

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, advice 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.

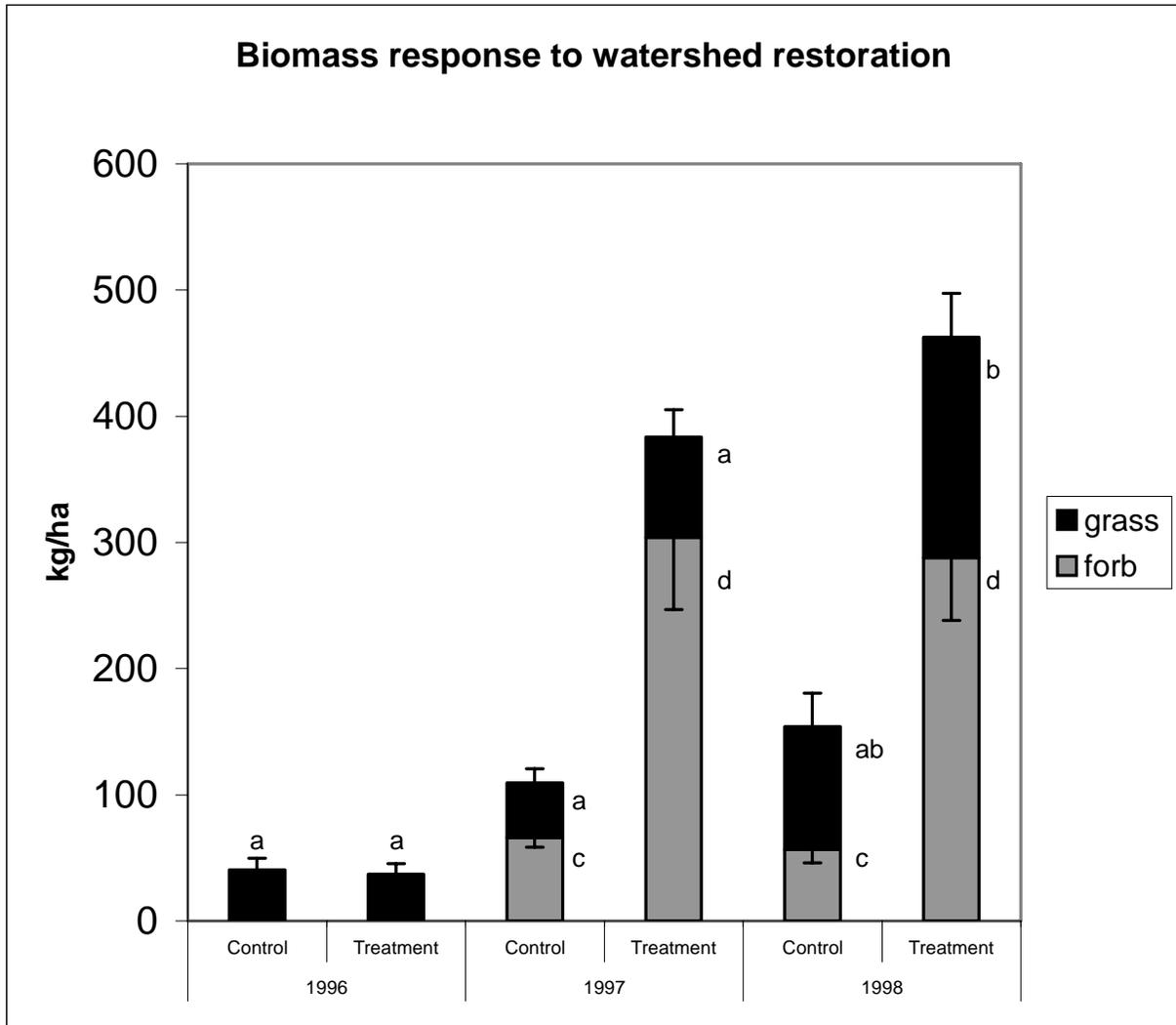


Figure. 23. Cumulative Mean Biomass (kg/ha) Across the Control and Treatment Watersheds (n=20) from 1996 (pre-treatment) to 1998 (two years of treatment) (Jacobs, et al. 2002b).

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 $1/10^{\text{th}}$ 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.

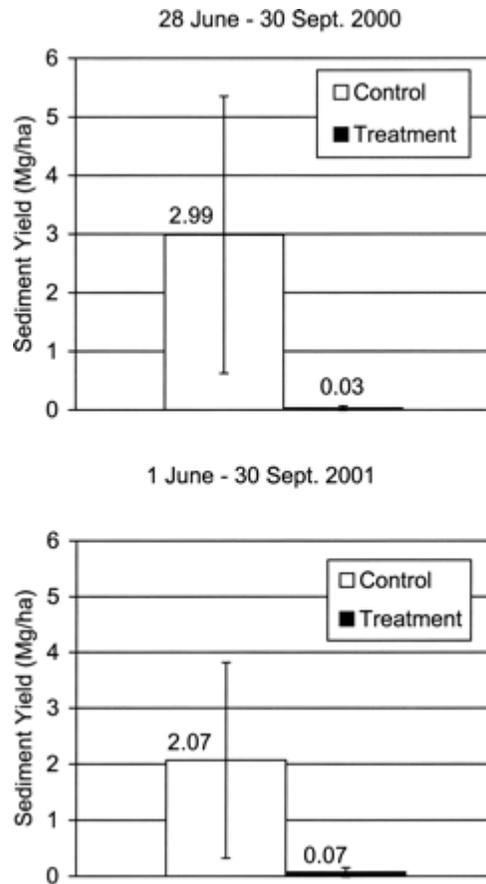


Figure 24. Seasonal Sediment Yields (Mg/ha) for Treatment (n = 6) and Control (n = 3) Microwatersheds, 2000 and 2001.

(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%

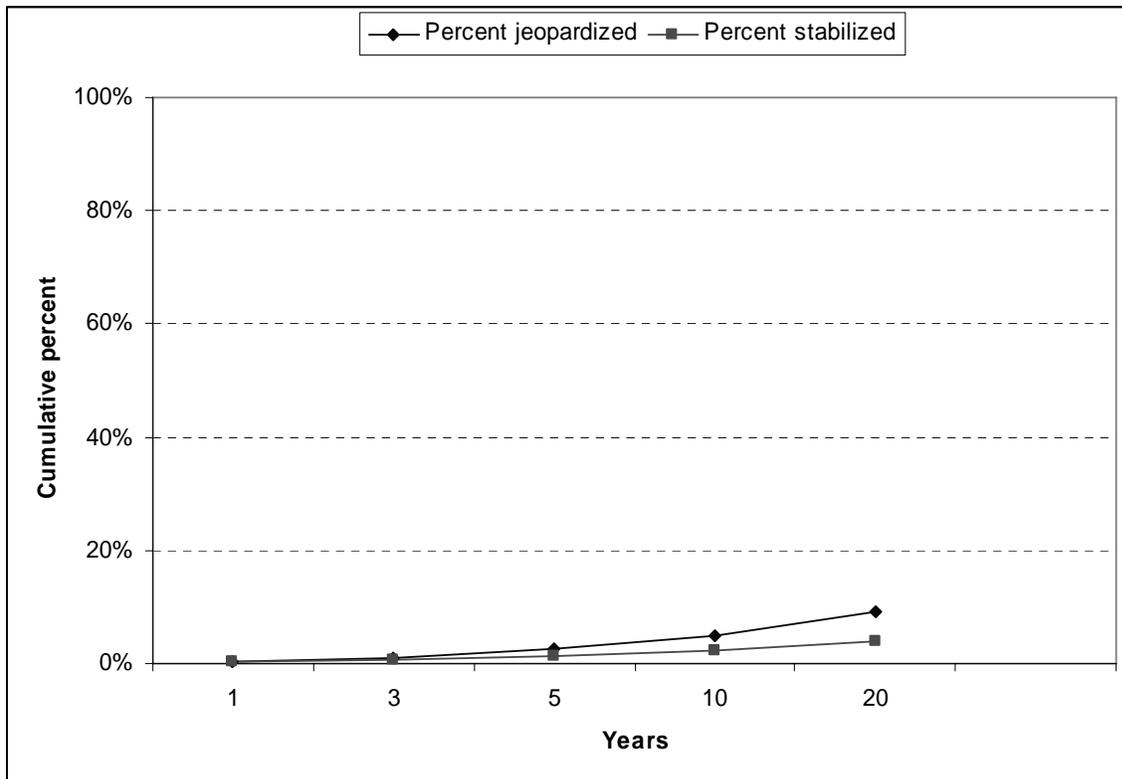


Figure 25: Percent of Sites Likely to be Jeopardized Versus the Percent of Sites Likely to be Stabilized at One, Three, Five, Ten, and 20 Years Into the Life of the Plan Under No Action. (Note: the interval between the data points is not equal.)

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.

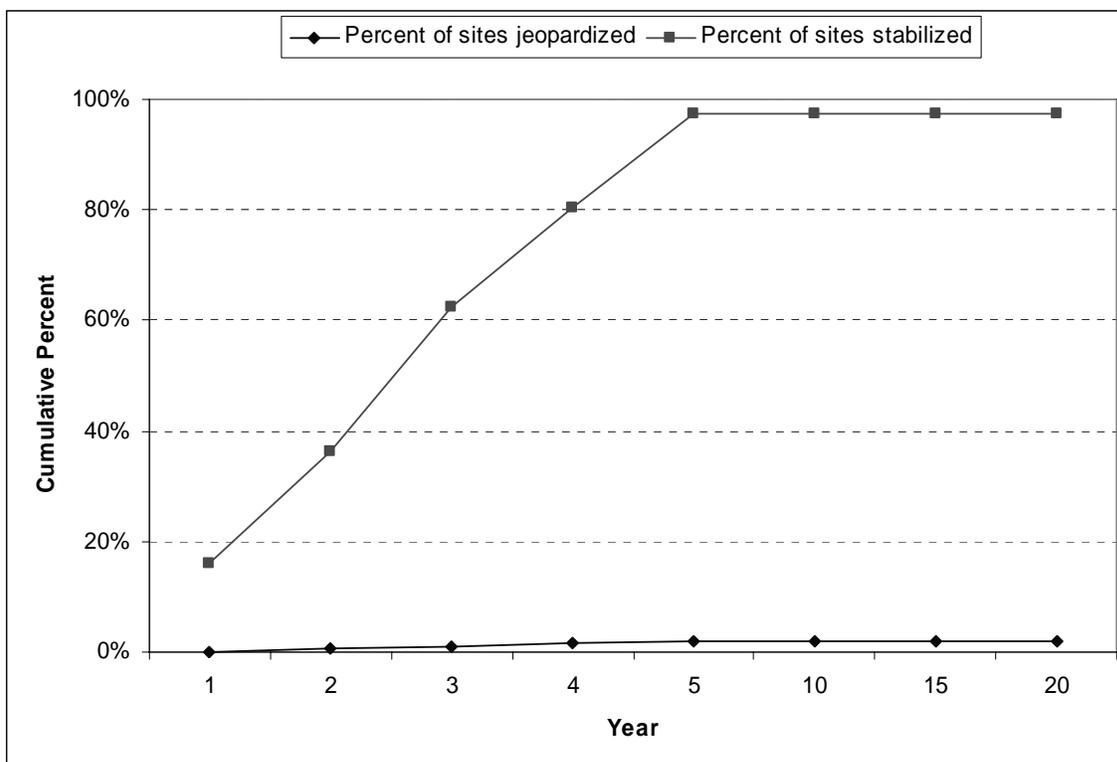


Figure 26. Percent of Sites Likely to be Jeopardized Versus the Percent of Sites Likely to be Stabilized at the End of Each Treatment Year, and Projected Out to the Life of the Plan Under Alternative B. (Note: the interval between the first five data points is 1, while the interval between the last three 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.

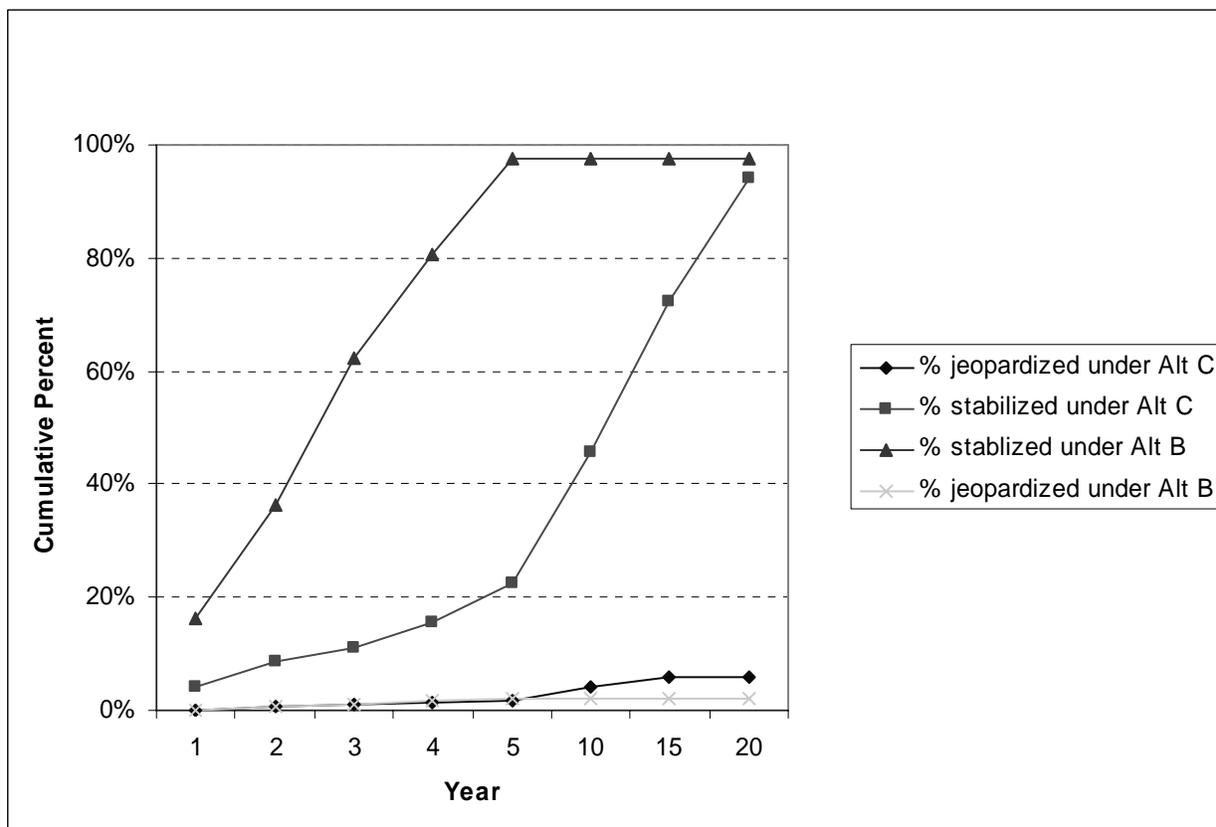


Figure 27. Comparison of the Percentage of Sites Likely to be Jeopardized Versus the Percentage of Sites Likely to be Stabilized at the End of Each Treatment Year, and Projected Out to the Life of the Plan, Under Both Action Alternatives. (Note: the interval between the first five data points is one, 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 that 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 be 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 that 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

Backcountry

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 untrammelled 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 untrammelled 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 untrammelled 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 untrammelled 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 untrammelled 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 untrammelled 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*, “untrammelled” 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 “trammelled.” 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 untrammelled 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 “untrammelled” 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 trammled 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, "untrammled" 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 “trammled” 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 “untrammled” 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 overall 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 treated 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 overall 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 NO_x, and about half a ton of PM₁₀/PM_{2.5}.

Table 27. Alternative B Emissions (tons/year).

Emission Source	Hydrocarbon (HC)	CO	NOx	PM₁₀/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	PM₁₀/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 PM₁₀/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.

Administration: 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.

Interpretation and Visitor Services: 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.

Facility Management: 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.

Resource Management: 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.

