial herbaceous understory is <5% cover; or soils are severely degraded and lack minimal organic, nutrient, seed bank, structural and textural qualities, would be removed from consideration for basic treatment. Selected high value areas which would otherwise be untreatable could still be considered for treatment with additional inputs required to overcome existing site deficiencies (i.e., additions of seed, erosion fabric, etc.).

Fuel loading and fine fuel continuity would both increase as a result of restoration treatment; however, while fuel loads would be higher short term due to thinning and slash treatments, they would be more evenly distributed, reducing duration, intensity, and adverse effects of fire as compared to the No Action alternative. This altered fuel structure would be expected to support lower severity fires, and with fewer adverse impacts on herbaceous vegetation and woodland trees than under the No Action alternative. Therefore, while short- term, moderate, adverse effects of fire on vegetation (i.e., leave trees and recovering understory) may occur (as they would under No Action) from increased fuel loading primarily due to application of slash mulch, longer- term effects are anticipated to be minor and beneficial, primarily through mitigation of potential for patchy crown fire behavior and negative changes in vegetation associated with post- fire woodland.

Prior to the recent multi- year drought, there was some potential for fresh cut piñon slash to attract Ips beetles, which might secondarily increase the incidence of beetle mortality of larger diameter piñon trees left uncut; however, this is no longer a concern given >90% mortality of piñon within the monument (from drought and beetles) and a prescription which retains all remaining live piñon. There is no evidence to suggest that juniper slash would attract and support levels of pests or pathogens that would subsequently threaten larger diameter, juniper or piñon trees.

Workers and pack animals can cause a variety of impacts to vegetation including localized trampling of vegetation, compaction of soils, transport of weed seeds, and creation of unofficial trails. While both action alternatives would generate localized impacts on vegetation at work, camp, and transit route locations (primarily from trampling effects), the sustained intensity of Alternative B (with relatively less time for recovery between impacts) would potentially produce more lasting damage to vegetation, given the combination of more crews, additional logistical support (i.e., horse packing and helicopter impacts), and shorter time frames. In addition to increased trampling and grazing pack animals may cause, they are also a major vector for introduction of exotic vegetation into backcountry locations. The combination of ground disturbance, exotic weed seed introduction, and nutrient enhancement from horse droppings may allow exotic plants an opportunity to establish along trail corridors and at disturbed backcountry locations. These impacts are expected to be short- term, adverse and minor in intensity, and to be primarily focused on herbaceous vegetation at work camp sites and along routes used by work crews and pack stock. However, the additional adverse effects attributable to increased crew size and associated activities would be minor compared to the large- scale beneficial effects of treating additional acres in a timely manner.

While both action alternatives could potentially treat up to 4,000 acres (i.e., the maximum number of acres identified as potentially suitable for treatment on basis of coarse scale mapping data), as noted above the actual number of acres treated under Alternative B would likely be higher than for Alternative C. The single most important consideration is the longer time period over which treatments would occur under Alternative C. Since losses of soil and understory vegetation are ongoing and progressive, the number of potentially treatable acres continues to decline with time, with the result that relatively longer implementation windows could affect how many acres are ultimately treatable and treated.

Under either action alternative, monitoring and adaptive management approaches (see Appendix B) would enable changes in site conditions, unexpected responses to treatment, and other pertinent information to be incorporated into planning of ongoing and proposed restoration activities.

No impairment of park vegetation is anticipated.

CUMULATIVE IMPACTS

Increases of suitable forage within treated areas can be expected to attract and support increased grazing and browsing pressure from deer; however, while ungulates could potentially affect grass species composition (through selective grazing of cool season grasses), it is not expected that ungulate herbivory will have measurable effects on total herbaceous response or restoration success.

Successful implementation of either action alternative at Bandelier is expected to have minor beneficial effects when viewed in the context of the larger regional scale of the Pajarito Plateau; however, restoration and maintenance of even small areas can provide suitable and sustainable habitat for increasingly uncommon vegetation types and associated species, and may ensure availability (of local sources) of propagules for re- establishment of these species into other areas.

Within the regional context, there are sites subjected to various restoration and thinning treatments. Cumulatively, small areas like Bandelier, in combination with ongoing or proposed fuel reduction and range improvement treatments on adjacent lands (i.e., Caja del Rio on Santa Fe National Forest and Los Alamos National Laboratory), can maintain viable grass dominated communities within the woodland, and these can serve as seed source for other areas at future points in time given disturbance which removes overstory and assuming sufficient site productivity (i.e. soil) still remains.

The potential for positive, additive or synergistic effects on vegetation from restoration treatment and from proposed actions described in the monument's recent *Fire Management Plan* (NPS 2005a) is substantial. During treatment, the monument would continue to maintain a fire suppression policy for the woodland for a period of at least 10 years post- mechanical treatment in order to allow herbaceous (grass and forb) vegetation adequate time to establish and recover (i.e., minimum 10% perennial grass basal coverage is pre- requisite for initiating prescribed fire actions), while also ensuring heavy slash fuels have had sufficient time to break down and minimize potential adverse effects from intense fires on recovering herbaceous vegetation. After 10 years and when perennial grass cover is sufficiently recovered, it may be possible to introduce prescribed fire either actively, or passively in the context of Wildland Fire Use (allowing naturally ignited fires to burn). Either approach could become feasible as fuel continuity is enhanced at patch and landscape scales, and if properly implemented could help create and sustain open or patchy woodland savanna systems while consuming excess slash. Actions under either action alternative could be expected to mitigate both potential for patchy, high severity fire and subsequent colonization by exotic weeds, as detailed for the No Action alternative.

CONCLUSION

In summary, impacts are anticipated to be: 1) long- term, major adverse, effects on standing live (juniper) and dead (piñon) woodland trees greater than 8 – 10- inch stem diameter, from implementation of restoration thinning prescription; 2) residual short- term, moderate, adverse effects on vegetation (i.e. leave trees and recovering understory) from increased fuel loading and potential for wildfire activity due to slash mulch that are the same as for No Action; 3) long- term, minor benefits from reduced potential for severe wildfires compared to No Action; 4) long- term, major, beneficial effects on understory (grasses, forbs, and shrubs) cover and diversity from reduced competition for water and enhanced site conditions; 5) short- term, minor, beneficial effects on live woodland trees (piñon and juniper) from reduced competition for water and enhanced site conditions; and 6) short- term, minor, adverse effects on herbaceous vegetation from work camp sites and routes used by work crews and pack stock including localized trampling of vegetation, compaction of soils, transport of weed seeds, and creation of unofficial trails. No impairment of park vegetation would occur under this alternative.

Alternative C—Phased Approach

While both alternatives could potentially treat up to 4,000 acres (i.e., the maximum number of acres identified meeting criteria for treatment) and result in major, long-term benefits for monument vegetation, the actual number of acres treated under Alternative C would likely be less given several considerations. For example, since implementation of treatments would be extended over a longer timeframe under Alternative C and losses of soil and understory vegetation are ongoing and progressive, some loss of current treatable acres is expected. Every year some fraction of potentially treatable acres would likely exceed the minimum site integrity thresholds required for treatment, and become essentially unrecoverable (i.e., no longer meeting minimum criteria, and with insufficient soil and plant materials to enable an acceptable response to treatment). Upland mesa areas most likely to become unrecoverable within the 20- year timeframe of this proposal. These areas are located at lower elevations and at the southern end of the monument. While the exact number of acres for which treatment potential is lost over the 20- year time period of this alternative is not known, the general trend is clear and provides some impetus for expedited implementation of restoration.

Conversely, since the number of crews, foot and horse traffic along trails and routes, and/or duration or intensity of trampling impacts would all be lower under Alternative C, considerably fewer sustained adverse effects on vegetation are expected (because of longer recovery periods between impacts) from these sources when compared with Alternative B.

Under Alternative C, short- term, minor, adverse effects are expected on herbaceous vegetation at work camp sites and along routes used by work crews and pack stock, with a range of possible impacts including: localized trampling of vegetation, compaction of soils, transport of weed seeds, and creation of unofficial trails. Although these impacts would be short- term and, like Alternative B, would be minor in intensity, they would be less severe than those for Alternative B.

Otherwise, the effects of Alternative C on monument vegetation would be similar to those in Alternative B. These effects include potential major adverse impacts to individual trees in piñon- juniper woodland that would occur as a result of thinning, and minor benefits to remaining trees from reductions in competition for water and nutrients.

Lopping and scattering branches would leave burnable slash on the ground, and this may result in a moderate adverse impact to vegetation in the form of localized severe fires during the short term (e.g. while slash remains on the ground). Because slash would be more evenly distributed than in the No Action alternative (where dying piñon pines fall or remain standing as an uneven fuel source), the danger of severe fires even in the short term would be less. However, in the long term, minor landscape- scale beneficial impacts to vegetation from the return of cooler surface fires and reduced risk of severe wildfires would occur as the understory is restored

Under either action alternative, monitoring and adaptive management approaches (see Appendix B) would enable changes in site conditions, unexpected responses to treatment, and other pertinent information to be incorporated into planning of ongoing and proposed restoration activities.

Impairment of park vegetation is not expected to occur under Alternative C, although the long timeframe to complete treatment means it is more likely that less piñon-juniper would be restored than under Alternative B.

CUMULATIVE IMPACTS

Successful implementation of Alternative C would have minor beneficial effects, when viewed in the context of the Pajarito Plateau, similar to those previously described for Alternative B. The extended time frame of this alternative, however, would potentially increase the probability for various adverse or beneficial effects at regional scales. For example a longer implementation window might allow restoration actions to be better coordinated with other agencies or implemented with favorable climatic patterns; conversely, changing actions or conditions over longer time frames (i.e. introduction of new invasive species) on adjacent lands might limit success or feasibility of restoration treatments within the monument.

CONCLUSION

In summary, impacts to vegetation under this alternative include: 1) long- term, major, adverse, effects on standing live (juniper) and dead (piñon) woodland trees greater than 8 – 10- inch stem diameter from implementation of restoration thinning prescription; 2) short- term, moderate adverse effects on the woodland from increased potential for wildfire activity; 3) long- term, minor benefits from reduced potential for severe wildfires; 4) long- term, major, beneficial effects on understory (grasses, forbs, and shrubs) cover and diversity from reduced competition for water and enhanced site conditions (but occurring across fewer total acres than for Alternative B); 5) short- term, minor, beneficial effects on live woodland trees (piñon and juniper) from reduced competition for water and enhanced site conditions; and 6) short- term, minor, adverse effects (but relatively less than for Alternative B) on herbaceous vegetation from localized trampling of vegetation, compaction of soils, transport of weed seeds, and creation of unofficial trails around work camp sites and routes used by work crews and pack stock. No impairment of park vegetation would occur.

SOIL AND WATER RESOURCES

Laws, Regulations and Policies

Soil and water are fundamental natural resource components whose integrity is addressed within the scope of numerous NPS policies and guidelines, specifically Chapter 4, Natural Resource Management, Sections 4.6 (e.g., Water) and 4.8 (e.g., Soils) in NPS *Management Policies 2006* (NPS 2006a). Section 4.8.2.4 states "Management action will be taken by Superintendents to prevent- or if that is not possible, to minimize- adverse, potentially irreversible impacts on soils". The policies specifically direct parks to prevent the "unnatural erosion, physical removal, or contamination of the soil or its contamination of other resources" and to prevent or minimize "adverse, potentially irretrievable impacts to soils" (Section 4.1.5).

Methodology

The assessment of impacts uses the general methodology described above and the resource specific information presented here. The area of analysis includes the monument and the watershed of the Pajarito Plateau. The primary sources of information used to evaluate potential adverse or beneficial effects on soil and water resources include results from long- term monitoring and experimental studies conducted at the monument, as well as input from researchers with expertise in woodland ecology, pertinent scientific literature, and the professional judgment of monument resource specialists.

Effects on soil and water resources are relative to treatment and expected treatment response, where restoration treatment increases effective cover (i.e., litter, slash, and herbaceous cover) and expected response is a reduction in runoff and sediment transport.

Definitions used to assess the intensity of impacts are defined below:

Negligible: The effect of the action on bed sediment production, percent exposed bare soil or litter/ slash cover, runoff, or suspended sediment is at or below the lowest levels of detection, and are not apparent even to a skilled observer.

Minor: The effects of the action on soils and water quality are slight, and not readily apparent to a skilled observer. Changes in bed sediment production, percent exposed bare soil, runoff, or suspended sediment between treatment and control areas, or post- treatment relative to pre-treatment, are no greater than one- to two- fold.

Moderate: The effects of the proposed action on soils and water quality are readily apparent to a skilled observer. Changes in bed sediment production, percent exposed bare soil, runoff, or suspended sediment between treatment and control areas, or post- treatment relative to pre- treatment, are two- to four- fold.

Major: The effects of the proposed action on soils and water quality are severe or of exceptional benefit. Changes in bed sediment production, percent exposed bare soil, runoff, or suspended sediment between treatment and control areas, or post- treatment relative to pre- treatment, are greater than four- fold.

Impairment: An impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is: 1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Short- term impacts are resolved within five to ten years, and long- term impacts continue beyond 10 years.

Alternative A—No Action

Exposed (bare) soil surfaces without the protective cover of litter, slash or vegetation are common in the intercanopy of degraded woodland systems at the monument and in the region, and the extreme hydrologic processes associated with these desertified conditions have been the subject of intensive study at Bandelier for nearly fifteen years (see *Affected Environment* for a description of this desertification process). These exposed soils are especially vulnerable to wind erosion during the dry spring (April- June) months and surface runoff erosion from intense monsoonal thunderstorm activity during rainy summer months (July- August). Bare soil surfaces are also subject to heaving by extremes of temperature and humidity (i.e., during late spring snow melt saturated soil is repeatedly frozen by cold night temperatures and subsequently baked by warm afternoon sun) giving the soil surface a patterned and fluffy appearance. This reduces bulk density and makes soil more susceptible to wind erosion or rain drop splash mobilization and subsequent transport by surface runoff. Both wind and water transport of soil are processes that are active in bare soil intercanopy locations. However, while runoff moves sediment primarily to lower gradient settings, wind may preferentially deposit sediments into canopy locations. The interaction of these two erosional processes can create the commonly observed mounded topography in woodland where runoff lowers and entrains intercanopy locations and wind deposition (in combination with canopy litter deposition) creates topographic highs on canopy mounds.

Exposed soil surfaces can exceed 80% cover in many woodland intercanopy areas (unpublished LTER data for 1993), and this large expanse of exposed soil can generate runoff transported sediment yields exceeding 2.5- 4.0 Mg/ha/year (i.e., Mg units are millions of grams and data is collected at 1/10th hectare scales). Sediment production can be visualized in a very general sense as vertical soil erosion rates of ~3.5 millimeter to 4 (mm) per decade from these upland intercanopy areas (Jacobs, et al. 2002; Hastings, et al. 2002). Projected into the future, this translates into a generalized soil loss rate of 3.5 to 4 centimeters (cm) per century due to water transported sediment; this is an unsustainable rate of loss given relatively shallow soils and inherently low rates of new soil formation under current climatic conditions. Even more critical for intercanopy locations is the realization that the upper soil layers, which are lost first, contain most of the attributes (i.e., organics, nutrients, seed, etc.) necessary for successful recovery. This realization suggests that many sites will lose their restoration potential long before all of the soil material is stripped away. Therefore, the window of opportunity for restoration of many areas is rapidly passing, and every year additional acreage will lose some measure of restoration potential. At a landscape scale, runoff and erosion of soils at one location are somewhat canceled by deposition at another. This is because there are no rivers or streams on the plateaus where treatment will be conducted, and soil which is lost from erosion is deposited as the slope decreases. The estimates are representative of what might be measured on any small (smaller than a hectare, for example) plot, but because of non- linear scale effects, would yield gross overestimates if simply extrapolated to the larger landscapes.

When a storm occurs, the bulk of this sediment (i.e., coarse fraction) is transported along the soil surface (i.e., bed sediment) while a much smaller proportion (i.e. fine fraction) is actually suspended in the surface water column (i.e., suspended sediment) of sheet or gully wash. A small 1/3 hectare test plot study found that, for one storm, about 63 cubic feet of water transported 22.5 kg (kilograms) of suspended sediment (see Figure 18 in *Affected Environment*), for an average sediment concentration of 12.6 milligrams per liter sampled. This same event likely moved much larger quantities of surface sediment (i.e., not suspended in water column), but surface sediment yields were not measured. Overall, because there are no permanent water bodies, the impact of increasing suspended sediment in surface water flowing as sheet or gully wash is short- term and minor in intensity.

For any particular event, storm intensity is probably a better predictor of sediment transport than total precipitation; that is, short, high intensity pulses of water are required to mobilize and transport sediment. Because the topography and soil and vegetative cover is spatially and temporally heterogeneous, actual runoff and soil movement are irregular, focused enough in some areas to create channels, and exceeding available soil depth in others where they will create areas of exposed rock. Other locations will be only minimally affected; for example down slope, lower gradient settings are likely to be depositional areas, receiving additional sediment and water inputs from eroding upslope areas. No permanent water sources would be materially impacted under this or any of the analyzed alternatives, since the relevant sediment transport and associated water quality impacts discussed are essentially local processes occurring within upland areas.

Under the No Action alternative, exposed soils would continue to dominate woodland intercanopy spaces, with runoff patterns and soil erosion rates comparable to or greater than those measured during the previous fifteen years. Movement of water and soil occurs primarily during high intensity precipitation events and within local landscape positions; i.e., soil and water resources are not really lost from the system, but are instead redistributed from bare soil intercanopy locations to adjacent canopy locations or to adjacent lower gradient (i.e., depositional) positions. Feedback loops of soil erosion and runoff can be expected to reinforce woodland desertification processes, where decreasing quantity and quality of mesa top soil resources support increasingly less effective herbaceous cover. Redistributed water would continue to be focused to tree canopy locations and low gradient positions.

Changes in soil texture would continue to variously influence runoff and infiltration patterns; silting and clogging of soil pores can limit infiltration and promote runoff, while removal of fine and organic soil components by wind and water erosion would act to increase coarse fractions and allow water to infiltrate to depths unavailable to herbaceous plant roots. This degraded hydrologic landscape in turn would yield higher levels of runoff during subsequent rain events (of comparable intensity), with increased capacity to erode and transport sediments. In short, desertification is a redistribution of soil, water, and nutrient resources where intercanopy locations are losing resources (in effect getting poorer) and canopy and lower gradient depositional locations are gaining them (i.e. getting richer). While recent, drought induced, piñon mortality has dramatically altered vegetation in woodland areas above 6,300 feet, these changes are not expected to notably improve hydrologic function (i.e., reduce runoff) in these systems.

Based on a conservative extrapolation of recent monitoring data into the future, implementation of a No Action alternative would result in extensive impacts to soil resources within upland portions of the woodland. Ongoing desertification processes are already irreversible in many areas, with redistribution of soil resources to canopy and lower gradient depositional locations. Implementation of the No Action alternative would allow accelerated runoff and sediment transport processes to degrade upland (intercanopy) soil resources beyond recovery across a large portion of the woodland, resulting in major, adverse impacts.

Soil is a resource that is key to the natural integrity of the woodlands at the monument. However, it is not a resource or value named in the presidential proclamation creating the monument and its preservation is not called out as a goal in a monument general management plan. Therefore, although woodland soils would continue to sustain landscape scale losses and major adverse impacts, they would not be impaired as defined by the Organic Act and NPS Management Policies (NPS 2006).

CUMULATIVE IMPACTS

The generally degraded condition of many areas within the piñon- juniper woodland, both in Bandelier and on the surrounding Pajarito Plateau, is thought to be largely due to historic grazing effects beginning around 1850. Grazing levels were reduced on many areas after 1940 for a variety of reasons including insufficient forage, changes in market conditions, and protection of lands from grazing (i.e., within National Parks, LANL and adjacent portions of National Forest lands). However, physical and biological changes initiated by grazing disturbance continue, even after its cessation, as systems proceed along new ecological trajectories. As degraded, former rangelands become increasingly tree dominated, shrub and herbaceous understories are progressively suppressed, while accelerated runoff and sediment transport processes permanently alter soil and hydrologic conditions. Thus, the cumulative effects of historic land use across the regional scope of the project area are similar, and a No Action alternative would allow for a continuation of current dynamics across the entire landscape, including at Bandelier.

Recent and future drought, insect, and fire disturbance events do have the potential to dramatically affect system dynamics in the monument and across the region, but adequate modeling of their long- term future effects is not possible due to the lack of information about landscape scale responses to these events. For example, the loss of piñon pine from drought and insect infestations may variously mitigate the erosion by eliminating competition for moisture and light for understory species, or exasperate it by increasing the possibility of high severity fire behavior and the loss of vegetation altogether. In other words, ongoing dynamics of system degradation, and effects of past events (e.g., 1950s drought) may or may not be representative of future system response or its cumulative impacts on soils and water resources across the region.

Under the No Action alternative, there are no ongoing or planned management activities that would materially contribute to existing systems dynamics (i.e., effects on soils or water quality) beyond those already discussed.

CONCLUSION

In summary we expect: 1) long- term, major, indirect, adverse, effects on soil resources, specifically erosion and redistribution of productive soils from upland, intercanopy locations and deposition in lower gradient down slope positions, and 2) long- term, minor, indirect, adverse effects on water resources, specifically redistribution of water inputs, and increased turbidity of runoff and bed sediment transport during high magnitude events.

Alternative B—Operational Priority

Expected effects of the proposed restoration treatment on soil and water resources have been well documented by field trials conducted at multiple spatial scales and over time periods of three to ten years, as Figure 24 demonstrates (Jacobs, et al. 2002). Expectations for desired future conditions in treated portions of the woodland are based in large part on conservative extrapolation of actual soil response documented within these restoration study sites at the monument. As Figure 24 indicates, thinning and slash mulch restoration efforts can decrease runoff and sediment production from degraded upland woodland locations by two orders of magnitude (i.e., 100-

fold) as measured at 1/10th hectare scale; sediment yields were reduced from 2.5- 4.0 Mg/ha/yr to .03- .07 Mg/ha/yr (Hastings, et al. 2002). Although erosional responses measured at smaller scales cannot be simply extrapolated to or summed across larger landscape scales, they are nonetheless representative of the type of response that can be expected on upland sites given similar restoration treatment. A conservative estimate of the change in soil erosion across the treatable 4,000 acres of degraded woodland following restoration is that it would decrease two- to four- fold over current rates (as measured within 0.1 or 0.3 hectare plots, respectively). This anticipated reduction in erosion would produce long- term, moderate to major, beneficial effects on soil and water resources compared to No Action.

Drought induced piñon mortality has dramatically altered vegetation in woodland areas above 6,300 feet; however, this reduction in overstory alone (i.e., without benefit of slash mulching effects) is not expected to significantly improve hydrologic function (i.e., reducing runoff, sediment transport or enhancing infiltration) in these systems. Although the drought would produce dead piñons that fall and slow soil erosion temporarily, research at Bandelier indicates the presence of fresh, live needles on scattered branches is an important component of successful treatment and long- term results. Hydrologic results from past experimental restoration efforts (i.e., using live piñon slash) are therefore still clearly applicable in drought affected woodland, and additional mechanical treatment will likely be necessary to mitigate current unsustainable patterns of runoff and sediment production. The proposed treatment prescription would thin smaller diameter live juniper (<8" individual stem diameter) and dead piñon (<10- inch dbh), and broadcast slash as a surface mulch onto (>50% of) exposed bare soil surfaces. Although proposed restoration treatment prescriptions would apply less fresh slash than in experimental trials, the addition of larger amounts of dead piñon with slightly more aggressive thinning of live juniper is expected to provide comparable treatment response. This treatment could potentially decrease runoff and sediment production by an order of magnitude (i.e., ten- fold) or more on some sites, although given the heterogeneity of landscape conditions, the average response to treatment may only be two- to four- fold. Treatment would therefore result in moderate to major, long- term benefits for soils and hydrologic function in the woodland.

While both action alternatives would generate localized, short- term, minor, adverse impacts on soil at work, camp, and transit route locations (primarily from trampling effects), the adverse effects of Alternative B on soil resources would be potentially more long- lasting than those if Alternative C were implemented. These differences would be related to the combination of more crews, additional logistical support (i.e., horse packing), and shorter time frames (providing some areas which are likely to result in more intensive and sustained trampling effects and less time for recovery between trampling episodes). However, these small additional, and generally localized, adverse effects of Alternative B attributable to increased crew size and associated activities would be outweighed by the greater and more widespread beneficial effects of treating additional acres in a timely manner.

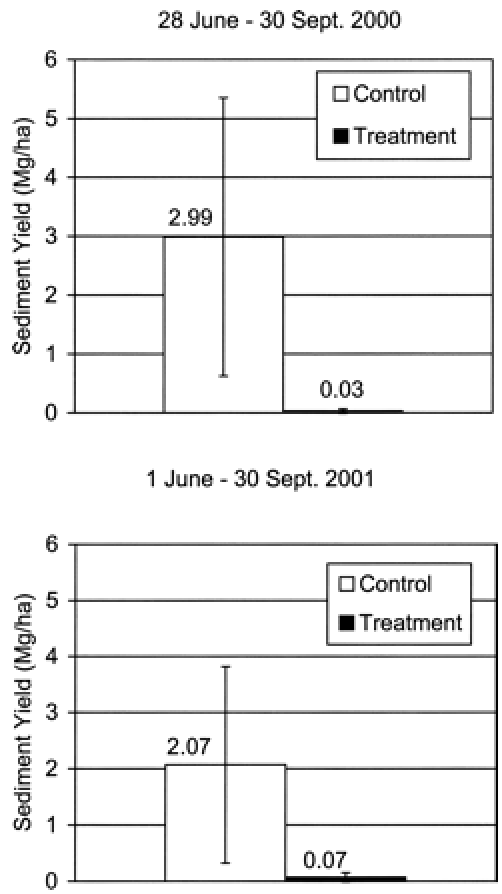

Figure 24. Seasonal Sediment Yields (Mg/ha) for Treatment (n = 6) and Control (n = 3) Microwatersheds, 2000 and 2001.
(Error bars represent one standard deviation. Source: Hastings, et al. 2002).

While the larger camps would also generate greater quantities of human waste, the location of camps on mesa tops away from streams and proper collection and disposal methods would mitigate any potential adverse water quality impacts so that they would be no more than negligible.

Under either action alternative, monitoring and adaptive management approaches (see Appendix B) would enable changes in site conditions, unexpected responses to treatment, and other pertinent information to be incorporated into planning of ongoing and proposed restoration activities.

No impairment of park soils or water resources is expected under this alternative.

CUMULATIVE IMPACTS

Successful implementation of either action alternative at Bandelier is expected have minor beneficial effects when viewed in the context of the larger regional scale of the Pajarito Plateau; however, restoration of even relatively small areas can positively influence adjacent areas. For example retention of soil and water on formerly degraded woodland sites within Bandelier may contribute to regional mitigation of wind erosion and water quality issues by demonstrating sustainable land management practices.

Under Alternative B, there are no ongoing or planned management activities that would materially contribute to cumulative effects on soils or water quality beyond those already discussed under the No Action alternative. At the regional landscape scale, no proposed actions are known for adjacent lands that would provide cumulative effects to soil and water resources in addition to those from proposed actions at Bandelier.

CONCLUSION

In summary, the anticipated impacts under Alternative B would be: 1) long- term, moderate to major beneficial effects on hydrologic function including mitigation of runoff and sediment production; 2) long- term, moderate to major benefits from reduced erosion rates; 3)) short- term, minor adverse effects to soils from trampling and soil compaction (e.g., camp areas, etc.), and 4) short- term, negligible, adverse effects on water quality associated with impacts created by temporary work camps. No impairment of park soils or water resources is expected under this alternative.

Alternative C—Phased Approach

As discussed under Alternative B, expected effects of the proposed restoration treatment on soil and water resources have been well documented by field trials conducted at multiple spatial scales and over time periods of three to ten years (Jacobs, et al. 2002, Hastings, et al. 2002). Currently, park specialists estimate there to be up to 4,000 acres of degraded woodland potentially suitable for restoration treatment which, when treated (i.e., thinned and slash mulched), would yield acceptable responses defined as at least a two- to –four- fold decrease in sediment production and runoff, as measured at one- tenth or one- third hectare scales, respectively, a moderate, long- term benefit to woodland hydrologic function and soils.

While both alternatives could potentially treat up to 4,000 acres (i.e., the maximum number of acres identified meeting criteria for treatment), the actual number of acres treated under Alternative C would likely be fewer given the factors as described above for *Vegetation*. Primarily, it is the longer timeframe for treatment that differentiates the alternatives and their impacts. Losses of soil and understory vegetation are ongoing and progressive, and every year some fraction of potentially treatable acres will likely cross over minimum site integrity thresholds required for treatment and become essentially unrecoverable (i.e., no longer meeting minimum criteria, and with insufficient soil and plant materials to enable an acceptable response to treatment). Upland mesa areas most likely to become unrecoverable within the 20- year timeframe of this proposal are located at lower elevations, and at the southern end of the monument. While it is unknown what the total numbers of acres per year which might be lost in this way (i.e., individual locations proposed for treatment must be evaluated on- site and changes in site potential may be triggered by episodic events like drought or intense rainfall), the general trend is clear and provides some impetus for implementation of restoration treatment sooner than later. The primary difference between Alternative C and Alternative B then is the actual number of acres ultimately treated (or treated successfully) given ongoing losses in restoration integrity.

Potential long- term benefits of restoration treatment to soil resources (reduced erosion rates) under Alternative C then, are similar to the other action alternative; however, the extended period of time (i.e., 20 years) over which treatment is planned for this alternative might result in a net loss of potentially treatable acres due to ongoing losses of soil from severely degraded sites. On a landscape scale, the loss of these sites would not change the degree of benefit as defined in the Methodology section. Therefore, although benefits to soils and hydrology may be less intense than in Alternative B, they would still be moderate to major in intensity.

Under Alternative C, short- term, minor, adverse effects on soil focused at work camp sites and along routes used by work crews and pack stock would occur. Although rated at the same level (i.e., short- term, minor), the relative magnitude of these adverse effects would be less than for Alternative B, despite the 20- year time frame for Alternative C. This is because camp use would be more spread out across the woodland, and only one crew would be working at a time.

The inappropriate or accidental disposal of human wastes and resulting soil or water contamination is also a remote possibility, although with mitigation is not expected to occur. If it did, impacts would be negligible and short- term.

Under either action alternative, monitoring and adaptive management approaches (see Appendix B) would enable changes in site conditions, unexpected responses to treatment, and other pertinent information to be incorporated into planning of ongoing and proposed restoration activities.

No impairment of park soils or water resources would occur if this alternative were implemented.

CUMULATIVE IMPACTS

Cumulative effects to vegetation under Alternative C are similar to those described under Alternative B.

CONCLUSION

In summary, the anticipated impacts soil and water resources are: 1) long- term, moderate, beneficial effects on hydrologic function including mitigation of runoff and sediment production; 2) long- term, moderate to major benefits to soils and hydrologic function from reduced erosion rates; 3) minor, adverse effects from trampling and soil compaction (e.g., camp sites); and 4) short- term, negligible, adverse effects on water quality associated with impacts created by temporary work camps. No impairment of park soils or water resources would occur if this alternative were implemented.

CULTURAL RESOURCES

As noted in the Affected Environment section, the only cultural resources that would experience an impact if the alternatives were implemented are archeological and ethnographic resources.

Laws, Regulations and Policies

There are several federal laws that concern cultural resources. The most comprehensive of these is the National Historic Preservation Act of 1966 (NHPA), but several others described in more detail below, also apply. NPS *Management Policies 2006* (NPS 2006) also provide guidance for management of cultural resources that is based on the legislation listed above as well as the NPS Organic Act, the Redwood Act, other proclamations, executive orders, and regulations as listed in the Cultural Resource Management Handbook accompanying Director's Order 28. Compliance with §106 of the National Historic Preservation Act (NHPA) will be completed through a separate Programmatic Agreement (PA) negotiated with the New Mexico State Historic Preservation Office (SHPO) and the with the Advisory Council on Historic Preservation (Council) in accordance with the Council's regulations implementing §106 of the National Historic Preservation Act [NHPA (36 CFR Part 800, Protection of Historic Properties)](Appendix C). Consultation with concerned Native American groups has also been initiated and will be continued to help ensure no adverse impacts occur to ethnographic resources from the alternatives.

Native American Graves Protection and Repatriation Act of 1990 (NAGPRA): This statute requires land managing agencies to consult with American Indian tribes regarding human remains, associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony.

Archeological Resources Protection Act of 1979 (ARPA), as amended: ARPA strengthened the permitting procedures required for conducting archeological fieldwork on federal lands, originally mandated by the Antiquities Act. It also establishes more rigorous fines and penalties for unauthorized excavation on federal land.

American Indian Religious Freedom Act of 1978 (AIRFA): AIRFA states that it is the policy of the United States to protect and preserve the inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians. This includes, but is not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.

Executive Order 13175. Consultation and Coordination with Indian Tribal Governments (November 6, 2000): This Executive Order seeks to establish regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the

United States government- to- government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

Executive Order 13007. Indian Sacred Sites (May 24, 1996): This Executive Order requires that each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.

Executive Memorandum. Government- to- Government Relations with Native American Tribal Government (April 29, 1994): This Memorandum places emphasis on the fact that the United States government has a unique legal relationship with Native American Tribal governments as set forth in the Constitution of the United States, treaties, statutes, and court decisions. As executive departments and agencies undertake activities affecting Native American tribal rights or trust resources, such activities should be implemented in a knowledgeable, sensitive manner respectful of tribal sovereignty. The Memorandum outlines principles that executive departments and agencies, including every component bureau and office, are to follow in their interactions with Native American tribal governments. The purpose of these principles is to ensure that the federal government operates within a government- to-government relationship with federally- recognized Native American Tribes.

NPS- 28: Cultural Resource Management Guideline (NPS 1998). Effective Date: June 11, 1998: Ethnographic Resources: NPS plans should consider the privacy of traditional user groups and their desire to continue cultural activities without intrusion from visitors. Proposed actions should, to the extent possible, avoid sacred places. Tribal leaders and elders should be consulted regarding appropriate lands they use or value.

CEQ regulations and the National Park Service's Director's Order 12 (NPS 2001a) also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (e.g., reducing the intensity of an impact from major to moderate or minor).

Methodology

Archeological Resources

Impacts to archeological resources were identified and evaluated by 1) determining the area of potential effects; 2) identifying cultural resources present in the area of potential effects that are either listed on or eligible to be listed on the National Register of Historic Places (National Register), or identified as traditional cultural properties by affiliated tribes; 3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed in the National Register; and 4) considering ways to avoid, minimize, or mitigate adverse effects.

As noted in *Affected Environment*, archeological sites were assigned a significance value based on data potential. Data potential refers to the scientific research value of a site, specifically its ability to provide information important to understanding the prehistory or history of a region (NPS 2005b:53 *asmis data dictionary)*. This potential was determined by examination of site documentation that included a description of all features on a site, artifact analysis sheets, photographs, and a site map by an archeologist meeting the Secretary of Interior's standards (NPS 1998, Appendix E). Criteria for determining data potential included: 1) relative rarity of a particular site type or time period represented, 2) quantity and diversity of artifacts based on surface indications, and 3) whether the site relates to prehistoric or historic themes that are significant either nationally or regionally. A significance level (SL) value of "1" was assigned to unique site types (pueblos with more than 200 rooms) or sites dating to rare time periods (Paleoindian sites). A value of "2" was assigned to rare site types (pueblos with 100 to 200 rooms), sites relating to time periods underrepresented in the archeological record (Archaic sites), and sites with diverse artifact assemblages including items of long distance trade (Ancestral Pueblo sites with non- local pottery, lithic scatters with non- local raw materials). A value of "3" was assigned to sites that may not be significant on their own, but viewed in a larger context of other similar sites, provide important information. A value of "4" was assigned to sites that relate to historic themes that are not regionally or nationally significant, contain few artifacts, or exhibit no other features.

Because it is comprehensive, terms in the National Historic Preservation Act (NHPA), particularly Sections 106 and 110, were used in developing impact thresholds. The thresholds of change for intensity of an impact are defined below at the individual site level and also for the population as a whole of sites located in the project area. Consideration of the potential impacts to the project area as a whole is as important as consideration of individual sites because Bandelier National Monument is listed on the National Register of Historic Places for the sum total of unique archeological resources that occur in high densities within its boundaries.

The use of the word "adverse" when describing impacts to cultural resources carries a specific meaning under the NHPA that is different from how the same word might be interpreted under NEPA and in the rest of this document. For example, "adverse" simply means a negative impact when discussing impacts to resources other than cultural resources. However, in the NHPA 106 consultation process, an "adverse" impact means consultation with the State Historic Preservation Officer is triggered. Both NEPA and NHPA interpretations are provided in this EIS.

Duration of Impact

Short- term: Due to the non- renewable nature of unknown prehistoric, Ancestral Pueblo or Euroamerican archeological artifacts, sites and features, adverse impacts are all permanent. However, beneficial impacts may be of short duration if the effects are only sustained for up to 10 years.

Long- term: Due to the non- renewable nature of archeological resources, adverse impacts represent permanent or irreparable changes in unknown prehistoric, Ancestral Pueblo or Euroamerican archeological artifacts, sites and features. Beneficial impacts may be long- term if the effects are sustained for greater than 10 years.

Type/Intensity of Impact

Negligible: Impact is at the lowest levels of detection with neither adverse nor beneficial consequences. The determination of effect for NHPA §106 would be *no adverse effect*.

Minor: *Adverse:* disturbance of a site(s) results in little, if any, loss of integrity. The determination of effect for NHPA §106 would be *no adverse effect*.

Beneficial: Maintenance of current site(s) stability and mitigation of immediate threats (threat timeframe of less than 2 years). Although only the most immediate of threats are addressed, the benefit to the archeological resources would range from short- to long- term. The determination of effect for NHPA §106 would be *no adverse effect*.

Moderate: *Adverse:* Prior to implementing mitigation measures beyond those identified in the programmatic agreement disturbance of a site(s) results in loss of integrity, which would be a long- term effect. A memorandum of agreement document is executed among the National Park Service and applicable state or tribal historic preservation officer and, if necessary, the Advisory Council on Historic Preservation in accordance with 36 CFR 800.6(b). Measures identified in the agreement to minimize or mitigate adverse impacts reduce the intensity of impact under NEPA from moderate to minor or negligible. Following mitigation, the determination of effect for NHPA §106 would be *no adverse effect*.

Beneficial: Maintenance of a site(s) and mitigation of short- term (within five years) threats. Threats to integrity over a time span of greater than 10 years are not addressed. Although only short- term threats are addressed, the benefit to the archeological resources would range from short- to long- term. The determination of effect for NHPA §106 would be *no adverse effect*.

Major: *Adverse:* Disturbance of a site(s) results in loss of integrity, a long- term effect. The determination of effect for NHPA §106 would be *adverse effect*. Measures to minimize or mitigate adverse impacts cannot be agreed upon and the National Park Service and applicable state or tribal historic preservation officer and/or Advisory Council are unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b).

Beneficial: Stabilization of a site(s) through active intervention. Stabilization refers to the mitigation of threats to its integrity over a period of greater than 10 years. This would have both short- and long-term effects. The determination of effect for NHPA §106 would be *no adverse effect*.

Impairment: A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of (park name); (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant National Park Service planning documents.

Using these thresholds, impact analysis was conducted using qualitative data on a 28% random sample of recorded sites within the project area. These qualitative data were collected in 2002 and 2003 using protocols designed to record current site condition information, particularly as it relates to erosion. The protocols included the collection of quantitative data that will be used as a baseline for future monitoring under this plan.

An additional caveat of this analysis is that it only involves data collected on 28%, or 446 sites out of 1596 in the project area. The results for the 28% sample can be extrapolated to the total, but it is emphasized that this is a statistical estimate of the likely outcome.

To quantify the percentage of sites within the project area likely to have their NRHP eligibility jeopardized by accelerated erosion, the available data on 446 randomly selected sites within the project area were examined to determine 1) in which treatment sub- basin they fall, 2) in which treatment year they are scheduled for treatment, 3) what their observed level of NHRP significance is, 4) what their level of depositional integrity is, and 5) the number of years estimated before their depositional integrity is expected to be impacted. This was conducted for both action alternatives, while only the last three were considered for the No Action alternative. A similar procedure was undertaken for all alternatives to estimate the number of sites that would be beneficially impacted by each alternative. As discussed in the *Alternatives* section, the No Action alternative would involve ad hoc treatment of a small number of sites over the lifespan of this plan. Sites were counted as having an increased chance of having their NRHP eligibility jeopardized if they were not slated to be treated before their observed threat timeframe had elapsed and their depositional integrity was already at level 4 (1- 25% intact). Sites were counted as having an increased chance of being stabilized through treatment if they were treated before their observed threat timeframe had passed, or if it had passed, if their depositional integrity level was initially above level 4. These data were quantified by NRHP significance level and by proposed treatment year.

Ethnographic Resources

Because of the nature of ethnographic resources and other culturally sensitive areas, the impact analyses are qualitative in nature and, in general, do not specifically identify sensitive or culturally important resources. For purposes of analyzing potential impacts to ethnographic resources, the thresholds of change for the intensity of an impact are defined below.

Type of Impact

Adverse: A change in the attributes of an ethnographic resource that is unfavorable and can be of permanent duration. Adverse impacts to ethnographic resources can result from manual or mechanical treatments to plants, post- treatment ecological processes that do not promote or enhance ethnographic resources such as plants, or restricted access to traditional use areas.

Beneficial: A change in the attributes of an ethnographic resource that is favorable and beneficial (for example, promotion of herbaceous plant growth or activities that maintain some plants for traditional use or improve the health or promote desirable characteristics of traditionally- used plants).

Duration of Impact

Short- term: Causes a temporary change in important vegetation or temporary restriction of access to an important resource, yet does not disrupt the cultural traditions associated with that resource.

Long- term: A change in culturally important vegetation or a cultural feature for a noticeable period. Long- term changes would disrupt cultural traditions associated with the affected resource, but the disruption would not alter traditional activities to the extent that the important cultural traditions associated with the resource are lost.

Permanent: Impacts to ethnographic resources would involve irreversible changes in important resources such that the ongoing cultural traditions associated with those resources are lost.

Intensity of Impact

Negligible: Impacts would be barely perceptible and would not alter traditional access or site preservation or the relationship between the resource and the affiliated group's body of practices and beliefs. The determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for §106 would be *no adverse effect*.

Minor: *Adverse* - impacts would be slight and noticeable but would not appreciably alter traditional access or site preservation or the relationship between the resource and the affiliated group's practices and beliefs. The determination of effect on Traditional Cultural Properties for §106 would be *no adverse effect*.

Beneficial – impacts would allow access to and/or accommodate a group's traditional practices or beliefs. The determination of effect on Traditional Cultural Properties for §106 would be *no adverse effect*.

Moderate: *Adverse* - impacts would be apparent and would alter resource conditions. Something would interfere with traditional access, site preservation, or the relationship between the resource and the affiliated group's practices and beliefs, even though the group's practices and beliefs would survive. The determination of effect on Traditional Cultural Properties for §106 would be *adverse effect*.

Beneficial – impacts would facilitate traditional access, promote site preservation, or accommodate a group's practices or beliefs. The determination of effect on Traditional Cultural Properties for §106 would be *no adverse effect*.

Major: *Adverse* - impacts would alter resource conditions. Something would block or greatly affect traditional access, site preservation, or the relationship between the resource and the affiliated group's body of practices and beliefs, such that the survival of a group's practices and beliefs would be jeopardized. The determination of effect on Traditional Cultural Properties for §106 would be *adverse effect*.

Beneficial – impacts would encourage traditional access, enhance site preservation, or accommodate a group's practices or beliefs. The determination of effect on Traditional Cultural Properties for §106 would be *no adverse effect*.

Alternative A—No Action

Archeological Resources

Under Alternative A, current management practices would continue, including biological, ecological and archeological studies and small- scale, ad hoc treatment of archeological sites. Degraded conditions in the piñon- juniper woodland would also continue because no actions would be taken to foster the growth of herbaceous understory, which facilitates water infiltration and inhibits runoff and erosion. Hundreds of archeological sites would continue to be eroded, with hundreds of thousands of artifacts moved out of their archeological contexts.

These processes have impacts on archeological sites because the sites are contained within the same soil that is being eroded due to the lack of herbaceous ground cover. Architectural features, hearths, storage pits, and artifacts would continue to be exposed, undercut, and washed away by water running over the surface unchecked by vegetation. All of these actions can result in the loss of information potential and depositional integrity, ultimately leading to the jeopardization of sites' NRHP eligibility. The lack of action to mitigate these processes has the potential to have major negative, direct and indirect, long- term impacts over the next 20 years to individual archeological resources throughout the project area, resulting in major negative direct and indirect long- term impacts to an estimated 9% of the archeological sites in the project area based on data from a 28% random sample of sites (Table 18).

	NRHP significance level	Jeopardized	Depositional Integrity 3 impacted	Depositional Integrity 1 or 2 impacted	Treated before jeopardized
	1	0%	0%	0%	10%
	2	9%	22%	65%	10%
	3	9%	26%	44%	2%
	4	8%	40%	36%	2%
No Action totals		***9%***	***29%***	***43%***	***4%***

Table 18. Percentage of Sites of Each Significance Level Class Likely to be Jeopardized, Impacted, or Treated Prior to Jeopardization Under Alternative A. (Note: totals do not add up to 100% because the table does not include sites that will not be impacted within the life of this plan.)

Management actions to mitigate erosion would be restricted to a small number of single archeological sites or specific areas within archeological sites done on an ad hoc basis with hand tools that is estimated to affect less than 5% of archeological sites in the project area. These small- scale actions are likely to have a localized major, beneficial, direct, short- and long- term impact on particular individual sites, but a negligible beneficial impact on the archeological resources as a whole within the project area. No other actions would be taken to mitigate erosion in this alternative, and the documented accelerated erosion rates described in the *Purpose of and Need for the Plan* and *Affected Environment* sections (in particular, see *Vegetation* and *Soils and Water Resources*) would continue.

Although less than 10% of all sites would be at risk of losing their eligibility for the NRHP, 9% of significance level 2 sites would be at risk, constituting a major negative, direct, long- term impact. This information is explained in more detail in the text, tables and figures below. Table 19 tabulates the same basic data broken down by one, three, five, 10 and 20 years, which are the threat timeframe intervals used during data collection. The data are compiled for all sites regardless of level of significance. The stabilized sites data are projected from small- scale stabilization activities that the monument intends to take, even if the action alternatives are not approved. The data from Table 19 are displayed graphically in Figure 25, and together these show that the risk of jeopardization increases with the passage of time when no landscape scale actions is taken to mitigate that risk. The percent of sites stabilized per year would be

Table 19. Percentage of All Sites in the Sample Projected to be Jeopardized or Stabilized per Treatment Year and at the End of Each Treatment Year Under Alternative A.

Treatment Year in Action Alts	Percent jeopardized per year (sites per year/total sites)	Percent jeopardized after each treatment year (cumulative %)	Percent stabilized per year (sites per year/total sites)	Percent stabilized after each treatment year (cumulative %)
1	0.2%	0.2%	0.2%	0.2%
3	0.7%	0.9%	0.2%	0.6%
5	1.8%	2.7%	0.2%	1.2%
10	2.2%	4.9%	0.2%	2.2%
20	4.3%	9.2%	0.2%	4.0%

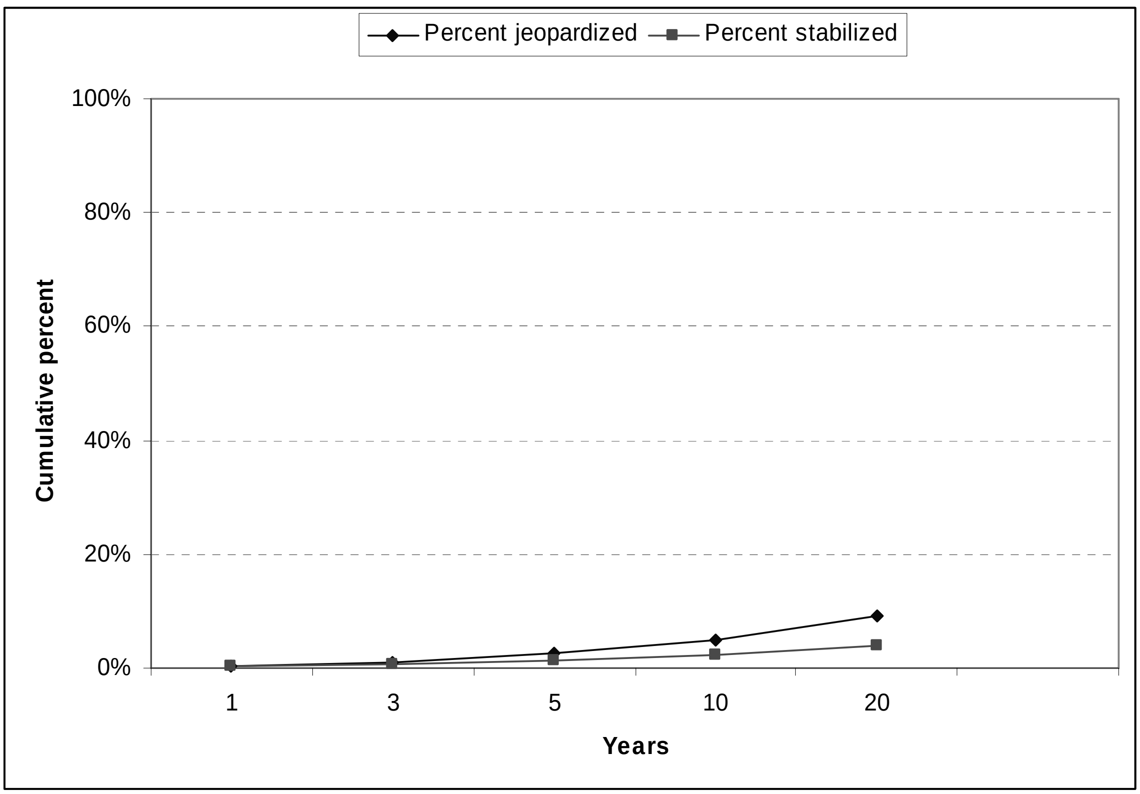

Figure 25: Percent of Sites Likely to be Jeopardized Versus the Percent of Sites Likely to be Stabilized at One, Three, Five, Ten, and 20 Years Into the Life of the Plan Under No Action. (Note: the interval between the data points is not equal.)

very low in Alternative A, and over the 20- year life of this plan would result in an overall low percentage of sites stabilized before they would be jeopardized. Although Alternative A would stabilize a few archeological resources with negligible landscape scale benefits, it would result in no treatment of most of the sites at risk at Bandelier, with landscape scale, major negative, indirect, long- term impacts.

This analysis shows that nearly 10% of high significance sites (significance level 2 or higher) and lower significance sites are at risk of losing enough of their information potential and integrity that they would no longer be eligible for listing on the NRHP. The potential loss of integrity and eligibility of this percentage of high significance sites within the project area would threaten Bandelier's listing on the NRHP as a district, and fail to uphold the principles laid out in Bandelier's enabling legislation. Because major negative impacts to resource whose conservation is 1) necessary to fulfill specific purposes in the establishing proclamation for Bandelier National Monument; 2) key to the natural or cultural integrity of the monument or to opportunities for enjoyment of the monument; 3) identified as a goal in relevant National Park Service planning documents, the No Action alternative could result in impairment of the monument's resources or values.

In addition to adverse impacts from continued erosion, localized, minor adverse impacts from current research and other park activities in the woodland could result under the No Action alternative from continued current management. For example foot and pack train traffic associated with establishment and operation of backcountry camps occupied by a small number of researchers can lead to trampling and scuffing of artifacts, increased erosion through trampling of vegetation, or toppling of standing architecture. These effects could be fully or nearly fully mitigated by avoiding archeological sites when establishing camps, and flagging access routes that avoid sites. Conducting ecological or archeological studies within the boundaries of archeological sites can have similar localized negative effects caused by foot traffic during recording activities, but these could be avoided through minimizing foot traffic within site boundaries, and by educating crews to avoid walking on walls or other features. Compliance with NEPA and Section 106 of the NHPA for individual research and monitoring projects follows the monument's standard environmental screening process.

Ethnographic Resources

Management practices including biological, ecological, and archeological research and monitoring activities could have short- term, negligible to minor adverse effects on ethnographic resources or traditional practices because of the presence and operation of backcountry camps. These impacts could be fully mitigated by completely avoiding use of those areas or avoiding those areas at times when traditional access or use occurs. Individual research and monitoring projects would follow Bandelier's standard environmental screening process so that known sensitive areas or ethnographic resources could be avoided and impacts would be negligible.

Management actions to mitigate erosion would be restricted to a small number of single archeological sites or specific areas within archeological sites done on an ad hoc basis with hand tools. Such activities will likely have a negligible impact on ethnographic resources. Overall, negligible to minor adverse impacts to ethnographic resources are likely for the short and long term under the No Action alternative.

CUMULATIVE IMPACTS

The depositional integrity and information potential of archeological resources would be threatened by soil loss under Alternative A as discussed above. Other forces that also have or would affect these same type of resources where they occur include wind erosion, windthrow, fire suppression, hazard fuel buildup, unauthorized collection, trails, and visitor use, which have either impacted or threatened to impact the depositional integrity and information potential of archeological sites within Bandelier. The degree of effects from these activities range from localized, minor to major, negative, direct and indirect, long- term effects (fire suppression, trails, wind erosion, windthrow, hazard fuel buildup) to localized negligible to minor, direct, long- term effects (visitor use, unauthorized collection). Overall, although major impacts to individual resources may have occurred from these activities, they have affected many fewer sites than the historic land uses and resulting soil loss that this planning effort is intended to treat, and probably do not constitute more than a negligible to minor negative impact on the archeological resources of Bandelier and the region as a whole.

Adjacent lands contain archeological sites that suffer from similar impacts seen at Bandelier, and adjacent land managers are currently and in the foreseeable future taking no action to mitigate soil erosion impacts to archeological sites by increasing the herbaceous cover on intercanopy spaces within piñon- juniper woodland. Therefore, major impacts from soil erosion related to historic overgrazing and fire suppression are expected to continue across the region. Limited biological, ecological, and archeological studies have been and will continue to be carried out on adjacent lands, but these are expected to have negligible impacts to the region's archeological resources.

Few sources of cumulative impact to ethnographic resources in the study area would occur. It is possible that fire management actions associated with suppression in piñon- juniper woodland such as initial attack and construction of hand lines could result in short- term, negligible to minor impacts to ethnographic resources. However, these impacts could be mitigated by having archeologists or cultural resources staff on- site to direct placement of crews and activities away from known ethnographic or culturally sensitive areas. Fire suppression activities in the piñon- juniper woodland would likely be of short duration and a relatively small area (possibly only a few acres), resulting in little change to the current woodland habitat and little increase in herbaceous vegetation. With the presence of cultural staff on fire activities, known sensitive areas could be avoided and potential impacts would be minimized. As such, no more than short- term negligible to minor adverse cumulative impacts are expected for ethnographic resources.

CONCLUSION

Under the No Action alternative, short- and long- term, major benefits to archeological resources could occur to a few individual sites from ad hoc mitigation efforts, though these benefits would be negligible at the landscape scale. This alternative would also have major adverse, direct and indirect, long- term impacts from continued soil erosion and loss of cultural integrity of sites at both the site specific and landscape scale. Negligible impacts from current research in piñon-juniper woodland would continue. The continuation of current management practices at Bandelier, in combination with continuation of regional management practices, would have major adverse, direct and indirect, long- term cumulative impacts to archeological resources from continued soil erosion, and negligible impacts from continuation of current management practices related to limited treatment and biological, ecological, and archeological research.

Because protection and preservation of its unique cultural resources is the primary reason the monument was established, continued loss or archeological resources under the No Action alternative risks impairment as defined by the Organic Act and NPS *Management Policies* (NPS 2006a).

For the purposes of §106 of the NHPA, the determination of effect would be *adverse effect*.

Negligible to minor, adverse impacts to ethnographic resources are likely for the short and long term under the No Action alternative. Cumulative impacts would also be adverse and negligible to minor over the short and long term. No beneficial impacts to ethnographic resources in the piñon- juniper woodland are expected under the No Action alternative. No impairment to ethnographic resources is expected under the No Action alternative.

Alternative B—Operational Priority

Archeological Resources

All activities proposed under Alternative B must follow the guidelines established in a Programmatic Agreement for §106 consultation. This PA would be signed by the State of New Mexico Historic Preservation Officer and the Superintendent of Bandelier National Monument, and could include the Advisory Council on Historic Preservation. Bandelier's §106 consultation requirements outlined in this PA would include development of annual specific treatment plans identifying geographic areas to be treated during the subsequent treatment year (see *Annual Treatment Plan* section of *Alternatives*). These annual treatment plans would be submitted to the SHPO no later than the month of July prior to each treatment year. They would define the area of potential effect (APE) for that season, the proposed actions, and the resulting level of potential impacts on archeological resources within the APE. Project areas that contain unsurveyed tracts of land on slopes less than 30% grade would be subjected to intensive surveys before any treatment takes place. Project areas that have been previously inventoried would be assessed for the presence of historic properties through examination of the BAND cultural resource base maps, the monument's archeological site database, and the List of Classified Structures (LCS).

Camp locations, helicopter landing zones and drop points, pack train and foot traffic access routes would be sited to completely avoid archeological sites. Monument archeologists would inspect proposed camps, landing/drop points, and temporary trails to ensure that they are located away from archeological sites. Prior to treatment, monument archeologists would visit each known site within a proposed treatment unit and assess the potential for adverse effects from the proposed slash mulch treatment. In this site- specific assessment, the archeologist would determine whether any sites would require special protective measures to mitigate the effects of the project. The mitigation measures are outlined in the *Alternatives* section and also included below.

Bandelier, in consultation with the SHPO, would follow the procedures described in 36 CFR 800.4(c) to evaluate the historical significance for all historic properties within the APE. Furthermore, Bandelier would seek comments from all potentially interested Pueblo Indian groups, pursuant to National Register Bulletin 38, in order to identify potential Traditional Cultural Properties located within the APE, and would then apply National Register criteria and evaluate the historical significance of those properties identified. Copies of all recommendations of eligibility for the National Register would be submitted to the SHPO for concurrence.

For every annual treatment plan, the monument would document the results of the field inventory, document consultation efforts with Pueblos regarding properties of traditional religious and cultural value, and identify any proposed measures to avoid adverse effects to historic properties. As part of consultation with SHPO and other consulting parties, the monument would report this information in the annual treatment plan and submit it to SHPO for review and comment no later than the month of July prior to each treatment year (treatment year = September to May). The treatment plan would present a determination of *no historic properties affected* pursuant to 36 CFR 800.4(d)(1), *no adverse effect*, pursuant to 36 CFR 800.5(b) for the project(s); or *adverse effect* pursuant to 36 CFR 800.5(a)(1). If avoidance of adverse effects is not possible, the monument would work to resolve adverse effects with the SHPO and other appropriate parties in accordance with 36 CFR 800.6. If the monument determines that adverse effects cannot be avoided or resolved, or if SHPO objects to a finding of *no adverse effect*, the monument may rescind some treatment activities in the analysis area and consult further in accordance with 36 CFR 800.6 to resolve the adverse effects.

Under Alternative B small diameter piñon and juniper trees would be flush cut at their base primarily using chainsaws. Limbs would be lopped and scattered over bare soil. Within each sub- basin, crews would be oriented to a basic thinning/slash prescription based on soil characteristics, remnant herbaceous cover, and tree age structure. Monument staff would monitor treatment sites and use information gathered from the sites to modify future treatments, site selection or other factors if needed. Under Alternative B, this treatment protocol would be implemented over a period of five years, maximizing the efficiency of treatment and minimize impacts associated with the amount of time treatment takes. Geography and logistics would determine the location and timing of treatment and crews would complete restoration in a wave- like fashion by working systematically across the monument from one end to the other. A total of eight camps would be established in the backcountry, five by helicopter and three by pack string. Actions associated with this alternative have the potential to affect archeological resources both individually and on a landscape scale. The impacts on the level of individual sites are analyzed first, and then the impacts to archeological resources on a landscape scale are analyzed. Although individual sites may experience negligible to major negative or beneficial impacts, the extent, frequency, and intensity of these impacts to individual sites determines the degree of overall effects on a landscape scale. Mitigation measures to lessen negative impacts associated with treatment activities have been identified in the *Alternatives* sections and are reiterated here.

Under both action alternatives, monitoring and adaptive management approaches (see Appendix B) would enable changes in site conditions, unexpected results to cultural resources, and other pertinent information to be incorporated into planning of ongoing and proposed restoration activities.

Mitigation Measures

The following mitigation measures would be applied to lessen or eliminate potential negative effects to archeological resources from activities carried out under both action alternatives.

- Camp areas, helicopter drop zones, and pack train/human access trails will be located away from archeological sites.
- Prior to the start of work, the archeologist will instruct crews in identification of cultural materials and review federal and state laws protecting archeological sites and artifacts.
- Work crews (treatment and monitoring) will minimize walking over architectural and other features.
- All cultural sites within the treatment area will be identified and relocated by an archeologist or archeology technician.
- One Archeological Technician per work crew will be present on site during treatments to identify site components, and supervise directional tree felling and placement of slash.

Sites within the treatment area will be treated following the prescription for the soil and vegetation type with the following modifications:

- All dead trees, regardless of species, will be removed from structural elements of sites. Non- structural elements of sites should be treated using the same prescription as the surrounding landscape.
- All three- inch diameter and smaller trees will be removed. Cactus and other non- tree vegetation will be retained.
- Larger (> three- inch) diameter junipers growing in structures will be retained unless deemed by an archeologist to be detrimental to the stability or integrity of the structure.
- Larger (> five- inch) diameter ponderosa pines growing in structures that are deemed unstable will be removed.
- Heavy fuels (any woody material greater than three- inch diameter) will be hand- carried off structural elements. Lighter slash can remain if deemed necessary by the on- site archeological technician.

HELICOPTER USE

Helicopters would be used to establish and supply camps in areas not accessible by pack trains, where water must be hauled in and where pack trains would be unfeasible. Supplies, equipment, and water would be flown into camp locations using long line sling load techniques, which do not necessitate landing at the drop zone. The sling load would be placed on the ground and offloaded to the camp area. The total number of helicopter trips made has no bearing on the impacts to cultural resources because the drop zone would be the same each time the helicopter releases a sling load at a particular camp. As only five camps would be established by helicopter, no more than five sites (less than 1% of the total sites in the project area) could possibly be affected by sling load errors. Because sites for drop zones would be first evaluated for the presence of absence of archeological resources and avoided if they have them as stipulated in the mitigation measures identified in *Alternatives*, the impacts to both individual sites and to resources across the project area from helicopter use should be non- existent.

PACK STRING USE

A pack string of four to six mules or horses would be used to establish and supply camps that would not require water to be hauled in, or that are located within three hours walking time of headquarters. Supplies, equipment, and water would be loaded into panniers carried by animals into camp locations. As noted above, this alternative would use pack strings instead of helicopters to establish and supply three camps in the five- year treatment period. Camp locations would be located off of main trails, so some off- trail travel by pack strings can be expected. If the pack trains were to travel over archeological sites, the sites could be indirectly impacted by soil exposure, and directly affected by trampling and scuffing of artifacts, trampling and breaking artifacts or architectural stone. If the disturbed soil resulting from the pack train travel was not rehabilitated, increased erosion would occur, which would increase with each trip made in by the pack string. Under Alternative B, crews of 12 to 20 people would be camped at each location, necessitating a large number of trips in and out by animals. The use of pack strings for set- up and supply of camps has the potential to affect archeological resources. Only three camps would be established and supplied in this manner. Under Alternative B, mitigation measures that include avoiding archeological sites when identifying off- trail travel routes for pack strings would be implemented, and the potential effects to sites would be negligible or non-existent.

CAMP OPERATION/OCCUPATION

Under Alternative B, a total of eight backcountry camp areas would be utilized over the five years of implementation. The camp areas would be approximately one acre in size and would contain tent sites for up to 20 people, two kitchen tents, a paperwork/equipment storage tent, a dining canopy, and a portable self- contained latrine. If sites are located within the camp area, they may be affected by foot traffic, stone removal for tent site preparation, and unauthorized collection of artifacts. Foot traffic would likely be heavy in the dining area and on social trails from high traffic areas to individual tents. If the camp area is situated on top of an archeological site or a portion of a site, these areas could be impacted by soil exposure, trampling and scuffing of artifacts, trampling and breaking artifacts or architectural stone, or toppling of standing masonry. When setting up tents people often remove stones which, if part of an archeological site, would affect the integrity of the site. Crew members may collect artifacts found on the ground. As only eight camp areas are to be established over the course of implementation and are relatively small in size, this practice would be expected to affect, at most, 5% of sites in the project area. Mitigation in the form of visual surveys of potential camp locations to avoid archeological sites, requirements that crew members camp only within designated areas, and by conducting crew training that includes sensitivity to cultural resources would be part of both this alternative and Alternative C. Implementing these mitigation measures would reduce or eliminate the effects of camps to archeological sites. Therefore, no more than negligible effects are expected.

MONITORING

Biological, ecological and archeological monitoring would occur before, during and after treatment under Alternative B. Monitoring activities involve small crews of researchers traveling to treatment areas and making observations on a variety of factors as discussed in *Alternatives*. These small crews could cause small- scale impacts as they scout treatment sites, including soil exposure, trampling and scuffing of artifacts, trampling artifacts or architectural stone, or toppling of standing masonry. The impacts would likely be minor negative, direct and indirect, long- term in intensity and only to individual archeological sites rather than across the landscape. They could be eliminated or mitigated to no more than negligible by training monitoring crews to conduct their work while minimizing foot traffic on sites, and avoiding walking on architectural or other features.

FALLING TREES, CUTTING/LOPPING, SCATTERING BRANCHES

Canopy reduction and scattering of the slash can negatively affect cultural resources in several ways. For example, while the process of cutting and scattering slash does not involve soil excavation, site types such as unknown prehistoric, Ancestral Pueblo, or Euroamerican refuse scatters may suffer artifact disturbance and displacement from this activity if monitors are not in place or other mitigation measures described above were not implemented. Similarly, uneducated or untrained crews working on archeological sites may engage in unauthorized collection of artifacts. The integrity of the location of surface artifacts often contributes significantly to a site's scientific interpretive value, because patterns in past behavior may be discerned from this type of spatial data (Sullivan 1998). Under Alternative B, the mitigations outlined above designed to address these potential effects would be implemented, holding impacts to archeological resources to negligible to minor, negative, direct, and long- term.

Falling trees or work crews inadvertently toppling walls or posts could also potentially damage sites with masonry or wood structural elements, such as stone masonry pueblos and historic wooden corrals. Such damage could also affect the spatial integrity of features of the sites, which contribute significantly to the interpretive and scientific value of the site. Mitigation measures outlined above will keep impacts to no more than minor.

Several classes of wooden archeological features in the monument could potentially be affected by canopy reduction. Foremost among these in the treatment area are historic telephone line insulator trees. The process of canopy reduction involves felling standing live or dead trees with chainsaws and then cutting them into portable sections. The implementation of mitigation measures would result in negligible to minor, negative, direct, long- term impacts to these archeological features.

Another result of implementing the canopy reduction and slash treatment is the increased presence of flammable material on the ground surface. Immediately following treatment, green, uncured wood, if ignited, would produce localized areas of high heat of long duration that can cause heat damage to artifacts, building stone, and flammable cultural resources. Having this material on the ground would increase the probability of minor to moderate, negative, direct, long- term impacts on archeological resources. Under Alternative B, these possible effects would be mitigated by only allowing small diameter (less than 3") slash to remain on sites and removing large standing dead trees. By following these mitigations and those outlined above, the effects would be reduced to negligible to minor negative, direct, long- term impacts.

CANOPY REDUCTION/SLASH MULCHING (TREATMENT)

The effects of canopy reduction and slash mulching on soils and vegetation have been studied on small test plots by monument and USGS scientists (See *Research at Bandelier*), but the specific effects on individual archeological sites are less well studied because the experimental treatment plots have tended to avoid or only partially treat archeological sites. Qualitative data are available from several sites that were treated that show herbaceous cover increases and active gullies and rills become inactive following treatment (data on file), which is to be expected given that archeological sites are primarily comprised of local soil and stone and are essentially part of the soil matrix. This conclusion is supported by quantitative data collected in study plots within Bandelier that showed a two- order- of- magnitude decrease in sediment production following treatment. Some differences are likely to occur between archeological sites and non- anthropogenic soils simply because many archeological sites are located on shallower soils, possibly because deeper soils were preserved for farming rather than habitation. The location of some archeological sites on shallower soils may make the herbaceous response to treatment less robust than on deeper, more productive soils. Regardless, the placement of slash on the bare ground of archeological sites provides a physical barrier to soil movement that would at least last as long as the slash itself, which may be 10 years or more.

Based on the vegetation and soils studies conducted on the canopy reduction and slash mulch treatment and the arguments above that similar results are likely on archeological sites, the basic program of canopy reduction/slash mulch applied to appropriate soils, slopes, and vegetation communities would affect archeological resources in several ways. It immediately stabilizes soil through the creation of physical barriers to erosion. This benefits sites by reducing surface artifact movement and reduces undercutting or pedestalling of artifacts, features, and architectural remains. Reduction in erosion decreases the probability of exposure and eventual loss of subsurface deposits. Thus, the creation of the physical barrier of the slash on the ground stabilizes the soil at least as long as the slash is present on the ground and is likely to have major beneficial, direct, short- term impacts to individual archeological resources. In addition, slash creates a physical deterrent to people walking over sites, creating social trails, and collecting and piling artifacts, and would be a minor to moderate beneficial, direct, short- term impact to individual archeological resources.

Stabilizing the soil of individual archeological sites and the surrounding landscape can also promote the growth of native perennial herbaceous ground cover, which provides long- term soil stabilization. Herbaceous cover increases infiltration and decreases runoff and erosion, thereby reducing surface artifact movement and undercutting or pedestalling of artifacts, features and architectural remains. Reduction in erosion decreases the probability of exposure and eventual loss of subsurface deposits. The effects of reestablishment of herbaceous cover would constitute major beneficial, indirect, long- term impacts to individual sites due to continuing reduction in erosion as ecological recovery continues and becomes self-sustaining. In addition, increased herbaceous cover reduces the surface visibility of artifacts and architectural features, which protects them from unauthorized collection and aggregation and from impacts due to social trails. This would be an additional moderate beneficial, indirect, long- term impact.

LANDSCAPE LEVEL EFFECTS OF TREATMENT

The above analysis has focused on impacts related to the operations of implementation of the treatment on the level of individual sites and at the project area landscape scale. The following analysis focuses on the longer term post- treatment landscape level effects of the implementation of this plan. The impact thresholds for the project area landscape listed above provide the criteria for determining the level of impact to the landscape scale archeological resource. The data used in this analysis are those described in the methodology at the beginning of the impact analysis to archeological resources. These data were used to generate percentages that can be used to estimate the effects on the archeological resources of the project area as a whole during the timeframe of implementation of Alternative B.

Table 20 shows that very few archeological sites as a whole would be in danger of jeopardization under Alternative B. A small percentage of significance level 3 and 4 sites are potentially jeopardized, but no significance level 1 or 2 sites are likely to be jeopardized. Although some sites of significance level 2 through 4 would be likely to have their depositional integrity negatively impacted, they are not jeopardized. A very high percentage of sites of all significance levels are likely to be stabilized before they become jeopardized, as seen in the final column of Table 20 each treatment year, sites that are treated within their threat timeframe would be stabilized without any measurable impact from erosion. Those sites that do not get treated within their estimated threat timeframe may be impacted by erosion, but if their depositional integrity was measured at 1, 2, or 3, they would not have their NRHP eligibility jeopardized by erosion by the time of treatment. Thus, the sites that are counted as treated before jeopardized are those that were stabilized before they lose their eligibility for listing on the NRHP. Under Alternative B, nearly all sites would be stabilized before loss of eligibility.

Table 20. Percentage of Sites of Each Significance Level Class Likely to be Jeopardized, Impacted, or Treated Prior to Jeopardization Under Alternative B.

	NRHP significance level	Jeopardized	Depositional Integrity 3 impacted	Depositional Integrity 1 or 2 impacted	Stabilized before jeopardized
	1	0%	0%	0%	100%
	2	0%	4%	22%	100%
	3	2%	3%	2%	98%
	4	2%	4%	1%	96%
Alt B totals		***2%***	***3%***	***3%***	***98%***

Table 21 tabulates the same basic data broken down by treatment year, but for all sites regardless of their level of significance. These data are displayed graphically in Figure 26. Table 21 shows that the percentage of sites jeopardized increases as time progresses, because sites' threat timeframes have a greater chance of being surpassed as treatment is delayed. Variation in the percentages of total sites stabilized per year is attributable to the variation in the number of sites contained in the treatment units for each year. The effect of jeopardization and stabilization is projected to stay at the same level predicted for year five due to the long- term effects of the overstory reduction and slash mulch treatment.

Table 21. Percentage of All Sites in the Sample Projected to be Jeopardized or Stabilized per Treatment Year and at the End of Each Treatment Year Under Alternative B.

Treatment Year	Percent jeopardized per year (sites per year/total sites)	Percent jeopardized after each treatment year (cumulative %)	Percent stabilized per year (sites per year/total sites)	Percent stabilized after each treatment year (cumulative %)
1	0.0%	0.0%	16.1%	16.1%
2	0.7%	0.7%	20.2%	36.3%
3	0.4%	1.1%	26.0%	62.3%
4	0.4%	1.6%	18.2%	80.5%
5	0.4%	2.0%	17.0%	97.5%
10		2.0%		97.5%
15		2.0%		97.5%
20		2.0%		97.5%

These data show that the rate of jeopardization is low over the five years of implementation, and results in less than 5% of all sites jeopardized at the end of treatment. Although this means a negative residual minor impact across the landscape would remain, compared to the No Action alternative, this would be a major beneficial impact. Figure 26 also shows that between 16 and 26% of the total sites are treated each year, and that by the end of year five nearly 98% of sites are stabilized before their NRHP eligibility is jeopardized. This would be a major beneficial, direct and indirect, long- term impact to the archeological sites at a landscape scale compared to the No Action alternative. No impairment to archeological resources in the monument would occur if Alternative B were implemented.

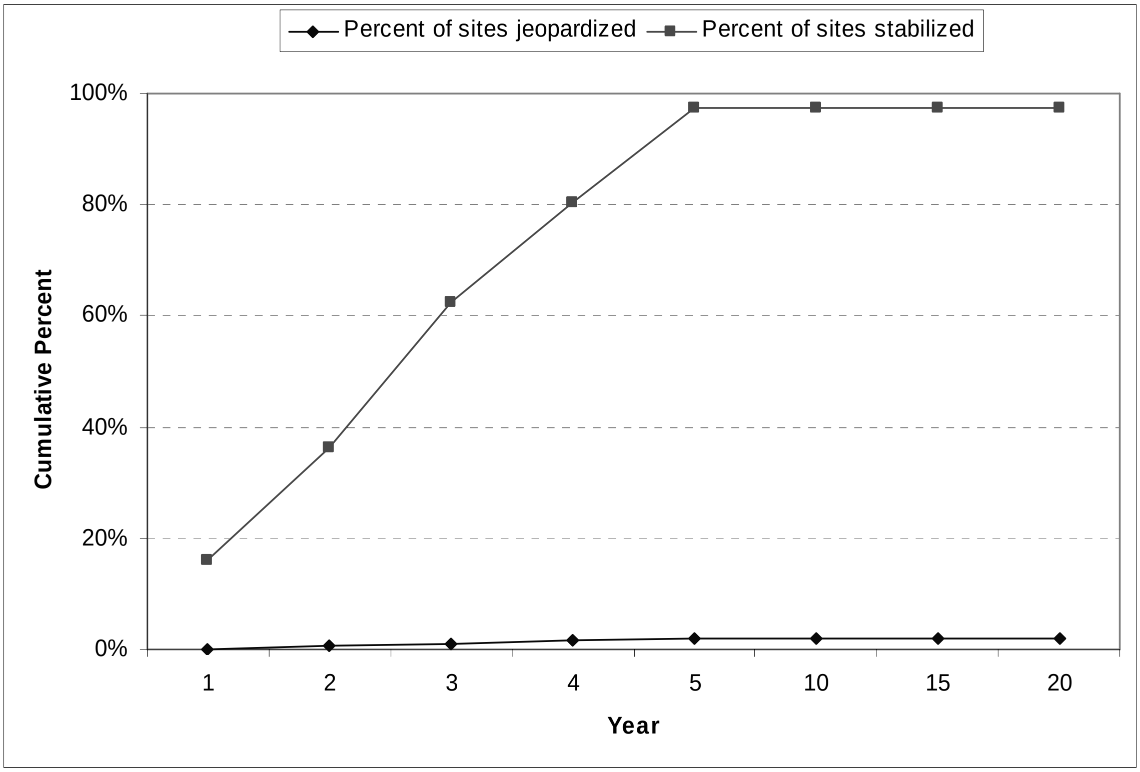

Figure 26. Percent of Sites Likely to be Jeopardized Versus the Percent of Sites Likely to be Stabilized at the End of Each Treatment Year, and Projected Out to the Life of the Plan Under Alternative B. (Note: the interval between the first five data points is 1, while the interval between the last three is 5.)

Ethnographic Resources

Actions associated with treatment activities, such as establishing camps, use of helicopters or chainsaws and alteration of the landscape have the potential to affect ethnographic or culturally sensitive resources. Mitigation measures to lessen any potential negative impacts associated with treatment activities primarily center on consultation with the Pueblos and SHPO and avoidance or other means of reducing impacts to these resources. The process is summarized here and in the *Alternatives* section.

On an annual basis, Bandelier National Monument would consult with the closely affiliated Pueblos regarding implementation of treatment activities in the area of potential affect. These consultations would identify treatment plans, site specific treatment maps, detailed archeological site maps, the need for tribal monitoring of treatment activities, proposed locations of camp sites, and any proposed mitigations for known ethnographic or culturally sensitive areas. The Pueblos would be invited to identify potential Traditional Cultural Properties and express their concerns about any sensitive cultural or ethnographic resources, including any additional proposed mitigations. The monument would consider the needs of cultural practitioners to access and use traditional resources in the treatment area in developing the annual treatment plans. For proposed treatment areas, Bandelier would document the results of field inventories, consultation efforts with Pueblos, and any proposed measures to avoid adverse effects to historic properties. Confidentiality of this information would be maintained to the extent possible under present law.

The monument would submit the report to the SHPO and other parties for review and comment. The report will include determinations of either *no historic properties affected* pursuant to 36 CFR 800.4(d)(1), *no adverse effect*, pursuant to 36 CFR 800.5(b), or *adverse effect* pursuant to 36 CFR 800.5(a)(1). If avoidance of adverse effects is not possible, Bandelier would work to resolve adverse effects with the SHPO and other appropriate parties in accordance with 36 CFR 800.6.

Because restoration treatments are expected to increase herbaceous plant cover in the piñon- juniper woodland, other plants and plant parts that may be important for traditional uses are expected to increase. This would result in a short- and long-term, negligible to moderate beneficial impact because of the potential increased availability of culturally important plants and plant material. Some small diameter piñon and juniper trees would be cut down, reducing their overall abundance. Small trees would still be available but in lower abundance; however, after five years, small diameter trees would likely begin to regrow in thinned areas. These conditions might result in an overall short- term, negligible adverse impact to traditional practices that might use small piñon and juniper trees. Most large diameter piñon and juniper trees would be retained (except those potentially threatening archeological resources, see impact analysis of Archeological Resources, above) and potential impacts would likely be negligible for the short and long term.

Consultations with affiliated pueblos would also include discussion of potential camps. Following any suggestions and potential additional mitigations that the Pueblos might offer, camps would be located away from any sensitive areas. Potential adverse impacts from camps and camp activities are expected to be short- term and negligible.

CUMULATIVE IMPACTS

Alternative B is likely to have major beneficial, direct and indirect, long- and short-term impacts to individual archeological sites and to the archeological resources at the scale of the project area. Compared to the No Action alternative, there are only beneficial impacts to archeological resources from treatment. As mentioned in *Affected Environment*, other natural and cultural forces such as wind erosion, windthrow, fire suppression, hazard fuel buildup, unauthorized collection, trails, and visitor use have either impacted or threaten to impact the depositional integrity and information potential of archeological sites within Bandelier, and none of the alternatives analyzed for this EIS would directly mitigate these issues. The impacts from these activities are long- term and adverse, and range in intensity from localized and negligible (visitor use, unauthorized collection) to more serious, localized, minor to major in intensity (fire suppression, trails, wind erosion, windthrow, hazard fuel buildup). These impacts, which affect many fewer sites than water erosion, constitute negligible to minor negative impacts on the archeological resources of Bandelier and the region at the landscape scale.

Adjacent lands contain archeological sites that suffer from similar impacts seen at Bandelier, and adjacent land managers are currently and in the foreseeable future taking no action to mitigate soil erosion impacts to archeological sites by increasing the herbaceous cover on intercanopy spaces within the piñon- juniper woodland. Implementation of Alternative B within the Bandelier project area constitutes only 4,000 acres out of close to 30,000 acres of piñon- juniper woodland on the Pajarito Plateau. It would affect approximately 10 to 15% of archeological sites in the piñon- juniper woodland of the Pajarito Plateau, so the impacts would be negligible beneficial, direct and indirect, and long- term on a regional scale. Limited biological, ecological, and archeological studies have been and will continue to be carried out on adjacent lands, but these are expected to have negligible impacts to the region's archeological resources.

Cumulative impacts to ethnographic resources would be similar to those identified under the No Action alternative and include fire suppression activities in the monument and adjacent lands. Fire management activities such as initial attack, construction of hand lines, prescribed fire, and other fire management activities could result in short- term, negligible to minor impacts to ethnographic resources but these impacts could be reduced to negligible by having archeologists or cultural resources staff on- site to direct placement of crews and activities away from known ethnographic or culturally sensitive areas.

CONCLUSION

Compared to the No Action alternative, Alternative B is expected to have major beneficial, direct and indirect, long- and short- term impacts to individual archeological sites and to the archeological resources on a landscape level through its stabilization of 98% of sites prior to their NRHP eligibility being jeopardized. For those sites that are not stabilized by treatment before their NRHP eligibility is jeopardized (2% of the sites in the study area), residual minor to major adverse localized impacts would remain. On the landscape scale, this translates to a residual minor adverse impact. However, if these impacts are compared to those associated with No Action, they are relative major beneficial effects. Negligible to minor negative, long- term, direct effects to individual archeological sites could result from vegetation treatment (falling trees, cutting, etc.). At the same time, direct, short- and long- term, minor to major benefits to individual sites could result from the stabilization of soils (slash mulching, etc). Negligible to minor impacts to archeological resources from camp use, felling trees, accessing treatment sites and monitoring are possible.

Short- and long- term, negligible to moderate beneficial impacts to ethnographic resources are expected because of the potential increased availability of culturally important plants and plant material. Because of the initial reduction of small diameter trees from cutting, lopping and scattering treatment activities, some short-term, negligible adverse impacts to traditional practices might occur if those practices used small piñon and juniper trees. Most large diameter piñon and juniper trees would be retained, resulting in negligible impacts to potential traditional activities involving large trees (e.g. nut or seed gathering). Potential adverse impacts from camps and camp activities are expected to be short- term and negligible. Cumulative impacts to ethnographic resources could include negligible to minor adverse effects resulting from fire management activities, as well as minor to moderate benefits caused by an increase in herbaceous plants and plant parts used in traditional practices.

Under NHPA §106, the determination of effect to monument cultural resources would be *no adverse effect*.

No impairment of park archeological or ethnographic cultural resources would occur under Alternative B.

Alternative C—Phased approach

Archeological Resources

Under Alternative C, the same treatment prescription used in Alternative B would be implemented, but implementation would take place over a period of up to 20 years utilizing one crew of six to ten people. Because implementation would proceed more slowly than under Alternative B, treatment sub- basins with higher numbers of high significance sites at risk from erosion would be treated earlier than those having fewer high significance or immediately threatened sites. Under Alternative C, treatment sub- basins prioritized as described in *Alternatives* would be treated in order of their cultural resource priority based on site significance and immediacy of threat. Within each treatment sub- basin, small diameter piñon and juniper trees would be flush cut at their base using chainsaws or hand tools, the use of which would be determined through the minimum requirements analysis process. Limbs would be lopped and scattered over bare soil. Within each sub- basin, crews would be oriented to a basic thinning/slash prescription based on soil characteristics, remnant herbaceous cover, and tree age structure. Monument staff would monitor treatment sites and use information gathered from the sites to modify future treatments, site selection or other factors if needed. A total of eight camp locations that would be reused year after year would be established in the backcountry, five by helicopter and three by pack string. Over the 20 years, a total of 32 camps would be established and used, 14 by helicopter and 18 by pack string, compared to a total of eight under Alternative B. Actions associated with this alternative have the potential to affect individual archeological resources as well as archeological resources on a landscape scale. The impacts on the level of individual sites are analyzed first, and then the impacts to archeological resources on a landscape scale are analyzed. Although individual sites may experience negligible to major negative or beneficial impacts, the extent, frequency, and intensity of these impacts to individual sites determines the overall effects on a landscape scale.

Under both action alternatives, monitoring and adaptive management approaches (see Appendix B) would enable changes in site conditions, unexpected results to cultural resources, and other pertinent information to be incorporated into planning of ongoing and proposed restoration activities.

Mitigation Measures

The same mitigation measures identified for Alternative B would be implemented under Alternative C to lessen or eliminate negative impacts associated with treatment activities (see above).

Sites within the treatment area will be treated following the prescription for the soil and vegetation type with the same modifications presented under Alternative B (see above).

HELICOPTER USE

As the number of camp locations (although not the same number of times that a camp has to be established) is the same under Alternatives B and C, the impacts would be the same in Alternative C as in Alternative B. The same mitigation measures would be implemented to avoid dropping sling loads on archeological sites, so only negligible impacts from this activity are expected.

PACK STRING USE

Under Alternative C, there would be the same number of camp locations established by pack train as in Alternative B. The same types of impacts would be expected under both alternatives. However, under Alternative C, these camp locations would be reused from year to year over the expected 20 years of implementation. This would result in a greater number of times that each camp would have to be established, supplied, and packed back out. Based on a 20- year implementation plan, a total of eight backcountry camps at three locations requiring off- trail travel by pack strings would have to be established, supplied, and carried back out at the end of occupation. The greater number of trips to establish and carry out camps would be partially offset by fewer per camp supply trips required due to the smaller number of people at each camp, but overall the number of back- and- forth trips is expected to be at least twice the number required by Alternative B. Only three camps are expected to be established and supplied by pack string under this alternative. Adverse impacts to archeological sites can be mitigated to no effect by avoiding archeological sites. This would be done by delineating a path that intersects no sites through flagging (see *Mitigation Measures*). These impacts are identical to those in Alternative B because they arise from initially establishing, rather than occupying the camps.

CAMP OPERATION/OCCUPATION

Under Alternative C, a total of eight backcountry camp locations would be utilized over the 20 years of implementation. This is the same number of camp locations as in Alternative B, with the only difference in camp operations and occupation being the number of people occupying the camps per occupation period, and the number of times the camps are used. The camp areas would be approximately one acre in size and would contain tent sites for up to 12 people, two kitchen tents, a paperwork/equipment storage tent, a dining canopy, and a portable self- contained latrine. The same types of impacts expected under Alternative B would be expected under Alternative C. There may be a difference in intensity of the impact to individual sites due to a smaller number of people occupying each camp at a time, but this decrease of intensity on a yearly basis would be offset by an increased number of years over which the camp locations would be used due to the extended period of implementation under Alternative C. Overall, these effects would be the same as the effects under Alternative B.

MONITORING

Under Alternative C, biological, ecological and archeological monitoring would be the same as under Alternative B.

FALLING TREES, CUTTING/LOPPING, SCATTERING BRANCHES

Under Alternative C, the effects of falling trees and lopping and scattering branches would be same as under Alternative B.

CANOPY REDUCTION/SLASH MULCHING

Under Alternative C, the effects of canopy reduction and slash mulching on the level of individual sites would be same as under Alternative B.

LANDSCAPE LEVEL IMPACT ANALYSIS

Although many of the above analyzed impacts related to the operations and implementation of treatment would be similar under Alternative C as under Alternative B, Alternative C has different longer- term post- treatment effects. These effects are examined using the same methodology as in Alternative B.

Table 22 shows that relatively few archeological sites as a whole are jeopardized under Alternative C. Four percent of significance level 2 sites would be expected to be jeopardized, and slightly more significance level 3 and 4 sites would be jeopardized, but no significance level 1 sites are likely to be jeopardized. Although many sites of significance levels 2 through 4 would have their depositional integrity negatively impacted, they would not be jeopardized. This is because a very high percentage of sites of all significance levels are likely to be stabilized before they become jeopardized, as seen in the final column of Table 22. In each treatment year, sites that are treated within their threat timeframe would be stabilized without any measurable impact from erosion. Those sites that do not get treated within their estimated threat timeframe may be impacted by erosion, but if their depositional integrity was measured at 1, 2, or 3, they would not have their NRHP eligibility jeopardized by erosion by the time of treatment. Thus, the sites that are counted as treated before jeopardized are those that were stabilized before they lose their eligibility for listing on the NRHP. Under Alternative C, 94% of sites are likely to be stabilized prior to loss of integrity and jeopardization of NRHP eligibility. This is only 4% lower than seen in Alternative B, and the difference between Alternative B and C in the percentage of each significance level stabilized is not more than 6%. This means that

Table 22. Percentage of Sites of Each Significance Level Class Likely to be Jeopardized, Impacted, or Treated Prior to Jeopardization Under Alternative C.

	NRHP significance level	Jeopardized	Depositional Integrity 3 impacted	Depositional Integrity 1 or 2 impacted	Stabilized before jeopardized
	1	0%	0%	0%	100%
	2	4%	39%	48%	96%
	3	6%	13%	34%	95%
	4	7%	31%	36%	90%
Alt C totals		***6%***	***19%***	***35%***	***94%***

both action alternatives would result in major beneficial impacts to cultural resources across the landscape from treatment.

Table 23 tabulates the same data broken down by treatment year, but for all sites regardless of their level of significance. These data are displayed graphically in Figure 27. Table 23 shows that the percentage of sites jeopardized is fairly steady through year five, but jumps up between years five and 10 because sites' threat timeframes have a greater chance of being surpassed as treatment is delayed. The rate of increase between years 10 and 15 decreases because there are fewer sites with threat timeframes longer than ten years. No sites with threat timeframes longer than 20 years would be jeopardized if treated within the 20 years of implementation of Alternative C. The percent of sites stabilized per year would be relatively low in Alternative C, but over the 20- year implementation period would result in a high percentage of sites stabilized before they would be jeopardized. Figure 27 shows these results graphically.

These data show that the rate of jeopardization is low over the 20 years of implementation, and results in less than 10% of all sites jeopardized at the end of treatment. This is a residual potential moderate negative, direct and indirect, long-term impact to the archeological sites at a landscape scale (e.g., compared to perfect and complete landscape scale treatment). Although there would be less than 10% of all sites jeopardized, some (less than 5%) significance level 2 sites would be jeopardized, and some (less than 10%) significance level 3 sites would be jeopardized, making the potential residual impact moderate rather than minor.

The graph also shows that between 2 and 9% of the total sites are treated each year, and that by the end of year 20 nearly 94% of sites are stabilized before their NRHP eligibility is jeopardized. This would be a major beneficial, direct and indirect, long-term impact to the archeological sites at a landscape scale relative to No Action.

Table 23. Percentage of all Sites in the Sample Projected to be Jeopardized or Stabilized per Treatment Year and at the End of Each Treatment Year Under Alternative C.

Treatment Year	Percent jeopardized per year (sites per year/total sites)	Percent jeopardized after each treatment year (cumulative %)	Percent stabilized per year (sites per year/total sites)	Percent stabilized after each treatment year (cumulative %)
1	0.0%	0.0%	4.3%	4.3%
2	0.7%	0.7%	4.5%	8.7%
3	0.2%	0.9%	2.5%	11.2%
4	0.4%	1.3%	4.3%	15.5%
5	0.4%	1.8%	7.0%	22.4%
10	2.5%	4.3%	23.3%	45.7%
15	1.8%	6.1%	26.5%	72.2%
20	0.0%	6.1%	21.7%	93.9%

Because a higher percentage of sites lose some depositional integrity before being stabilized under Alternative C, Alternative B would ultimately help preserve and protect the monument's archeological sites at a higher level of archeological integrity for the enjoyment of present and future generations. The major difference between the two alternatives is that, although roughly the same percentage of sites would be stabilized before they are jeopardized, Alternative C would result in more sites with lower levels of depositional integrity. In other words, by the time the sites are stabilized, they are in worse condition in terms of depositional integrity under Alternative C than under B. Thus, Alternative B would allow park managers to maintain the archeological resources within the project area at a higher level of integrity than under Alternative C, and this would be more consistent with Section 110 of the NHPA, the NPS Organic Act, and NPS Management Policies for cultural resources.

Ethnographic Resources

The longer period of time described under this treatment scenario would mean that smaller crews would be in areas of the monument during shorter periods of the year, thus lessening the potential conflicts with tribal schedules for visiting the park and engaging in traditional activities. However, if treatment is stretched out for this longer period of time, and if access to culturally significant treatment areas is also affected over the longer period of time, the total impacts over the 20- year treatment period on traditional cultural activities may be greater under this alternative than under Alternative B. A 20- year period is generational in length and if access is impacted over this period of time, visits to culturally important areas may be curtailed over a longer period time, affecting the training and experience of a new generation of cultural practitioners.

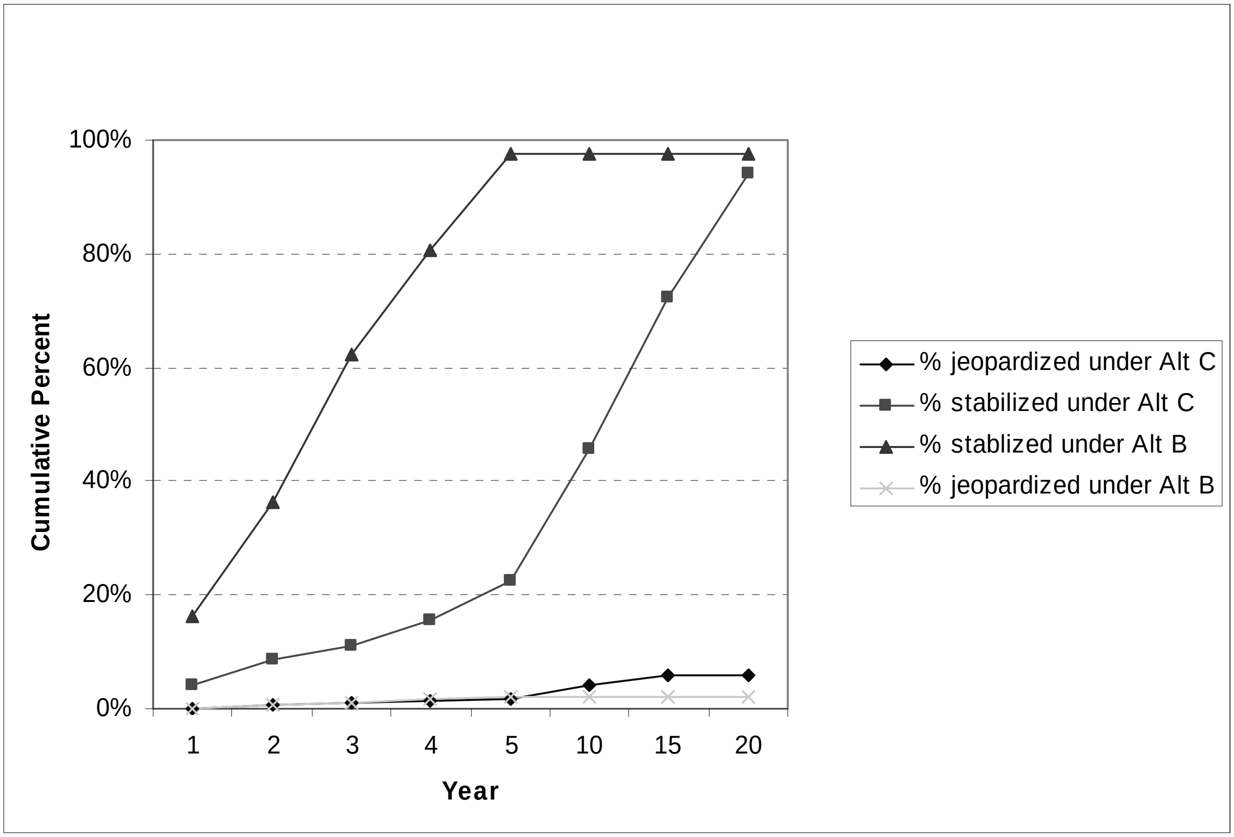

Figure 27. Comparison of the Percentage of Sites Likely to be Jeopardized Versus the Percentage of Sites Likely to be Stabilized at the End of Each Treatment Year, and Projected Out to the Life of the Plan, Under Both Action Alternatives. (Note: the interval between the first five data points is one, while the interval between the last three is five.)

Also under Alternative C, crews would return to the same camp areas year after year which may produce a greater potential for impact to the character of the camped areas. The physical character or integrity of an area may play a negative role in the ceremonial cycles of tribal traditional activities.

Mitigation measures to lessen any potential negative impacts to ethnographic resources under this alternative are similar to that proposed under Alternative B.

The slower pace of treatment, shorter season and fewer workers will allow a greater period of time for consultation with the affiliated Pueblos, and the chance of accurately identifying and avoid impacts to resources and properties of ethnographic significance would be increased. This would result in a short- and long- term, moderate beneficial impact relative to Alternative B because of the potential for more consultation with tribes to identify and find protective measures for culturally important places, plants and plant material before treatment activities take place. As in Alternative B, small trees would still be available in treated areas but in lower abundance following treatment phases and small diameter trees would likely begin to regrow in thinned areas. Compared to No Action, these conditions might result in an overall short- term, negligible adverse impact to traditional practices that might use small piñon and juniper trees. Most large diameter piñon and juniper trees would be retained (except those potentially threatening archeological resources, see analysis of Archeological Resources, above) and therefore long- term potential impacts would likely be negligible.

Under Alternative C, as in Alternative B, short- and long- term, negligible to moderate beneficial impacts to ethnographic resources are expected because of the potential increased availability of culturally important plants and plant material in treated areas.

Following any suggestions and potential additional mitigations that the Pueblos might offer, camps would be located away from any sensitive areas. However, if camp areas are in places that reduce tribal access over a long period, the potential adverse impacts from camp activities are expected to be long- term and major.

No impairment of park cultural resources would occur if Alternative C was implemented.

CUMULATIVE IMPACTS

The cumulative impacts of Alternative C on the archeological resources of the Pajarito Plateau are expected to be similar as under Alternative B, as are the potential effects of fire suppression on ethnographic resources. A longer period of time for treatment, coupled with decreased or disrupted access to the same area year after year may have detrimental effects not only on contemporary traditional practices in specific areas, but also on the ability of tribal members to teach these practices to younger members of the community. The phases of treatment will cover a total of 20 years – a length of time equal to a generation of younger tribal members. Successful transmission of cultural knowledge over generations is essential to the integrity and continuity of any cultural group. Potential impacts to contemporary cultural practices, coupled with a reduced ability to pass traditional cultural information to the next generation of practitioners may result in major, long- term adverse impacts to traditional cultural practices of closely affiliated Pueblos.

CONCLUSION

Alternative C would have minor to major negative, direct and indirect, long- term impacts from soil erosion on some individual archeological sites not mitigated before their NRHP eligibility is jeopardized. This alternative could create residual moderate negative, direct and indirect, long- term impacts from soil erosion to archeological resources on a landscape scale resulting from loss of integrity of sites not mitigated before NRHP eligibility is jeopardized. Effects to individual cultural resources resulting from actual vegetation treatment (negligible to minor and adverse) and soil stabilization (minor to major benefits) under this alternative are similar to those realized under Alternative B. Compared to the No Action alternative, Alternative C, which includes specific mitigation measures, is expected to have major beneficial, direct and indirect, long- and short- term impacts to individual sites and to the archeological resources on a landscape level through the stabilization of 94% of sites. In comparison, Alternative B would result in the stabilization of approximately 98% of sites by the end of the five- year implementation period.

Under Alternative C, as in Alternative B, short- and long- term, negligible to moderate beneficial impacts to ethnographic resources are expected because of the potential increased availability of culturally important plants and plant material in treated areas. Because of the initial reduction of small diameter trees from cutting, lopping and scattering treatment activities, some short- term, negligible adverse impacts to traditional practices might occur if those practices used small piñon and juniper trees. Most large diameter piñon and juniper trees would be retained, resulting in negligible impacts to potential traditional activities involving large trees (e.g. nut or seed gathering). Potential adverse impacts from camps and camp activities over the phased period of 20 years have the potential to be major and long-term if conditions coalesce to reduce access to culturally significant areas. At the same time, the longer project time frame under this alternative would result in short- and long- term, moderate beneficial impacts due to the potential for more consultation with tribes to identify and find protective measures for culturally important places, plants and plant material before treatment activities take place. Cumulative impacts to ethnographic resources could include negligible to minor adverse effects resulting from fire management activities; major adverse effects resulting from potential impacts to contemporary cultural practices, coupled with a reduced ability to pass traditional cultural information to the next generation of practitioners; and minor to moderate benefits caused by a increase in herbaceous plants and plant parts used in traditional practices.

Under NHPA §106, the determination of effect to monument cultural resources would be *no adverse effect*.

No impairment of the monument's cultural resources would occur under Alternative C.

VISITOR EXPERIENCE

Regulations and Policies

The importance of and commitment to the visitor experience is affirmed in various NPS- wide and monument- specific documents. The 1916 Organic Act requires the NPS to ensure its natural and cultural resources are not impaired, but it also requires parks “to provide for the enjoyment of” these resources. NPS *Management Policies 2001* (NPS 2000a) state that the enjoyment of park resources and values by the people of the U.S. is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high- quality opportunities for visitors to enjoy the parks. Because many forms of recreation can take place outside a national park setting, the NPS seeks to provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the natural and cultural resources found in a particular unit, and defer to other agencies, private industry, and nongovernmental organizations to meet the broader spectrum of recreational needs and demands that are not dependent on a national park setting.

In Bandelier’s 2000 *Strategic Plan*, one of its statements of purpose explains that, among other things, the monument provides

> …the means and opportunity to study, understand and enjoy the resources of the monument without unduly compromising the resources or ethnographic values. (NPS 2000b:7).

The visitor experience is also addressed in that same document:

> Provides rare opportunities for visitors to experience an environment rich in archeological sites and wilderness values in a relatively unaltered and scenic landscape (NPS 2000b:8).

The *Strategic Plan* more specifically addresses visitor experience through goal and mission goal statements, including:

- Provide for the public use and enjoyment and visitor experience of Bandelier National Monument (Goal Category II [NPS 2000b:17])
    - Visitors to Bandelier National Monument safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services, and appropriate recreational opportunities (Mission Goal IIa [NPS 2000b:17]).
    - Park visitors and the general public understand and appreciate the preservation of parks and their resources for this and future generations (Mission Goal IIb [NPS 2000b:19])

The visitor experience involves the enjoyment of a park’s natural soundscape. The NPS *Management Policies 2006* (NPS 2006a) provide guidance to parks in managing natural sounds or soundscapes. The policies indicate that NPS units must preserve “to the greatest extent possible, the natural soundscapes of parks” (section 4.9). Human activities that generate noise, including that caused by mechanical devices, are to be monitored in and around parks. The *Management Policies 2006* require parks to evaluate impacts of motorized equipment in their planning. Parks are required to choose equipment that has the least potential for impact to the natural soundscape (section 8.2.3). In addition, Director’s Order 47 (*Soundscape Preservation and Noise Management*) articulates the NPS policies that address the protection, maintenance or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources (NPS 2000e). The National Park Service is also required to "take all necessary steps to avoid or to mitigate adverse effects from aircraft," including from flights the park needs to function or manage its resources (section 8.4).

Methodology

The geographic area addressed within this analysis includes all of Bandelier National Monument, as well as any areas outside the monument boundaries which may be affected by proposed ecological restoration activities.

Potential impacts are described in terms of context, duration and intensity. Methods specific to the evaluation of soundscape effects are also presented.

Context

site- specific—area(s) in which a visitor would have direct contact.

local- - areas larger than "site- specific" but still located within monument boundaries.

regional- - areas involving lands both inside and outside monument boundaries.

Duration of Impact

Short- term- - less than one year

Long- term- - longer than one year

Soundscapes Methodology

As described in Affected Environment, the A- weighted sound level, or dBA, gives greater weight to the frequencies of sound to which the human ear is most sensitive. Sound levels in decibels (dB) are calculated on a logarithmic scale and each 10-decibel increase is perceived as an approximate doubling of loudness. In general, the louder the noise, the less time required before hearing loss will occur. For example, according to the National Institute for Occupational Safety and Health (NIOSH), the maximum exposure time at 85 dBA is 8 hours. At 110 dBA, the maximum exposure time is one minute and 29 seconds. Noise levels vary with distance from the source and with operation mode. For instance, at 10 feet away grading equipment produces 94 dBA, while at 70 feet the level falls to 82 dBA. Terrain, ambient weather conditions, and vegetation also influence noise levels at receptor sites.

Noise thresholds have not been identified by the monument's strategic plan or other relevant NPS planning documents, or as a resource necessary to fulfill specific purposes in the establishing proclamation for the monument. Resource Management documents, however, such as the 1995 *Resource Management Plan* document state that concerns for sound impacts particularly by aircraft, are an important issue for the monument.

The following noise levels (Tables 24 and 25) were used in assessing and comparing impacts (League for the Hard of Hearing, December 2005; NIOSH 2006; USDOT 2001).

Table 24. Noise Levels Used in Assessing and Comparing Impacts.

SOURCE OF NOISE	NOISE LEVEL (dBA)
Whispering at 5 feet	20
Normal conversation	60
Noisy restaurant	80
Hand tools, hand saw	80-85
Passing motorcycle	90
Helicopter (flyover)	80-93
Helicopter (takeoff and approach)	90-110
Chainsaw	110
Jet plane (at ramp)	120

Table 25. Exposure Thresholds for Noise.

A-weighted decibel	NIOSH exposure threshold
Up to 80 dBA	No limit
81-90 dBA	8 hours
91-95 dBA	4 hours
96-100 dBA	2 hours
101-104 dBA	1 hours
105-110 dBA	30 minutes
111-120 dBA	7.5 minutes
121-130 dBA	3.75 minutes
131-140	No exposure is safe

Intensity of Impact

Negligible: Visitors would not likely be aware of the effects associated with changes proposed. Visitor use and enjoyment of the monument's values and facilities would not be limited or enhanced. Impacts to soundscapes would be at the lower levels of detection, with sound levels comparable to a quiet rural area (40 dBA).

Minor: Visitors would be aware of the effects associated with changes but the effects would be slight. While noticeable, effects would not disrupt or enhance the experience and enjoyment of monument values and facilities. Visitors would not likely feel the need to pursue their activity/experience in other monument areas or other local/regional areas. Impacts to soundscapes would be slight but detectable, with sound levels comparable to normal conversation (60 dBA).

Moderate: Visitors would be aware of the readily apparent effects associated with changes proposed. Detectable effects would degrade/limit or enhance the visitor's ability to experience and enjoy the monument's values and facilities within certain areas. Where the experience is degraded, some may choose to pursue their activity/experience in other monument areas or other local/regional areas. Where the experience is enhanced, visitor awareness of and ability to enjoy the monument's resources and values would be notably improved. Noise levels for some visitors may be higher than 60 dBA but would not exceed NOISH standards.

Major: Visitors would be highly aware of the negative or beneficial effects associated with changes proposed. Where the experience is degraded, visitors may not be able to experience or enjoy monument values and facilities and may pursue their activity/experience in other local or regional areas. Where the experience is enhanced, visitor awareness of and the ability to enjoy the monument's resources and values would be substantially improved through increased access to and condition of various aspects of the visitor experience. NOISH standards for noise would be exceeded occasionally or in the short term.

Impairment: The evaluation of impairment applies only to the issue of soundscapes. Impairment of the natural soundscape would occur upon a finding of major adverse impact from a proposed action or cumulative sources of inappropriate sound. These major impacts would typically contribute substantially to deterioration of the monument's natural soundscape to the extent that it would be almost completely or completely masked by human- caused noises.

This section addresses the environmental impacts to the visitor experience, including effects to soundscapes, of the No Action and two action alternatives proposed for the Bandelier ecological restoration project. Analysis of effects on visitor experience associated with restoration activities include potential loss of cultural resources, methods of set- up/supply of camps, length of annual work seasons, visitors' understanding of restoration work, and alteration of views, wildlife viewing opportunities, and soundscapes.

Alternative A—No Action

Under the No Action alternative, current management of the piñon- juniper woodland would remain limited. No management of soils, vegetation, or wildlife beyond research/monitoring in small test plots would occur (see *Research at Bandelier* in *Background* section). Clearing for fuel breaks and hazard tree right- of- way removals along developed road corridors would continue. Current wilderness management would continue in compliance with NPS *Management Policies 2006*, including the issuance of backcountry use permits for campers in designated zones. Visitors to the backcountry would be allowed to travel to any part of the backcountry and, though encouraged otherwise, would not be restricted to established trails. Stock (horses, mules) owned by members of the public would continue to be restricted to approved trails and allowed by permit only.

Effects of the No Action alternative on the visitor experience at Bandelier are related to the continuation of current management strategies, and to the potential future degradation of the monument's cultural resource base.

Under the No Action alternative, no active ecological restoration activities would occur at Bandelier, avoiding the likely adverse effects on visitor experience associated with the two action alternatives. Visitors, particularly those visiting the backcountry, would not encounter potential odors introduced by chainsaws and helicopters. With no vegetation treatment activities, the visual effects of the landscape and wildlife viewing opportunities would remain unaltered. (also see *Visual Resources* and *Wildlife* sections). However, as described in the *Visual Resources* section, views would continue to be obstructed by dense woodland vegetation. The lack of ecological restoration activities under the No Action alternative would result in site-specific to local, long- term, minor benefits to the visitor experience.

Visitor studies (NPS 1995b; LAMVB 2005) over the past 10 years have shown that cultural resources are a primary reason people visit the area and, more specifically, Bandelier National Monument. As noted in other sections of this EIS, results of research indicate that 90% of the sites in piñon- juniper woodland at Bandelier are being negatively impacted by erosion (e.g., loss of informational integrity). Approximately 57% of Bandelier's recorded cultural resources are located within the piñon- juniper woodland (Herhahn, personal communications 2006).   Bandelier visitation is focused on the cultural resources of the frontcountry (developed area—visitor center, associated trails/ruins). However, the potential loss of cultural resources to erosion in the backcountry at the landscape scale could result in minor to moderate, adverse and long- term impacts to local and regional visitors who seek an uncrowded experience in which to enjoy the ruins or other archeological resources. This loss also precludes any future interpretive possibilities for visitation to these unique and less explored cultural resources.

SOUNDSCAPE

The impacts of No Action would result in the continuation of noise levels as they are now, and this analysis includes a summary of sources of noise and current conditions in the monument backcountry, where treatment would take place if Alternative B or C were implemented.

Background noise levels at the entrance of the monument are quite low on average (30- 35 dBA) and are the result of road traffic and limited visitor activities. When cars are idling at the entrance station, noise levels are higher, and can be on the order of 65- 70 dBA at close range (100 feet). This rapidly decreases with distance however, and at a distance of 300 meters would be undetectable. Visitors also generate noise from talking (60 dBA), and from moving equipment, cooking and other activities in the monument's campgrounds and campsites. Compared to completely natural conditions, long- term adverse impacts of these sources of noise in the piñon- juniper study area would be negligible or minor. No impairment of the monument's soundscape is expected.

CUMULATIVE IMPACTS

Bandelier National Monument has recently adopted a *Fire Management Plan* (NPS 2005a) which includes actions related to fire suppression, prescribed fire, Wildland Fire Use, and thinning. While prescribed fires could occur in other areas of the monument, none are planned within the piñon- juniper woodland prior to understory restoration. Fire suppression activities within the monument would likely affect visitor experience "through noise, smoke, odors, reduced visibility, traffic congestion, visitor use restrictions, and disruption of viewsheds" (NPS 2004a:223). Noise impacts are expected to be temporary and localized to the prescribed burn areas, with effects becoming more intense during fire suppression activities (e.g., chainsaws, helicopters). Viewsheds could be affected temporarily by smoke and, in the longer- term, by the presence of portions of charred landscape. Temporary restrictions on visitor use (including trails) could occur depending on the location, intensity, and extent of fire management activities. Adverse effects to visitor use and experience from fire management activities are expected to be negligible to minor and short- to long- term in duration. In addition, minor, long- term benefits to visitor experience are expected from the restoration and maintenance of open vistas and natural forest structure (NPS 2004a:226). Similar types of fire management actions would be expected on public lands surrounding Bandelier (LANL, Santa Fe National Forest, Valles Caldera National Preserve, Cañada de Cochiti). Short- term adverse effects to the Bandelier visitor experience from these fire management actions would be expected to be no greater than negligible to minor.

The Bandelier visitor center will undergo renovations, likely in Fiscal Year 2009. While it will remain open during construction, the use of some temporary alternative buildings may be necessary. The public will be kept informed of the project and its progress. Associated adverse cumulative effects to the visitor experience are expected to be negligible to minor and short- term in duration (Carpenter, personal communications 2006).

Visual intrusions which would add to the effects of ecological restoration efforts within Bandelier include existing facilities related to the Department of Energy's Los Alamos National Laboratory (e.g., antennas, towers, smoke plumes, LANL- related structures). These are considered negligible, adverse, long- term cumulative impacts to the visitor experience.

Current noise intrusions include those associated with activities at LANL (e.g., detonations, sirens, bomb- disposal training activities), road noise/traffic along New Mexico Highway 4, commercial air traffic, Kirtland Air Force Base (Albuquerque), and helicopters training along the Rio Grande River (SE monument boundary). However, in a study, visitors to the monument who may have been focused on cultural resources or other positive aspects of their immediate environment, reported being less aware of and/or less concerned by the noise of overhead aircraft than were park managers (NPS 1994). In the same study, a less than 10% of 424 visitors surveyed reported hearing aircraft. Of those, less than 1% found the noise annoying (NPS 1994). Existing noise around the monument is believed to result in negligible to minor, long- term, adverse cumulative effects to the visitor experience. Intensity of effect would depend on time of day of visits (highway noise; commercial air traffic) and whether or not LANL and helicopter training activities were occurring.

CONCLUSIONS

The No Action alternative could result in minor to moderate, local to regional, long-term adverse impacts to the visitor experience at Bandelier National Park. The effects are primarily related to the potential of loss and the degradation of the cultural resource base, a primary reason for visitation. Archeological resources are most likely to incur adverse impacts. Conversely, long- term, site- specific to local, minor benefits to the visitor experience are expected as a result of the continuation of existing management strategies within the piñon- juniper woodland. This is primarily associated with the avoidance of issues and conditions related to restoration efforts which could affect visitor experience (visual effects, wildlife viewing opportunities). Negligible to minor, adverse effects to the monument's soundscape occur under this alternative and are related to existing noise sources, primarily in the frontcountry areas. Cumulative adverse impacts to the visitor experience would result from fire management activities (inside and outside Bandelier), and existing visual impacts and noise disruptions. Cumulative benefits to the visitor experience would result from some fire management activities in Bandelier. No impairment to the monument's soundscape is anticipated under the No Action alternative.

Alternative B—Operational Priority

Location and timing of restoration work under Alternative B would be determined by geography and logistics Restoration of approximately 4,000 acres of piñon- juniper woodland would likely occur in a methodical, wave- like manner, with crews working from one corner of the monument to the other over the five- year life of the project (most likely from the southwest to the northeast, see Figure 8). An average of approximately 800 acres of vegetation would be treated annually with chainsaws and hand tools.

Two work crews (six to ten members each) would work simultaneously in pre- defined areas for eight- month seasons (September- May). Up to eight one- acre campsites would be used throughout the life of the project, with one or two camps occupied each season. Camps would typically be located away from trails and high visitor use areas (see mitigation discussion under archeological resources in *Alternatives*). Camp set- up/breakdown and provisioning would require the use of helicopters or pack strings.

ODORS/EMISSIONS

The proposed use of chainsaws and helicopters under both action alternatives will result in introduction of unnatural odors (emissions) to specific work areas within Bandelier. These odors/emissions would not present a health hazard to visitors due to the very limited exposure that is likely. However, some visitors may find such odors offensive and annoying. Expected short- term, adverse effects from these odors/emissions to the visitor experience would be site- specific, and negligible to minor in intensity.

VISUAL EFFECTS OF VEGETATION TREATMENT/REMOVAL

Vegetation treatment proposed along Bandelier's mesa tops and other areas of the piñon- juniper woodland has the potential to affect the visitor experience by its alteration of traditional landscape views. While surveys that specifically measure visitors' perceptions of visual effects of landscape modification within Bandelier are not available, views exist from all mesas into and across canyons (Coker, personal communications 2005). Visitors to Bandelier have mentioned the "beautiful scenery" as one of their "likes" (NPS b:57). Twenty percent of visitors to the City of Los Alamos reported they do so for the scenic beauty of the area (see *Affected Environment*; also see *Visual Resources* section for additional detail).

As a result of topographic setting and vegetation cover, much of the frontcountry (e.g., campgrounds, Visitor Center, Ruins Trails) does not offer views into the backcountry areas of the park where the majority of restoration activities are proposed. As the overwhelming visitor use is centered in this frontcountry area, it is unlikely that most Bandelier visitors would experience visual impacts related to the project under Alternative B. Exceptions could include visitors using the Tyuonyi Overlook (Frijoles Canyon) and the park entrance road, both of which have views that could potentially be affected by the project in ways similar to those describe below for the backcountry.

However, visitors to the backcountry would notice visual changes to the piñon- juniper woodland (primarily from mesa tops). Though the majority of designated backcountry trails are located in canyons, several traverse across mesa tops allowing for views into and out of the monument. Others that could be affected are those in the higher elevation areas of the Santa Fe National Forest lands, particularly the Dome Wilderness (west and north of Bandelier), and the Cerro Grande area of the Valles Caldera National Preserve (northwest of Bandelier)(Figure 20).

Currently, views into the piñon- juniper woodland areas reveal numerous natural openings. Vegetation treatment under Alternative B would result in a perception of patchy vegetation which would be apparent to visitors at particular vantage points (see above). This would likely be more noticeable as restoration efforts involving larger and larger areas proceed throughout the life of the project. It is expected than within five to ten years after treatment of an area, re- vegetation would have proceeded to the point that boundaries of these large areas would be obscured, reducing visual impacts to the landscape. In addition, fire within these treated areas would also encourage a more natural state. In the meantime, the overall effect on visitor experience related to these visual landscape alterations would result in local, long- term, minor to possibly moderate adverse impacts to those viewing the treated areas. These effects would also apply to visitors to the Dome Wilderness and the Valles Caldera National Preserve). Such effects could potentially be mitigated by providing visitors with interpretative/educational materials explaining the goals of the project (see *Education and Consultation* in the *Alternatives* section).

WILDLIFE VIEWING OPPORTUNITIES

Approximately 38% of visitors to Bandelier reported they engaged in wildlife viewing activities, primarily in backcountry areas (see *Affected Environment*). Vegetation removal has the potential to affect the composition and density of wildlife (e.g., elk, deer, coyotes, birds) that currently use proposed treatment areas. The extent of the effect would depend on whether species leave the treatment areas for other suitable habitat, whether a species will return and how long it will take for it to do so, and what new wildlife species might colonize a treated area.

The numbers of acres treated annually under this alternative would result in considerable vegetation alteration within the monument's piñon- juniper woodland (approximately 800 acres a year). In the short term, noise and human activity are expected to cause some animals to leave/avoid areas during restoration efforts. After revegetation (five to ten years), densities of some species would be expected to increase or decrease within the project area as a result of the long- term alteration of habitat. These changes will affect different species in different ways with those species most likely to experience the most visible effects being small herbivores. A decrease in some of these species densities (e.g., chipmunks, piñon mice) could be expected while others may increase in density (e.g., cottontails, gophers). Mule deer density would be expected to increase with the additional grass/forb cover but this may be moderated by an increase in coyote population. The effect on birds, some of which are considered rare or unique, from major habitat alteration would also include changes in their density (e.g., black- throated gray warblers may decrease while gray flycatchers may increase). Short- to long- term, local, minor adverse impacts are expected to wildlife viewing opportunities in the backcountry as a result of restoration efforts, particularly to those visitors who are expecting to view certain wildlife species which may have a reduced presence than in the past in certain areas. It is unlikely that similar effects to visitor experience are expected for the frontcountry. When compared to the No Action alternative, Alternative B would result in slightly increased adverse effects in the short- term, but likely beneficial, long- term, negligible to minor impacts because of an increase in biological productivity of the area, which could increase wildlife available for viewing by visitors.

CULTURAL RESOURCES STABILIZATION/PRESERVATION

Ecological restoration objectives are intertwined with efforts to stabilize the significant cultural resources for which Bandelier National Monument was created (also see *Cultural Resources* analysis). Over half of Bandelier's recorded cultural resource sites are located within the piñon- juniper woodland. The stabilization and preservation of these resources is critical to the visitor experience as it is a primary reason for monument visitation (see *Affected Environment*). When compared to Alternative C, the five- year ecological restoration efforts will more effectively slow the rate of erosion that is currently degrading the resource base in measurable ways, particularly archeological resources within the piñon- juniper areas (Herhahn 2003). Approximately 19- 20% of cultural resource sites within the project area would be stabilized annually under this alternative (refer to *Cultural Resources* section). These actions would result in enhanced historic preservation of significant resources for which many visit Bandelier—a moderate to major, long- term, local to regional benefit to the visitor experience.

SOUNDSCAPE

Backcountry

Sources of noise in both this alternative and Alternative C include chainsaws and hand tools, helicopters, and crew camps. The loudest and most sustained noise would be related to chainsaws which, on average, produce noise at the 110 dBA level (some sources report 120 dBA). Hand tools would occasionally be used to clear vegetation from cultural sites, for example. These would produce noise at the 80- 85 dBA level in the immediate vicinity.

Sound is attenuated by distance at roughly six dB for each factor of two increases in distance. For example, noise that is 100 dB at 10 meters from the source will drop to 94 dB at 20 meters, and 88 dB at 40 meters. Atmospheric conditions, including wind, humidity and temperature can also affect noise levels, as can topography and vegetation. Assuming no attenuation effect from topography, vegetation or climate, chainsaw noise would be greater than background noise for more than 4,000 meters. This is because the Bandelier backcountry is on average very quiet with sound levels approximating those of people whispering, and virtually any sound is noticeable if people are attuned to it. However, the sound of chain sawing would drop to levels approximating normal conversation at much shorter distances, on the order of 250 meters (see Table 26). This is a conservative estimate, as topography, climate and vegetation would dampen noise levels across much of the treatment area.

Helicopters would be used in Alternative B to set up and supply camps, as well as to carry waste and empty water containers away. The helicopter would fly from Albuquerque to the Bandelier helispot along the monument's entrance road or the heliport located at TA- 49 along New Mexico State Highway 4. From here it would be loaded with supplies and flown to the campsite where supplies would be off- loaded via sling loads. Flight routes would be restricted during the spring to avoid potential nesting Mexican spotted owls and peregrine falcons (see Figures 5 and 6).

Table 26. Chainsaw and Helicopter Noise Expected at and Near the Work/Camp Sites.

Distance from Source (meters)	Chainsaw dBA level	Helicopter dBA level (average)
1	110	118
2	104	112
4	98	106
8	92	100
16	86	94
32	80	88
64	74	82
128	68	74
256	62	68
512	56	62
1024	50	56
2048	44	50
4096	38	44
8192	32	38

Supplying the camps and carrying away waste would be accomplished with short flights in and out on average every two weeks. An average of three short flights in succession, or a total of approximately one hour for each two week period, would be required to restock camps and remove waste. Another three hours of helicopter flight time to set up and to move camp when required would also be needed. In this alternative, it is assumed that two crews would work for an eight- month season and that treatment in all units would be complete within a five- year period (see the detail in the *Alternatives* section for assumptions and calculations regarding helicopter use). This translates to approximately 70 hours of helicopter use per season, or about 2.4% of the total daytime hours in a season (assuming 12 hours of light/day average in a season).

As noted in Tables 24 and 26, helicopters can be quite loud on takeoff, approach and even on flyovers. Although workers at camps where helicopters are sling loading supplies would need to wear ear protection to avoid moderate or even major short term impacts (see *Health and Safety*), visitors would likely be unaware of them for the most part.

Analysis of the effects of noise on visitor experience in national parks involves a variety of factors, many of which are not easily quantifiable. These include, among other things, a visitor's expectation (e.g., presumptions of noise levels in developed vs. undeveloped/wilderness areas), a visitor's personal characteristics (the likelihood of being annoyed by noise), and the degree to which a quiet experience is desired (Gramann 1999). For instance, visitors may perceive noise as more annoying when it occurs in areas they expect to be very quiet (e.g., backcountry).

The effects of noise on an urban community are measured over an entire 24- hour period, as it may be most aggravating during what would normally be quiet nighttime hours. Several researchers (EPA 1974; American National Standards Institute [ANSI] 1980, 1988, FAA 2005) have found that exceeding 60 dB for this "day- night average sound level" (DNL) is annoying for 10% of urban residents surveyed, while approximately 75% are highly annoyed with DNL levels of 85 dB (under flight path) (FAA 2005).

These same noise levels are likely to adversely affect a greater percentage of visitors in Bandelier for two reasons. Research indicates that the psychological evaluation of noise is dependent not just on the acoustics, but on people's evaluation of the desirability of sound, involvement in other tasks or noticeability, and the person's expectations for noise in various settings (Gramann 1999). Although a difference of ten decibels in noise is noticeable to most people, it is likely to be noticeable to fewer if they are engaged in "foreground tasks," such as preparing a meal. A visitor's expectation and the difference between existing noise levels and those from mechanical sources also affect whether visitors report annoyance and interference with natural quiet. For example, exit interviews at 23 National Park units (NPS 1994) found that a higher percentage of backcountry than frontcountry visitors recalled hearing aircraft and were more likely to experience interference with enjoyment and natural quiet because of it. Another study (Anderson et al. 1983 as cited in Gramann 1999) found that, whereas traffic noise was found to be enhancing people's experience of urban areas, it strongly detracted from the experience in wooded sites. Whether or not sounds are consistent with the visual settings in which they are heard appears to be an important factor in judging whether the visitor experience is adversely or positively affected.

Studies at the monument have found that aircraft overflights are audible for more than one- third of the daylight hours with the average duration of quiet between noticeable aircraft sound only four to six minutes (NPS 1999a, 2000d). Visitors to Bandelier, most of whom visit the frontcountry where noise levels regularly approach or exceed 60 dBA, rarely report being annoyed by overflights of aircraft (NPS 1994).

New noise sources proposed under Alternative B would be noticeable to visitors in Bandelier's very quiet backcountry where restoration activities are focused and where noise could potentially carry across mesa tops. While backcountry use is at its lowest (20- 30 people/day) during the proposed work seasons, most of these visitors tend to stay three to four days (see *Affected Environment*). The introduction of new mechanized noise sources (i.e., helicopters, chainsaws) would not be consistent with these visitors' expectations of natural quiet, and would be at odds with the visual setting in which they occur. They therefore have the potential to degrade the visitor experience in the backcountry for the five- year project, with intensity of effect expected to vary with weather, terrain and vegetation; the proximity of crew locations to visitors (see Figure 8), and whether helicopters are being used (years one through three).

Bandelier staff would provide most visitors with information on work crew locations and helicopter over flights prior to their backcountry use (see *Mitigation* in *Alternatives* section), and it is assumed visitors would adjust their decisionmaking on where to hike or camp based in part on this information.

It is expected that chainsaw use would occur, with intermittent lapses, for eight to ten hours a day, for eight- to ten- day work sessions during each season. For this analysis, it is assumed that no or only an occasional visitor would be within 15 meters (about 50 feet) of chainsaw activity. At this distance, chainsaw noise levels are approximately 85 dBA. If this situation does occur, impacts would last only a few minutes (e.g., hikers passing a work crew near a trail) and impacts would be minimal, although these particular visitors would undoubtedly be annoyed by the increased noise. The majority of backcountry visitors would likely never be closer than a few hundred meters from the treatment sites, especially if they make use of information on locations of camps and treatment areas made available by monument staff. However, even at these further distances, visitors to the backcountry may be aware of and annoyed by chainsaw noise levels. At about 130- 250 meters (about 425- 800 feet), for example, chainsaw noise levels are about 62- 68 dBA, slightly higher than that of normal conversation. Using results from the FAA study cited above as tempered by the information from the study of noise in park units (FAA 2005, Gramann 1999), perhaps 10% of visitors to the backcountry would be aware of and annoyed by chainsaw noise at this level.

Helicopters used the first three years of the project for camp set- up/breakdown and supply would create noise that would be more sporadic and considerably less in duration than that from chainsaws (Figure 20). In total, camp set- up/breakdown and supply is expected to involve about 28 hours of flight time (FT) in years one and three, and 14 hours of FT in year two. Set- up and breakdown would require about three hours of FT each while supply flights of about one hour (FT) would occur once a session (eight to ten days) throughout the annual work season (approximately eight months)(no landings proposed). Helicopters would depart for camp locations from either the helispot in the park or the TA- 49 helibase along New Mexico State Highway 4. As with chainsaws, a visitor's exposure to helicopter noise would vary depending on their proximity to it, weather conditions, terrain and vegetation. It is expected that most visitors who would find this type of noise annoying would deliberately avoid helicopters during sling loading to supply or set up camps, as flight information would be provided on a daily basis by monument staff. However, even these visitors may not be able to evade helicopters flying overhead on supply days.

As noted in Tables 24 and 26, helicopters generally emit noise at levels ranging from 80 to 93 dBA during flyovers. For visitors hiking or camping along a flight path during supply or set up trips, most would find these noise levels annoying. As noted above, noise levels would drop off with distance; for example at a distance of about 500 meters (1640 feet) noise from helicopters would be about the level of normal conversation. For backcountry visitors at this distance, only about 10% would find noise levels (of about 60 dBA) annoying.

Anticipated short- term, adverse impacts to the monument's soundscape from the use of chainsaws and helicopters would range from minor to moderate in intensity, and site- specific to local in scope for backcountry users. The intensity would vary depending on whether a visitor was aware of work occurring in areas they visit prior to visiting that area and the distance from the sound, as well as the visitor's own awareness levels. Depending on a visitor's choice of hiking/camping locations, these effects could become long term for those who visit the Bandelier backcountry repeatedly over the five- year life of the project.

Frontcountry

The Bandelier frontcountry (developed area/visitor center) experiences the greatest number of visitors, with most using this area of the monument exclusively. Most are visiting Bandelier for the first time and stay less than four hours (see *Affected Environment*). Noise levels are elevated in this area when compared to the backcountry. Existing impacts to the monument's frontcountry soundscape include activities/noise associated with the visitor center and employee offices, vehicles, increased numbers of visitors, human/mechanized activity, guided walks, etc. As an example, idling vehicles in the visitor center area can produce noise levels of 65- 70 dBA while normal human conversation produces levels of around 60 dBA. This is quite different from the very quiet backcountry noise levels (around 30 dBA) and it is likely that visitors expect this type of noise in such a dynamic area as the visitor center.

Chainsaw noise from restoration efforts could potentially affect this area and would occur primarily during years four and five of the project (see Figure 8). Many of the developed trails in these areas are located within canyons in which little, if any restoration work will occur (Figure 20). Where chainsaw work occurs on the mesa tops adjacent to these canyons, it is expected that noise would be attenuated to a certain degree by the location of workers away from and above the canyon walls. The Juniper Campground and several trails (e.g., Tyuonyi Overlook, Frey) are located in upland areas where noise from restoration activities could affect visitors (Figure 20).

Adverse impacts to the monument's soundscape from chainsaw noise in the frontcountry area are likely to range from negligible (years one through three) to moderate, short- term in duration and site- specific in scope. Minor effects would be expected occasionally in this area during years four and five; moderate effects would be those possible in year four when work adjacent to Juniper Campground and associated trails is most likely to affect visitor use/satisfaction. Moderate effects could be reduced to minor if work in these specific areas could be scheduled for those months with the lowest visitation rates (December through February). For those few who repeatedly visit Bandelier's developed area during years four and five of the project, effects could be considered long- term.

Noise from helicopter within the frontcountry would intermittently affect the area for the first three years of the project (see Table 2). Take- offs and landings would occur from the helispot located along the park entrance road and the TA- 49 heliport along NM 4 (Figure 20). Both of these locations would involve over flights of the frontcountry to reach most camp locations.

Camp set- up and breakdown efforts would involve about nine round trips each (approximately three hours FT) from one of these locations. Under this alternative, one to two campsites per year will be used for the first three years of the project. Supply trips involving three round trips (approximately one hr. FT) would occur from these heliports once every eight to ten day session. Flights would occur between 7 a.m. and 7 p.m. and could occur any day of the week. In addition, visitors would be informed of anticipated helicopter use/noise on a daily basis.

Due to its greater distance from the developed area—the focus of the majority of visitor use- - use of the heliport located along NM 4 for take- offs and landings would result in negligible soundscape effects to frontcountry visitors (e.g., <60 dBA, normal conversation—noticeable but likely not annoying to most visitors). Overflights could temporarily affect the frontcountry soundscape as noise levels reaching those directly in the flight path would be in the 80 to 90 dBA range (see Table 24). However, the impact would only last for a few seconds, and as noted above, would occur, on average, three times (e.g. three round trips) every two weeks. The overall impact to the monument's soundscape would be minimal.

Most potential soundscape impacts from helicopter use would be associated with take- offs/landings from the helispot located within the park which has the potential to affect visitors of the Juniper Campground and nearby trails (Figure 20). Visitors using the Juniper Campground during take- offs/landings from the helispot (approximately 1200 meters/4000 feet east/southeast of the campground) would experience noise levels of about 56 dBA (less than that of normal conversation [60 dBA]—likely noticeable but not annoying). Visitors walking along the Frey Trail in the area located closest to this same helispot (about 200 meters/660 feet from the helispot) would experience noise levels of about 70 dBA (greater than normal conversation but less than that of a noisy restaurant) when helicopters approach for landing or take off. This would be very temporary as hikers move away from the source or as a helicopter completes its take off or landing. At distances greater than 750 meters (approximately 2450 feet), helicopter noise levels would mimic that of normal conversation levels or less. For those hiking to the south and west from the helispot along the Frey Trail, noise levels would diminish at shorter distances (about 265 meters/870 feet) as they drop down into Frijoles Canyon.

Impacts to the to the frontcountry's soundscape from the use of helicopters are anticipated to be negligible to minor and will depend on the timing of flights and the number of visitors in the affected area (helicopter use is planned for times of lowest annual visitation), proximity of visitors to helicopters, wind patterns, and topography. These effects are expected to be site- specific to local and short- term in effect.

When compared to the No Action alternative, the introduction of new mechanized noise from chainsaws and helicopters under Alternative B would result in increased adverse effects (negligible to moderate) to the monument's frontcountry soundscape.

CUMULATIVE IMPACTS

Cumulative impacts under Alternative B are similar to those described under the No Action alternative. These include negligible to minor adverse effects related to fire management activities in/around the monument; negligible to minor adverse effects related to the Visitor Center renovations; negligible adverse effects related to existing visual intrusions and negligible to minor negligible adverse effects related to highway and commercial aircraft noise and LANL and Kirtland Air Force base activities. Additional moderate, cumulative benefits to the visitor experience are expected under this alternative resulting from the long- term stabilization of cultural resources in the monument, a primary reason for visitation.

CONCLUSIONS

Temporary alteration of views into the monument's piñon- juniper woodland, changes in wildlife viewing opportunities and introduction of odors and emissions would have short- to long- term, negligible to moderate adverse impacts to the visitor experience in Bandelier. Long- term, negligible to minor benefits to wildlife viewing opportunities would result from increased biological productivity. Moderate to major, long- term benefits to the visitor experience are expected as a result of the stabilization of cultural resources through vegetation treatment actions. Increased mechanized noise from chainsaws and helicopters would result in negligible to moderate, short- term, adverse effects to the monument's soundscape. Cumulative adverse impacts to the visitor experience could result from fire management activities (inside and outside Bandelier), and existing visual impacts and noise disruptions. Cumulative benefits to the visitor experience could result from fire management activities in Bandelier. No impairment of the monument's soundscape is expected under this alternative.

Alternative C—Phased Approach

Alternative C focuses on the treatment of approximately 4,000 acres over a 20- year period. Restoration efforts within the piñon- juniper woodland would be based on cultural resource priorities. Work across the landscape would progress in an irregular fashion not likely discernible by visitors despite its real link to cultural resource priorities (Figure 9). An average of 200- 300 acres of vegetation would be treated annually with chainsaws and hand tools. Annual work would be conducted in several (two to three) smaller units scattered throughout the monument.

One work crew of about six to ten members would work in pre- defined areas for six- month seasons (September- March). Eight one- acre campsites would be used throughout the life of the project, with one to three camps occupied each season. Camps would typically be located away from trails and high visitor use areas (see *Mitigation* in *Alternatives* section). Camp set- up/breakdown and provisioning would require the use of helicopters for 11 of the 20 project years.

ODORS/EMISSIONS

Effects to the visitor experience as a result of project- related odors/emissions are similar to those described under Alternative B—negligible to minor adverse, site-specific, and short term.

VISUAL EFFECTS OF VEGETATION TREATMENT/REMOVAL

As is true under Alternative B, vegetation treatment proposed along Bandelier's mesa tops and other areas of the piñon- juniper woodland under this alternative has the potential to affect the views. As a certain number of people visit the area for its scenic beauty, it can be assumed that there will some effect on the visual aspects of the visitor experiences linked to vegetation removal (see Alternative B discussion above).

The topographic setting and vegetation cover in much of the frontcountry (e.g., campgrounds, Visitor Center, Ruins Trails) do not offer views into backcountry areas of the park where the majority of restoration activities would occur. As the overwhelming visitor use is centered in the frontcountry area, it is unlikely that Bandelier visitors would experience visual impacts related to the project under this alternative. Exceptions could include visitors using the Tyuonyi Overlook (Frijoles Canyon) and the park entrance road, both of which have views that could potentially be affected by the project in ways similar to that described below for the backcountry.

As is true for Alternative B, visitors most likely to notice visual changes under this alternative would be backcountry hikers/campers (primarily from mesa tops; refer to Alternative B discussion).

Restoration work under Alternative C would proceed in small units. Comparatively, the larger, contiguous areas of treatment over a much shorter time period proposed under Alternative B would present considerably more noticeable visual effects to visitors. In addition, under Alternative C, small sub- basins treated early in the 20-year project will have already begun to recover in a way that notable visual effects may be obscured prior to the completion of the project (20 years). In general, it is expected than within five to ten years after treatment of an area, re- vegetation would have proceeded to the point where the visual evidence of the treatment would be inconspicuous, reducing visual impacts to the landscape. In addition, fires occurring within these treated areas would also encourage a more natural state. In the meantime, visual effects to the backcountry visitor experience related to visual alterations of the landscape under this alternative would likely include negligible to minor, short- term, site- specific adverse impacts. For those repeat visitors, effects could be long- term. When compared to the No Action alternative (no view modifications), the alteration of views into and across the piñon- juniper woodland of Bandelier under Alternative C would result in increased minor adverse effects to the visitor experience.

WILDLIFE VIEWING OPPORTUNITIES

See Alternative B for discussion of information on visitors' interest in wildlife viewing and the general way in which it could be affected by vegetation removal.

Alternative C proposes annual treatment of approximately 200- 300- acre units, comprised of two or three smaller areas scattered throughout the piñon- juniper woodland, over a 20- year period. The work would result in relatively small, incremental vegetation changes when compared to the large, contiguous acres of treated vegetation under Alternative B (approximately 800 acres).

The numbers of acres treated annually under this alternative would be considerably less than under Alternative B. Effects to wildlife and wildlife viewing opportunities are related to habitat alteration and are generally similar to that described under Alternative B. Effects to wildlife viewing opportunities under Alternative C reflect the much smaller annual treatment acreage and longer project length (when compared to Alternative B). Short- term, site- specific, negligible to minor adverse impacts are expected to wildlife viewing opportunities as a result of restoration efforts. Long- term benefits to wildlife viewing opportunities as a result of increased biological productivity are similar to those described under Alternative B.

CULTURAL RESOURCES STABILIZATION/PRESERVATION

Ecological restoration objectives are intertwined with efforts to stabilize the significant cultural resource base for which Bandelier's National Monument was created (also see *Cultural Resource* analysis). Over half of Bandelier's recorded cultural resource sites are located within the piñon- juniper woodland. The stabilization and preservation of these resources are critical to the visitor experience as it is a primary reason for monument visitation. Ecological restoration efforts would slow the rate of erosion which is currently degrading the cultural resource base in measurable ways, particularly archeological resources, within the piñon- juniper areas (Herhahn 2003). However, the 20- year project life and small annual treatment areas would result in some cultural resources remaining untreated for long periods of time during which they are at greater risk of degradation.

Under Alternative C, approximately 4- 5% of the cultural resource sites within the project area would be stabilized annually (compared to 19- 20% under Alternative C). It is expected there would be minor, long- term, site- specific benefits to visitor experience related to the stabilization/preservation of cultural resources located in areas of early treatment (first five to ten years of the project). However, the potential for degradation and loss of vulnerable cultural resources which remain untreated until the last half or third of the 20- year project would likely create residual minor to possibly moderate, long- term, local, adverse effects to the visitor experience when compared to Alternative B. However, compared to the No Action alternative, the small number of residual impacts to untreated sites (a major benefit to cultural resources) would be a minor benefit to the visitor experience related to the preservation of the park's cultural resource base.

SOUNDSCAPE

<u>Backcountry</u>

As in Alternative B, the sources of noise in Alternative C include chainsaws and hand tools, helicopters, and crew campsites. However, as noted in the *Alternatives* discussion, Alternative C assumes a shorter season and only one work crew. This means noise from these activities would be confined to a single site in the monument, rather than split among two sites where work is ongoing simultaneously, as in Alternative B. The number of total camps required under this alternative would increase however, as the focus is on treating the highest priority cultural resource sites in the monument first. Therefore crews would work in treatment units that may be much further from each other in a given season than in Alternative B (see *Alternatives* for more detail). Completing treatment would also take much longer (20 years to the five years needed under Alternative B). As in Alternative B, the loudest and most sustained noise under this alternative would come from the use of chainsaws.

Noise visitors would likely experience from helicopter use would be more sporadic and considerably less in duration than that from chainsaws. The number of helicopter supply trips in a given season in Alternative C would be slightly more than half that of Alternative B, as only one camp would need to be supplied, but this camp would be moved twice per season. On average, this translates to between 15 and 22 hours of flight time per season, or less than 1% of the daytime hours in the season. Flight routes would be less restricted than in Alternative B because the treatment season would not extend into the spring, avoiding any impacts to nesting birds.

While backcountry use is at its lowest (20- 30 visitors/day) during the proposed work seasons, most of these backcountry visitors tend to stay three to four days (see *Affected Environment*). The introduction of new mechanized noise sources (chainsaws, helicopters) has the potential to affect the monument's soundscape and visitors to the backcountry for the 20- year project life, with intensity of effect expected to vary with weather, terrain, the proximity of crew locations to visitors, and whether helicopters are being used.

As is true under Alternative B, Bandelier staff would provide most visitors with information on work crew locations and helicopter over flights prior to their backcountry use (see *Mitigation* in *Alternatives* section). Based on the degree to which visitors perceive that restoration activities would degrade their experience, it is assumed they would make decisions on what part of the backcountry to visit, or whether to find alternative recreation areas. Some visitors may prefer to avoid certain areas of the monument, or choose other recreational areas to visit.

The lengthy 20- year project life (versus to the five- year project life of Alternative B), the small annual treatment areas, the use of only one crew, and the shorter annual work seasons are influential factors in the assessment of effects of mechanized noise on the monument's soundscape. Short- term, site- specific to possibly local, minor adverse impacts to the backcountry soundscape would be expected under Alternative C from new mechanized noise. When compared to the No Action alternative, Alternative C would result in increased minor adverse effects to the backcountry soundscape at Bandelier.

Frontcountry

See Alternative B discussion on frontcountry use, existing noise sources and general information on noise levels of chainsaws and helicopters and their effects to the monument's soundscape.

Effects of chainsaw noise to Bandelier's frontcountry soundscape would, for the most part, occur in the last 10 years of the project. Work in the area would be sporadic and in units typically less than 200 acres in size. The treatment of additional backcountry acreage would bring annual totals to approximately 200- 300 acres (see Figure 9).

Many of the developed trails in the frontcountry are located within canyons in which little, if any restoration work will occur (Figure 20). Where chainsaw work occurs on the mesa tops adjacent to these canyons, it is expected that noise would be attenuated to a certain degree by the location of workers away from the canyon walls. The Juniper Campground and several trails (e.g., Tyuonyi Overlook, Frey) are located in upland areas where restoration activities are planned in years 8, 18 and 19 of the project (Figure 9).

Adverse impacts from chainsaw noise to the soundscape in this frontcountry area are likely to range from negligible (years one through ten when very little work is proposed) to minor, short- term in duration and site- specific in scope. Minor effects would be expected in years when work occurs adjacent to Juniper campground and associated trails and is most likely to affect visitors.

Noise from helicopters in the frontcountry would be more intermittent than that from chainsaws and would affect the area throughout most of the first 15 years of the project (versus the first three years of the project under Alternative B). Take- offs and landings would occur from the helispot located between the park entrance road and the TA- 49 heliport (Figure 20). Both of these locations would involve over flights of the frontcountry to reach most camp locations.

The total hours of flight time under this alternative (188 hours) is roughly three times that anticipated under Alternative B (70 hours) This activity will persist under Alternative C throughout much of the first 15 years of the project (versus the first three years under Alternative B).

Flights would be occur between 7 a.m. and 7 p.m. and could occur any day of the week. In addition, visitors would be informed of anticipated helicopter use/noise on a daily basis.

Effects to the monument's soundscape related to helicopter use in the frontcountry are expected to be similar to those described under Alternative B (adverse, negligible to minor adverse, site- specific to local). However, due to the extended use of helicopters (11 of the first 15 years), it is likely that repeat visitors would be affected, increasing the potential for long- term effects to the soundscape.

When compared to the No Action alternative, the introduction of new mechanized noise from chainsaws and helicopters under Alternative C would result in increased minor adverse effects to the monument's soundscape.

CUMULATIVE IMPACTS

Cumulative impacts under Alternative C are the same as those described under the No Action alternative. These include negligible to minor adverse effects related to fire management activities in/around the monument; negligible to minor adverse effects related to the Visitor Center renovations; negligible adverse effects related to existing visual intrusions and negligible to minor negligible adverse effects related to highway and commercial aircraft noise and LANL and Kirtland Air Force base activities. Additional negligible to minor, cumulative benefits to the visitor experience are expected under this alternative resulting from the long- term stabilization of cultural resources in the monument, a primary reason for visitation.

CONCLUSIONS

Alternative C would result in negligible to minor, adverse impacts to the monument's soundscape related to increased mechanized noise (chainsaws/helicopters). Negligible to minor, adverse effects to the visitor experience at Bandelier are also expected due to alteration of views into the monument's piñon- juniper woodland, effects to wildlife viewing opportunities, and introduction of odors/emissions. Long- term, negligible to minor benefits to wildlife viewing opportunities would result from increased biological productivity. Potential degradation/loss of cultural resources over the long project duration could result in minor to moderate, adverse effects. Minor benefits to the visitor experience are expected as a result of the stabilization of cultural resources early in the 20- year life of the project. Cumulative adverse impacts to the visitor experience could result from fire management activities (inside and outside Bandelier), and existing visual impacts and noise disruptions outside Bandelier. Cumulative benefits to the visitor experience could result from some fire management activities in Bandelier. No impairment of the monument's soundscape is anticipated under Alternative C.

VISUAL RESOURCES

Regulations and Policies

A key management provision of the Organic Act of 1916 is: "[The National Park Service] shall promote and regulate the use of Federal areas known as national parks, monuments, and reservations hereinafter . . . **to conserve the scenery** (emphasis added) and the natural and historic objects and the wild life therein…" (16 USC 1). The NPS *Management Policies 2006* (NPS 2006a) also state that the enjoyment of park resources and values is part of the fundamental purpose of all parks, and that scenery is included in those resources and values that are subject to the no- impairment standards.

Methodology

The assessment of impacts uses the general methodology described above in the introduction to this section (*Environmental Consequences*) and the resource specific information provided here. The area of analysis includes all monument lands and adjacent lands with views into the monument. The degree to which the proposed management activity would affect the visual quality of the landscape (either adversely or beneficially) depends on the amount of visual change or contrast that would be created by the proposed activity. The potential change was evaluated through an analysis of the basic design elements of line, form, color and texture, and how those elements would change with project implementation. Several other factors were considered when gauging the amount of visual change and perceived impact, including visibility and distance of the proposed action to viewers, the length of time the project would be in view, the relative scale of the activities within the landscape, and the recovery time (time for successful reclamation). The duration and intensity of effects are described below.

Duration of Impact

Short- term: During the period of vegetation management activities and initial revegetation, approximately 2- 3 years.

Long- term: After management activity and initial revegetation, typically greater than two to three years.

Intensity of Impact

Negligible: The amount of visual change in the landscape is not visible or perceived.

Minor: The amount of visual change in the landscape can be seen but does not attract attention.

Moderate: A noticeable visual change in landscape elements and overall character of the landscape begins to attract attention and begins to dominate the view.

Major: The visual change in the landscape demands attention and is dominant in the viewshed.

Impairment: An impact would be more likely to constitute an impairment to the extent that it would be a major adverse effect on 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 identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative A—No Action

The No Action alternative would continue the existing management of resources. Other than research and monitoring, there is little active management of the piñon- juniper woodland at the monument. As described in other sections of this document (See the *Soils and Water Resources* and *Vegetation* sections for example), the existing condition of the piñon- juniper woodland is considered not to be in a functional state and is a degraded ecosystem, with areas of dense tree cover and little understory vegetation. Soils are unstable and erosion is an ongoing problem, both for sediment transport and for cultural sites that have been eroded along with the soil cover. This condition has resulted in a landscape with little diversity in line, form, color or texture, and generally presents the viewer with a landscape where the scenery has been adversely impacted by both natural and man- made causes. Without active management, the piñon - juniper woodland would continue to degrade with a corresponding loss in scenic quality. Impacts of the No Action alternative to visual resources are considered adverse, moderate, and long- term. An example of the existing piñon- juniper woodland is presented in Figure 28 below.

No impairment of park visual resources would occur under this alternative.

CUMULATIVE IMPACTS

No other federal or non- federal future foreseeable actions have been identified within the monument's piñon- juniper woodland, except for possible fire suppression activities. Recent droughts and an insect infestation have resulted in almost complete mortality of piñon trees throughout the region, including lands within the monument and across all of the Pajarito Plateau. This event has impacted the scenic quality on a regional level, of which the monument is a small component.

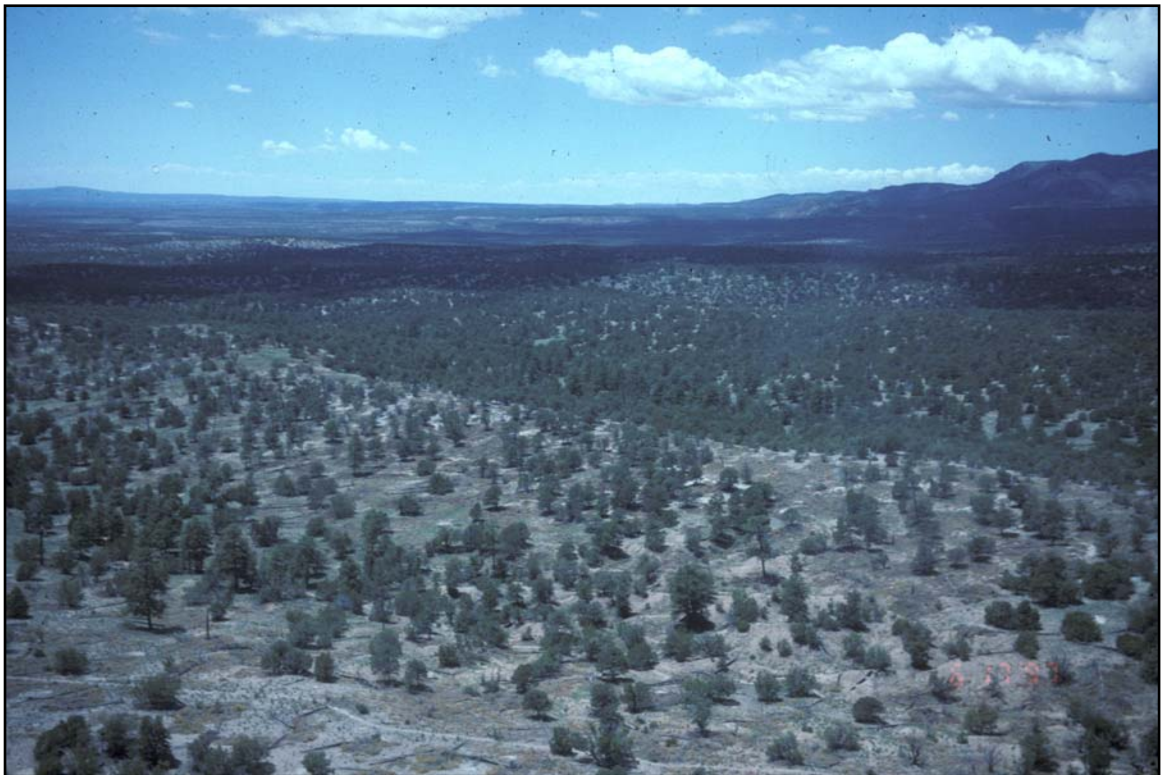

Figure 28. Photo of Existing Piñon-Juniper Woodland at Bandelier National Monument.

Past and present activities, the existing piñon mortality, and possible future fire suppression activities named in the monument's *Fire Management Plan*, would result in adverse, moderate, and long- term impacts to the visual resources of the monument.

CONCLUSIONS

Impacts to the visual quality of the piñon- juniper woodland from the continued degradation of the ecosystem, caused by unstable and eroding soils and areas of dense tree cover with little understory vegetation, would be adverse, moderate, and long- term.

There would be no impairment of the monument's visual quality resources or values under this alternative.

Alternative B—Operational Priority

In Alternative B, up to two crews would work simultaneously, sharing the same base camp. Work would progress from one corner of the monument across the woodland in wave- like fashion, and would take approximately five years to complete. Work would generally occur for eight months of the year, from September to May, avoiding the three summer months when visitor use is the highest across the park.

The vegetation treatment would involve flush cutting small diameter piñon and juniper trees and scattering the limbs over bare soil. Primary areas for treatment would be sites with more productive soils with remnant herbaceous cover. Sites with low productivity or sites dominated by larger diameter or older trees would receive little to no thinning. Figure 29 shows an area that has been treated with limbs scattered across the ground.

The proposed activities would result in visual change in the landscape. The degree of change is dependent on how many acres are actually treated, the pattern of cut areas, the size of any one area that is cut, how many older and large diameter trees are kept within a treatment area, etc. Every sub- basin would likely have slightly different conditions that would influence those determining factors. Since areas that are determined to be prime sites for treatment are based primarily on soil conditions, the treatment areas would likely be patchy, with treated areas interspersed with untreated areas that have poorer soil conditions or areas of steep and rocky terrain. Areas with that type of treatment (patchy, with treated and untreated sites) would experience less noticeable visual change than treatment areas where site conditions allowed a very large acreage to be cut. Large areas of cut trees would contrast with the surrounding landscape and attract viewer attention.

The impact to visual resources would change substantially over time. In the short term, the visual change in the character of the landscape would be highly noticeable for those who have views of the sites, primarily backcountry users. The flush cut stumps and the scattered limbs would be visible, and to most viewers, would be a

Figure 29. Photo of Treatment Site with Trees Lopped and Scattered.

negative impact on the perceived visual quality of the landscape. After successful revegetation by native herbaceous vegetation, the visual quality of the treated areas would be improved over the existing condition of the sites. Areas that have degraded into a landscape with little variety in form, color or texture in the vegetation cover, and which have areas of eroding soils, would, after successful treatment, have variety in the types of vegetation and improved soil cover. The ecological health of the landscape would be improved with a corresponding improvement in the scenic quality.

Figures 30 through 33 show areas that are representative of before and after treatment conditions. Figure 30 shows a foreground view of an area before treatment. Note the bare soil and dense tree cover, and the lack of variety in color, forms and texture. Figure 31 is typical of an area that has received treatment and has successfully revegetated. The area now has open views, a less dense and more random spacing of trees, and a good herbaceous ground cover that adds color and texture to the scenery. Figure 32 shows a foreground view of both treated and untreated areas. The center of the photo is the edge between the treated area on the left and the untreated area on the right. Note the greater herbaceous cover and variety of vegetation in the treated area compared with the solid dense tree cover and bare intercanopy in the untreated area. Figure 33 shows an aerial view of an area in the foreground of the photo that was successfully treated, and an area in the back half of the photo that was not treated. Note the differences in the openness of the views, the more varied and random tree spacing in the treated area, which generally presents a more interesting and scenic landscape than the homogeneous and monotonous visual condition of the untreated area.

The impacts of stumps and evidence of treatment in the short term would be adverse, but no more than moderate because most visitors to the monument do not go onto the piñon- juniper woodland mesas, but restrict their visits to the visitor center area or the trails along the canyon bottoms. Long- term impacts are considered beneficial and moderate. No impairment of monument visual resources would occur.

CUMULATIVE IMPACTS

Possible fire suppression activities are the only other foreseeable federal actions that would occur within the monument's piñon- juniper woodland. The effects of successful vegetation treatment included in Alternative B, and possible fire suppression activity, would result in beneficial, long- term, and minor to moderate impacts to the piñon- juniper woodland within the monument. At a regional scale, treatment of a relatively small area of piñon- juniper woodland would have little effect, and impacts would be beneficial, long- term and minor.

Figure 30. Foreground View of Existing Conditions.

Figure 31. Foreground View of Treated Area Showing Successful Revegetation.

Figure 32. Foreground View of Both Treated (left) and Untreated (right) Areas.

Figure 33. Aerial View of Successfully Treated (foreground) and Untreated (background) Areas.

CONCLUSIONS

Impacts to visual resources from the vegetation management activity proposed under Alternative B would result in minor to moderate, adverse impacts in the short term, and moderate, beneficial impacts in the long term. No impairment of monument visual resources would occur.

Alternative C—Phased Approach

Under Alternative C, the areas to be treated would be determined by prioritizing the stabilization of cultural sites, and the order of treatment would not necessarily be organized by geographic location. The season of treatment would last from about September to mid- March, which would avoid most of the backcountry use periods, and spring nesting season of special status species birds. The shortened season would result in the treatment program taking up to 20 years to complete, versus approximately five years for Alternative B.

Although the order of treatment and timing would change, the end result of the treatment would generally be the same between Alternatives B and C, with corresponding similarity in the expected visual impacts. There are however, some differences. By treating smaller areas at any one time, the scale of the visual contrast between cut and uncut areas would be less noticeable in Alternative C. Since the treatment would occur in a single sub- basin not necessarily adjacent to a second treated sub- basin and proceed at a slower pace, there would be time for revegetation to occur in any one sub- unit before a substantial amount of additional acreage was cut. In Alternative B larger areas would be cut generally at the same time, leaving a relatively large geographic area that would experience adverse, short- term impacts before revegetation moderates the visual impact.

Short- term visual impacts are considered adverse and minor. Long- term impacts would be beneficial, and moderate. These effects would be most noticeable to backcountry users. No impairment of monument visual resources would occur.

CUMULATIVE IMPACTS

Cumulative impacts to visual resources would be the same as Alternative B: beneficial, long- term, and minor to moderate within the monument, and beneficial, long- term and minor at a more regional level.

CONCLUSIONS

Impacts to visual resources from the vegetation management activity proposed under Alternative C would result in minor, adverse impacts in the short term, and moderate, beneficial impacts in the long term.

No impairment of monument visual resources would occur.

WILDERNESS

Regulations and Policies

The regulations and policies governing the management of wilderness are discussed in detail in other sections of this EIS (see *Purpose of and Need for Action*, and the *Wilderness* section of *Affected Environment*, for example) and are summarized here. Wilderness areas are to be administered "in such a manner as to leave them unimpaired for future use and enjoyment." This same language is part of the Organic Act of 1916 which created the National Park Service, and guides the management of all NPS resources and values. The Department of the Interior (NPS is an agency of the Department) has interpreted this and other sections of the Act to mean that wilderness designation of national park system lands "should, if anything, result in a higher standard of unimpaired preservation."

The House Report accompanying the Wilderness Act (HR No. 1538, 1964) indicates that wilderness areas are unique "because of the undeveloped character of their lands and the need to protect and manage them in order to preserve, as far as possible, the natural conditions that prevail." While management actions are discouraged in wilderness where ecosystem processes are naturally functioning, they are allowed when needed to correct "past mistakes" or "the impacts of human use" (NPS 2006a, section 6.3.7). Section 4(c) of the Wilderness Act discourages motorized equipment in the wilderness to accomplish the tasks of preservation and protection, but does allow it if there is justifiable need and it has been found to be the "minimum requirement needed by management to achieve the purposes of the area as wilderness" (NPS 2006a, section 6.3.5).

Bandelier has completed a required assessment to determine whether actions in the proposed alternatives are consistent with this "minimum requirement concept." The assessment both evaluates whether intervention in wilderness is warranted, and whether the techniques proposed to conduct the needed activities would have the minimum impact to wilderness resources. The results of this assessment are included as Appendix A, and are summarized in Alternatives B and C below.

Methodology

The essential features of wilderness and wilderness character as defined by the Wilderness Act and other sources (see *Affected Environment*) are its "wildness" and its "naturalness." These are both features which lend themselves to a qualitative discussion rather than a quantitative analysis, and so the methods used in this EIS are primarily descriptive and rely on the scientific literature. The thresholds used to evaluate the intensity of impact to wilderness are:

Negligible: A change in the wilderness character could occur, but it would be so small that it would not be of any measurable or perceptible consequence. The natural character of wilderness or its untrammeled nature would not be affected. Wilderness values would be unaffected.

Minor: Actions may result in detectable changes to the wilderness, but the majority of visitors would not notice them. Changes are likely to be highly localized and/or temporary, and so short term or located such that most visitors would not be aware of them. The natural character of wilderness or its untrammeled nature would not be noticeably affected. Slight impacts to the wilderness values of a few may occur.

Moderate: Actions may alter wilderness character so that visitors notice it quite often. The changes would be less localized and longer- lasting, although they would still be defined as short term. The natural character of portions of the wilderness or its untrammeled nature could be noticeably affected. Modest impacts to wilderness values of some may occur.

Major: A highly noticeable change in the wilderness character and associated values would occur. Actions would alter wilderness character across the landscape and changes would be more likely to be long- term or permanent. The natural character of wilderness or its untrammeled nature would be clearly altered on a large scale. Sizeable impacts to the wilderness values of many visitors may occur.

Impairment: An impact would be more likely to constitute an impairment to the extent that it would be a major adverse effect on 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 identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative A—No Action

WILDERNESS CHARACTER

The Wilderness Act includes a lengthy definition of wilderness, including phrases such as:

- An area where earth and its community of life are untrammeled by man.
- An area where man himself is a visitor who does not remain.
- An area of underdeveloped land retaining its primeval character and influence.
- An area protected and managed to preserve its natural conditions.
- An area that generally appears to have been affected primarily by the forces of nature.
- An area with the imprint of man's work substantially unnoticeable.
- An area with outstanding opportunities for solitude or a primitive and unconfined type of recreation.

National Park Service policies define wilderness character and values as including the primeval untrammeled character and influence of the wilderness; the preservation of natural conditions (including the lack of man- made noise); and assurances that there will be outstanding opportunities for solitude and the public will be provided with a primitive and unconfined type of recreational experience.

Like most wilderness areas in the National Wilderness Preservation System, the Bandelier Wilderness was not pristine when it was designated due to the history of Euro- American land use practices described in the *Background* section of this EIS, including overgrazing and fire suppression over the past century. As a result, highly "unnatural" conditions, including a degraded ecosystem with unsustainable ecological processes, exist today. These processes include the loss of organic topsoils, decreases in available soil moisture, extreme soil surface temperatures and freeze-thaw activities that characterize Bandelier's piñon- juniper woodland. Because scientific evidence indicates ecological thresholds have been crossed, these conditions will continue irreversibly to desertify the landscape and reduce the park's biological productivity without human intervention. Continuing current management (e.g., the No Action alternative) would result in continued loss of soils, changes in vegetative structure, fire regime, wildlife habitat and unique cultural resources, and would further imprint the effects of human uses. As noted in the *Affected Environment* section on *Wilderness*, "untrammeled" is a key word for wilderness management specialists and recreationists, and is most often defined both as showing no signs of external human influence and as offering an unconfined or unrestrained experience. If no changes to current management are made, ecological conditions in the piñon- juniper woodland in the Bandelier wilderness would worsen, and this portion of the wilderness would continue to show clear evidence of having been altered by external human influence, e.g., it would appear "trammeled." Major adverse impacts to both these elements of wilderness character would occur.

However, visitors to the backcountry at the monument are able to find a solitary and quiet experience which may feel "primitive" and "unconfined." As noted in the *Visitor Experience* section of this EIS, few people visit the backcountry, and the chances of encountering other hikers is relatively low. The backcountry is quiet, with few sources of loud noise except commercial aircraft occasionally flying overhead. Unless these visitors are or have been made aware of the unnatural and highly manipulated state of Bandelier's piñon- juniper wilderness, they may believe that the area has been "affected primarily by the forces of nature." Although some remnants of prehistoric occupation exist, the fact that they have survived European occupation may add to the feeling that these lands remain "undeveloped" and retain a "primeval character and influence." Other elements of a wilderness recreational experience, including an opportunity of personal challenge and self- sufficiency are also available as access to the backcountry (all of which is designated or managed as wilderness) is difficult. The terrain is rugged and surface water does not exist except in canyon bottoms. Continuing current management may therefore only have a negligible or minor adverse impact on visitors' perception of the study area as offering the kind of recreational experience defined by the Wilderness Act. In light of this, and because wilderness character is not called out as part of the presidential proclamation creating

Bandelier, identified in the monument's planning documents, or key to the natural or cultural integrity of the park, no impairment to this park resource would result from continuing with current management.

WILDERNESS VALUES

Similar to the discussion of wilderness character, the values ascribed to wilderness are sometimes grouped in biocentric and anthropocentric categories. Those with biocentric values may most appreciate the natural or ecological conditions at Bandelier, including protecting natural ecological processes, wildlife habitat, habitat for rare and endangered or unique plants and animals, protecting watersheds and water quality, etc. Anthropocentric values include experiential benefits from recreating in wilderness, educational and scientific values, generating tourism revenue for adjacent or nearby gateway communities, aesthetic and spiritual values, the knowledge that wilderness areas exist and will exist in the future, and intrinsic or symbolic values. Generally, the impact of continuing current management would have moderate or major adverse impacts to those with biocentric values and impacts ranging from minor and adverse to minor and beneficial to those with anthropocentric values. Subsets of each of these major categories of values are discussed below.

Values that may be affected by restoring the natural character of the Bandelier Wilderness include utilitarian ideals; conservationists' views; and views of backcountry users, day hikers and campers, Native Americans, and the general public. Those with utilitarian views value land or resources in terms of its usefulness to humans, and fall into the anthropocentric category described above. Continuing current management would be most consistent with these views, as conditions have resulted from extensive human use of grasslands and piñon- juniper woodland for grazing and to provide what settlers believed was a safe and fire- free existence. To the extent that those with utilitarian values are satisfied because the land was put to appropriate historical use, positive or only very slight adverse impacts to their wilderness views would occur under the No Action alternative. If they believe the Bandelier Wilderness would generate additional tourism revenue or serve other purposes useful to humans if it were restored, No Action may have minor adverse impacts.

Conservationists have traditionally tended to hold biocentric preservationist or ecological views about wilderness, e.g. that nature generally requires protection from the influence of humanity. Wilderness management has helped to solidify this perspective by distinguishing between natural and human- caused influences. For example, a human- caused fire would be suppressed but a lightning ignition would be allowed to burn. Bare ground may be allowed to remain if attributed to the behavior of native species, but would be remediated if the result of livestock.

Recently, however, Landres, et al. (2000) identified a second philosophy he termed the "organic" perspective that may characterize the views of some conservationists. The organic perspective is that the natural and human worlds are integrated and even inseparable. Humans are acknowledged as part of nature and wilderness, and society is given the responsibility to determine how extensive that role in wilderness should be. For those conservationists who hold preservationist views, continuing with the No Action alternative would have major and adverse impacts. For those who believe the organic model, current conditions are a result of human and natural interactions and no impact from the No Action alternative to their values regarding the Bandelier Wilderness would result.

Backcountry and frontcountry hikers in the monument may be less aware of the unnatural condition of resources in the Bandelier wilderness than its recreational attributes. As described above, the backcountry is remote, rugged, quiet and infrequently used by visitors, and a high quality experience that offers several of the benefits described by the Wilderness Act, including solitude, primitive and unconfined or untrammeled recreation, is possible. Therefore the impact of continuing current management into the foreseeable future on the values these groups place on the Bandelier Wilderness is likely to be only negligible or minor.

As with other groups, it is not possible to identify a single value that Native Americans place on wilderness. However, as the *Affected Environment* section explains, many tribes connect the land and Mother Earth to their spiritual, cultural and physical well being. The traditionalist view, to which many tribal members adhere despite economic difficulties on the reservation, is that spiritual values relative to the land and water should be honored and the natural environment should remain unaltered (Farhar and Dunlevy 2003). Other tribal members hold more to the organic point of view, and believe that Mother Nature should be allowed to act to change the earth without the interference of humans. Tribal groups contacted by the monument also indicated that to them, wilderness is without boundaries.

The spiritual value of wilderness is one that tends to be held by many non- Native Americans as well (Parker and Koesler 1998; Trainer and Norgaard 1999). Cole (2005) writes that the prominence of the word "untrammeled" as a descriptor of the wilderness ideal does not just mean an area should naturally show no evidence of external human influence, but that humans should refrain from intervening altogether in its management. He suggests that the human relationship to wilderness should be "characterized by restraint and humility," rather than manipulation because wilderness has significant "symbolic" or "intrinsic" values as entities where forces larger than man are at work. Here, scientists should leave behind any desire to manipulate, even if it is to return resources to what they believe is a better or more natural state. Attempting to do so requires them to "say they know best," and is characterized as arrogant. A similar sentiment was voiced by Howard Zahniser, the creator of the Wilderness Act, who in 1992 wrote "the distinctive ministration of wilderness is to know a profound humility, to recognize one's littleness, to sense dependence and independence" (Landres et al. 2000). For individuals with this symbolic or spiritual value, the continuation of current management would have a negligible impact.

Other studies of American public views regarding wilderness found that those qualities they most often placed highest were its undeveloped nature and therefore ability to provide sanctuary for wildlife, protection of water resources, help maintain or even improve air quality, etc. In addition, many indicated the “existence” value it had simply by existing now and in the future as a place that remains undeveloped for generations to enjoy was the primary benefit of wilderness. The portion of the public commenting on the proposal to treat piñon- juniper wilderness at Bandelier indicated by a large majority (91%) that intervention to conserve soil and cultural resources and return vegetation to a more natural state was important. These values are perhaps most in line with those described above as conservationist. Continuing with the No Action alternative would result in moderate or major adverse impacts to the values of these commenters.

As noted in other sections of this EIS, ethnographic, scientific and educational values at Bandelier are articulated in the 1977 Bandelier *Master Plan* (NPS 1977). No mention of wilderness or wild lands was made. Also, although the naturalness element of the wilderness character would continue to experience major adverse effects, the opportunities for a rugged and primeval recreational experience are not severely affected by ongoing erosion. Therefore, although it would continue to sustain major adverse impacts to elements of wilderness character and to some wilderness values (primarily those who hold conservationist or preservationist values), no impairment of monument wilderness character or wilderness values would occur under this alternative.

CUMULATIVE IMPACTS

New Mexico is 77 million acres in size, and of this, 26 million acres are public lands. About 6% of these public lands are managed as wilderness (Wilderness Society website: www.wilderness.org), of which the Bandelier Wilderness is a small (less than 0.1%) part. While public lands in the state are subject to a variety of activities, including grazing, mining, off- road vehicles, logging, oil and gas development, timber cuts, etc., wilderness is unique in that most of these activities are prohibited (grazing is allowed in some non- NPS areas). While these activities are not allowed in wilderness, their impacts, including siltation of streams, toxic drainage, loss of wildlife habitat, noise, etc. may affect the same type of natural or cultural resources that are protected by undeveloped lands designated or managed as wilderness, including water quality, air quality, wildlife, vegetation, archeological and historic resources and more. It is politically difficult to designate additional protected areas, although the 11,000 Bureau of Land Management Ojito Wilderness north of Albuquerque was recently approved (2005) after 10 years of struggle as the first new wilderness area in New Mexico in 18 years (New Mexico Wilderness Alliance webpage: http://nmwild.org/). To the extent that other wilderness areas in the state are impacted by pollution or land use practices in neighboring areas, the ecological degradation in Bandelier adds a negligible adverse additional impact.

CONCLUSION

If no changes to current management are made, the piñon- juniper woodland in Bandelier's wilderness would continue to appear "trammeled" and major adverse impacts to wilderness character would result. However, because visitors may be unaware of the degraded ecological conditions in the wilderness, continuing current management may only have a negligible or minor impact on visitors' perception of the study area as offering the kind of recreational experience defined by the Wilderness Act.

Wilderness values fall into two major categories, biocentric and anthropocentric. Biocentric would include those with conservationist or ecological values, and continuing with current management would have moderate or major, adverse impacts to these people. Those with anthropocentric values include utilitarian values and impacts of No Action would range from minor and adverse to minor and beneficial. Some conservationists or Native Americans who believe humans are an integral part of the ecology, or those who believe intervention in wilderness is never warranted because of its intrinsic or symbolic value would experience no adverse impact from continuing with the current management.

The portion of the American public commenting on this specific proposal had values most in line with those described above as conservationist. Continuing with the No Action alternative would result in moderate or major adverse impacts to the values of these commenters.

To the extent that other wilderness areas in the state are impacted by pollution or land use practices in neighboring areas, the ecological degradation in Bandelier adds a negligible adverse additional impact.

No impairment to monument wilderness resources or values would occur if No Action were implemented.

Alternative B—Operational Priority

WILDERNESS CHARACTER

The current degraded conditions in the wilderness would improve most quickly in this alternative. Within five years, an estimated 4,000 acres of piñon- juniper woodland and former grassland would have been treated. Within three to five years following this treatment period, the loss of organic topsoil would have been slowed to sustainable rates two- to four- fold less than that in adjacent untreated areas. As the understory returns, a regime of cool surface fires would also return, and over time the appearance of the woodland would become more open and savanna like, with grasslands and woodland intermixed.

During and for a period following treatment, the wilderness character would appear unnatural. Visitors to the wilderness would occasionally encounter crews or camps, although they would be informed of the locations of both when applying for a backcountry permit to camp overnight. After an area is treated and for a period of three to five years, tree stubs would be numerous and branches would be scattered in a pattern clearly created by human hands. During treatment, sustained noise of chainsaws and the infrequent sounds of supply helicopters would mar the natural quiet backcountry users often seek. Overall, for a period of five years and a season of eight months per year, the wilderness would appear unnatural and trammeled to the majority of backcountry users. Few users would be directly affected by noise, as work would be discontinued in the highest use, summer months. However, the appearance of the landscape would be obviously altered over a large portion of the wilderness for a period of at least three years following treatment. Depending on the time it takes for a natural or prescribed fire to burn treated areas, adverse impacts to the wilderness character would vary from minor to major, and would most likely fall into the moderate category during this period.

When the understory has returned, and particularly following the first lightning-caused or prescribed fire in the treated area, the landscape would be returned to a significantly more natural state, both ecologically and to the visitor's eye. Signs of external human influence, both from treatment and from the overgrazing and other historical harmful land uses, would disappear within five to 10 years, even without fire. No additional treatment is expected beyond that indicated in this EIS, and so this natural state would persist indefinitely or permanently, a major benefit to the wilderness character at Bandelier.

As noted above, "untrammeled" refers not only to showing no signs of external human influence but also to offering an unconfined or unrestrained experience. This experience would remain available to backcountry users during and following treatment, as elements of the experience such as requiring self- sufficiency and offering a personal challenge, would not change. However, as noted above, the chainsaw activity, helicopters and the crews would make noise, and backcountry visitors may encounter crews or camps while they are hiking or camping. This presence of humans would disrupt the solitude many backcountry hikers seek, and would affect the feeling of a primeval land the wilderness now offers. These impacts would be adverse and temporary, and would vary in intensity between minor and moderate. The degree of impact would depend to a degree on the location of the treatment compared to popular backcountry destinations.

MINIMUM REQUIREMENT RESULTS

As noted above, a minimum requirement assessment must be performed before the monument can intervene in wilderness. The assessment includes a review and analysis of tools and techniques available to accomplish management goals, and a determination of whether motorized tools are warranted and which tools would cause the least impact to wilderness resources and values.

The National Park Service utilizes the Arthur Carhart National Wilderness Training Center's *Minimum Requirements Decision Guide* (Arthur Carhart National Wilderness Training Center 2002) to apply the minimum requirement concept. The results of this process for Bandelier National Monument indicated that treatment of the area is critical to promote sustainable ecological conditions in the piñon- juniper woodland

and to protect the high number of valuable cultural resources for which the monument was created.

Further, the analysis indicated that motorized tools would be necessary to administer or manage the area based on the extent of treatment required in order to effectively restore piñon- juniper woodland and thus better protect cultural resources in the wilderness. The analysis showed that the speed with which the treatment would occur using motorized tools would result in better overall protection of wilderness values, cultural resources, soils and vegetation, and would offset the short- term adverse noise impacts to wilderness (Appendix A).

Subsequent site- specific minimum requirement analysis would be completed on an annual or treatment area basis to ensure intervention is needed, and to decide whether and to what extent mechanized or hand tools should be used under Alternative B.

WILDERNESS VALUES

In the long term, restoring natural ecological processes to the piñon- juniper woodland at Bandelier would have major beneficial impacts to those people with biocentric values and moderate and beneficial to moderate and adverse impacts for those with anthropocentric values. The former group is characterized as made up of people who most appreciate natural or ecological conditions in wilderness and so restoring these conditions would have permanent and positive effects on their social values regarding wilderness. Anthropocentric values include experiential benefits from recreating in wilderness, educational and scientific values, generating tourism revenue for adjacent or nearby gateway communities, aesthetic and spiritual values, the knowledge that wilderness areas exist and will exist in the future, and intrinsic or symbolic values. In other words, wilderness is valued for what it can provide to people. Given that only through treatment would the soil and resources dependent on it (vegetation, cultural artifacts, and indirectly, wildlife) be sustained, those with anthropocentric values would be benefited if this alternative was implemented. Additional benefits are possible if it becomes widely known that the Bandelier wilderness is a restored piñon- juniper woodland, as this is quite rare in the region. Sub- categories of anthropocentric and biocentric values include utilitarian, conservationists and recreationists; these are discussed in more detail below.

Those with utilitarian ideals may experience adverse effects to their values by efforts to restore the piñon- juniper in Bandelier Wilderness, as these people believe the land was put to appropriate historical use. However, utilitarian views may also be consistent with the anthropocentric ideal that restoration is beneficial if it generates tourism revenue, for example. Impacts to those with utilitarian values from implementing Alternative B would likely range from moderate beneficial to moderate and adverse.

For those conservationists who hold ecological views about wilderness, eliminating the impacts of human use through treatment of the piñon- juniper woodland at

Bandelier would have moderate or major beneficial effects. For those who believe in the organic model, that humans are an integral part of the ecology of an area and society must determine the extent of humanity's role in wilderness, impacts could range. For example, those who believe all human use is natural could experience moderate or even major adverse impacts to their values regarding wilderness. Those who believe humans should intervene to restore natural conditions if humans have greatly altered the natural ecology would experience moderate to major beneficial impacts.

The impacts to the wilderness values of recreationists would be consistent with those described above for wilderness character. These include minor or moderate adverse impacts associated with the loss of a solitary and quiet recreational experience during the five- year treatment period, and a minor to major beneficial impact from the eventual return of natural conditions. The degree of impact restoration brings to recreationists would vary depending on their knowledge of current degraded conditions in the woodland. For those that are knowledgeable, or respond to a more open, savanna look esthetically, benefits would be moderate to major. For those that are unaware or less aware, or who prefer a more closed- canopy, forest look to the landscape, the impact would be negligible or minor.

The values Native Americans place on wilderness may be similar to the organic conservationist view described above, in that humans are an integral part of the natural environment. Some tribes also believe that spiritual values relative to the land and water should be honored and the natural environment should remain unaltered (Farhar and Dunlevy 2003). The values of Native Americans who believe either of these philosophies would experience minor to major adverse effects from human intervention in the form of treatment of piñon- juniper in the Bandelier Wilderness.

Similarly, those who most highly value the intrinsic, spiritual or symbolic nature may experience adverse effects. These people might describe wilderness as similar to a church, e.g., as offering a transcendental experience or a part of the earth where humans should be humbled by forces larger than themselves and restrain any effort to manipulate. The highest symbolic value the wilderness has is that it is left to Mother Nature, rather than humans, to manage. For these people, the intervention represented by treatment as described in Alternative B would have a major adverse impact.

For the majority of Americans, including those who commented during scoping on this EIS, treatment of Bandelier piñon- juniper woodland would be consistent with the values they place on wilderness, including its ability to provide sanctuary for wildlife, protection of water resources, help in maintaining or improving air quality, and as a preserve for future generations to enjoy. Restoration would have major beneficial impacts to the values of these people.

No impairment to the monument's wilderness character or wilderness values would occur if Alternative B was implemented.

CUMULATIVE IMPACTS

The adverse impacts described above for cumulative impacts of No Action would continue. However, they would be offset to a negligible degree by the restoration of natural conditions in a portion of the Bandelier Wilderness. During treatment, short-term impacts to wilderness character at Bandelier would be a negligible cumulative adverse effect on wilderness in the region.

CONCLUSION

Minor to major, short- term, adverse impacts to the wilderness character from noise, the presence of crews and camps, and the unnatural appearance of treated areas would occur during and for a period of a few years following treatment. Major permanent benefits to the character of the Bandelier wilderness would result from restoration of the degraded and unnatural state of its piñon- juniper woodlands. Although the use of motorized equipment would adversely affect the wilderness character during treatment, it would also result in better overall protection of wilderness values, cultural resources, soils, wildlife and vegetation, and would offset the short- term, adverse noise impacts to wilderness. In the long term, restoring natural ecological processes to the piñon- juniper woodland at Bandelier would have major beneficial impacts to those people with biocentric values and a range of impacts from moderate and beneficial to moderate and adverse for those with anthropocentric values. For those who believe in the organic model, that humans are an integral part of the ecology, or for those that believe the value of wilderness is symbolic and intrinsic, minor to major adverse impacts from implementing Alternative B are possible. For the majority of Americans, including those who commented during scoping on this EIS, treatment of Bandelier piñon- juniper woodland would be consistent with the values they place on wilderness, and restoration would have major beneficial impacts.

During treatment, short- term impacts to wilderness character at Bandelier would be a negligible cumulative adverse effect on wilderness in the region, and in the long term, restoration would have a minor beneficial cumulative impact. No impairment to the monument's wilderness character or wilderness values would occur if Alternative B was implemented.

Alternative C—Phased Approach

WILDERNESS CHARACTER

The current unnatural and degraded conditions in the wilderness would improve if this alternative is selected, but more slowly than in Alternative B. Within 20 years, (and assuming no loss of acreage with restoration potential during this time period) an estimated 4,000 acres of piñon- juniper woodland and former grassland would have been treated. Within three to five years following this treatment period, the loss of organic topsoil would have been slowed to sustainable rates two- to four- fold less than in adjacent untreated areas. As the understory returns, a regime of cool surface fires would also return, and over time the appearance of the woodland would become more open and savanna like, with grasslands and woodland intermixed.

During and for a period following treatment, patches of the wilderness landscape would appear unnatural. As in Alternative B, visitors to the wilderness would occasionally encounter a crew or camp, although they would be informed of the locations of both when applying for a backcountry permit to camp overnight. After an area is treated and for a period of three to five years, tree stubs would be numerous and branches would be scattered in a pattern clearly created by human hands. During treatment, sustained noise of chainsaws and the infrequent sounds of supply helicopters would mar the natural quiet backcountry users often seek. Overall, for a period of 20 years and a season of six months per year, units where the crew is working would seem "trammeled" to the majority of backcountry users. During this time and following it for five to ten years until the visual evidence of treated sites—that is, distributed branches and cut tree stubs—disappears, many backcountry visitors would continue to perceive the wilderness as an area where humans have intervened and a primeval experience is unavailable over much of the piñon- juniper woodland.

Fewer users would be directly affected each season by noise in this alternative compared to Alternative B, as only one crew would be working and the season would last only six months. This means fewer visitors would be exposed to these impacts, and the chances of encountering a crew or camp are lower. However, over the lifetime of the plan, 120 crew months (e.g., months of work per crew) would be required to treat the landscape vs. 90 crew months in Alternative B. This cumulative effect of noise or visual evidence of human intervention in Alternative C may therefore have a greater overall effect on wilderness character and on the wilderness experience for most backcountry users. This is because most backcountry users are repeat visitors from the local area and so would be subject to noise and the presence of humans over a larger portion of the total 20- year period. These same visitors would experience a less severe seasonal, but longer overall impact from visible alteration of the piñon- juniper woodland. Because treatment would be more random across the wilderness landscape, surrounding vegetation would likely mask treatment and the understory in one sub- basin is more likely to return before work begins on the adjacent sub- basin. As the *Visual Resources* section indicates, impacts to visitors from short term appearance of stumps, branches and an otherwise altered landscape in this alternative are likely to be less severe than in Alternative B. Because these effects during treatment, and visual impacts following treatment for a period of time are likely to counterbalance each other, they are likely to be similar in intensity to those in Alternative B, and range between minor and major, but most likely fall into the moderate category.

When the understory has returned, and particularly following the first lightning-caused or prescribed fire in the treated area, the landscape would be returned to a significantly more natural state, both ecologically and to the visitor's eye. Signs of external human influence, both from treatment and from the overgrazing and other historical harmful land uses, would disappear. No additional treatment is expected beyond that indicated in this EIS, and so this natural state would persist indefinitely or permanently, a major benefit to the wilderness character at Bandelier.

As in Alternative B, an "untrammeled" visitor experience would remain available to backcountry users during and following treatment, as elements of the experience such as requiring self- sufficiency and offering a personal challenge, would not change.

MINIMUM REQUIREMENT RESULTS
No changes from the minimum requirement results as explained in Alternative B above would occur.

WILDERNESS VALUES
The discussion of wilderness values described above for Alternative B would also apply for Alternative C, as it focuses on the debate between whether humans should manage resources in the wilderness to return a more natural character (biocentric, conservationist values) or limit their intervention either because nature is a better manager (intrinsic, symbolic or spiritual value), human activities and impacts are an inherent part of the ecology of an area (organic or Native American values), or the "used" condition of the lands appropriately reflects the value of wilderness for human use (anthropocentric or utilitarian values).

In the long term, restoring natural ecological processes to the piñon- juniper woodland at Bandelier would have major beneficial impacts to those people with biocentric values and a range of impacts from moderate and beneficial to moderate and adverse for those with anthropocentric values for the reasons described in Alternative B.

Impacts to those with utilitarian values from implementing Alternative B would likely range from moderate beneficial to moderate and adverse.

For those who hold ecological views about wilderness, eliminating the impacts of human use through treatment of the piñon- juniper woodland at Bandelier would have moderate or major beneficial effects. For those who believe in the organic model, and for traditional Native Americans who believe the natural environment should remain unaltered, impacts could range. For example, those who believe all human use is natural could experience moderate or even major adverse impacts to their values regarding wilderness. Those who believe humans should intervene to restore natural conditions if humans have greatly altered the natural ecology would experience moderate to major beneficial impacts.

As described above under impacts to wilderness character for Alternative B, backcountry hikers in the monument are most likely to experience minor or moderate adverse impacts associated with the 20 years of treatment itself, as well as the adverse impacts associated with unnatural distribution of branches and tree stumps than other groups. In the long term, backcountry users that are unaware of the current unnatural condition of the wilderness may be unaffected by the restored ecological processes in the wilderness. Some may respond positively or negatively to the changed “look” of the vegetation, depending on their esthetic sense and knowledge of what natural processes should be.

Those who most highly value the intrinsic, spiritual or symbolic nature may experience moderate to major adverse effects for the reasons described under Alternative B.

For the majority of Americans, including those who commented during scoping on this EIS, treatment of Bandelier piñon- juniper woodland would be consistent with the values they place on wilderness, including its ability to provide sanctuary for wildlife, protection of water resources, help in maintaining or improving air quality, and as a preserve for future generations to enjoy. Restoration would have major beneficial impacts to the values of these people.

No impairment to the monument’s wilderness character or wilderness values would occur if Alternative C was implemented.

CUMULATIVE IMPACTS

The adverse impacts described above for cumulative impacts of No Action would continue. However, as in Alternative B, they would be offset to a negligible degree by the restoration of natural conditions in a portion of the Bandelier Wilderness. During treatment, short- term impacts to wilderness character at Bandelier would be a negligible cumulative adverse effect on wilderness in the region.

CONCLUSION

Minor to major, with most impacts in the moderate range, short- term, adverse impacts would occur during the treatment period to the wilderness character from noise, and the presence of crews and camps, and the unnatural appearance of treated areas. Throughout the 20- year treatment period, there will always be small portions of the monument that appear manipulated, each of which may require ten years to regain a more natural appearance. However, these are relatively small areas when compared to alternative B and areas treated early in the plan may have completely recovered by the end of the 20- year schedule. Major permanent benefits to the character of the Bandelier wilderness would result from restoration of the degraded and unnatural state of its piñon- juniper woodland. As in Alternative B, the use of motorized equipment would adversely affect the wilderness character during treatment but would result in better overall protection of wilderness values and resources. In the long term, restoring natural ecological processes to the piñon-juniper woodland at Bandelier would have major beneficial impacts to those people with biocentric values and a range of impacts from moderate and beneficial to moderate and adverse for those with anthropocentric values. For those who believe in the organic model, that humans are an integral part of the ecology, or for those that believe the value of wilderness is symbolic and intrinsic, minor to major adverse impacts from implementing Alternative B are possible. For the majority of Americans, including those who commented during scoping on this EIS, treatment of Bandelier piñon- juniper woodland would be consistent with the values they place on wilderness, and restoration would have major beneficial impacts.

During treatment, short- term impacts to wilderness character at Bandelier would be a negligible cumulative adverse effect on wilderness in the region, and in the long term, restoration would have a minor beneficial cumulative impact.

No impairment to the monument's wilderness character or wilderness values would occur if Alternative C was implemented.

WILDLIFE

Laws, Regulations and Policies

The NPS Organic Act and *Management Policies 2006* (NPS 2006) provide the basis for resource protection, conservation, and management and are described in better detail in the *Purpose of and Need for the Plan* section.

Director's Order 12 and Handbook: Conservation Planning, Environmental Impact Analysis and Decision Making offers the guidance to analyze the potential impacts of the alternatives and to prepare the environmental impact statement.

The Fish and Wildlife Coordination Act of 1934, as amended, requires consultation with the U.S. Fish and Wildlife Service and the fish and wildlife agencies of states to prevent "loss of and damage to wildlife resources."

The Migratory Bird Treat Act of 1918, (as amended, 88 Stat 190, 16 USC §703 et seq.) prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts and nests except as authorized under a valid permit (50 CFR 21.11). Additionally, the Act authorizes and directs the Secretary of the Interior to determine if, and by what means, the take of migratory birds should be allowed and to adopt suitable regulations permitting and governing take. "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb.

The Bald and Golden Eagle Protection Act of 1940, as amended, provides for the protection of the bald eagle and the golden eagle (as amended in 1962) by prohibiting the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit, "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb.

Methodology

This analysis discusses impacts to general wildlife species, as species that are threatened or endangered are analyzed in the *Special Status Species* section below. This assessment of impacts uses the general methodology described at the beginning of this section and the resource specific information presented here. The area of analysis includes the project area, the monument, and the Pajarito Plateau (for cumulative effects analysis) as described in *Purpose of and Need for Action* section.

Analysis of impacts of the alternatives on wildlife was developed through consultation with monument staff knowledgeable in wildlife responses at both the individual and population levels from noise disturbance and habitat change. Results from test plots (the paired watershed study described in the *Research at Bandelier* section of *Purpose of and Need for Action*) and the scientific literature were also used in conjunction with best professional judgment. The following thresholds were used to evaluate the intensity of impact to wildlife:

Negligible: Native wildlife species, their habitats, and the natural processes sustaining them would not be affected, either beneficially or adversely, or the effects would be at or below the level of detection. Effects would be well within the range of natural fluctuations and would not be of any measurable or perceptible consequence to wildlife populations. Habitats would retain adequate ecological integrity to support native wildlife species.

Minor: Effects on native species, their habitats, and the natural processes sustaining them would be detectable and would occur over a small area. Population numbers, structure, and other demographic factors may experience small changes, but the change would not likely affect population viability. Habitats would retain adequate ecological integrity to support native wildlife species.

Moderate: Effects on native species, their habitats, or the natural processes sustaining them would be readily detectable and likely have consequences at the population level. Population numbers, population structure, and other demographic factors for species may change, and the changes may affect the viability of a population. Habitats would retain adequate ecological integrity to support native wildlife species.

Major: Effects on native species, their habitats, or the natural processes sustaining them would be easily detectable and would have consequences at the population level. Population numbers, structure (e.g., age or sex ratios), and other demographic factors would experience changes that would have an effect on the viability of a species. Habitats would be affected in a way that would change support for native wildlife.

Impairment: Impairment of wildlife resource or values would occur if a permanent, major, adverse effect of wildlife and habitats affected a large portion of the monument. The effect would be highly noticeable, could not be mitigated, and would affect wildlife and habitats to the extent that would preclude enjoyment of wildlife and habitat resources by future generations of park visitors. In addition, the adverse effects on the monument's wildlife resources and values would: contribute to the deterioration of wildlife resources and values to the extent that the purpose of the park would not be fulfilled as established in the monument's enabling legislation; affect resources essential to the natural and cultural integrity of the monument or opportunities for enjoyment; or affect resources whose conservation is a goal in monument planning documents.

Type of Impact

Beneficial: Impacts that would result in wildlife populations whose size, density, and other population characteristics (e.g., age and sex ratios, survival, mortality, recruitment) would be within normal parameters and in ecological balance with other resources. Behavior, habitat, necessary resources, migration, or dispersal characteristics would be supported by the action.

Adverse: Impacts that would cause wildlife populations to experience negative effects with respect to size, density, and other population characteristics, as identified above. The proposed action would restrict or limit behavior, habitat, necessary resources, migration, or dispersal characteristics.

Alternative A—No Action

Under Alternative A, current land management activities described in *Alternatives* would continue. These activities include visitor hiking and backcountry camping, law enforcement patrols, ongoing research on soils and vegetation in piñon- juniper woodland, monitoring of certain special status species, and ongoing cultural resource inventories. Although wildland and prescribed fire, as well as fire suppression, are allowed in piñon- juniper woodland as part of the Bandelier *Fire Management Plan*, the likelihood of any of these occurring is very low given the generally sparse fuel conditions and minimal potential to affect park resources. No thinning or mechanical removal of trees, except for occasional removal of heavy fuels from archeological sites at the request of cultural resource staff, is planned in the project area.

POTENTIAL IMPACTS RELATED TO NOISE DISTURBANCE

Under this alternative, disturbance, if any, would likely come from on- trail hikers and backcountry camping. However, winter backcountry use by visitors in Bandelier is low with only an average of 20- 30 hikers per day (see *Visitor Experience* section). There may be some short- term, indirect, negligible impacts to certain species within close proximity to hiking trails or camping areas. Some small mammals, reptiles, and birds may disperse from the area in the short term, but readily return once the noise disturbance has disappeared. Some studies have shown that repeated and regular intrusions by people walking can cause some breeding bird species to sing less than individuals of the same species without intrusions (Gutzwiller, et al. 1994). Similarly, human intrusions may cause a change in the dates of breeding season song for some species of birds (Gutzwiller, et al. 1997). However, these impacts were not consistent between species and seemed to vary between individual birds within a species, and none were shown to negatively affect overall breeding success. Impacts to wildlife from foot patrols by law enforcement, hazard tree removal using hand tools, and ongoing research activities would likely have the same type impacts as visitor use, but of a smaller magnitude and shorter duration.

POTENTIAL IMPACTS DUE TO HABITAT CHANGE

Under Alternative A, no restoration activities would occur and the existing habitat would remain, with a possible increase in piñon- juniper overstory cover and general reduction in herbaceous understory. Under current conditions, the fluctuation in the abundance of wildlife would likely be in response to variations in precipitation and associated plant growth. Such variations would likely change most rapidly for small herbivores such as chipmunks, piñon mice, rock squirrels, desert cottontails, and pocket gophers. Populations of these small mammals often change in response to a relatively close temporal relationship with the availability of plant foods. The same plant- related fluctuations would be expected for mule deer but at slower rates or responding with longer time delays due to the longer reproductive cycles and life spans of deer compared to the named small mammals. Coyotes would also likely fluctuate in response to prey populations of chipmunks, rock squirrels, cottontails, and other small mammal prey. Insect eaters such as eastern fence lizards, collared lizards, and short- horned lizards would similarly fluctuate with food availability. Fluctuations in moisture may also lead to fluctuations in invertebrate abundance and diversity. More moisture may often lead to short- term increases in overall invertebrate numbers and thus increase in potential prey for these reptiles. Conversely, lower moisture levels may lead to a decrease in the overall abundance of most species. Under this alternative, impacts to wildlife due to habitat change over the short and long term are anticipated to be indirect and negligible.

No impairment to park wildlife or wildlife habitat would occur under the No Action alternative.

CUMULATIVE IMPACTS

In the project area under Alternative A, existing management practices and research would continue. There would be no prescribed fire and no other new activities are currently being planned. Within Bandelier National Monument and the regional Pajarito Plateau area, activities in piñon- juniper woodland such as fire suppression and thinning would occur as well as law enforcement patrols, research activities, tourism and visitor use, and other activities conducted by adjacent landowners (U.S. Forest Service, Valles Caldera National Preserve, and Los Alamos National Laboratory). Although fires that do occur in woodland are currently suppressed, prescribed or wildland fire in adjacent habitat could have a beneficial effect on wildlife species by promoting greater nutrient recycling, decreased water consumption by woody vegetation, and increased grass and herbaceous cover. These changes would yield increased biological productivity for the areas affected and would in turn produce slight benefits for wildlife abundance and diversity. For wildlife in the project area, the cumulative impacts would likely be negligible.

CONCLUSION

Under Alternative A, there may be some short- term, indirect, negligible impacts to wildlife due to noise disturbance mostly unrelated to piñon- juniper management and short- and long- term, indirect, negligible impacts to wildlife due to habitat change. There may be negligible cumulative effects under this alternative when combined with actions such as certain fire management activities within the monument and region- wide. No impairment to park wildlife would occur.

Alternative B—Operational Priority

Under Alternative B, geography and logistics would determine the location and timing of treatment and crews would complete restoration in a wave- like fashion by working systematically across the monument from one end to the other. As described in *Alternatives*, treatment would be conducted over a five- year term, with approximately 800 acres treated per year, using two crews over an eight- month working season per year. Under this alternative, helicopters would be used to transport supplies to some work camps in the backcountry. Table 2 (*Alternatives*) details the number of flight hours needed during each year under this alternative. In addition, motorized tools may be used to complete the actual lopping and scattering of piñon and juniper branches. Table 26 (see *Soundscape* analysis in the *Visitor Experience* section) details the approximate noise, in decibels (sound pressure level using dBA), that is expected from the use of chainsaws and helicopters within a given distance from the source.

POTENTIAL IMPACTS DUE TO NOISE DISTURBANCE

Under Alternative B, treatment could occur from September to May; this is during the non- breeding seasons for many species and would help in mitigating potential adverse impacts to breeding and nesting species within the project area. Additionally, during the winter months, most small mammals and reptiles spend their time underground, further mitigating impacts from noise and human disturbance. However, there may be some impacts to wildlife species from the use of chainsaws, helicopters, and noise produced by human crews in the project area.

Sensitivity to sound varies considerable among small mammal wildlife species. The work of Konstantinov (1978) suggests some patterns among species. Animals with exclusively underground life habits (e.g., moles) have relatively poor hearing and hearing focused on the lowest frequencies when compared to species that regularly use aboveground habitats. Species active at night have considerably greater hearing sensitivity with greater ability to detect higher frequencies than diurnal species. Species such as bats that use sound to locate prey have the most refined hearing and are most sensitive to ultrasonic sounds.

For some small mammals, noise above about 90 dB could have adverse effects, such as causing a strong startle response, retreat from the sound source, or freezing. Noise below approximately 90 dB usually causes fewer responses. Under this alternative, chainsaws may be used which, in general, would produce short pulses of noise that may impact small mammals depending on the distance from the source to the individual animal and the hearing sensitivity of that animal. For example, using a chainsaw to lop branches from a standing juniper tree could produce a sound level above 90 dBA if the chainsaw is located within three to four meters from a mammal burrow. However given the season of year and time of day during treatment, it is likely that the mammal would be underground, which would likely reduce the sound to a much lower decibel level below ground. Mammals that are above ground during treatment, including larger mammals like deer and elk, would likely disperse from the area in the short term, but return once the noise has stopped. Thus, the adverse impacts to mammals from the use of chainsaws are anticipated to be short term, direct, and negligible to minor.

Adverse impacts to birds from chainsaw noise under this alternative are anticipated to be short term, direct, and negligible. Treatments would occur outside of the breeding season for most avian species, thus mitigating any impacts to population numbers or breeding success. The only impacts that may occur in response to noise disturbance are dispersal from the area in the short term. Most individuals would likely return to the area once the noise has stopped.

Most reptiles have similar responses to noise as small mammals, and thus would have similar impacts associated with this alternative. Short pulses of noise could startle the animal, cause a retreat or dispersal from the area, or even some hearing loss. In lizard species with greater sensitivities to low- frequency and low- intensity sounds, exposure to extended duration, high decibel- level noise (greater than 110 dBA) has shown some adverse impacts to hearing (Bondello 1976, Bondello, et al. 1979). However, noise levels from chainsaws are not expected to be continuous in one area for an extended period of time and animals would likely disperse or seek refuge underground until the noise abated.

Within the project area, there may be one amphibian species impacted by the proposed treatment. The New Mexico spadefoot toad (*Spea multiplicata*) may inhabit drainages within the project area and may be indirectly negligibly impacted, if at all, from chainsaw noise disturbance. One study conducted on another spadefoot species (*Scaphiopus couchi)* demonstrated emergence behavior in response to recorded motorcycle sounds at 95 dBA (Brattstrom and Bondello 1983). However, this study was designed to examine the impacts of off- road vehicle use in the California desert, and the duration of noise exposure in this study far exceeds what is expected during the proposed treatment. In addition, the New Mexico spadefoot toad, if present in the project area, is likely to inhabit drainages located away from areas to be treated. Thus, any noise impacts are likely to be attenuated by distance from the noise source. Furthermore, treatments will be conducted mostly during colder months, which may inhibit any sound cues for eliciting emergence. Thus impacts to the New Mexico spadefoot toad are anticipated to be indirect and negligible.

Helicopter noise levels are anticipated to produce only negligible adverse impacts to general wildlife species, as the noise levels would not reach a level as to disturb most species. There would be no helicopter landings under this alternative, only sling load supply drops, which may cause noise disturbance in the vicinity of 80 dBA. This is not anticipated to have adverse impacts to small animals and only negligible, short- term, direct impacts to larger mammals such as elk and deer.

POTENTIAL IMPACTS DUE TO HABITAT CHANGES

Restoration activities may cause changes to wildlife habitat in the project area, which may prove beneficial to some habitat generalist species and adverse to more piñon-juniper habitat dependent species. The most visible changes will likely occur in small mammal species such as chipmunks, piñon mice, rock squirrels, desert cottontails, and pocket gophers. Chipmunks and piñon mice may decrease in population numbers as restoration actions may decrease the number of trees and the overall woody components of treatment areas. At the same time, the increase in grass and forb cover may provide improved habitat for cottontails and gophers. Rock squirrels may also benefit from the increase in grass and forb cover. Mule deer populations may also respond positively to the increased grass and forb cover. However, any potential increases in mule deer populations may be moderated by coyote predation. Coyote numbers would likely increase with the restoration treatments in response to an overall increase in available small mammal prey species. Impacts to mammals from habitat changes are anticipated to be beneficial and adverse, short and long- term, direct, indirect, and negligible to minor. Most mammal species would benefit from the increased biological productivity following treatment, with a few species decreasing in numbers from a loss of suitable habitat.

Observations collected during the five years (1998- 2003) following a small- scale pilot study at Bandelier (Jacobs 2002b) using the same treatment methodology as proposed in this EIS, suggest that over- all increase in birds across all species may result from the treatment. Specifically, the mean number of detected individual birds was 30.80 for the treatment watershed and 23.56 for the untreated watershed, based on 10-minute counts to five points in each watershed, four times each year. The difference was in the same direction for each of the five years of data.

Specifically, habitat generalists would benefit from the proposed treatments and increased biological productivity in the project area, and habitat specialists (e.g., piñon- juniper dependent species) would be adversely affected. One example of adverse impacts to a habitat specialist species involves the black- throated gray warbler, which is a bird of conservation concern (U.S. Fish and Wildlife Service 2002). In New Mexico, this species makes extensive and nearly exclusive use of piñon- juniper woodland. Black- throated gray warbler gleans insects in the dense foliage at the end of the branches of piñon and juniper trees (USFWS 2002; Rich, et al. 2004). Alternative B would decrease terminal foliage volume of piñon and junipers, and so may have an indirect adverse impact on black- throated gray warblers at Bandelier through the loss of forest insect prey.

Observations collected during the five years following (1998- 2003) a study at Bandelier to compare a watershed treated with techniques similar to those proposed in this EIS with one that was not treated support the predicted decrease in number of black- throated gray warblers. Over five years of observations, 35 black- throated gray warblers were detected in the untreated watershed while this species was observed only seven times in the treatment watershed with the same level of effort ($p<0.01$). This was consistently true across each of the five years of observations, as the mean number observed each year in the untreated watershed was seven, and in the untreated watershed was 1.4. This is a five- fold decrease presumably resulting from habitat changes for this species, and thus demonstrates a potential minor adverse impact to this particular species from implementing Alternative B, assuming similar precipitation and other environmental variables as were true during the paired- watershed study. This species may decrease in number and distribution within the project area, but extensive suitable habitat exists outside of the treatment boundary, thus the local species abundance would not change permanently.

In contrast to the black- throated gray warbler, another piñon- juniper specialist, the gray flycatcher may not be as adversely impacted from the proposed treatment. During the same period of study described above, observations taken on this species did not show the same decrease in population numbers as the warbler. The five years of observations yielded 27 detections in the treated watershed as compared to 24 detections in the untreated watershed ($p>0.1$). Overall the number of detections of gray flycatcher was higher in the treatment watershed (mean = 5.4 per year) vs. the untreated watershed (mean = 4.8 per year); however the absolute number of detections was greater in the untreated watershed for two of the five years of observations. Since the paired- watershed experiment (Jacobs 2002b) used the same methods proposed for Alternative B, similar results can be anticipated for these species, given similar precipitation and other uncontrolled environmental factors. Applying these results across the treated landscape, it is likely that the flycatcher would experience only negligible to minor impacts from treatment under Alternative B, and that these impacts could be beneficial or adverse on balance. Thus, impacts to bird species under Alternative B are similar to those for mammals and may range from beneficial and adverse, short- and long- term, direct, indirect, and negligible to minor. Most species would benefit from the increased biological productivity following treatment, with a few species decreasing in numbers from a loss of suitable habitat.

Impacts to reptiles from habitat changes under Alternative B are likely to be beneficial in both the short and long term. In the short term, an increase in ground cover from lopped and scattered branches may create additional refuge space from predators and harsh winter weather. In the long term, an increase in grass and forb cover is likely to increase insects, and thus food availability for insectivorous reptiles. However, the increased biological productivity could increase predators, such as coyotes, exerting predation pressure on reptile species. Both the short- and long- term impacts to reptile populations (in terms of numbers of individuals and population structure) would likely be beneficial, short- and long- term, direct and indirect, and negligible.

No impairment to park wildlife would occur under this alternative.

CUMULATIVE IMPACTS

In addition to the treatment actions proposed in Alternative B, existing management practices and research would continue in the project area. There would be no prescribed fire and no other new activities are planned within the project area. Within Bandelier National Monument and the regional Pajarito Plateau area, activities such as active fire management (including prescribed fire, wildland fire, and thinning) would occur as well as law enforcement patrols, research activities, tourism and visitor use, and other activities conducted by adjacent landowners (U.S. Forest Service, Valles Caldera National Preserve, and Los Alamos National Laboratory). The only activities likely to have a cumulative impact on wildlife under this alternative are fire management activities. Although suppression is currently the prescription for the study area, within the monument and region wide, fire could have a beneficial effect on wildlife species by promoting greater nutrient recycling, decreased water consumption by woody vegetation, and increased grass and herbaceous cover. These changes would yield increased biological productivity for the areas affected and would in turn produce slight benefits for wildlife abundance and diversity. For wildlife in the project area, the impacts from this alternative when combined with past, present, and future foreseeable activities on the Pajarito Plateau would likely be negligible to minor.

CONCLUSION

Under Alternative B, potential adverse impacts to mammals, birds, and reptiles/amphibians due to noise disturbance may be short- term, direct, and negligible to minor. Impacts to mammals, birds, and reptiles from habitat changes are anticipated to range from beneficial to adverse, short- and long- term, direct, indirect, and negligible to minor. Cumulative impacts to wildlife under this alternative are expected to be negligible to minor. No impairment to park wildlife would occur.

Alternative C—Phased Approach

Alternative C focuses on treating sub- basins containing the highest priority cultural resource sites in piñon- juniper woodland to stabilize them first. Under this alternative, the methodology of treatment is the same as Alternative B, but the duration of treatment could take up to 20 years, treating approximately 200- 300 acres per year. Crews would work a six- month season, from September to March and would utilize motorized and hand tools to complete the treatment. Camps would be supplied by helicopters and pack strings. Table 4 in *Alternatives* details the number of flight hours required under this alternative, as compared to Alternative B. Because the field season is during winter months only, adverse impacts to breeding species would be avoided. The number of acres treated per year is less under this alternative than under Alternative B, but the duration of treatment is longer.

POTENTIAL IMPACTS DUE TO NOISE DISTURBANCE

The type of impacts to wildlife due to noise disturbance under this alternative would be similar to those described under Alternative B. The temporal impact of noise on wildlife in the project area would be less in each treatment year, but in- total would be cumulatively more across the duration of the 20- year implementation period when compared with Alternative B. Specifically, localized and short- term displacement of animals due to chainsaw noise and human activities, and decreased ability to hear due to noise would influence fewer animals each year under Alternative C; but more years of disturbance would occur under Alternative C. Mammals, birds, and reptiles/amphibians may experience adverse, short- term, direct, and negligible to minor impacts as a result of Alternative C. As described in Alternative B, animals may disperse from treatment areas in the short term, but return when the noise is eliminated.

POTENTIAL IMPACTS DUE TO HABITAT CHANGES

The type of impacts to wildlife under this alternative would be similar to those described under Alternative B. Habitat changes would benefit certain generalist wildlife species, while adversely impacting piñon- juniper dependent species such as the black- throated gray warbler. Because the treatment duration could last up to 20 years and smaller patches of habitat would be treated during a single treatment year, the impacts from habitat changes may not be of the same magnitude until larger contiguous treatment areas become complete, towards the end of the 20- year period. Overall, however, the impacts would be the same as described under Alternative B: beneficial to adverse, short- and long- term, direct, indirect, and negligible to minor.

No impairment to park wildlife would occur under Alternative C.

CUMULATIVE IMPACTS

The cumulative effects under Alternative C would be similar to those described under Alternative B. While no new activities are planned for the project area, the monument, or the regional Pajarito Plateau other than those described in the *Alternatives* section and Alternative B analysis, the extended duration of treatment under Alternative C makes it more difficult to predict cumulative impacts of projects not yet under consideration. However, based on the information provided in this EIS at the time of publication, the cumulative impacts of Alternative C on wildlife are anticipated to be negligible to minor.

CONCLUSION

Under Alternative C, the impacts to wildlife from noise disturbance would be similar to Alternative B: adverse, short- term, direct, and negligible to minor. The impacts to wildlife from habitat changes would also be similar to Alternative B: beneficial to adverse, short- and long- term, direct, indirect, and negligible to minor. Cumulative impacts are anticipated to be negligible to minor. No impairment to park wildlife would occur.

SPECIAL STATUS SPECIES

Bandelier National Monument is responsible for complying with the Endangered Species Act of 1973, as amended, and for conserving and protecting animal and plant species that are deemed to have special status by federal and state agencies. The analysis of effects on special status species and critical habitats includes those species listed by the U.S. Fish and Wildlife Service as endangered, threatened, proposed for listing, or considered candidates for listing and with potential to be affected by the actions proposed in this EIS. Designated critical habitats, if any, are also considered in the determination of effects. Species that are considered endangered, threatened, or of special concern by the New Mexico Department of Game and Fish (state- listed species) and have the potential to be affected by the actions proposed in this EIS are also analyzed. The federal and state listed species are referred to as "special status species" for this evaluation of effects.

In order to comply with the consultation requirements set forth in Section 7 of the Endangered Species Act of 1973, as amended, a Biological Assessment will be submitted in a separate non- public document to the U.S. Fish and Wildlife Service for concurrence of the determination of effects (Appendix D).

Laws, Regulations and Policies

For special status species, the Endangered Species Act of 1973, as amended (Act), provides strict legal protection for endangered and threatened species, as well as those special concern species that may be in jeopardy of extinction, and for which special protection under federal and state law is afforded. The federal list of plants and animals is published in the 50 Code of Federal Regulations (50 CFR) 17.11- 12, and is administered by the U.S. Fish and Wildlife Service. Special status species of wildlife are included in this section. There are no special status species of plants found in the project area. If the National Park Service determines that an action may adversely affect a federally listed species, consultation with the U.S. Fish and Wildlife Service under section 7 of the Act is required to ensure the action would not jeopardize the species' continued existence or result in the destruction or adverse modification of designated critical habitat (Appendix D).

In addition, the other laws as described in the earlier wildlife section apply here and include the following:

- *NPS Organic Act* and *Management Policies 2006*
- *Director's Order 12 and Handbook: Conservation Planning, Environmental Impact Analysis and Decision Making*
- *Fish and Wildlife Coordination Act of 1934*, as amended
- *Bald and Golden Eagle Protection Act of 1940*, as amended

Methodology

This analysis discusses impacts to special status species that may be found in the project area. Special status species include: 1) species federally listed as threatened or endangered under the Endangered Species Act of 1973, as amended (ESA); 2) species that are proposed or are candidates for listing under ESA or federal species of concern that are not protected pursuant to ESA but are monitored for conservation status; and 3) State of New Mexico listed threatened or endangered species. Table 15 in *Affected Environment* lists the special status species that are likely to occur within the project area and be affected by treatment activities. Only wildlife special status species are listed in this table, because no listed, proposed or candidate species of plants occur in the monument. Rare, but unlisted species of plants are discussed in the *Vegetation* analysis section, and rare unlisted species of animals are evaluated in the *Wildlife* analysis section of this EIS.

Of the federally listed species in this table, only the Mexican spotted owl and the bald eagle are likely to both occur and potentially be affected. The peregrine falcon which is both a state- listed species and a federal "species of concern" also occurs in the project area and may be affected by proposed project activities. There are no federal proposed or candidate species likely to occur in the project area.

The methods used to analyze impacts of the alternatives on special status species were primarily consultation with monument staff and the application of best professional judgment . Sources of information include Bandelier survey data and the scientific literature. Impacts were analyzed in terms of wildlife responses (individual and population levels) to noise disturbance and habitat changes that may result from implementation each alternative.

In order to evaluate impacts to special status species (both federal and state listed species) for this EIS, the following impact thresholds were used.

Negligible	No special status species would be affected, or the action would affect an individual of a listed species or its critical habitat, but the change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population; a discountable effect.
Minor	The action would result in detectable impacts on an individual (or individuals) of a listed species or its critical habitat, but the action would not be expected to result in substantial population fluctuations and would not be expected to have any measurable effects on species, habitats, or the natural processes sustaining them.
Moderate	An action would result in detectable impacts on individuals or a population of a listed species, its critical habitat, or the natural processes sustaining them. Key ecosystem processes may experience disruptions that may result in population or habitat condition

	fluctuations that would be outside of the range of natural variability but would return to natural conditions.
Major	Individuals or a population of a listed species, its critical habitat, or the natural processes sustaining them would be measurably affected, including mortality for special status individuals. Key ecosystem processes might be permanently altered, resulting in long- term changes in population numbers or permanently modifying critical habitat.
Impairment	An impairment of a listed species would occur when the action contributes substantially to deterioration of a listed species or its critical habitat in the monument to the extent that the listed species would no longer survive as a viable population. Impairment would "jeopardize the continued existence" of a listed species in that the action would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild. In addition, the adverse effects on the monument's wildlife resources and values would: contribute to the deterioration of wildlife resources and values to the extent that the purpose of the park would not be fulfilled as established in the monument's enabling legislation; affect resources essential to the natural and cultural integrity of the monument or opportunities for enjoyment; or, affect resources whose conservation is a goal in monument planning documents.

Alternative A—No Action

Federally Listed Species

MEXICAN SPOTTED OWL

As noted above, the Mexican spotted owl is a federally listed species that may occasionally use the project area, possibly for nighttime foraging. There is no breeding and no overnight roosting habitat located in the project area.

Under Alternative A, existing management practices and on- going research as described in the *Alternatives* section would continue. These activities include visitor hiking and backcountry camping, law enforcement patrols, ongoing research on soils and vegetation in piñon- juniper woodland, monitoring of certain special status species, and ongoing cultural resource inventories. Although wildland and prescribed fire, as well as fire suppression, are allowed in piñon- juniper woodland as part of the Bandelier *Fire Management Plan*, the likelihood of any of these occurring is very low given the generally sparse fuel conditions and minimal potential to affect park resources. No thinning or mechanical removal of trees, except for occasional removal of heavy fuels from archeological sites at the request of cultural resource staff, is planned in the project area

For the Mexican spotted owl, annual occupancy surveys would continue to determine whether there are any breeding or roosting owls in the monument. Ongoing surveys have not documented any spotted owls in the monument since

2002. However, since suitable habitat exists for the species within the canyons and mixed- conifer forests of Bandelier, annual surveys are needed to determine occupancy status and identify any potential management concerns.

Potential Impacts Due to Noise Disturbance

Under Alternative A, the primary cause of noise disturbance would be from hikers and backcountry camping but it is anticipated to be short- term and negligible at most. Most trails traverse the canyons in one place only and then move across the tops of mesas and thus would enter into suitable spotted owl nesting and roosting habitat only in a few places. Currently, there are no documented owls in the monument. But if annual surveys were to demonstrate occupancy of a nesting pair of owls, there may be certain entry and noise restrictions placed around the nesting site, or in the designated suitable nesting area (SNA) until the young have fledged in late summer.

Potential Impacts Due to Habitat Changes

If Alternative A were implemented, no restoration activities would occur and the existing habitat would remain, with a possible increase in the piñon- juniper overstory cover and a general reduction in herbaceous understory. This may cause a subsequent decrease in the prey base for spotted owls. If owls utilize the project area for foraging at night, there may be less available prey items due to the lack of herbaceous cover and seed availability needed by small mammals and birds that are used as prey by the owl. This would likely have no more than a long- term, negligible, indirect adverse impact on spotted owls as the piñon- juniper woodland is not the primary foraging area for spotted owls in the monument. There are many other suitable foraging areas found within and adjacent to the monument that could provide additional food sources if needed.

Bandelier National Monument is located within Mexican spotted owl critical habitat unit SRM- NM- 4 (69 CFR 53182). This unit is located in the Jemez Mountains, south of Los Alamos, in north- central New Mexico. Habitat that is deemed suitable for the spotted owl includes only those areas within the critical habitat unit that are composed of steep slopes (greater than 40% slope), canyons incised into volcanic rock, and rocky outcroppings with dense, and mixed- coniferous forest. Based on these criteria, lands within the project area, while within Bandelier and the SRM- NM- 4 unit, are not suitable habitat for spotted owls and are therefore not considered critical habitat. Thus there would be no adverse modification to critical habitat under this alternative.

No impairment to park Mexican spotted owls would occur.

BALD EAGLE

As noted above, the bald eagle is a federally listed species that may occur in the project area and might be affected by project activities. This section describes the impacts of current management in Bandelier piñon- juniper woodland to bald eagles.

Under Alternative A, existing management practices and on- going research as described in the *Alternatives* section would continue. These activities include visitor hiking and backcountry camping, law enforcement patrols, ongoing research on soils and vegetation in piñon- juniper woodland, monitoring of certain special status species, and ongoing cultural resource inventories. Although wildland and prescribed fire, as well as fire suppression, are allowed in piñon- juniper woodland as part of the Bandelier *Fire Management Plan*, the likelihood of any of these occurring is very low given the generally sparse fuel conditions and minimal potential to affect park resources. No thinning or mechanical removal of trees, except for occasional removal of heavy fuels from archeological sites at the request of cultural resource staff, is planned in the project area.

Winter surveys for bald eagles have been conducted in Bandelier since 1994. The latest data available (from 2003) show approximately 11 eagles observed during winter counts over two consecutive days in January and February. Winter roosting and fishing habitats for bald eagles are located near canyon mouths and along the Rio Grande, respectively. In the Bandelier area, bald eagles make use of tall, large ponderosa pines in deep canyons for roosting and protection from winter storms. Most eagles typically leave winter roosts in the Bandelier area each day at first light, often as much as an hour before sunrise, and return late in the day near or after sunset. The project area does not include any bald eagle roosting or fishing habitats.

Potential Impacts Due to Noise Disturbance

Bald eagles are known to only occasionally use the project area in winter, apparently for foraging on carrion. Any potential impacts from noise disturbance would likely take the form of visitors and park staff displacing bald eagles from tree perches or from scavenged food on the ground during the winter. Such displacement impacts to non- breeding bald eagles would be rare and would continue under this alternative due to on- going administrative activities, such as the removal of hazard trees. Any adverse impacts on bald eagle behavior of such displacements would be direct and negligible over the short term due to increased energy use or interruption of feeding activities. Changes in bald eagle use would be predominantly due to natural variability or successional changes in habitat and food availability over the long term. Thus, over the short and long term, impacts to bald eagle individuals and populations would be negligible and result only from occasional noise disturbance.

Potential Impacts Due to Habitat Changes

Under this alternative, no treatment activities would take place and current existing habitat would continue, with even a possible increase in the canopy of piñon- juniper trees and additional loss of herbaceous ground cover. This may have a negligible impact on foraging bald eagles through a possible reduction in carrion and prey items due to lack of food availability over the long term. These impacts are anticipated to be indirect, long- term, and negligible.

State Listed Species

PEREGRINE FALCON

As noted above, the peregrine falcon is the only state- listed species that both occurs in the study area and may be affected by actions in the alternatives.

Under Alternative A, short- term impacts to peregrine falcons may include individuals moving short distances (tens of meters) in response to humans walking and hazard- tree cutting activities but the population would likely remain at or near their current densities in the project area. Impacts to individuals could take the form of displacing peregrine falcons from tree perches. Such rare displacement impacts to peregrine falcons would continue under this alternative from on- going administrative activities. Long- term, indirect changes in peregrine falcons populations would be due to natural fluctuations or natural successional changes in habitat and food availability. Over both the short term and long term, impacts to peregrine falcon populations (in terms of numbers of individuals and population structure) and their habitat throughout the project area would be negligible.

CUMULATIVE IMPACTS

In the project area under Alternative A, existing management practices and research would continue. There would be no prescribed fire and no other new activities are currently being planned. Within Bandelier National Monument and the regional Pajarito Plateau area, activities such as active fire management (including prescribed fire, wildland fire, and thinning) would occur as well as law enforcement patrols, research activities, tourism and visitor use, and other activities conducted by adjacent landowners (U.S. Forest Service, Valles Caldera National Preserve, and Los Alamos National Laboratory). Of these, the only activities likely to have a cumulative impact on the listed species above under this alternative are fire management activities.

A Final Biological Opinion was issued by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife 2005) for the Bandelier Fire Management Plan and outlines mitigation measures required under the Opinion to help protect the Mexican spotted owl from any adverse impacts due to fire management activities. It also provides an Incidental Take Permit to the monument in the event a spotted owl is adversely impacted from any fire management activities. Based on the potential impacts to spotted owls from fire management activities and implementation of Alternative A, the cumulative impacts are anticipated to be negligible to minor. Fire may also benefit the spotted owl through reduction in the risk of catastrophic wildfire and increasing prey base populations by creating more upland open habitat.

Currently, Wildland Fire Use is currently allowed in bald eagle winter roosting habitat. Direct adverse impacts to the eagles from WFU are expected to be highly unlikely and discountable. Beneficial impacts from WFU and fires located outside of eagle habitat and the project area may occur by increasing prey populations and reducing the overall threat of catastrophic wildfire. Therefore, cumulative impacts for bald eagles are anticipated to be negligible.

As discussed under the Mexican spotted owl and bald eagle sections, no prescribed fires will occur in the project area. However, WFU and prescribed fires may occur within Bandelier and the Pajarito Plateau region. This is likely to have a negligible cumulative impact on peregrine falcons when combined with actions proposed under this alternative.

CONCLUSION

Under Alternative A, impacts to the Mexican spotted owl from noise disturbance and any potential habitat change are anticipated to be indirect, short- and long- term, and negligible. Cumulative impacts are anticipated to be negligible to minor.

Alternative A may have negligible, direct and indirect, short- and long- term impacts to bald eagles due to noise disturbance and potential habitat changes. There may be negligible cumulative effects to bald eagles when combined with past, present, and future foreseeable activities, such as certain fire management activities.

This alternative may also have negligible, direct and indirect, short- and long- term impacts to the American peregrine falcon. Continued compliance with the 2006 Bandelier *Peregrine Falcon Habitat Management Plan* would minimize these impacts. There may be negligible cumulative impacts when considering fire management activities in the project area.

No impairment to any listed species in the monument would occur under this alternative.

Alternative B—Operational Priority

Federally Listed Species

MEXICAN SPOTTED OWL

Under Alternative B, geography and logistics would determine the location and timing of treatment and crews would complete restoration in a wave- like fashion by working systematically across the monument from one end to the other. As described in the *Alternatives* section, treatment would be conducted over a five- year term, with approximately 800 acres treated per year, using two crews over an eight- month working season per year. Under this alternative, helicopters and pack strings would be used to transport supplies to some work camps in the backcountry.

Potential Impacts Due to Noise Disturbance

As described in *Affected Environment*, Mexican spotted owl suitable habitat in Bandelier is identified as suitable nesting areas (SNAs) and nesting roosting zones (NRZs). SNAs include all known historic spotted owl nests and regular roost areas, plus other areas that are known to have similar habitat characteristics, such as cliff areas and forest stands. The NRZs contain all nesting habitat and nearly all roosting habitat, but may also contain areas that are not suitable nesting and roosting habitat. The NRZ also includes foraging habitat, which is thought to be defined by the proximity to nesting and roosting habitat and its ability to provide vulnerable prey

(U.S. Fish and Wildlife Service 1995). Within the project area, there are patches of designated NRZs. However, most of this includes only the tops of mesas and is only suitable for foraging. There are no SNAs located within the project area. Annual surveys for spotted owls have been conducted in the monument since 1995. No owls have been documented in the monument since 2002.

Noise disturbance from chainsaws and helicopters does have the potential to impact spotted owls by incidentally flushing birds from nests or roosts. However, most of the noise would be attenuated by topography and distance, as historic nesting habitat is located deep within the canyons of the monument. To further mitigate any adverse impacts to breeding spotted owls due to noise disturbance, treatments would take place mostly outside of the breeding season (September 1 to February 28). At the start of the breeding season (March 1), in order to mitigate any potential impacts to any nesting owls, surveys would be conducted to determine whether Mexican spotted owls are present in the monument and if so, their nesting status. During the annual survey period (March 1 to July 31) the mitigation measures listed below would be implemented to mitigate any adverse impacts to undetected owls. If surveys detect the presence of owls and they are determined to be nesting, these mitigation measures would be implemented until August 15 of that year. If annual surveys do not detect the presence of Mexican spotted owls in the monument, mitigations would end on July 31 or sooner, depending on when the surveys documenting no occupancy for that year are completed. Figure 5 in (*Alternatives* section) denotes the specific treatment sub- basins subject to the mitigations.

- Motorized activities on mesa tops will be prohibited within 100 meters of canyon rims within the shaded treatment basins shown in Figure 5 between March 1 and May 15.
- In general, helicopter flights will be avoided over the shaded treatment basins shown in Figure 5 between March 1 and May 15.
- If nesting Mexican spotted owls are detected, the use of chainsaws and aircraft will not be allowed within 600 meters of an occupied SNA (PAC) unless intervening topography attenuates the sound.

By prohibiting motorized activities within 600 meters of an occupied SNA, or within 100 meters from canyon rims, and controlling non- motorized human activity, the potential for adverse effects on Mexican spotted owls from noise disturbance would be minimized. Based on previous consultation with the U.S. Fish and Wildlife Service regarding activities near SNAs (U.S. Fish and Wildlife Service 2005), the USFWS has stated that the above proposed mitigation measures will ensure that 1) harassment of spotted owls during the sensitive breeding season will be avoided to the extent possible and 2) other interrelated or interdependent actions (e.g., helicopter flights) will be minimized. Although the NPS will be consulting specifically with the U.S. Fish and Wildlife Service on this plan and potential impacts to MSOs, we anticipate any potential adverse impacts to Mexican spotted owl from noise disturbance under this alternative to be direct, short- term, and negligible."

Potential Impacts Due to Habitat Changes

As discussed in the *Affected Environment* section, Mexican spotted owls may utilize the project area for nighttime foraging. The impacts of habitat alteration from lopping and scattering of piñon- juniper within the treatment area would serve to provide enhanced habitat for spotted owl prey, such as small mammals. Treatment would increase the biological productivity, nutrient cycling, and water availability of owl foraging areas, which would in turn increase the food availability for small mammals and birds, and thus owls. Therefore, Alternative B is likely to have an indirect, short- and long- term, minor beneficial impact on Mexican spotted owls due to habitat changes.

As described in Alternative A, Bandelier National Monument is located within Mexican spotted owl critical habitat unit SRM- NM- 4 (69 CFR 53182). Habitat that is deemed suitable for the spotted owl includes only those areas within the critical habitat unit that are composed of steep slopes (greater than 40% slope), canyons incised into volcanic rock, and rocky outcroppings with dense, and mixed- coniferous forest. Based on these criteria, lands within the project area, while within Bandelier and the SRM- NM- 4 unit, are not suitable habitat for spotted owls and are therefore not considered critical habitat. Thus there would be no adverse modification to critical habitat under this alternative.

BALD EAGLES

Under Alternative B, restoration treatments would be conducted relatively rapidly over relatively fewer years than with Alternative C and with an emphasis on maximizing logistical efficiency. Bald eagles only occasionally use the project area and only in winter. As described above, bald eagles are only in the Bandelier area from approximately November 1 through February 28. Winter roosting and fishing habitats for bald eagles are located near canyon mouths and along the Rio Grande, respectively. In the Bandelier area, bald eagles make use of tall, large ponderosa pines in deep canyons for roosting and protection from winter storms. Most eagles typically leave winter roosts in the Bandelier area each day at first light, often as much as an hour before sunrise, and return late in the day near or after sunset. The project area does not include any bald eagle roosting or fishing habitats. In areas beyond fishing and roosting sites, bald eagles are known to occasionally use upland forest and grassland habitats during the winter. They appear to use these habitats during the day for scavenging on carcasses of large mammals such as deer and elk, which have died from a variety of causes.

Potential Impacts Due to Noise Disturbance

Impacts to bald eagles from noise disturbance could occur under this alternative, causing flush responses from roosting sites. Displacement of an eagle by helicopter or chainsaw activities in upland settings (mesa tops) may occur and may produce a direct, short- term negligible impact on the individual eagle involved. Under this alternative, in order to mitigate any potential adverse impacts to bald eagles from noise disturbance, no helicopter flights or chainsaw operations would be conducted within bald eagle fishing habitat along the Rio Grande. To further mitigate any potential adverse impacts, no chainsaws would be utilized within 425 meters (0.26 miles) from fishing habitats and no helicopters would be flown within 1000 meters (0.62 miles) of fishing habitat along the Rio Grande. At these distances sound stimulus from chainsaws and helicopters is likely to illicit only head movements and no flush responses. Work would also be limited to daylight operating hours between 8:00 a.m. and 4:30 p.m. MST, November 1 to February 28, in treatment sub- basins adjacent to bald eagle roosting and fishing habitat (Figure 5, *Alternatives* section). Because bald eagles generally leave their winter roosting sites in Bandelier by the end of February, there would be no work restrictions from March 1 to the end of the season in the bald eagle mitigation sub- basins shown in Figure 5. These mitigations would serve to reduce any potential adverse impacts to bald eagles from noise disturbance to the level of indirect, short- term, and negligible.

Potential Impacts Due to Habitat Changes

Habitat changes associated with restoration treatments are likely to have a long- term, indirect, negligible effect on bald eagles. Restoration treatments would not change any primary winter roosting or fishing habitat, but could have a negligible impact on bald eagle numbers and distribution. Changes in bald eagle use would be predominantly due to natural variations and successional changes in habitat and fish availability over the long term. Thus, over the short and long term, potential impacts by Alternative B on bald eagle individuals and wintering populations would be indirect, short- term, and negligible.

State Listed Species

PEREGRINE FALCON

As described above under Mexican spotted owl, geography and logistics would determine the location and timing of treatment under this alternative and crews would complete restoration in a wave- like fashion by working systematically across the monument from one end to the other. As described in *Alternatives*, treatment would be conducted over a five- year term, with approximately 800 acres treated per year, using two crews over an eight- month working season per year. Under this alternative, helicopters and pack strings would be used to transport supplies to some work camps in the backcountry.

Potential Impacts Due to Noise Disturbance and Other Activities

Peregrine falcons may be disturbed by both audible and visual human activities when they occur during the nesting season (March to May), although disturbance is dependent on the peregrine's relative tolerance to background noise levels and routine visual occurrences (Oregon Department of Transportation 2002). Disturbance responses may include visual, vocal, positional, or flight responses (Johnson 1993). Disturbance may result in nest or territory abandonment or desertion; exposure of eggs and/or young; egg breakage, ejecting eggs or young from the nest by a frightened or flushing adult; missed feedings of the young; and premature fledging of the young, resulting in injury or death (e.g., due to critical injury, exposure, or predation) (Fyfe and Olendorff 1976, Olsen and Olsen 1978, Pacific Coast American Peregrine Falcon Recovery Team 1982). Peregrines are most susceptible to human disturbance during courtship and incubation; nest tenacity by adults increases as incubation progresses and hatching occurs.

To prevent adverse impacts to nesting falcons, motorized restoration- related activities would follow the recommendations of Bandelier's *Peregrine Habitat Management Plan* (NPS 2006c). These restrictions would prohibit human activities and noise disturbance due to project operations during the critical nesting period from March 1 to May 16 within zone B, 1,400 meters (0.8 mile) from suitable nesting habitat (stippled basins, Figure 6, *Alternatives* section). In addition, motorized activities in stippled basins in Figure 6 would be restricted within 100 meters of canyon rims. Outside of this zone and time period, adverse direct impacts to peregrines from motorized activities may range from negligible to minor if peregrines respond visually (glancing at or intently watching the noise stimulus) or by flight. These impacts would be short- term as peregrines would likely return once the noise has abated. For non- motorized activities, there would be negligible, direct and indirect impacts to peregrine falcon populations and their habitat throughout the project area under Alternative B. Specifically, short- term impacts to peregrine falcons may include individuals moving short distances (tens of meters) in response to human activities such as walking, but the population would likely remain at or near their current densities in the project area.

Potential Impacts Due to Habitat Changes

Changes in habitat due to the restoration treatments could indirectly influence peregrine falcon prey availability. Restoration treatment would not alter cliff habitats required for nesting by peregrine falcons, but would likely increase overall biological productivity of the mesa top areas. Observations collected during the five years (1998- 2003) following a small- scale pilot study at Bandelier (Jacobs 2002b) using the same treatment methodology as proposed in this EIS, suggest that over- all increase in birds across all species may result from the treatment. Specifically, the mean number of detected individual birds was 30.80 for the treatment watershed and 23.56 for the untreated watershed, based on 10- minute counts to five points in each watershed, four times each year. The difference was in the same direction for each of the five years of data. The difference was statistically stronger for aerial insectivores, which may have a higher risk of being peregrine falcon prey, with a mean of 9.64 for the treatment watershed and 4.61 for the untreated watershed. These data suggest that there could be an increase in the availability of avian prey for falcons, which could result in negligible to minor beneficial effects to peregrine falcons. Long- term, indirect changes in peregrine falcons populations would most likely be dominated by natural fluctuations or natural successional changes in habitat and food availability.

CUMULATIVE IMPACTS

The cumulative impacts to Mexican spotted owls under Alternative B would be similar to those described above for Alternative A: negligible to minor. As discussed, fire may also benefit the spotted owl through reduction in the risk of catastrophic wildfire and increasing prey base populations by creating more upland open habitat.

Cumulative impacts to the bald eagle and peregrine falcon under Alternative B would be similar to those described under Alternative A: negligible. No prescribed fires will occur in the project area. However, prescribed fires may occur within Bandelier and the Pajarito Plateau region. This is likely to have a negligible cumulative impact on bald eagles and peregrine falcons when combined with actions proposed under this alternative.

CONCLUSION

Under Alternative B, negligible, short- term impacts related to the noise of treatment activities may occur to both the Mexican spotted owl and bald eagle. The impacts would be mitigated through certain restrictions placed on treatment operations. For example, if owls are detected within the monument, flights or treatment may be confined to certain areas.

There may be indirect, short- and long- term, minor beneficial impacts to spotted owls due to increased prey availability from habitat changes associated with the treatment under this alternative. Cumulative impacts are anticipated to be similar to those described under Alternative A: negligible to minor.

Impacts under Alternative B to bald eagles due to habitat changes are likely to be indirect, short- term, and negligible. Cumulative impacts are anticipated to be negligible.

Impacts under Alternative B to peregrine falcons are expected to be adverse, short-term, direct, and negligible to minor due to noise disturbance and beneficial, long-term, indirect, and negligible to minor due to potential habitat changes from the treatment. There may be negligible cumulative impacts to peregrine falcons when considering fire management activities within and outside of the project area.

No impairment to special status species in the monument would result from implementing this alternative.

Alternative C—Phased Approach

Federally Listed Species

MEXICAN SPOTTED OWL

Alternative C focuses on treating sub- basins containing the highest priority cultural resource sites in piñon- juniper woodland to stabilize them first. Under this alternative, the methodology of treatment is the same as Alternative B, but the duration of treatment could take up to 20 years, treating approximately 200- 300 acres per year. Crews would work a six- month season, from September to March and would utilize motorized and hand tools to complete the treatment. Camps would be supplied by helicopters and pack strings. Table 4 in the *Alternatives* section details the number of flight hours required under this alternative, as compared to Alternative B. Because the field season is during winter months only, adverse impacts to breeding species would be avoided. The number of acres treated per year is less under this alternative, but the duration of treatment is longer.

Potential Impacts Due to Noise Disturbance

Under this alternative, the proposed field season is shorter at six months, compared to the eight- month season proposed under Alternative B. Thus fieldwork would conclude by March 1, and avoid the Mexican spotted owl breeding season altogether. If birds are present prior to March 1, they likely would be incidental. Thus there would be no impacts to Mexican spotted owls from noise disturbance under Alternative C.

Potential Impacts Due to Habitat Changes

Impacts to Mexican spotted owls due to habitat changes under this alternative are similar to those described under Alternative B: indirect, short- and long- term, minor, and beneficial. This is due to the long term increase in biological productivity of owl foraging areas within the project area. An increase in food availability for owl prey would increase prey populations for foraging owls when present in the area.

As described in Alternative A, Bandelier National Monument is located within Mexican spotted owl critical habitat unit SRM- NM- 4 (69 CFR 53182). Habitat that is deemed suitable for the spotted owl includes only those areas within the critical habitat unit that are composed of steep slopes (greater than 40% slope), canyons incised into volcanic rock, rocky outcroppings with dense, and mixed- coniferous forest. Based on these criteria, lands within the project area, while within Bandelier and the SRM- NM- 4 unit, are not suitable habitat for spotted owls and are therefore not considered critical habitat. Thus there would be no adverse modification to critical habitat under this alternative.

BALD EAGLES

As noted above, the duration of treatment under Alternative C could take up to 20 years, treating approximately 200- 300 acres per year. Crews would work a six- month season, from September to March and would utilize motorized and hand tools to complete the treatment. Camps would be supplied by helicopters and pack strings. Table 4 in the *Alternatives* section details the number of flight hours required under this alternative, as compared to Alternative B. The number of acres treated per year is less under this alternative, but the duration of treatment is longer.

Potential Impacts Due to Noise Disturbance

Impacts would be similar to impacts under Alternative B: indirect, short- term, and negligible. Mitigation measures described under Alternative B would be implemented under this alternative and would serve to mitigate potential adverse effects to bald eagles from implementation of this alternative.

Potential Impacts Due to Habitat Changes

Impacts would be similar to those described under Alternative B: indirect, short-term, and negligible. Proposed treatments would not alter any fishing or roosting habitat and would only negligibly alter upland foraging habitats for bald eagles.

State Listed Species

PEREGRINE FALCON

Potential Impacts Due to Noise Disturbance

Under this alternative, direct impacts from noise disturbance to nesting peregrine falcons would be avoided because project work would occur from September to March only. Impacts to non- nesting falcons may occur and would be similar to those described for Alternative B: adverse, short- term, direct, and negligible to minor. These impacts may include visual responses (glancing at or intently watching the noise stimulus) or by flight. These impacts would be short- term as peregrines would likely return once the noise has abated. Individuals may move short distances (tens of meters) in response to human activities such as walking, but the population would likely remain at or near their current densities in the project area.

Potential Impacts Due to Habitat Changes

Impacts to peregrine falcons due to habitat changes would be similar to those described under Alternative B: beneficial, long- term, and negligible to minor. There may be an increase in peregrine falcon prey availability through increase biological productivity within the project area.

CUMULATIVE IMPACTS

The cumulative impacts to the Mexican spotted owl, bald eagle, and peregrine falcon would be the same as those discussed for Alternatives A and B.

CONCLUSION

Under Alternative C, there would be no impacts to Mexican spotted owls from noise disturbance as the field work season would conclude prior to the start of the breeding season. There may be indirect, short- and long- term, minor beneficial impacts to spotted owls due to habitat changes in the project area. Cumulative impacts are anticipated to be similar to those described under Alternative A: negligible to minor.

Under Alternative C, project- related noise would result in impacts to bald eagles similar to those described under Alternative B: indirect, short- term, and negligible. Impacts due to habitat changes are likely to be indirect, short- term, and negligible. Cumulative impacts are anticipated to be negligible.

Under Alternative C, there may be adverse, short- term, direct, negligible to minor impacts to non- breeding peregrine falcons due to noise disturbance. Any direct impacts from noise disturbance to nesting peregrine falcons would be avoided because project work would occur from September to March only. There may be beneficial, indirect, long- term, negligible to minor impacts due to habitat changes.

There may be negligible cumulative impacts when considering fire management activities within and adjacent to the project area.

No impairment of the Mexican spotted owl, bald eagle, or peregrine falcon in the monument would occur from implementing this alternative.

AIR QUALITY

Laws, Regulations and Policies

The Clean Air Act establishes national ambient air quality standards (NAAQS) to protect the public health and welfare from air pollution. The Act also establishes the Prevention of Significant Deterioration (PSD) of air quality program to protect the air in relatively clean areas. One purpose of this program is to preserve, protect, and enhance air quality in areas of special national or regional natural, recreational, scenic, or historic value (42 USC 7401 et seq.). The program also includes a classification approach for controlling air pollution.

Bandelier National Monument is designated a “mandatory Class 1” area through specific visibility protection regulations under the Prevention of Significant Deterioration provisions of the Clean Air Act. The PSD provisions protect visibility at Bandelier by requiring all major new and modified sources with the potential to affect the visibility of a "mandatory Class 1" area to obtain a new source permit that assures no adverse impact on the Class 1 area's visibility.

The NPS Organic Act of 1916 (16 USC 1 et seq.) and the NPS *Management Policies 2006* guide the protection of park and wilderness areas. The general mandates of the Organic Act state that the National Park Service will:

> promote and regulate the use of . . . national parks . . . by such means and measures as conform to the fundamental purpose of the said parks, . . . which purpose is to conserve the scenery and the natural and historic objects and the wild life 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 (16 USC 1).

Under its *Management Policies 2006* the National Park Service will:

> seek to perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas (NPS 2006a, section 4.7.1).

The *Management Policies 2006* further state that the National Park Service will assume an aggressive role in promoting and pursuing measures to protect air quality related values from the adverse impacts of air pollution. In cases of doubt as to the impacts of existing or potential air pollution on park resources, the National Park Service “will err on the side of protecting air quality and related values for future generations” (NPS 200a).

The Organic Act and the Management Policies 2006 apply equally to all areas of the national park system, regardless of Clean Air Act designations. Furthermore, the NPS Organic Act and Management Policies 2006 provide additional protection beyond that afforded by the Clean Air Act's national ambient air quality standards alone because the National Park Service has documented that specific park air quality-related values can be adversely affected at levels below the national standards or by pollutants for which no standard exist.

Methodology

Air quality impacts were analyzed by reviewing current state and federal laws regarding air quality and previously completed environmental compliance documents for the park. Information about regional air quality was obtained from EPA Air Quality Monitors at Zia Pueblo, Jemez Pueblo, Bernalillo, and Rio Rancho. Chainsaw emissions are estimated using emission factors from, Assessment of Cost Effectiveness and Public Acceptance of Tier II Emission Standards for Handheld Equipment (Chan and Weaver, 1997). Helicopter emissions are estimated using emission factors from the Air Force Institute for Environment, Safety and Occupational Health Risk Analysis, Risk Analysis Directorate, Environmental Analysis Division, Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations, Revised December 2003.

The area of analysis for this topic includes Bandelier National Monument and the surrounding area.

Type of Impact

Adverse: Increases emissions or raises pollutant concentrations.

Beneficial: Reduces emissions or lowers pollutant concentrations.

Duration of Impact

Short- term: Occurs only through the duration of treatment.

Long- term: Continues beyond the duration of the treatment.

Impact Threshold Definitions

Negligible: Changes in air quality would be below or at the level of detection, and if detected, would have effects that would be considered slight. Emissions would be less than 50 tons/year for each pollutant.

Minor: Changes in air quality would be measurable, although the changes would be small and the effects would be localized. Emissions would be less than 100 tons/year for each pollutant. No air quality mitigation measures would be necessary.

Moderate: Changes in air quality would be measurable and would have consequences, although the effect would be relatively local. Emissions would be greater than or equal to 100 tons/year for each pollutant. Air quality mitigation measures would be necessary and the measures would likely be successful.

Major: Changes in air quality would be measurable, would have substantial consequences, and be noticed regionally. Emissions would be greater than or equal to 250 tons/year for each pollutant. Air quality mitigation measures would be necessary and the success of the measures could not be guaranteed.

Impairment: An impact would be more likely to constitute an impairment to the extent that it would be a major adverse effect on 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 identified as a goal in the park's general management plan or other relevant NPS planning documents.

Alternative A—No Action

As described in Affected Environment, air quality in the monument and adjacent areas is generally good, with compliance with nearly all of the national air quality standards except those occasionally for windblown dust in neighboring Pueblos. Visibility is the only air quality feature measured at Bandelier National Monument, and is generally very good. Alternative A would continue current activities in piñon-juniper at Bandelier which, as described elsewhere in this EIS, consist of removing occasional hazard trees, ad hoc stabilization of individual cultural resources as time and money allow, recreational use, and research and monitoring. The result of not treating piñon- juniper would be to continue current fire conditions as well, where the woodland does not have enough understory to carry a fire and is generally considered immune to large scale burning. No Action would continue these activities and this fire management scenario, with resulting maintenance of good air quality in the monument. Because burns are even less likely in piñon- juniper woodland than under pre- disturbance conditions, air quality impacts related to smoke or particulates from fires would also continue to be abnormally mitigated.

On the local and regional level, impacts to air quality from continuing current management would be long- term, and range from negligible and beneficial to negligible and adverse. No impairment of monument air quality would occur if the No Action alternative was implemented.

CUMULATIVE IMPACTS

Cumulative impacts on air quality could result from existing management combined with other activities, including fire management, within the park. Although fire is generally suppressed or does not occur in piñon- juniper woodland in the monument, prescribed burning and natural ignitions do occur in other vegetative communities at Bandelier and on surrounding public lands. Other sources of impact to air quality include cars, aircraft, windblown dust, a nearby gypsum mine and regional sources. Cumulative impacts with regard to air quality would be short- term, and negligible to minor.

CONCLUSION

Under Alternative A, the lack of new management activities beyond on- going research and monitoring would result in no new air emissions. As a result impacts would be long- term and negligible. Cumulative impacts associated with the fire management program would be short- term, negligible to minor and adverse.

No impairment of monument air quality would occur if the No Action alternative was implemented.

Alternative B—Operational Priority

Under Alternative B, emissions would result from operation of chainsaws by two crews of approximately six to ten members each, for eight months per year, and the helicopter used to transport and supply the crews. Commercial- grade chainsaws with an average horsepower of 5.2 are assumed (Chan and Weaver 1997). Estimated emissions from Alternative B are provided in Table 27. Emissions levels would be minimal. The chainsaw exhaust would be low in temperature and would occur near ground level. Therefore, emissions would generally stay near the ground and disperse in the immediate area, rather than rise high into the atmosphere. These low level, localized emissions would not exceed NAAQS, nor would they significantly impact air quality related values including visibility and vegetation.

The helicopter emissions would also be minimal. Most emissions would occur high in the atmosphere over a broad area, and would quickly disperse. These emissions would not exceed the NAAQS, nor would they significantly impact air quality related values, including visibility and vegetation. Therefore, impacts would be short- term, negligible and adverse.

While total emissions from this equipment are considered small, they would amount to an increase over current conditions. Over the five year project implementation period, chainsaws and helicopters are estimated to emit approximately 13 tons of HC, 45 tons of CO, .7 tons of NOx, and about half a ton of $PM_{10}/PM_{2.5}$.

Table 27. Alternative B Emissions (tons/year).

Emission Source	Hydrocarbon (HC)	CO	NOx	$PM_{10}/PM_{2.5}$
Chainsaws [a]	2.61	8.81	0.02	0.06
Helicopters [b]	0.07	0.13	0.12	0.03

[a] Chainsaw emissions are estimated using emission factors from Assessment of Cost Effectiveness and Public Acceptance of Tier II Emission Standards for Handheld Equipment (Chan and Weaver 1997).

[b] Helicopter emissions are estimated using emission factors from the U.S. Air Force Institute for Environment, Safety and Occupational Health (2003). Emission factors for a Blackhawk helicopter were used.

No impairment of monument air quality would occur if Alternative B were implemented.

CUMULATIVE IMPACTS

Cumulative impacts on air quality could result from the same activities as described above for Alternative A, including cars, dust, aircraft and from prescribed or natural caused fire in and out of the monument. Cumulative impacts with regard to air quality would be the same as described under Alternative A: short- term, negligible to minor and adverse.

CONCLUSION

Under Alternative B, active management would include the use of chainsaws and helicopters over an eight- month period for a five- year duration. As a result impacts would be short term, negligible, and adverse. While effects under Alternative B are considered minimal, they represent an increase in emissions over those expected under No Action. Cumulative impacts would be short- term, negligible to minor and adverse.

No impairment of monument air quality would occur if Alternative B were implemented.

Alternative C—Phased Approach

Under Alternative C, the same number of acres would be treated as under Alternative B, but treatment would take place over a longer period of time. Emissions would result from operation of chainsaws by one crew of up to 12 members for six months per year. A helicopter would also be used to transport and supply the crew. As in Alternative B, commercial- grade chainsaws with an average horsepower of 5.2 were assumed (Chan and Weaver 1997) and emission levels would be minimal (see Table 28). Chainsaw exhaust would be low in temperature, would occur near ground level and would disperse in the immediate area.

Helicopter emissions would also be minimal. Most emissions would occur high in the atmosphere over a broad area, and would quickly disperse. These emissions would not exceed the NAAQS, nor would they significantly impact air quality- related values, including visibility and vegetation. Therefore, impacts would be short- term, negligible and adverse.

Table 28. Alternative C Emissions (tons/year).

Emission Source	Hydrocarbon (HC)	CO	NOx	$PM_{10}/PM_{2.5}$
Chainsaws[a]	0.94	3.18	0.01	0.02
Helicopters[b]	0.05	0.08	0.06	0.02

[a] Chainsaw emissions are estimated using emission factors from Assessment of Cost Effectiveness and Public Acceptance of Tier II Emission Standards for Handheld Equipment (Chan and Weaver 1997).

[b] Helicopter emissions are estimated using emission factors from the U.S. Air Force Institute for Environment, Safety and Occupational Health (2003). Emission factors for a Blackhawk helicopter were used.

While total emissions from this equipment are considered small, they would amount to an increase over current conditions. Over the 20 year project implementation period, chainsaws and helicopters are estimated to emit approximately 20 tons of HC, 65 tons of CO, and about 1 ton each of NOx and $PM_{10}/PM_{2.5}$.

No impairment of monument air quality would occur if Alternative C was implemented.

CUMULATIVE IMPACTS

Cumulative impacts to air quality could result from the use of chainsaws and helicopters combined with other activities, including fire management, within the park. Cumulative impacts with regard to air quality would be the same as described under Alternative A: short- term, negligible to minor and adverse during periods of treatment as defined in the Fire Management Plan.

CONCLUSION

Under Alternative C, active management would include the use of chainsaws and helicopters over a six- month period for a 20- year period. As a result, impacts would be short- term, negligible, and adverse. While effects under Alternative B are considered minimal, they represent an increase in emissions over that proposed under Alternative B; no new emissions are expected under the No Action alternative. Cumulative impacts would be short- term, negligible to minor and adverse.

No impairment of monument air quality would occur if Alternative C was implemented.

PARK OPERATIONS

Laws, Regulations and Policies

The NPS is required by the Organic Act of 1916 (16 USC §1) to protect and preserve unimpaired the park resources and values of the national park system while providing for public use and enjoyment. National Park Service *Management Policies 2006* (NPS 2006a) detail the basic service- wide policies for implementation of the Organic Act, including NPS park operations. Additional policy guidance can be found in separate NPS Director's Orders specific to each division, but adhering to the NPS *Management Policies 2006*.

Methodology

The assessment of impacts uses the general methodology described at the beginning of this section (*Environmental Consequences*) and the resource- specific information presented here. For this analysis, park operations include the human and fiscal resources available to protect and preserve the natural and cultural resources within Bandelier, and provide for safe and enjoyable visitor experiences. The discussion of impacts to park operations focuses on each of the five park management divisions described in *Affected Environment* and evaluates the potential impacts to staffing levels and job duties, division program budgets, and quality and effectiveness of the infrastructure used to manage the monument. The timing and duration of impacts as defined above in *General Methodology for Establishing Impact* are used in this analysis, as well as the intensity of impacts as defined below:

Negligible: Park operations would not be affected, or the effects would be at the lower limit of detection and would have a barely noticeable effect on monument operations, including staffing levels, duties, or operations budget.

Minor: The effect would be detectable, but would be of a magnitude that would not have an appreciable effect on monument operations, including staffing levels, duties, or operations budget.

Moderate: The effects would be readily apparent, likely long term, and would result in a change in park operations, including staffing levels, duties, or operations budget, in a manner noticeable to staff and to the public.

Major: The effects would be readily apparent, long term, and would result in a substantial change in monument operations, including staffing levels, duties, or operations budget, in a manner noticeable to staff and the public and markedly different from existing operations.

Impairment: Because park operations are not considered a park resource or value under the NPS *Management Policies 2006*, no impairment finding is required.

Alternative A—No Action

Under Alternative A, park operations would continue at approximately the same level as present. The same level of service, monitoring, oversight, and management activities would continue. As noted in the *Affected Environment* section, five of the six park divisions could potentially be affected by this alternative, each with different functions and responsibilities. These include the divisions of Administration, Interpretation and Visitor Services, Facility Management, Visitor and Resource Protection, and Resource Management. Under this alternative, there would be no change in the monument's ability to ensure employee and visitor health and safety, and the ability to provide quality visitor service and experience. There would be no impact to the park divisions of Administration, Interpretation and Visitor Services, Facility Management, and Visitor and Resource Protection.

However, because accelerated soil erosion conditions and subsequent cultural resource degradation would continue to occur, there may be minor to moderate, adverse, direct, short- and long- term impacts to the Resource Management division with regard to staffing duties. This may be manifested through an increased need for existing staff to develop other solutions to treat or mitigate the continued impacts to resources of concern, which could take time away from other, more routine job duties. For instance, staff archeologists may need to conduct data recovery investigations and site- specific remediation for individual cultural resources that are in imminent danger of collapse or loss of all contextual information, which could divert time from other archeological job duties. Natural resource specialists may also experience similar impacts associated with job duties.

The Resource Management division's annual budget, currently at 26% of Bandelier's overall annual base operations budget, would not be affected under this alternative. While certain job duties may involve addressing issues such as data recovery of archeological sites due to continued resource degradation, there would be no change to permanent base staffing levels or the division's operations budget. If any new projects are implemented that require additional funds, they would be funded through a separate funding process and involve only project- specific monies, separate from the Resource Management division's annual operations budget. No additional staff would be hired using the division's annual operating budget money.

CUMULATIVE IMPACTS

Under Alternative A, there would be no cumulative impact to park operations based on past, present, and future foreseeable actions. Currently, there are no present or future anticipated projects that would require additional time from the permanent staff that would cause a cumulative impact when combined with impacts from this alternative. Park management activities would continue at approximately the same level as present. The same level of service, monitoring, oversight, and management activities would continue and no additional funding or staff would be required.

CONCLUSION

Under Alternative A, there would be no impacts to the park management divisions of Administration, , Interpretation, Maintenance, and Visitor and Resource Protection. There may be minor to moderate, adverse, direct, short- and long- term impacts to the Resources Management division based on demands for funding and staff duties. There would be no cumulative impacts anticipated from implementation of Alternative A, when combined with past, present, and future foreseeable actions.

Alternative B—Operational Priority

Under Alternative B, there may be adverse impacts to some park operations divisions. These impacts are separated by division and are described below.

<u>Administration</u>: Impacts to this division may be negligible, adverse, direct, and short-term, e.g. only for the duration of the five- year treatment. Some staff may experience additional workloads related to human resources and employee recruitment, contract administration, and budget tracking. Administrative duties related to this alternative would not be out of staff's normal job duties, but may constitute a negligible increase in workload. The Administration division's operating budget would not be affected.

<u>Interpretation and Visitor Services</u>: Impacts to this division may be negligible, adverse, direct, and short- term. Visitor center and fee collection staff would be required to inform the public about the project and advise visitors about the location of treatments in the backcountry during treatment seasons. Staff may need to answer questions from visitors regarding the project and subsequent visual conditions on the landscape in the short term. Duties related to this alternative, (e.g., giving information to the public about the project, etc.) would not be out of the staff's normal job duties and the division's operations budget would not be affected.

<u>Facility Management</u>: Impacts to this division may be negligible to minor, adverse, direct, and short- term. Maintenance staff may be used to assist with pack operations and field camp set up. A packer would be used intermittently during the field season and would be funded out of project monies. A maintenance staff member would also manage and assign housing units for field crew members for the season. Duties related to this alternative would not be out of the staff's normal job duties and the division's operations budget would not be affected.

<u>Resource Management</u>: Impacts to this division may be negligible to minor, adverse, direct, short and long- term. Some resource staff would be directed away from their normal job duties to manage project implementation and monitoring or to act as resource advisors. Staff archeologists and natural resource specialists may be required to assist field crews with thinning activities, mitigation measures, and camp operations. Permanent Resource Management division staff, such as the vegetation specialist, may be directed to manage this project over the lifetime of implementation. This would likely cause shifting work priorities, such as postponing of other time intensive projects, and possibly an increase in workloads for the duration of the

project for that employee. Project management duties may also be shared between staff members, thus lessening the impact to each individual's overall workload over time.

Funding sources are currently being sought to fund all aspects of project operations under this alternative, so no impacts to the division's operations budget are anticipated. All temporary and seasonal staff required to implement this alternative would be hired and managed through separate project funds and would not come from the Resource Management division's annual operations budget.

Visitor and Resource Protection: Impacts to this division under this alternative may be negligible, adverse, direct, and short- term. Protection staff may be required to assist with camp operations or may increase patrol efforts during project implementation. There may be a slight increase in the likelihood of backcountry rescue efforts due to a risk of field crew job injuries. Staff may also need to provide basic CPR and first aid training to all field crew and field crew supervisors. Duties related to this alternative would not be out of the staff's normal job duties and the division's operations budget would not be affected.

CUMULATIVE IMPACTS

Under Alternative B, there may be negligible cumulative impacts when combined with past, present, and future foreseeable actions. Currently, there are no additional projects identified over the lifetime of this plan that would significantly affect the staff's ability to perform their normal duties and implement the proposed plan. Park divisions and operations budgets would not experience an appreciable adverse impact under this alternative. There may be a slight increase in workloads associated with this alternative, but it would not be out of the staff's normal job duties and operations budgets would not be impacted.

CONCLUSION

Under Alternative B, there may be negligible, adverse, direct, and short- term effects to the divisions of Administration, Interpretation and Visitor Services, and Visitor and Resource Protection. There may be negligible to minor, adverse, direct, and short- term impacts to the Facility Management division, and negligible to minor, adverse, direct, short- and long- term impacts to the Resource Management division. There may be negligible cumulative impacts when combined with past, present, and future foreseeable actions.

Alternative C—Phased Approach

Under Alternative C, there may be adverse impacts to some park operations divisions. Impacts under this alternative are anticipated to be the same as those described under Alternative B for the Administration, Interpretation and Visitor Services, Visitor and Resource Protection, and Facility Management divisions. The project implementation period under this alternative is significantly longer than that of Alternative B; however, the duration is not likely to change the impacts to park operations from that of Alternative B for these divisions.

The Resource Management division may experience increased adverse impacts compared to Alternative B ranging from minor to moderate, short- and long- term impacts from this alternative due to the extended implementation period (20 years). As described under Alternative B, some staff would be directed away from their normal job duties to manage project implementation and monitoring, or to act as resource advisors. However, the extended implementation time frame could divert staff from other job duties for a greater length of time both within the year and across years. In addition, some other resource projects may be postponed due to inadequate staffing over the lifetime of the project. For instance, over a 20- year period the Resource Management division vegetation specialist or archeologist may be required to devote a certain percentage of their workload towards project implementation. This may cause other projects or duties to be postponed for a longer duration as compared with Alternative B. If funding for this alternative is intermittent and work does not proceed every year, Resource Management staff would have to allocate their time to complete other projects during years where no implementation funding for this project is received. As in Alternative B, additional outside funding sources are currently being sought to fund all aspects of project operations, so there would likely be no impact to the division's operations budget.

CUMULATIVE IMPACTS

Under Alternative C, there may be negligible to minor cumulative impacts when combined with past, present, and future foreseeable actions. There may be a greater impact to the Resource Management division under this alternative, but would not appreciably alter the cumulative impacts across all divisions for any past, present, and future foreseeable projects. Currently, there are no additional projects identified over the lifetime of this plan that would significantly affect the staff's ability to perform their normal duties and implement the proposed plan. However, because of the duration of the 20- year implementation period, it is more difficult to predict other projects that may arise that could cumulatively impact the staff's ability to perform their jobs. Base operations budgets are not anticipated to be cumulatively impacted.

CONCLUSION

Under Alternative C, impacts to the park operations divisions of Administration, Interpretation and Visitor Services, Visitor and Resource Protection, and Facility Management would be the same as those described under Alternative B. For the Resource Management division, impacts may be minor to moderate, adverse, and short- and long- term due to the extended project implementation time frame and the resulting demands on Resource Management division staff. There may be negligible to minor cumulative impacts when combined with past, present, and future foreseeable actions.

HEALTH AND SAFETY

Laws, Regulations and Policies

Director's Order 50B (*Occupational Health and Safety Program*) requires the routine monitoring of noise and its effects on employees, the provision of written safety rules and practices that are understood and followed by all employees, and training in and provision of written rules for use and maintenance of personal protective equipment (NPS 1999b).

Methodology

The primary health and safety issue for staff is the possible effect on hearing from operation of chainsaws and helicopter loading and unloading. Noise impacts affecting humans can range from temporary, mild annoyances for local residents to noise- induced hearing loss resulting from a combination of high sound levels and an extended period of exposure to sound above 85- 90 dBA for more than eight hours. The A- weighted sound level, or dBA, gives greater weight to the frequencies of sound to which the human ear is most sensitive. Sound levels in decibels (dB) are calculated on a logarithmic scale and each 10- decibel increase is perceived as an approximate doubling of loudness. In general, the louder the noise, the less time required before hearing loss will occur. According to the National Institute for Occupational Safety and Health (NIOSH), the maximum exposure time at 85 dBA is 8 hours. At 110 dBA, the maximum exposure time is one minute and 29 seconds. Noise levels above 140 dBA can cause damage to hearing after just one exposure.

The health effects of noise include hearing loss, but have also been associated with other physiological changes, including elevation in blood pressure and gastrointestinal changes (increased peristaltic esophageal contraction and gastric emptying). Background noise may also disturb sleep, increase annoyance and may even increase aggression if it is loud and chronic (League for the Hard of Hearing fact sheet 2006).

Tables 24, 25 and 26 were used in assessing and comparing impacts (League for the Hard of Hearing, December 2005; NIOSH 2006; USDOT 2001). Table 24 can be found in the *Visitor Experience* analysis under *Soundscapes*. Table 25 and 26 are repeated here for convenience.

Table 25. Exposure Thresholds for Noise.

A-weighted decibel	NIOSH exposure threshold
Up to 80 dBA	No limit
81-90 dBA	8 hours
91-95 dBA	4 hours
96-100 dBA	2 hours
101-104 dBA	1 hours
105-110 dBA	30 minutes
111-120 dBA	7.5 minutes
121-130 dBA	3.75 minutes
131-140	No exposure is safe

Table 26. Chainsaw and Helicopter Noise Expected at and Near the Work/Camp Sites.

Distance from Source (meters)	Chainsaw dBA level	Helicopter dBA level (average)
1	110	118
2	104	112
4	98	106
8	92	100
16	86	94
32	80	88
64	74	82
128	68	74
256	62	68
512	56	62
1024	50	56
2048	44	50
4096	38	44
8192	32	38

The following thresholds for impact intensity were applied:

Short- term impacts are defined as equal to or less than the NIOSH standards indicated in Table 25 above.

Long- term impacts are defined as longer than the NIOSH standards indicated in Table 25 above.

Negligible:	Sound levels would be comparable to a quiet rural area. No hearing loss would occur even with unlimited exposure.
Minor:	The impact would be slight, but detectable. Sound levels would be comparable to normal conversation (60dBA). No hearing loss would occur even with unlimited exposure.
Moderate:	The impact would be readily apparent. Chronic or sustained noise levels would not exceed 85- 90 dBA for eight hours per day, or ear protection to maintain noise levels at or below this level would be used. No NIOSH standards would be exceeded, although protection may be required to ensure this is the case. Short periods of noise up to 110 dBA could occur.
Major:	The impact would be severe. Sustained sound levels could exceed NIOSH standards (see Table 25) occasionally even with ear protection. Short periods of noise greater than 110 dBA could occur, and short-term NIOSH standards could also be exceeded on a temporary basis.
Impairment:	Worker health and safety is not considered a park resource or value, and so impairment does not apply.

Alternative A—No Action

No workers would be exposed to noise or other additional safety risks from any activities in piñon juniper woodland. Therefore there would be no impact from this alternative to health and safety.

CUMULATIVE IMPACTS

Sources of noise outside the monument but in the immediate area are described in the cumulative impact section of the *Soundscapes* part of *Environmental Consequences* for *Visitor Experience*, and include non- park traffic, commercial airliner overflights, military training and monitoring, and activities at Los Alamos National Laboratory (LANL) facilities.

CONCLUSION

Negligible to minor impacts from activities inside the monument, including car traffic and visitor activities, occur now in the study area. Additional temporary, minor impacts to the natural quiet of the area from overflights, LANL activities and construction also occur. No impacts related to the No Action alternative would add to these sources of noise.

Alternative B—Operational Priority

Sources of noise in both this alternative and Alternative C include chainsaws and hand tools, helicopters, and sounds associated with camp occupation. The loudest and most sustained noise would be related to chainsaws which, on average, produce noise at the 110 dBA level (some sources report 120 dBA). The NIOSH recommends that exposure to 110 dBA be limited to no longer than 30 minutes per day. Ear protection would be required for workers. According to information provided on the NIOSH noise website (cdc.gov/niosh/noise), protective devices currently available offer protection at 110 – [33- 7] (84 dBA). This is just under the NIOSH limit at which hearing loss may occur if exposure is unlimited (85dBA). At this level, no more than eight hours exposure is recommended. Therefore, if the chainsaws do not emit more than 110 dBA and workers wear the most effective protection sold on the market today, moderate impacts would be expected for an eight- to ten- hour working day. Alternatively, if chainsaw noise exceeds 85 dBA, but does not rise above 90 dBA, workers would experience no more than moderate impacts if they are not exposed for longer than 8 hours per day, but could be subject to major impacts if the work day exceeds 10 hours.

Hand tools would occasionally be used to clear vegetation from cultural sites, for example. These would produce noise at the 80- 85 dBA level and because they would not be used more than intermittently, are not expected to have more than short- term and moderate impacts. Hearing protection could reduce these impacts to minor.

Helicopters would be used in Alternative B to set up and supply camps, as well as to carry waste and empty water containers away. Supplying the camps and carrying away waste would be accomplished with short flights in and out on average every two weeks. An average of three short flights in succession, or a total of approximately one hour for each two week period, would be required to restock camps and remove waste. Another three hours of helicopter flight time to set up and to move camp when required would also be needed. In this alternative, it is assumed that two crews would work for an eight- month season and that treatment in all units would be complete within a five- year period (see the description of this alternative in the *Alternatives* section for assumptions and calculations regarding helicopter use). This translates to approximately 70 hours of helicopter use per season, or about 2.4% of the total daytime hours in a season (assuming 12 hours of light/day average in a season).

As noted in Table 26, helicopters can be quite loud on takeoff, approach and even on flyovers. Noise levels from helicopters at close range vary depending on the angle to the receiver. They are lowest when directly in front or in back of the receiver and highest when the helicopter is on either side and toward the back (Avarindakshan, et al. 2002).Although the supply helicopter may fly high enough to lower sound levels to the maximum decibel level remaining unrestricted by NIOSH (85 dBA) it would exceed this level on approach and while it hovers to deliver the sling load at the camp site. Landing would occur only at the helispot along the entrance road or heliport located at TA- 49 and not within the project area. These higher noise levels would be temporary and occur intermittently as supplies are delivered on the order of twice a month throughout the treatment season. Assuming an eight- month work period, noise levels from helicopters would be loud enough to have a short- term, moderate to major effect on workers who are very close to them at each camp for 10- 15 minutes during each of the 84 trips per season if ear protection is not worn. This translates to about 15- 20 hours per season. Even maintaining a distance of a few meters or wearing protection would reduce these short- term impacts to moderate. Crews working even thousands of meters from the camp would be able to detect incoming helicopters, although sound would begin to be indistinguishable from background noise at these distances. Very short- term, minor impacts on the order of a few minutes to crews would occur from about 100- 900 meters and short- term, moderate impacts are possible from 10 to 100 meters.

Chainsaws can cause vibration related injury and can result in accidents. Both of these are possible negligible to minor impacts resulting from Alternative B.

CUMULATIVE IMPACTS

No cumulative impacts beyond those described for No Action would occur.

CONCLUSION

Negligible to minor noise impacts from activities inside the monument, including car traffic and visitor activities occur now in the study area. Chainsaw activities could have moderate impacts related to noise exposure to workers; hand tools could have minor to moderate impacts to workers. Helicopters establishing or supplying work camps could have short- term, moderate intermittent effects on those workers unloading supplies. Additional temporary, minor impacts to the natural quiet of the area from overflights, LANL activities and construction would continue.

Alternative C—Phased Approach

As in Alternative B, the loudest and most sustained noise under this alternative would come from the use of chainsaws. With ear protection, crews should be able to dampen sound levels to those where exposure is either unlimited, or allowed for up to 10 hours per day. Therefore no more than moderate impacts similar to those described in Alternative B are expected. Because this alternative takes four times as long to complete, crews are also more likely to change during the treatment period. This means the cumulative total exposure per worker from treatment at Bandelier is likely to be less than in Alternative B. Similar minor to moderate intermittent impacts from the occasional use of hand tools would be true for workers completing treatment in Alternative C as described for Alternative B.

The number of helicopter supply trips in a given season in Alternative C would be slightly more than half that of Alternative B, as only one camp would need to be supplied, but this camp would be moved twice per season. On average, this translates to between 15 and 22 hours of flight time per season, or less than 1% of the daytime hours in the season. Flight routes would be less restricted than in Alternative B because the treatment season would not extend into the spring to avoid any impacts to nesting birds.

Although the supply helicopter may fly high enough to lower sound levels to the maximum decibel level remaining unrestricted by NIOSH (85 dBA) it would exceed this level on approach and while it hovers to deliver the sling load. These higher noise levels would be temporary and occur intermittently on the order of twice a month throughout the treatment season. Sling loading supplies and waste would take only 10- 15 minutes per trip, and three trips in succession would be required. Assuming a six- month work period, noise levels from helicopters would be loud enough to have a moderate to major effect on workers who are very close to them for 8- 12 hours total per season. Over 20 seasons, this effect could impact unprotected staff for 100- 200 hours. This is a higher cumulative total than Alternative B. However, maintaining a distance of a few meters or wearing protection would reduce these impacts to moderate. Members of the crew hiking even thousands of meters from the camp would be able to detect incoming helicopters, although sound would begin to be indistinguishable from background noise at these distances.

CUMULATIVE IMPACTS
No cumulative impacts beyond those described for No Action would occur.

CONCLUSION
Negligible to minor noise- related impacts from activities inside the monument, including car traffic and visitor activities occur now in the study area. Chainsaw activities could have moderate impacts related to noise; hand tools could have minor to moderate impacts to workers. Helicopters establishing or supplying work camps could have moderate intermittent effects on those workers unloading supplies. Additional temporary, minor impacts to the natural quiet of the area from overflights, LANL activities and construction would continue.

SUSTAINABILITY AND LONG-TERM MANAGEMENT

All environmental impact statements are required to consider long- term impacts and effects of foreclosing on future options (sec. 101[b]). These considerations must address the relationship between short- term uses of the environment and the maintenance and enhancement of long- term productivity (NEPA section 102[c][iv]). As further explained in *Director's Order 12 (the NPS NEPA Regulations)*, "sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their needs" (NPS 2001:58). This relationship is discussed below for each alternative.

Alternative A—No Action
Under this alternative, accelerated soil erosion within the piñon- juniper woodland would continue, resulting in long- term cumulative adverse effects to soils, vegetation and archeological resources of the monument. Impairment of the archeological resource base is possible. The monument's piñon- juniper woodland would continue

to exhibit an unnatural fire regime that is incapable of maintaining grass- dominated communities. In the short- term, this alternative would provide for the existing use of the land while jeopardizing the enhancement of long- term productivity of park resources, some of which are mentioned in the monument's enabling legislation and are at risk of impairment under this option.

Alternative B—Operational Priority

Under this alternative, accelerated soil erosion would be mitigated via vegetation restoration actions within the piñon- juniper woodland over a five- year period. Improvements in vegetation cover are expected to reduce runoff and loss of archeological resources over time. In addition, conditions for a surface fire regime sufficient to maintain restored grass- dominated communities would be improved. Compared to the No Action alternative, Alternative B would notably improve conditions for the long- term productivity and enhancement of the monument's resources, particularly, soils, vegetation and archeological resources. These improvements would be considerably accelerated under this alternative when compared to Alternative C.

Alternative C—Phased Approach

Under this alternative, accelerated soil erosion would be mitigated via vegetation restoration actions within the piñon- juniper woodland over a 20- year period. These actions are expected to result in the long- term enhancement of productivity of monument resources- - vegetation, soils, water resources, and archeological resources—but on a much smaller annual scale than that realized under Alternative B (much smaller annual treatment areas). At the same time, conditions would slowly improve for a surface fire regime sufficient to maintain restored grass- dominated communities. The 20- year project schedule puts the monument's archeological resources at greater long- term risks at the expense of short- term use of the environment due to the on- going loss of these resources to erosion.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

All environmental impact statements are to summarize any commitments of resources the alternatives would entail. This includes irreversible, or long- term or permanent, losses, and irretrievable, or short- term commitments. The NPS must also determine if such effects on park resources would mean that, once gone, the resource could not be replaced or restored (NEPA sec. 102[c][v]).

Alternative A—No Action

The No Action alternative would continue to have long- term impacts on park resources within the piñon- juniper woodland, resulting in permanent loss of some resources. Existing conditions (erosion/runoff) contribute to additional loss of soils and archeological resources and promote the unnatural state of vegetation in the piñon- juniper woodland. Approximately 9% of archeological resources could be jeopardized (loss of NRHP eligibility) under the 20- year life of the No Action alternative. Loss of both soils and archeological resources are considered irreversible, that is, once lost, they cannot be restored or replaced. Without soils, vegetation loss would also be irreversible. As Bandelier's enabling legislation specifically cites the preservation of its unique archeological resources as the purpose for the monument's existence, the permanent loss of integrity to these sites could result in impairment. The No Action alternative has the greatest potential of all alternatives to result in irreversible or irretrievable commitments of resources.

Alternative B—Operational Priority

Under this alternative, vegetation restoration within the piñon- juniper woodland would improve the condition of soils, the vegetation community and the archeological resource base. However, it is expected that a small percentage (approximately 2%) of archeological sites would be jeopardized (loss of NRHP eligibility) during the 5- year life of the project. This loss would be irreversible. The permanent loss of a small number of the monument's archeological resources under this alternative would be preferable when compared to the other alternatives, particularly the No Action alternative under which impairment of this resource is possible.

Alternative C—Phase Approach

Under this alternative, vegetation restoration would eventually improve the condition of soils, the vegetation community and the archeological resource base within the piñon- juniper woodland. However, the extended 20- year life of the project would likely result in additional permanent loss of soils and the jeopardization (loss of NRHP eligibility) of a small percentage (approximately 6%) of archeological sites. These losses would be irreversible. When compared to the No Action alternative under which impairment of this resource is possible, the permanent loss of a relatively small number of the monument's archeological resources under this alternative would be preferable and would not constitute impairment. However, when compared to Alternative B, Alternative C would result in a greater irreversible loss of resources (e.g., soils, archeological resources) due to its longer project schedule.

ADVERSE IMPACTS THAT COULD NOT BE AVOIDED

The NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA sec. 101[c][ii]).

Alternative A—No Action

The No Action alternative would continue to have adverse impacts to park resources that would not be mitigated or avoided. Major, unavoidable adverse effects to vegetation, soils, archeological resources, and wilderness would occur due to continued accelerated erosion/runoff, environmental factors exacerbated by existing conditions (drought, fire potential), and the modified appearance of the monument's natural environment. In the case of archeological resources, these major, unavoidable effects could potentially result in impairment of the monument's resources.

Alternative B—Operational Priority

No unavoidable landscape scale impacts would occur under this alternative, and in fact, many of the impacts described above for Alternative A would be avoided by implementing Alternative B. However, some archeological sites would likely be jeopardized because treatment would take a few years and sites would continue to be lost during this treatment interval. Individual piñon and juniper that are cut and used for treatment would also experience impacts. Visitors, especially those seeking a primitive or wilderness experience, would be exposed to human activity and noise which could have a short term impact on them, and those people who believe wilderness should be left untouched by human managers would also experience adverse impacts to their wilderness values.

Alternative C—Phased Approach

The same impacts as described above for Alternative B would result from this alternative. Because treatment would take longer, the potential loss of archeological resources is greater than in Alternative B.

Chapter 5: Consultation and Coordination

Blue Grama
Boutelous gracilis

CONSULTATION AND COORDINATION

PUBLIC INVOLVEMENT EFFORTS IN THE PLANNING PROCESS

Governmental agencies and the public have been invited to help during the scoping phase of this planning process to identify purpose, need, alternatives, and environmental issues. The scoping process began with a notice of intent to prepare an environmental impact statement, which was published in the *Federal Register* on April 2, 2003. The monument then conducted four open houses to inform the public of the planning process and to invite comments on work to date. The open houses were held in June 2003 and November 2003. Each time, one open house was conducted in Los Alamos and a second in Santa Fe.

The first set of open houses in June 2003 presented the need for action, a summary of research results to date, and a summary of existing NPS and national monument policies regarding resource conservation, wilderness management, and other topics relevant to whether action should be undertaken. Comments from these sessions, as well as written comments received as a result of the *Federal Register* notice, were integrated into the scope of the planning effort to refine purpose, need, and objectives; to produce a range of reasonable alternatives; and to supplement the list of issues and impact topics. Written and oral comments were received at these open house sessions.

After the need for action, purpose, objectives and constraints were further refined based on the results of the first set of open houses, a second set was held in November 2003. These sessions presented very specific objectives for each vegetative community (see *Desired Future Conditions for Piñon- Juniper Woodland* [*Purpose of and Need for the Plan* section]) in this EIS, and a preliminary set of alternatives for review and comment. They also introduced the concept of adaptive management. Written and oral comments were received. Impact topics or issues and suggestions for new alternatives either resulted in additions or changes to the existing scope, or were considered and rejected for reasons described in , *Impact Topics Dismissed from Further Analysis* (see *Purpose of and Need for the Plan* section), or *Alternatives Dismissed from Further Analysis* (see *Alternatives* section).

Any substantive comments (e.g., those bearing on the analysis in this environmental impact statement) are summarized below.

Summary of Comments received during public scoping workshops:

- 11 comment documents were received; five from first scoping session and six from second.
- All commented on whether intervention was necessary to restore piñon- juniper in a designated wilderness; 91% supported intervention, 9% suggested that additional substantiation was needed to support the need for mechanical action in the face of the piñon die- off.

- Nearly three- quarters of the respondents directly addressed whether intervention in the wilderness was acceptable to achieve stated objectives. Of this group, 50% said it was acceptable or desirable to sacrifice wilderness values to return the wilderness to a more natural state or to slow erosion and save cultural resources. Thirty- seven percent indicated caution should be used or disturbance minimized. One of eight who commented on this issue, or 11%, indicated is was not acceptable to use mechanized means to treat wilderness ("Mechanical treatment will destroy wilderness character, and impacts will persist for many decades or even centuries.") This person did not comment on the acceptability of treatment with hand tools.
- Of those who indicated a preference for one or another alternative, 72% (five of seven) indicated they preferred mechanized tools to accomplish the restoration more quickly; the other 28% said hand tools were preferable.
- Five of the commenters directly or indirectly addressed prescribed burning in the park. All indicated prescribed fire was desirable; two of these five asked that the park consider prescribed burning either instead of mechanical treatment (one) or in addition to mechanical treatment (one).

The remainder of the comments fall in the category of "miscellaneous." They include comments on the planning process (e.g., The first scoping hearing was vague and had no alternatives; The park is correct in designing alternatives to meet the Desired Future Conditions, as DFCs should not change from alternative to alternative; The park should include a strong minimum requirement analysis as per DO 41; The plan should have a zoning map and identify the maximum use of motorized tools in each zone; The park should coordinate with USFS and LANL in this effort; How is this related to the wilderness EIS, etc.); money (e.g., Bandelier National Monument should have more money to educate, assess and mitigate impacts from erosion); and suggested alternatives beyond those presented (e.g., widespread reseeding; reestablish beaver; hand remove exotics; inject herbicides in junipers; allow bark beetles to kill off trees.).

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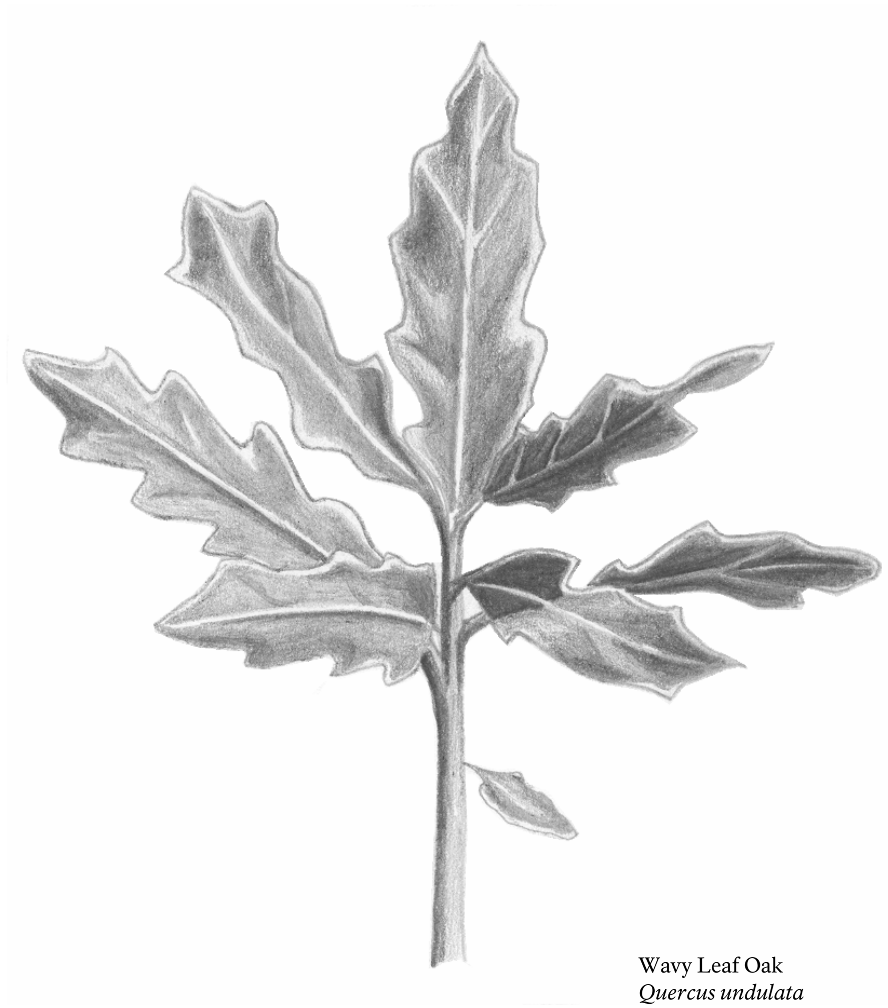

Wavy Leaf Oak
Quercus undulata

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Index and Appendices

Yucca

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APPENDIX A

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENT DECISION GUIDE

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act."

– Wilderness Act, 1964

Instructions and worksheets for the Minimum Requirement Analysis

for actions, projects, and activities in Wilderness

The Minimum Requirement Decision Guide (MRDG) is designed for wilderness administrators to effectively analyze proposed actions to minimize negative impacts to wilderness character and values. It assumes a basic knowledge of the Wilderness Act of 1964, agency policies, and specific provisions of the wilderness designation legislation for each unit. This guide is suggested for wilderness administrators for the four federal land management agencies, the Bureau of Land Management, the National Park Service, the U.S. Fish & Wildlife Service and the U.S. Forest Service.

Section 4(c) of the Wilderness Act of 1964 prohibits certain activities in wilderness by the public, and, at the same time allows the agencies to engage in those prohibited activities in some situations. Section 4(c) states:

> "… except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

Therefore, unless a generally prohibited use is allowed by specific unit designation, most of these activities are prohibited. However, in the above language, Congress acknowledged that there are times when exceptions are allowed to meet the minimum required administration of the area as wilderness.

How to Use This Guide

The MRDG displays a two-step process to assist in making the right decision for wilderness. First, the administrator must decide if a problem or issue in the wilderness unit needs administrative action, and then, and only then, the administrator must decide what tool/action/method, available from a range of identified alternatives, would minimize negative impacts on wilderness character and values. This guide includes templates for documenting both steps of the decision-making process, instructions for completing each step, and a cover sheet for signatures. The MRDG and future revised editions of the MRDG can be found on the Arthur Carhart National Wilderness Training Center page at www.wilderness.net.

STEP 1 – DETERMINING THE MINIMUM REQUIREMENT

SHEET 1

Is Administrative Action Needed?

What is the problem/issue that **may** require administrative action? Do not include methods or tools here. This sheet only refers to the issue or problem, not proposed action/project, or tools to be used. Include references from other legislation, policy, or plans, decisions, analyses, and how this issue is addressed in those documents.

Briefly describe the issue/problem:

- Loss of natural fire regime in pinon-juniper woodlands.
- Decrease in herbaceous ground cover due to historic land use practices and fire exclusion.
- Increased soil erosion removing top soil layers and degrading and damaging archeological resources.
- Need to restore healthy-sustainable vegetative communities in pinon-juniper woodlands to prevent further degradation of cultural resources, restore herbaceous ground cover, reduce erosion, and promote natural fire regime in pinon-juniper woodlands.

The following questions assist in analyzing whether the issue needs to be resolved in wilderness. Do not consider what tools are to be used here. Please circle **Yes** or **No**, and explain your reasoning:

1. Is this an emergency? **Yes** **No** If yes, follow established procedures for Search and rescue (SAR), fire or other plans/policies. If no, please continue.

2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc? **Yes** **No**

If no, continue with **Sheet 1**.

If yes, briefly explain here and then proceed to **Sheet 3**

3. Can the problem/issue be addressed by administrative actions outside a wilderness area? (For example, the administrative actions could be an information program at the visitor center or trailhead instead of a physical action in the wilderness, etc) **Yes** **No**

If yes, conduct actions outside wilderness. If no, continue with **Sheet 2**.

4. Is there a special provision in legislation (the 1964 Wilderness Act or subsequent laws), that allows this project or activity? (For example, maintenance of dams or water storage facilities, access to private inholdings, etc.) **Yes** **No** **If yes, Go to SHEET 3; if no, Go To SHEET 2.**

STEP 1: DETERMINING THE MINIMUM REQUIREMENT (Continued)

Is Administrative Action Needed? (Continued)

The following questions are provided to evaluate whether resolving the issue protects wilderness character and values identified in the Wilderness Act. Answer the questions in terms of the need to resolve the issue/problem. If the answer to most of the questions is yes, then the issue/problem probably requires administrative action. **Please circle Yes or No for each answer, and briefly explain.**

1. If the issue/problem is not resolved, or action is not taken, will the natural processes of the wilderness be adversely affected?

   Yes **No** **Why/How?**

Continued soil erosion will further degrade soil conditions and alter natural fire regimes. This will lead to continued loss of biodiversity and site productivity.

2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened?

   Yes **No** **Why/How?**

3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable?

   Yes **No** **Why/How?**

Further loss of soil and fire exclusion would continue to show evidence of past human land use practices and human manipulation.

4. Does addressing the issue/problem or taking action protect the wilderness as a whole as opposed to a single resource?

   Yes **No** **Why/How?**

Yes, it would protect all values of wilderness including wildlife, vegetation, natural fire regimes, soils, cultural resources, and vegetation. This would enhance wilderness users experience in the long term.

5. Does addressing this issue/problem or taking action contribute to protection of an enduring resource of wilderness for future generations?

   Yes **No** **Why/How?**

Yes, it will preserve and protect cultural resources, reduce soil erosion, restore the natural fire regime, and increase biodiversity and site productivity.

6. Is this an issue for reasons other than convenience or cost of administration?

   Yes **No** **Why/How?**

To promote ecologically sustainable conditions in pinon-juniper woodlands and to better protect cultural resources for which the Monument was created.

If administrative action is warranted, then proceed to Sheet 3 to determine the minimum tool or method for resolving the problem.

STEP 2: DETERMINIMG THE MINIMUM TOOL

SHEET 3: Determining the Minimum Tool: Fill out a Sheet 3 for each alternative.

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

Alternative # ___1___

Describe briefly or attach description:

Hand tools only (traditional and non-motorized tools) to complete thin and slash treatments.

Circle yes or no:

Does this alternative involve:

use of temporary road?	Yes	No
use of motor vehicles?	Yes	No
use of motorized equipment?	Yes	No
use of motorboats?	Yes	No
landing of airplanes?	Yes	No
landing of helicopters?	Yes	No
use of mechanical transport?	Yes	No
creating a structure or installation?	Yes	No
Other impacts to wilderness character?		
___visual, vegetation, noise, soils_	Yes	No

The next set of descriptions may be put on Optional SHEET 3a, if desired:

Describe the biophysical effects/benefits of this alternative: *More workers needed, increasing adverse impacts due to increase in treatment times (could be up to 20 years for hand tool use only).*

Describe the social/recreation effects/benefits: *Presence of humans, visual impacts of stumps and worker trails, decrease in quality solitude wilderness experience because of higher number of workers and longer duration.*

Describe societal/political effects/benefits: *Could have impacts to wilderness "philosophy" related to manipulation of wilderness by human activities. May have some political effects.*

Describe health and safety concerns/benefits: *There would be an increased risk to health and safety of workers due to longer duration of treatment and higher number of workers, as well as the increase in human waste and disposal from campsites.*

Describe economic and timing considerations/benefits: *Hand tools only would require additional workers and a longer treatment time. This would increase project implementation costs and require up to 20 years to treat the landscape. It may take up to 10 times longer to treat with hand tools only than with motorized tools.*

Describe heritage resource considerations/benefits: *There would be adverse impacts to heritage and cultural resources due to the longer duration of treatment. The longer the treatment time, the more cultural resource degradation that may take place. There may be greater cultural resource loss under this alternative.*

STEP 2: DETERMINIMG THE MINIMUM TOOL

SHEET 3: Determining the Minimum Tool: Fill out a Sheet 3 for each alternative.

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

Alternative # ___2___

Describe briefly or attach description:

Combination of hand tools (traditional tools) and motorized tools to complete treatment.

Circle yes or no:

Does this alternative involve:

use of temporary road?	Yes	No
use of motor vehicles?	Yes	No
use of motorized equipment?	Yes	No
use of motorboats?	Yes	No
landing of airplanes?	Yes	No
landing of helicopters?	Yes	No
use of mechanical transport?	Yes	No
creating a structure or installation?	Yes	No
Other impacts to wilderness character?		
___visual, vegetation, noise, soils_	Yes	No

The next set of descriptions may be put on Optional SHEET 3a, if desired:

Describe the biophysical effects/benefits of this alternative: *A shorter treatment time frame will reduce adverse impacts and shorten recovery time for herbaceous growth, which would reduce soil erosion rates faster than hand tools only.*

Describe the social/recreation effects/benefits: *There would be flush cut stumps, but overall less visual impacts because of decreased human presence in wilderness, reduced noise disturbance, and reduced impacts to wilderness experience by visitors because of fewer workers that would complete work in shorter time.*

Describe societal/political effects/benefits: *Potential effects related to manipulation of wilderness resources as well as motorized tool usage in wilderness. Would not negatively affect society or political environment in the long term.*

Describe health and safety concerns/benefits: *There would be some safety issues related to chainsaw usage and fuel handling, but overall fewer workers would generally mean less health concerns related to waste disposal.*

Describe economic and timing considerations/benefits: *The treatment would be completed in shorter time frame than Alt. 1 and could potentially cost less because of fewer workers over shorter treatment duration.*

Describe heritage resource considerations/benefits: *A shorter implementation time frame would lead to faster protection of at-risk cultural resources. Erosion rates would be reduced faster which would reduce the adverse impacts to cultural resources from erosion.*

STEP 2: DETERMINING THE MINIMUM TOOL

Sheet 4: Selection of the Minimum Tool Alternative

What is the method or tool that will allow the issue/problem to be resolved or an action to be implemented with a minimum of impacts to the wilderness?

The Selected alternative is # ___2____.

Describe the rationale for selecting this alternative

- Lower intensity adverse biophysical impacts.
- Fewer and less intense adverse impacts to wilderness
- Offers faster treatment of erosion problem and subsequent protection of resources.
- Alt. 1 is cost prohibitive and cannot meet resource protection objectives.

Describe the specific operating requirements for the action. Include information on timing, locations, type of actions, etc. (Use this space or attach a separate sheet)

Location: *pinon-juniper woodland zone in Bandelier Wilderness.*

Timing: September to May

Type of Action: Lopping and scattering of pinon-juniper to create microsites to promote herbaceous growth that will slow soil erosion and increase

What are the maintenance requirements?

After 10+ years, fire will be reintroduced to the ecosystem through either WFURB or prescribed fire. There would be no additional cutting with motorized tools after original treatment as part of this alternative.

What standards and designs will apply?

Best Management Practices will be employed, NPS Health and Safety rules and regulations will be followed, Use of Minimum Requirements Decision Guide (this form) will be used for project level actions (annual basis for treatments planned for that year).

APPENDIX B- MONITORING AND MANAGEMENT PLAN FOR THE PIÑON-JUNIPER WOODLAND RESTORATION PROJECT

GENERAL MONITORING APPROACH AND DETECTION THRESHOLD LEVELS

Archeological Resources

The effects of the two action alternatives on archeological resources would be monitored through qualitative data collection on the key variables of site condition, depositional integrity, and information potential, each of which relate to the eligibility of a site for listing on the National Register of Historic Places (NRHP). In addition, quantitative proxy measures of site stability will be monitored following an established protocol using Bandelier Archeological Site Condition Assessment and Monitoring forms. These forms record site condition, depositional integrity, data potential, detectable threats and disturbances from natural or human forces, presence of invasive species, site- wide and 2x2m vegetation- plot estimates of surface cover and sheetwash, repeat photography, and surface topography along a single transect across the site.

Monitoring would occur on a 10% representative sample of treated archeological sites one year after treatment, then every three years afterward. Data collection would occur from mid- August to mid- September, which is the end of the growing season. The purpose of the monitoring is to determine what, if any, changes are observed pre- and post- treatment, and in successive years following treatment. Collection of the full range of qualitative and quantitative data will provide the opportunity to identify unforeseen consequences (beneficial or detrimental) to treated archeological sites. Vegetation plots and site- wide estimates of ground cover provide a proxy measure of soil and site stabilization. Monitoring will be scheduled for the end of the summer growing season, which falls during the month of August.

Ongoing research outside of this monitoring will include additional revisitation of sites lacking a current condition assessment, recording of insufficiently documented sites, inventory of unsurveyed areas, and limited data recovery through detailed surface recording or excavation are planned, but dependent upon funding.

Soil and Water

Effects of proposed actions on soil and water resources would be monitored primarily using a single integrated metric which would be based on monthly (July-September) volumetric measurements of sediment production for discrete contributing areas (e.g. 0.1 to 1.0 hectares) located wholly within representative treatment and control areas. Comparable contributing areas within representative treatment and control areas would be instrumented with fabric sediment dams and sediment removed and measured on a monthly basis. Sediment production estimates would be adjusted using precipitation data obtained from rain gauges co- located with each sediment dam. Detailed procedures for measuring sediment production in relation to restoration treatments are detailed in supporting research by Hastings, et al. (2003). Supplemental information from repeat photography, erosion bridges, and vegetation cover may also be utilized to clarify system response.

Fabric sediment dam with rain gauge

Sampling vegetation along a transect

Vegetation

Effects of proposed actions on vegetation resources would be monitored on the basis of data collected annually from vegetation transects located wholly within representative treatment and control areas. Two, permanently marked 100- meter vegetation line transects, running downslope (perpendicular to contours) from the watershed divide, and spaced at least 25 meters apart, would be established within representative treatment and control areas. Vegetation and ground cover data (per species and ground cover type) is collected at centimeter resolution during the early fall of each year, with basal and aerial cover intercepts recorded separately. Detailed procedures for measuring vegetation in relation to restoration treatments are detailed in supporting research in Jacobs, et. al. (2000, 2002). Supplemental information from repeat photography may also be utilized to clarify system response.

Anticipated Management Response per Threshold Level

The following indicates the specific management response Bandelier would take if soil, water or vegetation responses as indicated in the *Threshold Response* column.

Threshold Response of Monitored Soil, Water or Vegetation	Management Response
Soil, Water, and Vegetation	
Negligible The effect on vegetation, soil, and water resources is at or below the lowest levels of detection with neither adverse nor beneficial consequences. Measured differences in herbaceous cover and diversity, native understory cover and diversity, tree cover, bed sediment production, percent exposed bare soil, runoff, or suspended sediment between treatment and control areas, or for post-treatment relative to pre- treatment (adjusted for climatic effects), are not apparent even to a skilled observer.	Detection of response (beneficial or adverse) at this level would suggest restoration treatment was insufficient and supplemental thinning or mulching actions would be evaluated for the affected area.
Minor The effects of the proposed action on vegetation, soil, and water resources are slight, and not readily apparent to a skilled observer. Measured changes in herbaceous cover and diversity, native understory cover and diversity, tree cover, bed sediment production, percent exposed bare soil, runoff, or suspended sediment, on treatment versus control areas, or for post- treatment relative to pre- treatment (adjusted for climatic effects) are one- to two- fold.	Detection of response (beneficial or adverse) at this level would suggest restoration treatment was insufficient to meet management objectives and supplemental thinning or mulching actions would be evaluated for the affected area; alternatively, additional time to achieve an acceptable system response might be proposed if less than two growing seasons have elapsed, or sustained drought conditions have prevailed, since treatment was implemented. If several areas with similar site characteristics are producing marginal results, additional evaluation of what site features may be limiting response will be conducted, with possible global refinement of the range of woodland sites considered suitable for future treatment efforts.

Moderate The effects of the proposed action on vegetation, soil, and water resources are readily apparent to a skilled observer. Measured changes in herbaceous cover and diversity, in native understory cover and diversity, tree cover, bed sediment production, percent exposed bare soil, runoff, or suspended sediment, on treatment versus control areas, or for post- treatment relative to pre- treatment (adjusted for climatic effects) are two to three fold.	Detection of a beneficial response at this level would suggest restoration treatment was sufficient to meet management objectives and no additional action would be necessary. Detection of an adverse response at this level would suggest an unanticipated system response, contrary to management objectives, and inconsistent with results from prior research, indicating either new system dynamics or inappropriate treatment application. All restoration treatments would be suspended pending additional research to evaluate if current methods are still appropriate when applied correctly.
Major The effects of the proposed action on vegetation, soil, and water resources are severe or of exceptional benefit. Measured changes in herbaceous cover and diversity, in native understory cover and diversity, tree cover, bed sediment production, percent exposed bare soil, runoff, or suspended sediment, on treatment versus control areas, or for post- treatment relative to pre- treatment (adjusted for climatic effects) are four- fold or more.	Detection of a beneficial response at this level would suggest restoration treatment was sufficient to meet management objectives and no additional action would be necessary. Detection of an adverse response at this level would suggest an unanticipated system response, contrary to management objectives, and inconsistent with results from prior research, indicating either new system dynamics or inappropriate treatment application. All restoration treatments would be suspended pending additional research to evaluate if current methods are still appropriate when applied correctly; in addition, emergency measures (e.g. installation of erosion fabrics) might be implemented to protect vulnerable cultural sites within the affected treatment area.

APPENDIX C - NHPA CONSULTATION

SECTION 106

Preserving America's Heritage

October 19, 2006

Ms. Darlene M. Koontz
Superintendent
Bandelier National Monument
National Park Service
15 Entrance Road
Los Alamos, NM 87544-9508

Ref: Notification of Intent to Develop a Programmatic Agreement for the proposed Ecological Restoration Plan at Bandelier National Monument

Dear Ms. Koontz:

On October 16, 2006, the Advisory Council on Historic Preservation received the additional documentation we requested in support of your notification of intent to develop a Programmatic Agreement for the above referenced undertaking. Based upon the information you provided, we have concluded that Appendix A, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases,* of our regulations, Protection of Historic Properties (36 CFR Part 800), does not apply to this undertaking. As such, we do not believe that our participation in the consultation to develop this agreement is needed, and we request the document be modified accordingly to reflect this decision. However, should circumstances change and you determine that our participation is required, please notify us.

Pursuant to 36 CFR 800.6(b)(1)(iv), you will need to file the final executed Programmatic Agreement, developed in consultation with the New Mexico State Historic Preservation Officer and other consulting parties, and related documentation with us at the conclusion of the consultation process.

Thank you for providing us with this notification. If you have any questions or require the further assistance of the ACHP, please contact me at 202-606-8583, or by EMAIL at kfanizzo@achp.gov.

Sincerely,

Kelly Y. Fanizzo

Kelly Yasaitis Fanizzo
Historic Preservation Specialist
Federal Property Management Section
Office of Federal Agency Programs

ADVISORY COUNCIL ON HISTORIC PRESERVATION

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PROGRAMMATIC AGREEMENT BETWEEN NATIONAL PARK SERVICE

AND

THE NEW MEXICO STATE HISTORIC PRESERVATION OFFICER

REGARDING THE ECOLOGICAL RESTORATION PLAN AT BANDELIER NATIONAL MONUMENT

WHEREAS, the National Park Service (NPS) has determined that the proposed Ecological Restoration Plan and Environmental Impact Statement (EIS) at Bandelier National Monument (Monument) would not have an adverse effect on contributing elements to the Bandelier Civilian Conservation Corps (CCC) Historic District, as well as the overall integrity of archeological resources, cultural landscapes, and other properties or sites that are listed or eligible for inclusion on the National Register of Historic Places (NRHP); and

WHEREAS, the NPS has established *Management Policies 2001* that stipulate that every "…proposed action will be evaluated to ensure consistency or compatibility with treatment of park resources. The relative importance and relationship of all values will be weighed to identify potential conflicts between and among resource preservation goals, park management and operation goals, and park user goals. Conflicts will be considered and resolved through the planning process, which will include any consultation required by 16 U.S.C. 470f" (Chapter 5.3.5, *Treatment of Cultural Resources*); and

WHEREAS, this Programmatic Agreement (PA) seeks to provide the mechanism to complete any and all requirements of Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) (16 U.S.C. 470f) and the Advisory Council on Historic Preservation (Council) implementing regulations from 36 CFR Part 800, with regard to work related to implementation of the Ecological Restoration Plan and EIS at Bandelier National Monument; and,

WHEREAS, the Monument consulted with the New Mexico State Historic Preservation Officer (SHPO) pursuant to 36 CFR 800, regarding implementation of Section 106 of the National Historic Preservation Act {16 USC 470(f)}; and

WHEREAS, the Monument notified the Advisory Council on Historic Preservation (ACHP) in accordance with 36 CFR Part 800, regarding implementation of Section 106 of the National Historic Preservation Act {16 USC 470(f)}, and the ACHP elected not to participate in the consultation as stated in their letter of October 19, 2006; and

WHEREAS, the Monument consulted with the 19 federally recognized Pueblo Indian groups in New Mexico regarding the Ecological Restoration Plan and EIS and held consultation meetings with the six pueblos having the closest cultural affiliation with Bandelier—the pueblos of Santa Clara, Santo Domingo, San Ildefonso, San Felipe, Cochiti, and Zuni, regarding the development of this PA;

NOW, THEREFORE, the NPS and SHPO agree that the Bandelier Ecological Restoration Plan shall be implemented in accordance with the following stipulations.

STIPULATIONS:

Bandelier National Monument will ensure that the following measures are carried out:

I. INVENTORY, EVALUATION AND DETERMINATION OF EFFECT

A. Bandelier National Monument will develop annual specific treatment plans that will identify geographic areas to be treated during the subsequent treatment year (treatment year = September through May) using the methodology described in attached Ecological Restoration Plan and EIS. These annual treatment plans will be submitted to the SHPO no later than the month of July prior to each treatment year. The treatment plans will define the area of potential effect (APE) for that treatment year, the proposed actions, and the resulting level of potential impacts on archeological resources within the APE. Project areas that contain unsurveyed tracts of land on slopes less than 30 percent grade will be subjected to intensive surveys. Project areas that have been previously inventoried will be assessed for the presence of historic properties through examination of the BAND cultural resource base maps, the Monument's archeological site database, and the List of Classified Structures (LCS). Camp locations, helicopter landing zones and drop points, pack train, and foot traffic access routes will be sited to completely avoid archeological sites. Monument archeologists will inspect proposed camps, landing/drop points, and temporary trails to ensure that they are located away from archeological sites. Prior to treatment, Monument archeologists will visit each known site within a proposed treatment unit and assess the potential for adverse effects to each site from the proposed slash mulch treatment. In this site- specific assessment, the archeologist will determine whether any sites will require special protective measures to mitigate the effects of the project. These special protective measures include the following:

1. Camp areas, helicopter drop zones, and pack train/human access trails will be located away from archeological sites.
2. Prior to the start of work, the archeologist will instruct crews in identification of cultural materials and review federal laws protecting archeological sites and artifacts.
3. Work crews (treatment and monitoring) will minimize walking over architectural and other features.
4. All cultural sites within the treatment area will be identified and relocated by an archeologist or archeology technician.
5. One Archeological Technician per work crew will be present on site during treatments to identify site components, and supervise directional tree felling and placement of slash.

Sites within the treatment area will be treated following the prescription for the soil and vegetation type with the following modifications:

1. All dead trees, regardless of species, will be removed from structural elements of sites. Non- structural elements of sites should be treated using the same prescription as the surrounding landscape.
2. All 3- inch diameter and smaller trees will be removed. Cactus and other non- tree vegetation will be retained.
3. Larger (> 3- inch) diameter junipers growing in structures will be retained unless deemed by an archeologist to be detrimental to the stability or integrity of the structure.
4. Larger (> 5- inch) diameter ponderosa pines growing in structures that are deemed unstable will be removed.
5. Heavy fuels (any woody material greater than 3" diameter) will be hand- carried off structural elements. Lighter slash can remain if deemed necessary by the on- site archeological technician.

B. The Monument, in consultation with the SHPO, will follow the procedures described in 36 CFR 800.4(c) to evaluate the historical significance for all historic properties within the Area of Potential Effect (APE). Furthermore, the Monument shall seek comments from all potentially interested Pueblo Indian groups, pursuant to National Register Bulletin 38, in order to identify potential Traditional Cultural Properties located within the APE, and will then apply National Register criteria and evaluate the historical significance of those properties identified. Copies of all recommendations of eligibility for the National Register will be submitted to the SHPO for concurrence.

C. For every annual treatment plan, the Monument will document the results of the field inventory, document consultation efforts with Pueblos regarding properties of traditional religious and cultural value, and identify any proposed measures to avoid adverse effects to historic properties. As part of consultation with SHPO and other consulting parties, the Monument will report this information in the annual treatment plan and submit it to SHPO for review and comment no later than the month of July prior to each treatment year (treatment year = September to May). The treatment plan will present a determination of no historic properties affected pursuant to 36 CFR 800.4(d)(1), no adverse effect, pursuant to 36 CFR 800.5(b) for the project(s); or adverse effect pursuant to 36 CFR 800.5(a)(1)historic properties may be adversely affected.

D. If avoidance of adverse effects is not possible, the Monument will work to resolve adverse effects with the SHPO and other appropriate parties in accordance with 36 CFR 800.6. If the Monument determines that adverse effects cannot be avoided or resolved, or if SHPO objects to a finding of no adverse effect, the Monument may rescind some treatment activities in the analysis area and consult further in accordance with 36 CFR 800.6 to resolve the adverse effects.

II. INADVERTENT RESOURCE DISCOVERIES

If previously unknown archeological resources are discovered during implementation of a treatment project, all work in the immediate vicinity of the discovery would be halted and the procedures of 36 CFR Part 800.13[c] would be followed. In the event that human remains, funerary objects, sacred objects, or objects of cultural patrimony are discovered during project implementation, the regulations implementing the Native American Graves Protection and Repatriation Act (43 CFR Part 10) would be followed.

III. AVOIDANCE

If direct or indirect effects on prehistoric or historic sites, structures, or properties within the APE are identified subsequent to the review of Ecological Restoration Plan and EIS, but prior to the implementation of the proposed work, Bandelier will seek to avoid affects to those sites, structures, or properties through implementation of protective measures. Bandelier will notify the SHPO of proposed avoidance measures. Documentation submitted to the SHPO shall include site forms. If SHPO concurs with the adequacy of avoidance measures, the project may proceed without further consultation. If Bandelier determines avoidance is not possible or if, within 15 days of receipt of documentation, the SHPO objects to the adequacy of avoidance measures, consultation shall proceed in accordance with 36 CFR part 800.4 – 6.

IV. MONITORING OF ECOLOGICAL RESTORATION PLAN ACTIVITIES

The Monument will monitor the effectiveness of this PA to ensure that the level of tribal consultation and inventory and monitoring of archeological resources are sufficient for protection of cultural resources as required under 36 CFR Part 800. The SHPO may also monitor activities pursuant to this agreement.

V. DISPUTE RESOLUTION

Should any party to this agreement object within (30) days, or within other time frames provided in this agreement after the receipt of any treatment plans, specifications, or other documents provided for review pursuant to this agreement, or to the manner in which this agreement is being implemented, Bandelier National Monument shall consult with the objecting party to resolve the objection. If the Monument determines that the objection cannot be resolved, Bandelier shall forward all documentation relevant to the dispute to the Council. Within thirty (30) days after receipt of all pertinent documentation, the Council will either:

a. Provide Bandelier with recommendations, which the Monument will take into account in reaching a final decision regarding the dispute, or;
b. Notify Bandelier that it will comment pursuant to 36 CFR Part 800.6(b) and proceed to comment. Any Council comment provided in response to such a request will be taken into account by Bandelier in accordance with 36 CFR Part 800.6(c) (2) with reference to the subject of the dispute.

Any recommendation or comment provided by the Council will be understood to pertain only to the subject of the dispute; Bandelier's responsibility to carry out all actions under this agreement that are not the subject of the dispute will remain unchanged.

At any time during implementation of the measures stipulated in this agreement, should an objection be raised by a member of the public, Bandelier shall take into account and consult as needed with the objecting party, the SHPO and the Council to resolve the objection.

VI. ANNUAL REPORT AND REVIEW

A. On or before December 30 of each year, Bandelier National Monument shall prepare and provide the SHPO an annual report addressing, but not limited to, the following topics in relation to the implementation of the Ecological Restoration Plan and EIS:

1. Description of work completed under this agreement including the number of acres treated to date.
2. Number of sites listed or determined eligible for listing on the National Register of Historic Places located within the acres treated to date.
3. Copies of correspondence initiating consultation with Native American tribes or other interested parties.
4. Actions taken to implement the terms of this agreement.
5. Recommendations for implementation during the coming year, including any suggestions to amend the agreement.

B. The SHPO will review the annual report and provide comments to Bandelier National Monument. At the request of any party to this agreement, a meeting or meetings will be held to facilitate review and comment, to resolve questions, or to resolve comments that are adverse.

VII. AMENDMENT OF AGREEMENT

Any party to this agreement may request that it be amended, whereupon the parties will consult in accordance with 36 CFR Part 800.13 to consider such amendment.

VIII. TERMINATION OF AGREEMENT

Any party to this agreement may terminate it by providing thirty (30) calendar days notice to other parties, provided that the parties will consult during the period prior to termination and seek agreements on amendments or other actions that would avoid termination. In the event of termination, Bandelier National Monument will comply with 36 CFR Part 800.4 through 800.6 with regard to individual undertakings covered by this agreement.

IX. TERMS OF AGREEMENT

This agreement shall become effective after the date of the last signatory. The agreement shall be null and void if its terms are not carried out within ten (10) years from the date of its approval by the Monument and SHPO unless the signatories agree in writing to an extension. Otherwise, this agreement shall become null and void on the sunset date of the Ecological Restoration Plan and EIS. The agreement and any amendments shall be binding upon the parties, their successors, or assigns.

Execution and implementation of this agreement evidences that the National Park Service has satisfied its § 106 responsibilities for all work related to the Ecological Restoration Plan and EIS, Bandelier National Monument. This PA encompasses the entire agreement among the parties and should be signed by all parties.

AUTHORIZING SIGNATURES

Bandelier National Monument

By: ______________________________ Date: ________________

Darlene M. Koontz
Superintendent, Bandelier National Monument

New Mexico State Historic Preservation Office

By: ______________________________ Date: ________________

Katherine Slick
New Mexico State Historic Preservation Officer

APPENDIX D- ESA CONSULTATION

(SECTION 7)

Consultation with the USFWS regarding Section 7 of the Endangered Species Act is on- going. Results of consultation will be provided in the Final EIS.

APPENDIX E

COMPARISON OF PROJECT COSTS IN ALTERNATIVE B (5-YEAR PROJECT) AND ALTERNATIVE C (20-YEAR PROJECT)

This appendix describes the assumptions to derive project costs for Alternative B and Alternative C, and compares the present value project costs under two different discount rate assumptions.

Both alternatives would implement vegetation management activities over 4,051 acres. Alternative B would carry these activities over 5 years. Alternative C would stretch these activities out over a 20 year time period. Given the nature of the project tasks and the resources utilized, Alternative B exhibits economies of scale that reduce the unit and total nominal costs of the project cost relative to Alternative C.

Alternative B assumes a work force consisting of three seasonal bio- tech group leaders, three seasonal archeologists, and 15 seasonal forestry technicians. These teams would be supported in the backcountry by a backcountry horse packer and a cook. The crews would also rely on supplies provided by GSA truck and a helicopter. The Alternative B workforce would complete vegetation activities over about 800 acres per year.

Alternative C represents a scaled down workforce that would complete vegetation activities on approximately 200 acres per year. The primary work team of 6 workers would consist of a bio- tech group leader, an archeologist, and four forestry techs. For each season, the work team would need at least one bio- tech and one archeologist. For approximately one- half the operational period (12 years), the team would be supported in the backcountry by the backcountry horse packer, a cook, the GSA truck, and a helicopter. The helicopter use would be scaled back to 2/3 the hours used in Alternative B given the smaller work force. Other assumptions about equipment repair, tools and other supplies are scaled down to about 1/3 the amount specified in Alternative B but are not eliminated because many of the tools and supplies needed in this alternative serve a group (for example, a GSA vehicle) and do not scale down proportionately to the number of individuals in a group and are not eliminated in later years. Alternative C incurs diseconomies of scale since the number of inputs cannot be scaled proportionately to the output of the project, in this case, acres of vegetation thinning activities completed. The larger work teams in Alternative B gain economies of scale because work teams always require a bio- tech and archeologist, and they more efficiently use supplies, equipment, and support crew services.

Itemized costs were developed for Alternative B for each job category, supplies, and equipment for years 1 through 5 with costs rising 4 percent in year 2 and year 3 and then 3.6 percent in year 4 and year 5. For Alternative C, the same unit costs were applied for years 1- 5 and then costs were assumed to rise 3.6 percent annually during years 6- 20.

Total project costs of Alternative B and Alternative C were derived in nominal terms and present value terms. Project costs were discounted assuming a discount rate of 3% and 7%.[2] Generally, a higher discount rate imposes a greater reduction on future expenditures relative to a lower discount rate. As applied to this analysis, the higher discount rate reduces the present value costs of Alternative C greater than Alternative B because Alternative C costs are set further in the future.

As shown in the table below, Alternative B project costs are less than Alternative C in all three assumptions of the discount rate. The Alternative B gains from economies of scale are large enough to yield lower project costs with a discount rate of 0%, 3% and 7%.

	Nominal Dollars, 0% Discount Rate	Real Dollars, 3% Discount Rate	Real Dollars, 7% Discount Rate
Alternative B (5 year project)	1,975,343	1,813,743	1,628,887
Alternative C (20 year project)	3,519,164	2,619,954	1,862,464

[1] The discount rates of 7% and 3% was recommended by Circular A- 4 of the Office of Management and Budget, September 17, 2003

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