National Park Service
U.S. Department of the Interior

Intermountain Region
Flagstaff, Arizona

INVASIVE PLANT MANAGEMENT PLAN
AND
ENVIRONMENTAL ASSESSMENT

FLAGSTAFF AREA NATIONAL MONUMENTS

Wupatki National Monument
Walnut Canyon National Monument
Sunset Crater Volcano National Monument

JULY 2009

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Invasive Plant Management Plan

Environmental Assessment

Summary

Non-native, invasive plants have infested our national parks causing tremendous damage to our resources. They threaten the structure, organization, function, and overall integrity of the historic cultural resources and natural ecosystems that the National Park (NPS) service is mandated to protect. Controlling invasive species is a serious challenge facing the the Flagstaff Area National Monuments of the National Park Service, which includes: Walnut Canyon National Monument, Sunset Crater Volcano National Monument, and Wupatki National Monument. These three monuments contain approximately 43 species of exotic/invasive plants. Of these, approximately 21 species are of particular concern because of their aggressive nature and ability to displace intact, native vegetation communities. This Invasive Plan Management Plan and Environmental Assessment (IPMP/EA) outlines alternative invasive plant management strategies that are based on the principles of Integrated Pest Management (IPM) and that use control treatments including some, a combination of, or all of the following: manual/mechanical treatments, chemical treatments, cultural treatments, and biological treatments. Integrated Pest Management is a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to address pests, such as exotic plants, cost effectively and with the least possible risk to people, resources, and the environment.

This Environmental Assessment evaluates three alternatives; a No Action Alternative (I), and two additional action alternatives. The No Action alternative describes the current strategy of using limited mechanical and chemical treatments. The second alternative (II), is the preferred alternative. Actions under the preferred alternative include the use of Integrated Pest Management; whivh includes increased education, prevention, and collaboration; and increased manual, mechanical, cultural, and chemical controls. This alternative provides a framework for exotic plant management and serves as a planning document that will guide this type of work in the FLAG monuments for the next ten years. The third alternative (III) would not use either chemical or biological treatments.

This Environmental Assessment has been prepared in compliance with the National Environmental Policy Act (NEPA) to provide the decision-making framework that:

1) analyzes a reasonable range of alternatives to meet objectives of the proposed plan;
2) evaluates potential issues and impacts to the resources and values of Walnut Canyon National Monument, Sunset Crater National Monument, and Wupatki National Monument; and
3) identifies specific and required mitigation measures that are designed to lessen the degree or extent of these impacts.

Resource topics included in this document because the resultant impacts may be greater than minor include: Geologic and Soil Resources, Vegetation, Wildlife, Special Status Species, Water Resources, Wetlands/ Floodplains and Riparian Areas, Archeological and Historic Resources, Cultural Landscapes, Ethnographic Resources, Visitor Use Experience, Adjacent Land Use, and Public Health. Other resource topics were examined and dismissed because it was determined that this plan would result in only negligible or minor effects to those resources. No major effects are anticipated as a result of this program. Public scoping was conducted to assist with the development of this document and comments were received.

Public Comment

The FLAG IPMP/EA is accessible to the public via the internet at http://parkplanning.nps.gov/parkHome.cfm?parkId=53. If you wish to comment on this environmental assessment, you may mail comments to the name and address below. This environmental assessment will be on public review for 30 days; comments are due by , 2009. Please note that names and addresses of people who comment become part of the public record. **If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comments.** We will make all submissions from organizations, businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses available for public inspection in their entirety.

Please address comments to:

Superintendent, Attn: Exotic Plant Management Plan, Flagstaff Area National Monuments, 6400 N. Highway 89, Flagstaff, Arizona 86004, Email: FLAG_Planner@nps.gov

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1.0 PURPOSE AND NEED

1.1 Introduction

The National Parks are home to a complex mix of native communities of plants and animals that have developed over millions of years. This natural heritage is threatened by the invasion of exotic plants and animals as well as by human-caused disturbances that foster the establishment of exotic species. The introduction of harmful exotic species is an emerging global problem. A recent Cornell University study estimated that invasive plants and animals cost the US Economy $137 billion annually. The Ecological Society of America noted that invasive species contribute to the loss or habitat for and listing of 35 to 46 percent of all threatened and endangered species. Today, exotic plants infest some 2.6 million acres in the national parks. Control of exotic species is one of the most significant land management issues facing national parks (NPS 2009).

Invasive plants impact National Park Service (NPS) lands throughout the country, causing infestations that compete with native plants for space, light, water, and nutrients. They impact the ecological structure and function of many plant communities, often with such negative impacts that they destroy or reduce native habitat quality by altering forage plants, soils, hydrology, and fire cycles. As NPS land managers we are tasked with the mission to *preserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations* (NPS Organic Act 1916). Thus, we have developed strategies to address and treat these invasive plants so that proper functioning native ecosystems can be restored and maintained.

The Flagstaff Area National Monuments (FLAG) is comprised of three national monuments located in northern Arizona near the city of Flagstaff (see **Figure 1**). These include:

1) Walnut Canyon National Monument (WACA);
2) Sunset Crater Volcano National Monument (SUCR); and
3) Wupatki National Monument (WUPA).

The three units are generally characterized as being dominated by coniferous woodlands and forests, including semi-desert grasslands. The Flagstaff area monuments contain a wide diversity of vegetation habitats due to their differing elevations and soil types. They include prime native examples of ponderosa pine forest, pinyon-juniper woodland , native semi-desert grasslands and shrublands, important desert seeps and springs including riparian habitat along the Little Colorado River and in Walnut Canyon. These habitats support abundant wildlife; including a diversity of birds, reptiles, and and large mammals, including pronghorn antelope. These habitats also support threatened, endangered, and special status species. At the same time, the monuments have significant infestations of invasive plants that are impacting the rare and diverse natural resources contained within the monument boundaries. The goals of this document are to develop a comprehensive Flagstaff Area Monuments Invasive Plant Management Plan and Environmental Assessment (FLAG IPMP/EA) that will return many areas to their native habitat, to protect cultural resources from damage caused by exotic vegetation, and

to analyze the environmental consequences of the proposed and available treatment alternatives, thus arriving at the best means of addressing this increasing problem.

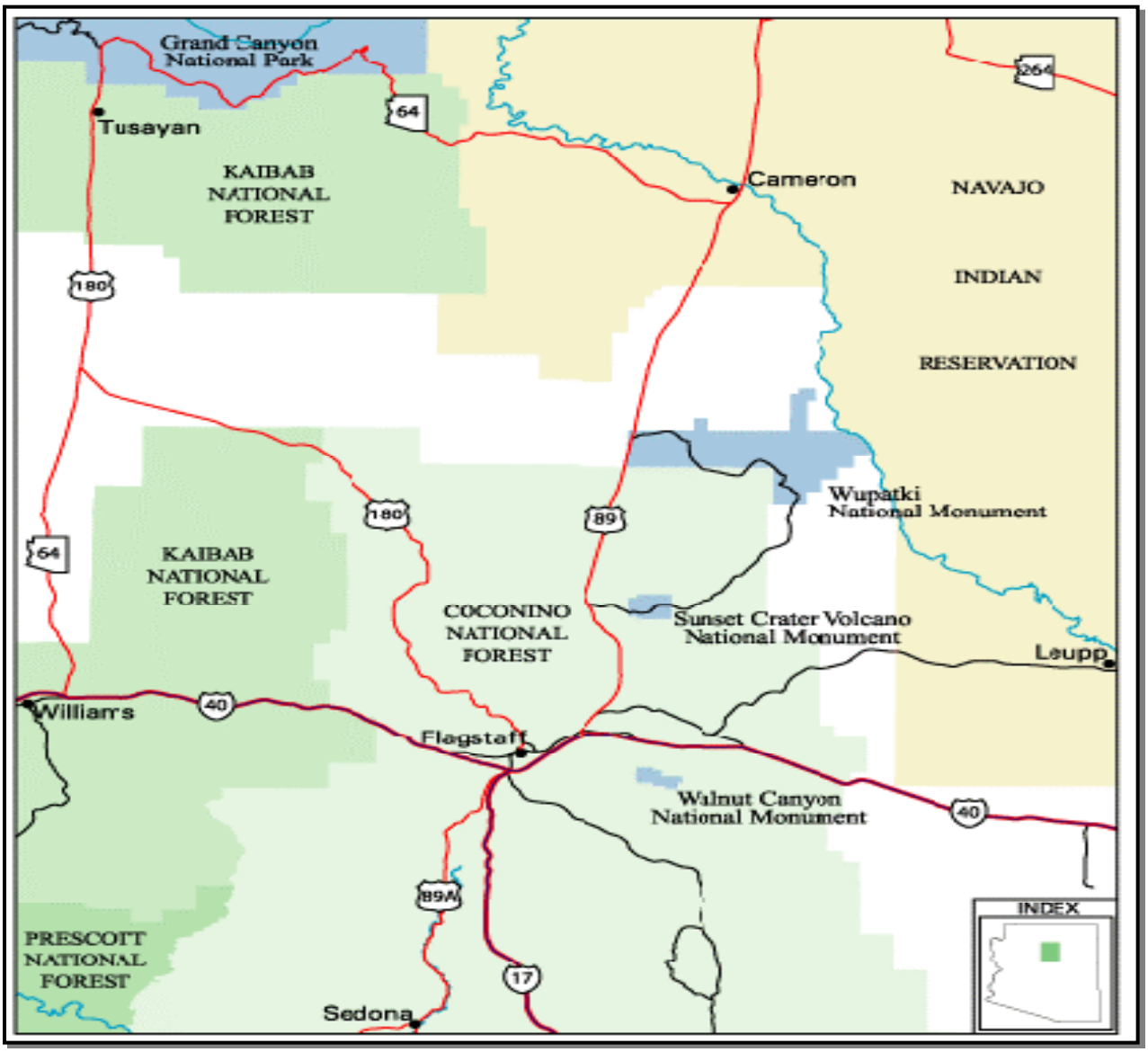

Figure 1. Location of the three National Park Service units of the Flagstaff Area National Monuments in northern Arizona. Grand Canyon NP at top of Map is not included in the Flagstaff Area Monuments.

1.2 Walnut Canyon National Monument

Walnut Canyon National Monument (WACA) was established by President Woodrow Wilson on November 30, 1915, to preserve ancient cliff dwellings. Initially managed by the US Forest Service, the monument was transferred to the National Park Service in 1934. Today a variety of archeological and natural resources are preserved on approximately 3600 acres. See Figure 2 for a detailed map of Walnut Canyon National Monument.

Ruin in Walnut Canyon *Photo by CSchelz*

Walnut Canyon has a long human history. Artifacts show that Archaic peoples, who traveled throughout the Southwest thousands of years ago, occupied the canyon at times. Later the first permanent inhabitants arrived, who flourished in the region from about A.D. 600 to A.D. 1400. Archeologists labeled this prehistoric culture Sinagua, from the old Spanish name for the region, *Sierra de Sin Agua*, or "mountains without water."

Scattered families farmed the canyon rims for centuries, growing small gardens of corn, squash, and beans. During the 1100s, many moved into limestone alcoves below the canyon rim, where they constructed the cliff dwellings we see today. The Walnut Canyon community thrived for another 150 years before the people moved on.

Others have visited the canyon since the Sinaguans departed. With the construction of the railroad nearby in the 1880s, Walnut Canyon became a popular destination; scores of "pot-hunters" streamed into the canyon. Armed with shovels and dynamite, these souvenir-seekers upturned ancient floors, toppled enduring walls, and desecrated graves. These activities alarmed local citizens who supported the establishment of Walnut Canyon National Monument.

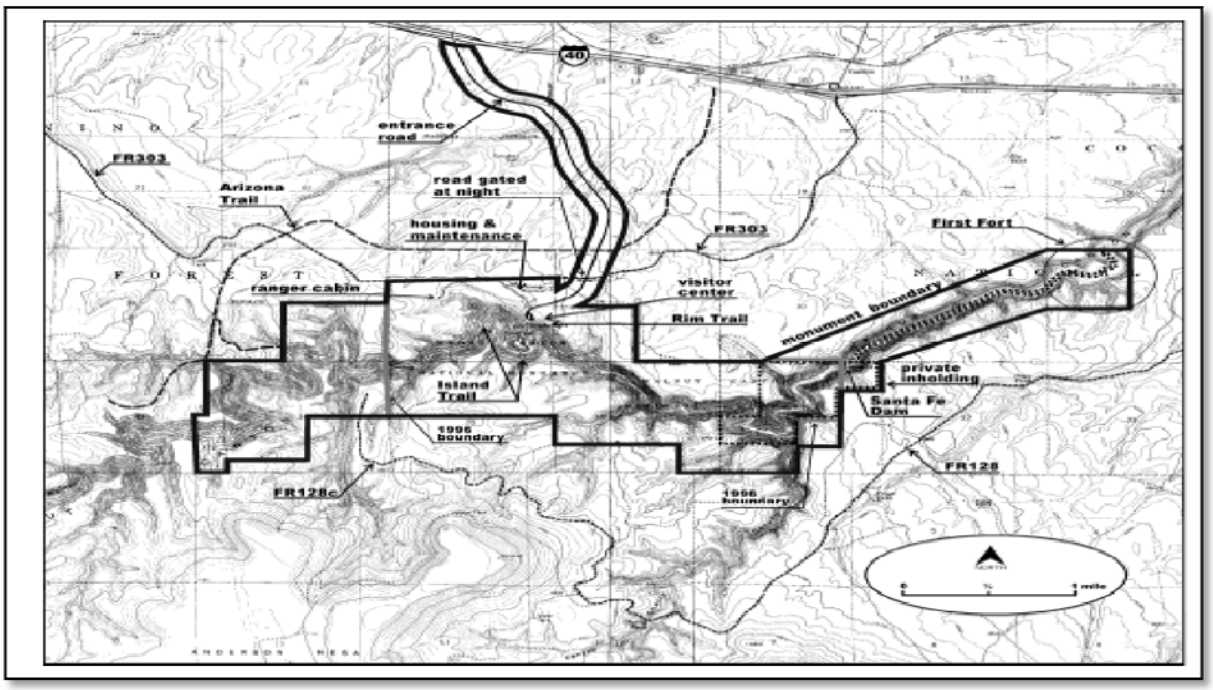

Figure 2. Map of Walnut Canyon National Monument

Climate at Walnut Canyon National Monument

WACA has a semi-arid, continental climate typified by a moderately hot and moist summer, cool and dry spring and fall, and cold, periodically wet, winter. Monsoon-like precipitation events, often in the form of violent thunderstorms, occur principally from July through September. On average from 1971-2000, 5.9 in (15 cm) of rain fell from July-September out of the total 15.8 in (40 cm) of total precipitation (NOAA 2004). Average summer maximum temperatures range from 45 to 91 degrees F (7 to 33 degrees C), while average winter minimum temperatures range from 21 to 57 degrees F (-6 to 14 degrees C) (NOAA 2004). Winter snowfall average ranges from 2.5 to 4 in (6.4 to 10 cm) a month (NOAA 2004). Strong to moderate winds are commonplace within the region.

1.3 Sunset Crater Volcano National Monument

Sunset Crater National Monument (SUCR) was established by President Herbert Hoover on May 26, 1930, to protect its geologic formations. In 1990, the name was changed to Sunset Crater Volcano National Monument. It occupies 3,040 acres surrounded by Coconino National Forest. See **Figure 3** for a detailed map of SUCR.

Sunset Crater Volcano was created in a series of eruptions sometime between 1040 and 1100. Powerful explosions profoundly affected the lives of local people and forever changed the landscape and ecology of the area. No evidence has been found that people died as a direct result of the eruption. However, pithouses for miles around were burned and filled with cinders, and others undoubtedly remain buried beneath layers of lava. These lava flows and cinders still exist in relatively pristine form today.

Sunset Crater Volcano NM *Photo by CSchelz*

In the aftermath, the Sunset Crater area was no longer farmable. People relocated, some to nearby Walnut Canyon and others to Wupatki, where they found that thinner layers of ash and cinders actually benefited crops by holding moisture in the soil. Agriculture and trade flourished for about 100 years before people once again moved on. Their descendants still live nearby and memories of the eruption live on in their stories and traditions. Nineteenth-century explorers John Wesley Powell marveled at the well-preserved pueblos and the stark but strangely beautiful volcanic landscape, and legend has it that Powell named Sunset Crater for the red and yellow colors of its rim.

Ranching, logging, mining, and the railroad arrived in the 1800s, and tourism followed. In 1928 a movie company wishing to film a landslide proposed blowing up Sunset Crater. The public, fearing irreversible damage to the volcano, pushed for its protection. In 1930, President Hoover established Sunset Crater National Monument ("Volcano" was later inserted into the name), and the National Park Service took on the responsibility for preservation of volcanic and human history. The Civilian Conservation Corps (CCC) assisted in construction of roads and visitor facilities during the 1930s." (NPS 2008)

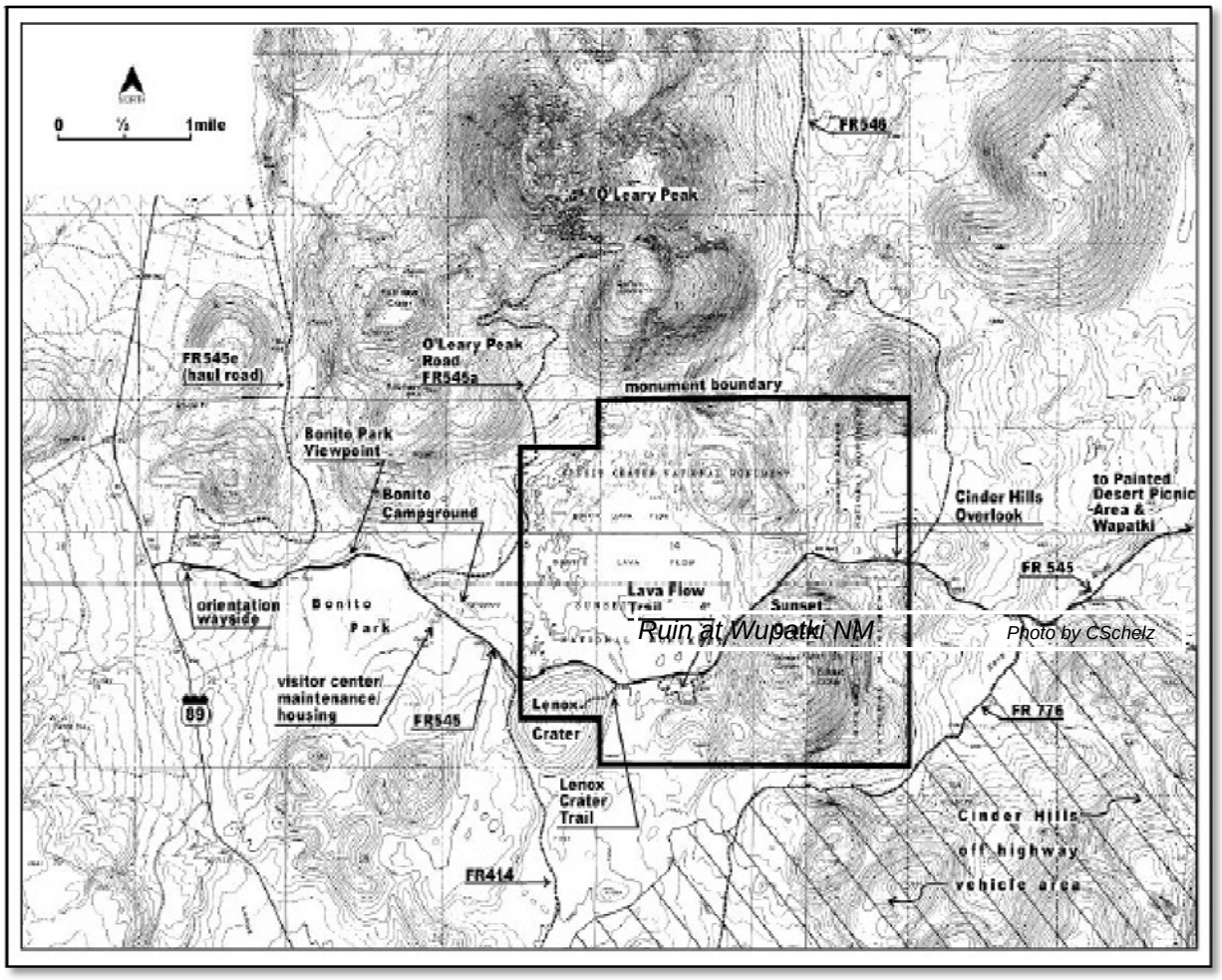

Figure 3. Map of Sunset Crater Volcano National Monument

Climate at Sunset Crater National Monument

SUCR has a semi-arid, continental climate that includes moderately hot, moist summers and cold, dry winters (Appendix B). Precipitation events, often in the form of violent thunderstorms, occur from July through September. For example, during 1997, NOAA records show that 45% of the annual 20 inches of precipitation fell during this three-month period (NOAA 2004). Summer maximum temperatures range between 80-95 degrees F., while winter minimum temperatures may reach down to -25 degrees F. The prevailing winds are southwesterly.

1.4 Wupatki National Monument

Wupatki National Monument (WUPA) was established by President Calvin Coolidge on December 9, 1924, to preserve Citadel and Wupatki pueblos. Monument boundaries have been adjusted several times since then, and now include additional pueblos and other archeological resources on a total of 35,422 acres.

Wupatki National Monument covers approximately 35,400 acres (14,325 hectares) of Colorado Plateau semiarid grassland and shrub land environment located approximately 35 miles (56.33

kilometers) northeast of Flagstaff, Arizona. Wupatki's elevation ranges from 4,200 ft. to 5,600 ft. (1,281 m to 1,707 m) and contains a diverse array of topographical features, geological characteristics, and hydrological regimes creating a wide range of habitats sustaining many distinct vegetation communities. See **Figure 4** for a detailed map of WUPA.

Wupatki's geology and soils provide diverse substrates for a wide array of plant communities, including arid grassland, one-seed juniper woodland, mixed grassland-shrubland, sparsely vegetated badlands, volcanic cinder dune, ephemeral drainage, and riparian vegetation (Bateman 1976, Hansen et al. 2004b). While the varied habi-tats harbor a diverse native flora, many areas are sparsely vegetated and/or dominated by natural aeolian and fluvial depositional processes or frequent fire regimes, which perturb soil and vegetation, and may favor the establishment of invasive plants over native early succession plants. The prevailing southwesterly winds of the area are also of consequence because of their intensity, especially in spring, and their ability to spread seeds over wide expanses in this open desert ecosystem.

Ruin at Wupatki NM *Photo by CSchelz*

At least 29 invasive plant species are known to occur in WUPA (Batemen et al. 1976, Kearny 1960, Epple 1995, Howery 2001, Whitson et al. 2001, SWEPIC 2008). The General Management Plan for Wupatki National Monument (National Park Service 2002) identifies a set of mission goals for the monument, including maintaining the biotic integrity of natural systems. The exclusion of invasive exotic plant species is one of the listed actions for achieving this goal. (Behl et al. 2008)

Less than 800 years ago, Wupatki Pueblo was the largest pueblo around. It was the tallest, largest, and perhaps the richest and most influential pueblo around, and was home to 85-100 people, and several thousand more lived within a day's walk. Human history at Wupatki spans at least 4,000 years, but only in the 1100s, was the landscape densely populated. This may have been prompted by the eruption of nearby Sunset Crater Volcano a century earlier, and people may have discovered that the cinders blanketing lands to the north could hold moisture needed for crops.

As the new agricultural community spread, small scattered homes were replaced by a few large pueblos, each surrounded by many smaller pueblos and pithouses. Wupatki, Wukoki, Lomaki, and other masonry pueblos emerged from bedrock. Trade networks expanded, bringing exotic items like turquoise, hematite, salt, shell jewelry, copper bells, and parrots. Wupatki flourished as a meeting place of different cultures. By about 1250, the people moved on.

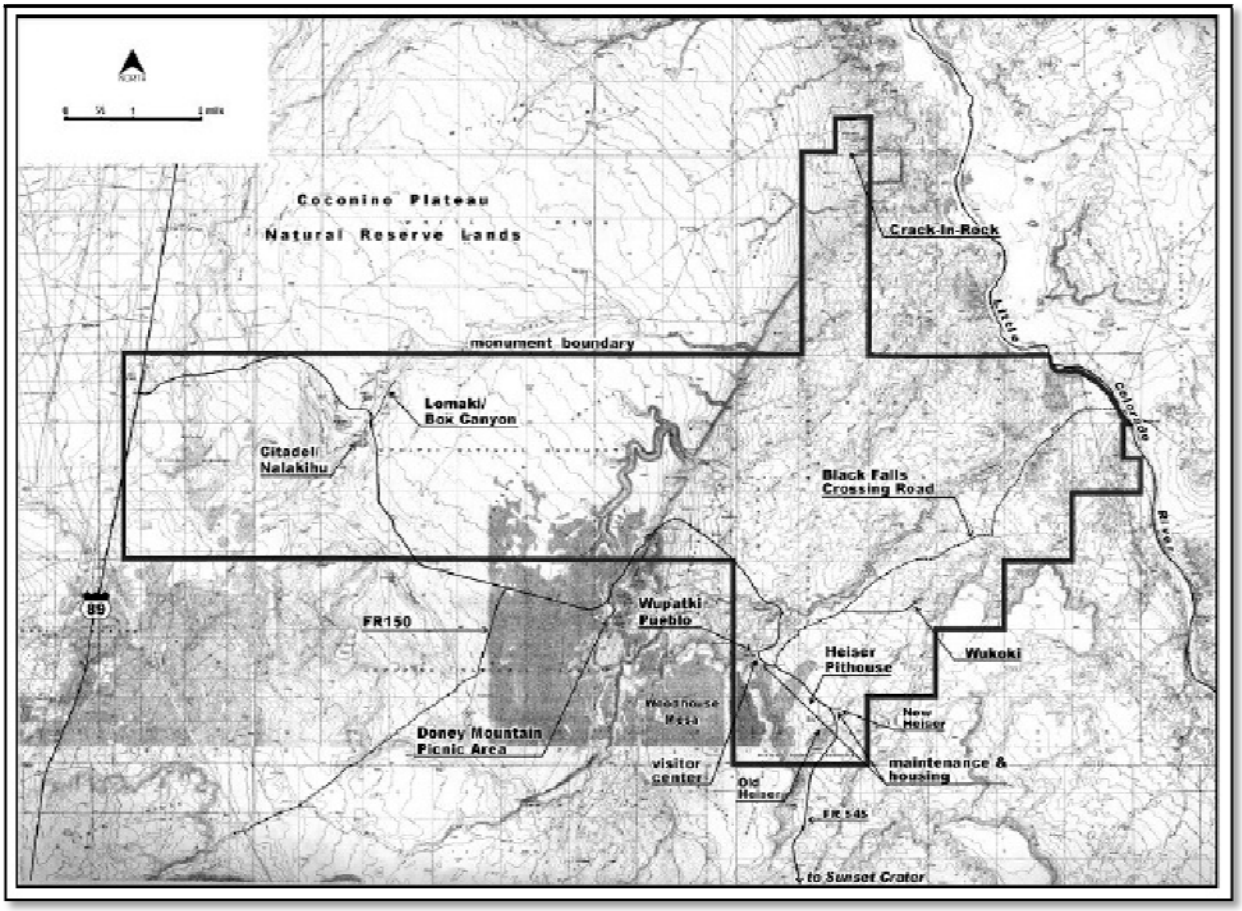

Figure 4. Map of Wupatki National Monument

Climate at Wupatki National Monument
WUPA is typified by a semi-arid climate that includes hot, moist summers and cool, dry winters. Precipitation events, often in the form of violent thunderstorms, occur from July through September and provide most of the annual moisture. Summer maximum temperatures are often 100 degrees F, while winter minimum temperatures rarely go below freezing (NOAA 2004).

1.5 Purpose of the Environmental Assessment

The purpose of this FLAG Invasive Plant Management Plan (FLAG IPMP) is to use an integrated approach to eradicate, contain, control, and prevent targeted weeds within the park units. The desired goal is to contain or control the spread of invasive species, and eradicate species that are the most invasive and pose the greatest threat to the biological diversity within FLAG monument units, and prevent any new invasive plants from becoming established. The planned proactive management of these plants will promote ecosystem health of the diverse native communities in the monuments by maintaining and improving native forbs, shrubs, and grass species, increasing the regeneration of native cottonwoods and willows in riparian corridors, and ultimately preventing the loss of wildlife habitat and species diversity.

This Environmental Assessment (EA) will examine the environmental impacts associated with the proposal to treat invasive plant species and restore native plant communities at FLAG.

Treatments may include: manual/mechanical, chemical, cultural, and biological treatments. This Environmental Assessment has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, regulations of the Council on Environmental Quality (CEQ) (40 CFR 1508.9), and the National Park Service (NPS) Director's Order (DO)-12 (*Conservation Planning, Environmental Impact Analysis, and Decision-making*).

Under DO-12, "purpose" is defined as a statement of goals and objectives that the NPS intends to fulfill by taking action. Under this definition, the purposes of this FLAG IPMP/EA are to:

- Restore native plant communities for future preservation and to reduce the need for ongoing exotic/invasive plant management.
- Prevent unacceptable levels of exotic plant damage, using environmentally sound, cost effective management strategies that pose the least possible risk to people, park resources, and the environment.
- Develop an IPMP/EA that provides the necessary environmental compliance for exotic/ invasive plant management treatments at the FLAG monuments.
- Standardize exotic plant management at FLAG monuments so their actions can be more effectively implemented and explained to the public.
- Inform resource managers about various treatment options and mitigation measures so they have a number of "tools in their toolbox" for the safe and effective treatment of invasive plants.
- Decrease exotic plant cover and increase native plant cover.

1.6 Background

During the initial planning phase of this project, we reviewed the various approaches that the FLAG monuments were taking toward obtaining compliance with National Environmental Policy Act (NEPA) for exotic plant management. Also reviewed were the Environmental Screening Forms completed for this project. In a few instances the FLAG monuments were using Categorical Exclusions (CE) to cover current and past exotic/invasive plant management activities. However, in some instances, the proposed treatment methods could not be covered under a CE because of potential impacts, issues, or concerns, and could not be undertaken.

Because some activities could not be covered under a CE, and because all the monuments had the same need to conduct additional environmental analysis the NPS has identified a need to prepare one multi-monument EA. This EA could effectively evaluate the potential effects of various exotic/invasive plant treatments at all the units of the FLAG are monuments. The EA process would also provide members of the public with the opportunity to participate in the planning and environmental analysis process.

This FLAG IPMP/EA includes an analysis of potential impacts of each proposed treatment on various resource categories. The broad nature of this IPMP/EA will allow the FLAG monuments to implement individual actions at each unit included in this IPMP/EA document. For future exotic/invasive plant management actions, the FLAG monuments would use the decision tree "Confirm Compliance of Treatment Method with an Existing NEPA document" in **Appendix A** to determine the NEPA compliance needed. For actions that are consistent with those evaluated in this IPMP/EA, the NEPA process would often end with a memo to file.

The three units of FLAG have been partially inventoried for invasive plant species in recent years. Complete inventories are needed in order to accomplish two overall program goals:

1) Identify which exotic/invasive species are not yet present on the monument and will therefore be monitored for appearances on the monument (early detection monitoring); and
2) Map the spatial location, distribution, and abundance of exotic/invasive plants that already occur at the monument to serve as the basis for future trend assessment.

The FLAG invasive plant surveys searched for and mapped any exotic/invasive plant species. These surveys identified a total of approximately43 target species.

This document is intended to assess the effects of implementing an Integrated Pest Management (IPM) system to reduce/eliminate exotic/invasive plant species within the FLAG monuments. Ecological restoration methodologies will be implemented on all treatment areas to discourage re-invasion and encourage the establishment of native plant communities. Active restoration plans for each project are a necessity due to the high susceptibility of these habitats to re-invasion after disturbance.

1.7 Purpose and Need

The purpose of this planning effort is to develop integrated invasive plant management plan for all FLAG monuments that is in compliance with NPS's *Management Policies* (2006), Director's Order 12 – *Environmental Impact Analysis*, and Director's Order 77-7 - *Integrated Pest Management* which requires that the NPS and each park unit use Integrated Pest Management to address invasive plant and other pest issues.

The proposed plan is needed to achieve the following:

- Preserve, protect, and restore natural conditions and ecological processes by eradicating, significantly reducing, or containing infestations of known exotic/invasive plants;
- Prevent further introductions of invasive species already present, as well as new species introductions by increasing visitor and staff awareness through education;
- Establish decision-making tools (see **Appendix A**) and protocols that will guide treatment plan development for routine and project-based invasive plant management activities.

1.8 Scope of Plan

The scope of this FLAG Invasive Plant Management Plan/EA is to develop a long-term management plan that would reduce the threats and impacts of exotic/invasive plants to native plant communities and other natural and cultural resources within the monuments. Although this EA considers impacts within the monuments and adjacent areas that could reasonably be impacted by invasive plant management actions, only these activities occurring within the boundaries of the Flagstaff Area National Monuments are within the scope of this document.

This plan utilizes the Principals of Integrated Pest Management and considers all treatment methods that are currently available, or that may be used in the foreseeable future. Proposed treatments include:

Prevention: Prevention is generally agreed to be the most effective and economic form of invasive plant management (Sheley et al. 1999). There are countless ways of preventing invasive plant introductions, such as minimizing unnecessary soil disturbance, containing neighboring invasive plant infestations, establishing and properly maintaining desirable vegetation, using only barren or sterile fill and gravel in park construction and maintenance activities, cleaning park vehicles and equipment after working in an infested area, and landscaping only with non-invasive native plants.

Manual/Mechanical Treatments: Physical damage to or removal of part or all or of the plant. Examples include hand pulling, cutting, grubbing, haying, and mowing.

Chemical Treatments: Applying safe, low toxic pesticides as prescribed by their labels, using a variety of application methods. Examples of application methods include portable sprayers, vehicles equipped with sprayers, and aerial application (helicopter and fixed wing).

Cultural Treatments: Practices that promote the growth of desirable plants and reduce the opportunities for exotic/invasive plants to establish and grow. Examples include applying fire to a predetermined area to reduce the growth of exotic plants. Also the use of irrigation, revegataion and seeding of native plant species and to increase the growth of desirable plants.

Biological Treatments: Biological control includes the use of "natural enemies", such as insects and microorganisms to reduce the abundance of an exotic/invasive plant. Natural enemies are usually imported from areas where the target exotic plant occurs as a native plant and are deliberately released into areas where the plant is exotic. Examples include plant-feeding insects such as Chinese leaf beetles (*Diorhabda elongate deserticola*) for tamarisk (*Tamarix* spp.), flea beetles (*Aphthona lacertosa*) for leafy spurge (*Euphorbia esula*), and leaf beetles (*Galerucella* spp.) for purple loosestrife (*Lythrum salicaria*). Approved biological agents will be host-specific and have negligible risk for becoming a pest. Individual treatments, or combinations of treatments, would be implemented as appropriate to control invasive plants in FLAG monuments. The Flagstaff Area National Monuments will cooperate with state, county, private, tribal, and federal officials, which would be necessary in parks with management partnerships.

However, not all plants defined as "exotic plants" will necessarily be managed. Under NPS policy (NPS 2001, page 37, Section 4.4.4.), an exotic plant must also meet several criteria in order for management activities to be initiated:

"All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed, up to and including eradication, if (1) control is prudent and feasible and (2) the exotic species:

- Interferes with natural processes and the perpetuation of natural features, native species or natural habitats; or
- Disrupts the genetic integrity of native species; or
- Disrupts the accurate presentation of a cultural landscape; or

- Damages cultural resources; or
- Significantly hampers the management of a park or adjacent lands; or
- Poses a public health threat as advised by the U.S. Public Health Service (which includes the Centers for Disease Control and the NPS Public Health Program); or
- Creates a hazard to public safety."

Only exotic/invasive plants that meet the above NPS definition and criteria will be managed under this FLAG IPMP/EA.

For species that meet these criteria, management priorities will be assigned to each exotic/ invasive plant. These will then be managed according to relative management priority. In accordance with NPS policy, relative management priorities will be determined as follows (NPS 2001, Section 4.4.4.2):

> Higher priority will be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controlled.
>
> Lower priority will be given to exotic species that have almost no impact on park resources or that probably cannot be successfully controlled.

This plan is intended to serve as long-term guidance for all invasive plant management activities; therefore, the approach is general enough to address management actions without becoming excessively restrictive. It provides resource managers with multiple treatment options and allows them to select the most appropriate treatment option or combination of treatments included in this FLAG IPMP/EA to minimize potential impacts and maximize overall management success. It is also flexible enough to allow for future use of treatment actions not currently available, and to address new exotic/invasive species that may colonize the park units, provided that the impacts remain similar to or less than those described in this document. However, this document is specific enough to guide site and species-specific planning considerations. Included in this plan is the requirement that individual monuments produce separate annual Work Plans in November of each year, so that specific projects can be effectively planned for the coming year.

1.9 Relationship to Other Plans and Policies

The proposal to use the full range of IPM techniques in FLAG is consistent with previous planning efforts. The management goals for the vegetation resources are to minimize impacts from construction activities and visitor traffic. The proposal is consistent with the objectives of the *2006 NPS Management Policies* (NPS 2006) section 4.4.4 on the Management of Exotic Species.

Table 1: Relationship of FLAG IPMP/EA to other Plans

Park Unit	Policy Plan	Requirements/ Goals/Objectives	Relationship
WACA	**Walnut Canyon National Monument** General Management Plan (NPS 2007)	• Excluding Non-native species. • Protecting plant species diversity and the locally rich assemblage of plant communities. • Maintaining the integrity of natural systems for ecological research. • Maintaining naturally functioning drainage systems within the side canyons. • Preserving and restoring riparian vegetation and ephemeral pools along the Walnut Canyon floor • Protecting seeps and springs in the side canyons. • Minimally altered environment	The FLAG IPMP/EA is consistent with the overall management directions and specific management requirements of the WACA General Management Plan
SUCR	**Sunset Crater Volcano National Monument** General Management Plan (NPS 2002)	• The volcanic eruption profoundly affected people in the area and their lifeways and left a unique archeological and ethno-graphic record of human adaptation, response, and recovery to volcanic eruption. Sunset Crater Volcano and its natural resources continue to have cultural significance to contemporary native tribes. • The microhabitat and climate of Sunset Crater Volcano create an unusual species mix, including lichens, molds, and endemic species that are highly visible examples of the scientific concepts of succession and adaptation. • Minimally altered environment	The FLAG IPMP/EA is consistent with the overall management directions and specific management requirements of the SUCR General Management Plan
WUPA	**Wupatki National Monument** General Management Plan (NPS 2002)	• Preserving unfragmented natural systems. • Preserving microhabitats • Maintaining the pristine character /condition of grasslands. • Integrity of natural systems for ecological research • Preserving and restoring perennial springs and the Little Colorado River • Protecting federally listed threatened and endangered species, "species of concern," and critical habitats • Minimally altered environment	The FLAG IPMP/EA is consistent with the overall management directions and specific management requirements of the WUPA General Management Plan
FLAG	**Flagstaff Area National Monuments** Strategic Plan (NPS 2000)	• Natural and cultural resources and associated values within the three Flagstaff Area monuments are protected and maintained in good condition and managed within their broader ecosystem and cultural contexts.	The FLAG IPMP/EA is consistent with the overall management directions and specific management requirements of the FLAG Strategic Plan.
	Flagstaff Area National Monuments Resource Management Plan (NPS 1996)	• Protect diverse native ecosystems. • Restore altered natural areas • Maintaining the pristine character /condition of plant communities. • Preserving the integrity of natural systems for ecological research • Protect surface aquatic resources • Develop a comprehensive Integrated Management Plan. • Control exotic species • Physically protect cultural sites	The FLAG IPMP/EA is consistent with the overall management directions and specific management requirements of the FLAG Resource Management Pan.

	Flagstaff Area National Monuments Fire Management Plan (NPS 2008)	• Provides guidance for using prescribed fire to restore natural vegetation communities and fire regimes, and for exotic plant management.	The FLAG IPMP/EA is consistent with the overall management directions and specific management requirements of the Fire Management Plan

1.10 Public Scoping

Scoping is a process to identify the resources that may be affected by a project proposal, and to explore possible alternative ways of achieving the purpose and need while minimizing adverse impacts. The Flagstaff Area National Monuments conducted both internal scoping with appropriate NPS staff and external scoping with the public and interested/affected groups and agencies.

Internal scoping was conducted by an interdisciplinary team (IDT) of professionals from FLAG monuments. Interdisciplinary team members met at FLAG Headquarters on March 11, 2009 to discuss the purpose and need for the project; various alternatives; potential environmental impacts; past, present, and reasonably foreseeable projects that may have cumulative effects; and possible mitigation measures.

External scoping was initiated with the distribution of a scoping letter to inform the public of the proposal to treat invasive species at all three monuments, and to generate input on the preparation of this Environmental Assessment. The scoping letter dated February 21, 2009 was mailed to approximately 90 addressees including adjacent landowners, various federal and state agencies, affiliated Native American tribes, local governments and local news agencies.

During internal scoping meetings, it was determined that the FLAG IPMP/EA should not be so specific or complicated that it is no longer useful. The document also should not be so restrictive that it prevents site-specific exotic plant management actions from being implemented on a case-by-case basis. In general, it is agreed that this plan should:

- Include common treatment methods currently used at each park unit, as well as any methods that could be used in the foreseeable future.
- Account for any activities (such as various application methods) associated with each treatment method.
- Be flexible to allow for treatment of additional exotic/invasive plants in the future (including plants that currently do not occur in a park unit or are currently not being managed).
- Mitigate potential impacts to resources.
- Be both integrated and adaptive.
- Be specific enough to address site-specific issues at each monument.
- Be general (broad) enough to address exotic/invasive plant management actions without becoming too restrictive, and
- Be flexible enough to allow for future use of treatment actions that are not currently being used by resource managers.

1.11 Impact Topics Retained for Further Analysis

Impact topics for this project have been identified on the basis of federal laws, regulations, and orders, including the NPS *2006 Management Policies,* and NPS knowledge of resources at FLAG monuments. Impact topics that are carried forward for further analysis in this Environmental Assessment are those where the proposal may to have a measurable effect. For each of these topics, the analysis also includes a description of the existing setting or baseline conditions (i.e. affected environment) within the project area. Some impact topics were dismissed from further consideration when the environmental effects were estimated to be either minor or negligible. This information will be used to analyze impacts against the current conditions of the project area in the *Environmental Consequences* chapter (Chapter 3).

The following impact topics were retained for further analysis:

Natural Resources

1) Geologic and Soil Resources
2) Vegetation
3) Wildlife
4) Special Status Species
5) Water Resources
6) Wetlands, Floodplains, and Riparian Areas

Cultural Resources

7) Archeological and Historic Resources
8) Cultural Landscapes
9) Ethnographic Resources

Social Issues

10) Visitor Use Experience
11) Adjacent Land Issues
12) Public Health and Safety

Natural Resources

1) Geologic and Soil Resources

According to the NPS's *2006 Management Policies*, the NPS will preserve and protect geologic resources and features from adverse effects of human activity, while allowing natural processes to continue (NPS 2006). These policies also state that the NPS will strive to understand and preserve the soil resources of park units and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources. Mechanical and chemical treatments of invasive species have potential to have a measurable impact the soil resource; therefore this topic will be analyzed further.

2) Vegetation

The NPS's *2006 Management Policies* state that the NPS strives to maintain all components and processes of naturally evolving park unit ecosystems, including the natural abundance, diversity, and ecological integrity of plants (NPS 2006). Proposed invasive

plant treatments including mechanical and chemical treatments could impact the native plant communities of the parks; therefore this topic will be analyzed further.

3) Wildlife

According to the NPS's *2006 Management Policies*, the NPS strives to maintain all components and processes of naturally evolving park unit ecosystems, including the natural abundance, diversity, and ecological integrity of animals *(*NPS 2006*)*. There are more than 230 vertebrate species recorded for WUPA, 201 for WACA, and 158 for SUCR. This high diversity is due in part to the rich diversity of wildlife habitats found within the monuments and because of the riparian habitat found in WUPA (Little Colorado River and tributaries) and WACA (Walnut Canyon and tributaries). The proposed invasive plant treatments have the potential to have negligible to minor impacts on wildlife or their habitats. Treatments would not result in direct mortality to any wildlife species. Wildlife may be disturbed during treatment implementation that would result in minor, short-term adverse impacts to some wildlife species. However, impacts would be further mitigated because of in-place requirements forbidding treatments during breeding season. Removal of invasive plants and restoration of native species would have short-term minor negative impacts, and long-term beneficial impacts from the improvement of native wildlife habitat. Even though these impacts apper to be minor or less, it was decided that this topic should nevertheless be analyzed in detail.

4) Special Status Species

The Endangered Species Act of 1973 requires examination of impacts on all federally-listed threatened, endangered, and candidate species. Section 7 of the Endangered Species Act requires all federal agencies to consult with the U.S. Fish and Wildlife Service (or designated representative) to ensure that any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of listed species or critical habitats. In addition, the *2006 Management Policies* and Director's Order 77 *Natural Resources Management Guidelines* require the NPS to examine the impacts on federal candidate species, as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species *(*NPS 2006*)*. The U.S. Fish and Wildlife Service was contacted with regards to federal- and state-listed species. Due to the complexity of this group and because WACA contains critical habitat for the Mexican Spotted Owl this topic will be analyzed in detail.

5) Water Resources

NPS policies require protection of water quality consistent with the Clean Water Act. The purpose of the Clean Water Act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters". To enact this goal, the U.S. Army Corps of Engineers has been charged with evaluating federal actions that result in potential degradation of waters of the United States and issuing permits for actions consistent with the Clean Water Act. The U.S. Environmental Protection Agency also has responsibility for oversight and review of permits and actions, which affect waters of the United States. Chemical and mechanical invasive plant treatments have the potential to impact water quality, thus this subject will be analyzed in detail.

6) Wetlands/Floodplains

For regulatory purposes under the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or ground water at a frequency and duration

sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

Executive Order 11990 *Protection of Wetlands* requires federal agencies to avoid, where possible, adversely impacting wetlands. Further, Section 404 of the Clean Water Act authorizes the U.S. Army Corps of Engineers to prohibit or regulate, through a permitting process, discharge of dredged or fill material or excavation within waters of the United States. NPS policies for wetlands as stated in *2006 Management Policies* and Director's Order 77-1 *Wetlands Protection*, strive to prevent the loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In accordance with DO 77-1 *Wetlands Protection*, proposed actions that have the potential to adversely impact wetlands must be addressed in a Statement of Findings for wetlands. There will be no adverse impacts to wetlands as described in DO77-1 and no Statement of Findings has been prepared.

Executive Order 11988 *Floodplain Management* requires all federal agencies to avoid construction within the 100-year floodplain unless no other practicable alternative exists. The NPS under *2006 Management Policies* and Director's Order 77-2 *Floodplain Management* will strive to preserve floodplain values and minimize hazardous floodplain conditions. According to Director's Order 77-2 *Floodplain Management*, certain construction within a 100-year floodplain requires preparation of a Statement of Findings for floodplains. There will be no net loss of floodplains and no construction in these areas. Therefore a Statement of Findings for floodplains will not be prepared.

Currently, the most serious invasive plant infestation is tamarisk found along the riparian area of the Little Colorado River and adjacent floodplains. These areas are a high priority for treatment in order to restore the diverse native riparian habitat, wildlife habitat, and threatened and endangered species habitat. This infestation is continuous along the Little Colorado River and treatment could have minor to major impacts on the functioning of the channel, riparian area or floodplains. Prevention of new infestations will be a high priority in the future. Thus this subject will be analyzed in detail.

Cultural Resources

7) Archeological and Historic Resources

Section 106 of the National Historic Preservation Act, as amended in 1992 (16 USC 470 *et seq.*); the NPS's Director's Order 28 *Cultural Resource Management Guideline*; and NPS *2006 Management Policies* (NPS 2006) require the consideration of impacts on historic properties that are listed, or eligible to be listed, in the National Register of Historic Places. The National Register is the nation's inventory of historic places and the national repository of documentation on property types and their significance. The above-mentioned policies and regulations require federal agencies to coordinate consultation with State Historic Preservation Officer regarding the potential effects to properties listed on or eligible for the National Register of Historic Places.

The NPS, as steward of many of America's most important cultural resources, is charged to preserve historic properties for the enjoyment of present and future generations. Manage-

ment decisions and activities throughout the National Park System must reflect awareness of the irreplaceable nature of these resources. The NPS will protect and manage cultural resources in its custody through effective research, planning, and stewardship and in accordance with the policies and principles contained in the *2006 Management Policies* and the appropriate Director's Orders. Because there is the potential to impact archaeological resources from mechanical and chemical treatments this topic is retained for further analysis.

The term "historic structures" refers to both historic and prehistoric structures, which are defined as constructions that shelter any form of human habitation or activity. The project area contains several historic and prehistoric structures that are eligible for the National Register of Historic Places. Because there is the potential to impact historic structures from mechanical and chemical treatments this topic is retained for further analysis.

8) Cultural Landscapes

As defined in the Cultural Resource Management Guideline (NPS-28), cultural landscapes are settings humans create in the natural world. They are intertwined patterns of things both natural and constructed, expressions of human manipulation and adaptation of the land. The Flagstaff Area Monuments have recently completed Cultural Landscape Inventories at WUPA (NPS 2007) and SUCR (NPS 2007). An inventory is planned for WACA in the near future. These inventories assess the character of the natural world that includes and encompasses historic districts. Such inventories describe a landscape's physical development as it evolved over time, and evaluate its significance and integrity. These inventories sometimes include vegetation management recommendations. Characteristics of cultural landscapes include land uses and activities, patterns of spatial organization, response to the natural environment, cultural traditions, circulation networks, vegetation, buildings, structures, and features. Cultural landscape reports and cultural landscape inventories would be used in management of vegetation within historic districts and cultural landscapes throughout the FLAG monuments. Due to the potential of invasive plant treatments to alter the cultural landscapes this has been retain for further analysis.

9) Ethnographic Resources

Per the NPS's Director's Order 28 *Cultural Resource Management*, ethnographic resources are defined as any site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a an associated traditional group. According to DO-28 and Executive Order 13007 on sacred sites, the NPS should preserve and protect ethnographic resources.

The tribes were sent letters describing the projects and no response was received. There is the potential for ethnographic resources to be identified in the future and this project would not adversely impact any designation of these resources. The proposed treatments would be designed to minimize any impacts to natural resources and to restore native plant communities that could be identified as ethnographic resources. If projects are proposed that would significantly alter the physical characteristics of a site all the tribes claiming cultural affiliation to the monuments will be notified and given at least 30 days notice to respond. Otherwise, sites with ethonographic resources such as plants will in all cases be improved by the use of this plan. However, due to the importance of these resources, potential impacts of this plan will be analyzed in detail.

Social Issues

10) Visitor Use Experience

The 1916 NPS Organic Act, and NPS Management Policies (National Park Service, 2006) direct national parks to provide for public enjoyment of park resources and values. Exotic plant species management activities that could affect visitor experience include survey and treatment in areas near high visitation sites, use of herbicides on selected species, and use of brush cutters and other mechanized equipment in developed areas. In addition, the overall goal to preserve or restore natural environmental conditions could affect visitor experience. Therefore, visitor experience is discussed in Chapter 3.

According to *2006 Management Policies*, the enjoyment of park resources and values by people is part of the fundamental purpose of all park units (NPS 2006). The NPS is committed to providing appropriate, high quality opportunities for visitors to enjoy the parks, and will maintain within the parks an atmosphere that is open, inviting, and accessible to every segment of society. Further, the NPS will provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the superlative natural and cultural resources found in the parks. The NPS *2006 Management Policies* also state that scenic views and visual resources are considered highly valued associated characteristics that the NPS should strive to protect *(*NPS 2006*)*. This proposal could result in short-term negligible impacts to visitor use and experience as visitors may be excluded from areas during treatments. This impact would be localized and short-term, negligible to minor. Because most of the invasive species occur in scattered patches across the park, except along the Little Colorado River at WUPA, there would not be any large treatment areas that would detract from the visual experience. In the long-term, there would be a progression toward a major, beneficial improvement of the visitor experience from the restoration of native plant communities and resultant wildlife habitat improvements. Even tough it is estrimated that impacts to visitor use and experience would be short-term and minor an in-depth effects analysis is proposed due to the importance of providing a quality and safe experience in the monuments this resource will be analyzed in detail.

11) Adjacent Land Issues

Adjacent land owners to the three FLAG Area Monuments include the Forest Service, private in-holdings, the Navajo and Hopi Nations, and private land. All of these have expressed interest in invasive plant control and are willing to cooperate with the FLAG monuments in this endeavor. The management of exotic/invasive plants is not a series of isolated events. The more communication and coordination with NPS neighbors the more effective the program. Thus, these issues will be analyzed in detail.

12) Public Health and Safety

NPS Management Policies direct park managers to strive to protect human life, as well as provide for injury free visits and a safe and healthful environment for visitors and employees. Invasive plant control methods could impact health and human safety. Therefore, public health and safety is discussed in Chapter 3.

1.12 Impact Topics Considered but Dismissed From Further Analysis

Some impact topics have been dismissed from further consideration, as listed below. The rationale for dismissing these specific topics is stated for each resource. The following impact topics were dismissed from further analysis:

1) Park Operations
2) Paleontological Resources
3) Museum collections
4) Air quality
5) Soundscape management
6) Lightscape management
7) Socioeconomics
8) Prime and unique farmlands
9) Indian trust resources
10) Environmental Justice
11) Wilderness

1) Park Operations

The proposed action would not significantly change overall park operations. The proposed action would enable the park to more effectively manage invasive plant populations and implement restoration of disturbed areas. The proposed action would involve relatively few staff members for short periods of time and would not measurably change overall park operations. For these reasons this topic was dismissed from further analysis.

2) Paleontological Resources

According to *2006 Management Policies*, paleontological resources (fossils), including both organic and mineralized remains in body or trace form, will be protected, preserved, and managed for public education, interpretation, and scientific research *(*NPS 2006*)*. The geologic condition at all three monuments is formed by depositional processes and is composed of alluvial and colluvial materials that are not conducive to the formation of paleontological resources. Therefore, there would be no impacts to paleontological resources as a result of this proposal and the topic is dismissed from further assessment.

3) Museum Collections

According to Director's Order 24 *Museum Collections,* the NPS requires the consideration of impacts on museum collections (historic artifacts, natural specimens, and archival and manuscript material), and provides further policy guidance, standards, and requirements for preserving, protecting, documenting, and providing access to, and use of, NPS museum collections.

Some collections may be made as a result of this plan and this may add to the inventory. However, this is expected to be minimal and a normal process of documenting the resources of the monuments. Also, any plant specimen collection would not be housed by the monuments but stored at the facilities at the Museum of Northern Arizona or at Northern Arizona University. Any documents that are a result of work generated by this plan will need to be curated but this will be minimal and have minor impacts. Museum

collections and their administration would be minimally impacted by this plan, thus the topic of museum collections has been dismissed from further consideration.

4) Air Quality

The Clean Air Act of 1963 (42 U.S.C. 7401 *et seq.*) was established to promote the public health and welfare by protecting and enhancing the nation's air quality. The act establishes specific programs that provide special protection for air resources and air quality related values associated with NPS units. Section 118 of the Clean Air Act requires a park unit to meet all federal, state, and local air pollution standards. The FLAG monuments are designated as Class II air quality areas under the Clean Air Act. A Class II designation indicates the maximum allowable increase in concentrations of pollutants over baseline concentrations of sulfur dioxide and particulate matter as specified in Section 163 of the Clean Air Act. Furthermore, the Clean Air Act provides that the federal land manager has an affirmative responsibility to protect air quality related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts.

There is the potential to cause minor, short-term impacts to air quality if mechanical methods of invasive plant treatments and restoration techniques are implemented, such as dust from tillage or exhaust from chainsaw operation. Furthermore there are no plans to broadcast pesticides over large areas using aircraft or other wide area dispersal techniques. The FLAG monuments are committed to low impact, low dispersal, and quick natural breakdown times when selecting chemicals and application methods for the control of invasive species. The extent of invasive species within the monuments is not yet at a point where large scale pesticide dispersal techniques are necessary, and it is not anticipated that this will occur over the life of this plan. No long-term adverse impacts to air quality related values would occur from implementing the low impact invasive species control methods that will result from this plan. Therefore, air quality was dismissed as an impact topic from this environmental assessment.

5) Soundscape Management

In accordance with *2006 Management Policies* and Director's Order 47 *Sound Preservation and Noise Management*, an important component of the NPS's mission is the preservation of natural soundscapes associated with national park units *(*NPS 2006*)*. Natural soundscapes exist in the absence of human-caused sound. The natural ambient soundscape is the aggregate of all the natural sounds that occur in park units, together with the physical capacity for transmitting natural sounds. Natural sounds occur within and beyond the range of sounds that humans can perceive and can be transmitted through air, water, or solid materials. The frequencies, magnitudes, and durations of human-caused sound considered acceptable varies among NPS units as well as potentially throughout each monument, being generally greater in developed areas and less in undeveloped areas.

Impacts to the soundscape could occur from the implementation of invasive species treatments from the operation of chainsaws, tractors, ATV's or other mechanized equipment. These impacts are predicted to be minor and short-term, limited to the time of treatments. Therefore, the topic of soundscape management was dismissed as an impact topic.

6) Lightscape Management

In accordance with *2006 Management Policies*, the NPS strives to preserve natural ambient landscapes, which are natural resources and values that exist in the absence of human caused light *(*NPS 2006*)*. FLAG strives to limit the use of artificial outdoor lighting to that which is necessary for basic safety requirements. There sould be no impacts to lightscape management, thus this topic has been dismissed from further analysis.

7) Socioeconomics

The proposed action would neither change local and regional land use nor appreciably impact local businesses or other agencies. Implementation of the proposed action could provide a negligible impact to the economies of nearby Flagstaff. There could be minimal increases in employment opportunities and revenue generated from this project. Any increase in workforce and revenue would be temporary and negligible. Because the impacts to the socioeconomic environment would be negligible, this topic has been dismissed.

8) Prime and Unique Farmlands

The Farmland Protection Policy Act of 1981, as amended, requires federal agencies to consider adverse effects to prime and unique farmlands that would result in the conversion of these lands to non-agricultural uses. Prime or unique farmland is classified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS), and is defined as soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. There are no prime and unique farmlands designated in the FLAG monuments, thus this topic has been dismissed.

9) Indian Trust Resources

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

There are no Indian trust resources at FLAG monuments. The lands comprising the monuments are not held in trust by the Secretary of the Interior for the benefit of Indians due to their status as Indians. Therefore, the project would have negligible effects on Indian trust resources, and this topic was dismissed as an impact topic.

10) Environmental Justice

Executive Order 12898 *General Actions to Address Environmental Justice in Minority Populations and Low-income Populations* requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. The proposed action would not have disproportionate health or environmental effects on minorities or low-income populations or communities. Therefore, environmental justice has been dismissed as an impact topic in this document.

11) Wilderness

With the signing of the Wilderness Act by President Lyndon B. Johnson on September 3, 1964, the National Wilderness Preservation System was established to "…secure for the American people of present and future generations the benefits of an enduring resource of wilderness."

The Wilderness Act states that "In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness." Although there is great similarity between the NPS Organic Act and the Wilderness Act, Congress applied the Wilderness Act to NPS to strengthen its protective capabilities.

The 2001 Management Policies, Section 6 states, "The National Park Service will evaluate all lands it administers for their suitability for inclusion within the national wilderness preservation system. For those lands that possess wilderness characteristics, no action that would diminish their wilderness suitability will be taken until after Congress and the President have taken final action. The superintendent of each park containing wilderness will develop and maintain a wilderness management plan to guide the preservation, management, and use of the park's wilderness area, and ensure that wilderness is unimpaired for future use and enjoyment as wilderness."

The purpose of Director's Order-41 is to guide NPS efforts in meeting the letter and spirit of the 1964 Wilderness Act. DO-41 also establishes specific instructions and requirements concerning the management of all NPS wilderness areas. DO-41 should be applied to management actions carried out within the framework of a park's general management plan, the Government Performance and Results Act, a park's natural and cultural resource plans, and the park's wilderness management plan.

There are no lands designated as wilderness in the Flagstaff Area Monuments. Only a small area within Wupatki National Monument has been shown to have some wilderness qualities and managed as de facto wilderness. Thus wilderness has been dismissed as an impact topic in this document.

2.0 ALTERNATIVES, INCLUDING THE PREFERRED ALTERNATIVE

2.1 Integrated Pest Management (The Preferred Alternative)

Prioritization and Planning
Planning efforts proposed under Alternative II include the use of a Decision-making Tool and continued use of annual work plans.

Decision-making Tool and Prioritization
Under Alternative II, FLAG proposes to use the Decision-making Tool listed in **Appendix A** to prioritize and determine treatment for exotic plant species. In using this tool, Vegetation staff would follow a standard decision-making process to identify exotic plants that meet project objectives described in Chapter 1, prioritize as new species enter and others are treated successfully, identify and evaluate efficacy and environmental effects of proposed treatment, consider alternative treatments having less impacts, justify why a treatment was selected, and confirm compliance with applicable policies and regulations. Outcomes of this process would provide the foundation of each annual work plan. Management would also be able to use results to explain to the public how each of these factors was accounted for in selecting treatment methods. **Appendix A** provides an overview of the decision-making tool. The decision-making process is described in detail as well.

Use of Integrated Pest Management
Alternatives were designed to implement NPS Director's Order "77-7 Integrated Pest Management", from which the 10 Invasive Plant Management steps (outlined below) have been developed. These policies mandate the use of an integrated approach to pest management that includes: prevention, education, inventory, monitoring, tracking management, prioritization, cooperation, appropriate treatments, developing work plans, and restoration. Implementing the 10 steps of the plan would have negligible environmental affects, except for Step 8 - Identify the control techniques most appropriate for each species; and Step 10 - Restoration. Therefore, the control techniques or treatment methods form the basis for the development of the three alternatives chosen.

All alternatives would use an adaptive management approach to invasive plant management. The adaptive, integrated approach is defined as a system for the planning and implementation of a program, using an interdisciplinary approach, to select a method for containing or controlling an undesirable plant species or groups of species using all available methods including education, prevention, physical or mechanical methods, biological control agents, herbicide methods, cultural methods, and general land management. However, the ability to use the whole spectrum of tools that make up the adaptive, integrated approach is limited under Alternatives I and III as not all possible treatments would be available for use.

Infestations of invasive plants that may become established but which are not currently identified on the species list or known to occur in the park would be treated, provided the effects of the treatment are similar to, or less than, those defined for the selected alternative. This analysis proposes to treat all species considered invasive within the monuments, both native and non-native. There may be some native species that become invasive on heavily disturbed areas. If

prescribed management fails to result in the desired outcome, alternative strategies will be developed, and management will be adapted until the desired conditions are achieved. New alternative strategies will be reviewed on a site-specific and case-by-case basis. If it is demonstrated through analysis that the environmental impacts of a new approach fall outside the impacts as disclosed in this document, then additional environmental and cultural analysis would be undertaken under NEPA and §106 of the National Historic Preservation Act.

The 10 Steps for Invasive Plant Management outlined below were developed from information contained in NPS Director's Order 77-7, and from sections of the Dinosaur National Monument *Invasive Plant Management Plan and Environmental Assessment* (NPS 2005).

2.2 Integrated Pest Management 10 Steps:

1. Prevent new infestations by employing prevention and early detection techniques

The most effective, economical, and ecologically sound approach to managing invasive species with zero risk to resources of value is to prevent their invasion in the first place. Often, managers direct limited resources to fighting firmly established infestations, but by that stage, management is expensive and eradication is extremely costly and difficult. While it is desirable to manage infestations on order to limit the spread of invasive plants into non-infested areas, limited resources might be spent more efficiently on proactive invasive plant management that both contains existing invasive plant infestations and focuses strongly on prevention and early detection of new invasions.

In this plan, FLAG seeks to adopt a set of invasive plant prevention guidelines. These are practical and proactive techniques designed to prevent invasion and permanent establishment of invasive plants during the course of daily or routine activities and operations. They include:

- Incorporating invasive plant prevention and control into project planning.
- Avoiding or removing sources of invasive plant introduction and spread of seeds and propagules to prevent new infestations or the spread of existing invasives.
- Avoiding the creation of environmental conditions that promote invasive plant germination and establishment.
- Re-establishing native vegetation to prevent conditions conducive to establishment of invasive plants when project disturbances create bare ground.
- Improving the effectiveness of prevention practices through invasive plant awareness and education.

Early detection of invading plants minimizes spread, enhances opportunities for eradication, and is most effectively done at the local level by land managers and landowners. Early detection of invasive plants is a vital sign of the Southern Colorado Plateau Inventory and Monitoring Network (SCPN) (http://www.nature.nps.gov/im/units/scpn). FLAG staff will work with SCPN to monitor the detection and spread of invasive species.

2. Educate visitors and staff about invasive plants and their management

There are several programs already in place that make connections with the public regarding invasive species. The monuments have very active environmental education programs that

reach thousands of students and visitors every year to teach the importance of protecting our natural resources.

FLAG will increase efforts to inform the public and staff about invasive plants and the monument's strategy for managing them. Some ideas for expanding awareness among visitors and staff include:

- Visitor center displays and brochures on invasive species and their management within the monuments.
- Partnering with neighboring agencies and organizations in regional educational awareness efforts.
- Developing an invasive species webpage within the three FLAG national monument websites that will provide current information on the activities of the park, regional news, and technical information on management.
- Initiate staff project days where monument staff can learn about a particular invasive plant problem in the park and then participate in a short work project focusing on a particular goal or species, such as improving rare plant habitat or eradicating a new invader.
- Hold informal annual meetings with interdisciplinary staff members and adjacent landowners who may be potentially impacted by invasive plant management activities to give updates, discuss effectiveness of treatment techniques, and inform them of upcoming annual work plan.
- Distributing press releases to the local media concerning invasive plant control activities, dates, locations, and treatment methods.

3. Inventory of Invasive Plants in the three Monuments of the Flagstaff Area National Monuments

Wupatki National Monument completed an exotic plant inventory in 2007 (NPS 2007). Field work for this project was performed from 2004-2006. Schelz et al. (2007) completed an inventory and mapping of invasive plants at high priority areas in Walnut Canyon National Monument.

Invasive species that were surveyed for and may be treated as part of this analysis are listed below in **Table 2**. This analysis is intended to be dynamic and to treat invasive species that are not known to exist in the monuments at this time, but may invade in the future. NPS park staff are working together with Southern Colorado Plateau Network staff on protocols to track the status and trends of invasive species, as on the early detection of invasive species.

4. Monitor effectiveness of control efforts

Monitoring is the repeated collection and analysis of information to evaluate progress and effectiveness in meeting resource management objectives. Follow-up monitoring is an essential part of an integrated invasive plant program because without effective monitoring and focused follow-up treatments most projects are destined to fail. A good monitoring program saves time and money by informing managers which control techniques are working and which ones are not. It also picks up small areas where treatment may have been missed, thus avoiding a re-infestation of the area. Monitoring programs can range from simple, such as establishing photo- points, to more complex plot and/or transect data collection. All are ongoing processes designed to detect useful trends with each year of repetition. Without monitoring for at least 2-3 years after a project is completed, there is no way of knowing

whether control efforts are contributing to fulfillment of desired management objectives or adding to the problem.

A number of NPS entities and other agencies are currently researching and developing invasive species treatment effectiveness monitoring protocols that may be used by FLAG to monitor treatments. NPS entities include the Sonoran Desert Inventory and Monitoring Network (SODN), The Southern Colorado Plateau Inventory and Monitoring Network, and Lake Meade/Petrified Forest Exotic Plant Management Teams (EPMT); in addition to a number of other parks, EPMT's, and I&M networks. Other government agencies are also developing effective and low-cost monitoring protocols.
Monitoring protocols will likely include techniques such as the establishment of permanent photo-points, transects, and/or plots. Minimum monitoring standards will be established for consistency and comparability of results across the FLAG monuments. Data generated from park monitoring programs will be entered into a monitoring module in the FLAG invasive species management database that is currently under development.

TABLE 2. List of Known Exotic Plants at Walnut Canyon National Monument (WACA), Sunset Crater National Monument (SUCR), and Wupatki National Monument (WUPA).

#	Latin Name	Common Name	WACA	SUCR	WUPA	Priority
Amaranthaceae (Pigweed Family)						
1)	*Amaranthus albus*	Prostrate Pigweed	X		X	
2)	*Amaranthus blitoides*	Mat amaranth			X	
Asteraceae (Sunflower Family)						
3)	*Acroptilon repens*	Russian knapweed			X	X
4)	*Centaurea diffusa*	Diffuse knapweed	X			X
5)	*Cirsium vulgare*	Bull thistle	X			X
6)	*Lactuca serriola*	Prickly lettuce	X	X	X	X
7)	*Onopordum acanthium*	Scotch Thistle	X			X
8)	*Taraxicum officinale*	Dandelion	X	X	X	
9)	*Tragopogan dubius*	Common salsify	X	X	X	
Bassicaceae (Mustard Family)						
10)	*Erysimum repandum*	Wallflower	X			
11)	*Sisymbrium altissimum*	Tumble mustard	X	X	X	
Chenopodiaceae (Goosefoot Family)						
12)	*Chenopodium album*	Lambsquarters	X	X		
13)	*Halogeton glomeratus*	Halogeton		X	X	
14)	*Kochia scoparia*	Common kochia	X		X	
15)	*Salsola collina*	Slender Rus. Thistle	X			X
16)	*Salsola kali*	Russian thistle	X		X	X
17)	*Salsola tragus*	Russian thistle	X	X	X	X
Convolvulaceae (Bindweed Family)						
18)	*Convolvulus arvensis*	Field bindweed	X	X	X	
Elaeagnaceae (Oleaster Family)						
19)	*Elaeagnus angustifolia*	Russian olive			X	X
Fabaceae (Bean Family)						
20)	*Alhagi maurorum*	Camelthorn		X	X	X
21)	*Melilotus alba*	White sweetclover	X	X	X	X
22)	*Melilotus officinalis*	Yellow sweetclover	X	X	X	X
Geraneaceae (Geranium Family)						
22)	*Erodium cicutarium*	Storksbill	X	X	X	
Lamiaceae (Mint Family)						
23)	*Leonurus cardiaca*	Motherwort	X			
24)	*Marrubium vulgare*	Horehound	X	X	X	X

Plantaginaceae (Plantain Family)						
25)	*Plantago lanceolata*	Lanceleaf plantain	X			
Poaceae (Grass Family)						
26)	*Agropyrun cristatum*	Crested Wheatgrass	X			X
27)	*Bromus diandrus*	Ripgut brome	X			X
28)	*Bromus rubens*	Red Brome	X		X	X
29)	*Bromus tectorum*	Cheatgrass	X	X	X	X
30)	*Poa pratensis*	Kentucky bluegrass	X			
Polygonaceae (Knotweed Family)						
31)	*Rumex crispus*	Curly dock	X			
32)	*Rumex obtusifolius*	Bitter dock				
Portulaceae (Purslane Family)						
33)	*Portulaca oleraceae*	Purslane	X		X	X
Rosaceae (Rose Family)						
34)	*Malus pumila*	Paradise apple	X			
35)	*Polypogon monspeliensis*	Rabbitfoot grass			X	
36)	*Potentilla norvegica*	Norwegian cinquefoil	X			
Rubiaceae (Madders Family)						
37)	*Galium aparine*	Bedstraw	X			
Scrophulariaceae (Figwort Family)						
38)	*Linaria dalmatica*	Dalmatian toadflax	X	X		X
39)	*Verbascum thapsus*	Common mullein	X	X	X	X
Tamaricaceae (Tamarisk Family)						
40)	*Tamarix ramosissima*	Tamarisk	X		X	X
Ulmaceae (Elm Family)						
41)	*Ulmus pumila*	Siberian elm	X			X
Vitaceae (Grape Family)						
42)	*Parthenocissus quinquefolia*	Virginia creeper	X			
Zygophyllaceae (Caltrop Family)						
43)	*Tribulus terrestris*	Goathead			X	X

5. Track invasive plant management efforts

Invasive plant management efforts will be recorded according to established protocols and centralized and tracked in an MS Access database at FLAG headquarters in Flagstaff. If work is conducted by an NPS EPMT, they will be responsible for data collection and providing this information as part of their reporting process. EPMT's will share that data with the park for reporting in the Pesticide Use Proposal System, GPRA reporting, and for inclusion in FLAG natural resource GIS database.

6. Prioritize both invasive plant species and locations to be controlled

Because it is impossible to control every invasive species, it makes sense to focus management efforts on those species that have, or could have, the greatest impact to the park resources. Prioritizing management activities by both species and location will help guide the most efficient use of resources (specifically staff time and budget) according to predetermined invasive plant management objectives. Species that are not likely to pose a large threat to resources may be treated with volunteer labor, when available.

State or Federal government agencies may list any plant that is deemed an economic threat, an environmental threat, or a threat to public health as "noxious". Arizona has a State Noxious Invasive Plant List (R3-4-244 and R3-4-245) (www.azda.gov/PSD/quarantine 5.htm). Arizona is also under the jurisdiction of the federal noxious invasive plant list http://www.aphis.usda.gov/ ppq/invasive plants. (source = http://www.azdot.gov/Highways/ NResources/Priority_ Weeds.asp).

The Alien Plant Ranking System v 7.1 (APRS 2001) was applied to the invasive species of FLAG to determine and rank priority treatment species (NPS Draft). This ranking system helps the park establish species that are a high priority for treatment.

7 Work with adjacent landowners, local, state and federal agencies, local interest groups, invasive plant cooperative networks, and others to develop and achieve common goals of invasive plant management

The spread of invasive plants throughout Arizona poses a serious environmental and economic threat to public land, ranchland, farmland and private property in Coconino County. The success of an invasive plant management program is, in part, dependent on the actions of neighboring landowners, thus FLAG resource staff are in the process of building partnerships with other federal, state and local government agencies, non-profit organizations, and private landowners to develop joint strategies for curbing this threat.

The following agencies, organizations, and landowners are potential partners that have expressed interest in working with the FLAG monuments on management issues:

- US Forest Service, Coconino National Forest
- US Fish and Wildlife Service
- Arizona Department of Transportation
- Friends of Walnut Canyon
- Local school groups
- Public Land Crews
- Coconino County
- City of Flagstaff
- Navajo Nation
- Hopi Nation

Potential projects for these partnerships include:

- Treatment of invasive species along the Little Colorado River in Cooperation with the adjacent Native American tribes and other government agencies.
- Treatment of invasive species in cooperation with Coconino National Forest and Arizona Department of Transportation.
- Volunteer treatment projects with Friends of Walnut Canyon, Coconino County, and the City of Flagstaff.

The FLAG Group will continue to participate in invasive plant management meetings, discussions, and treatments with other agencies and groups, and remains committed to pursuing new partnerships with interested entities to manage invasive plants cooperatively in the greater Flagstaff area.

8. Identify control techniques most appropriate for each species

Control techniques will be selected that achieve maximum effectiveness in control while minimizing risks to humans, and natural and cultural resources. The selected control actions should be effective at killing invasive plants or managing infestations at an acceptable threshold level. This FLAG IPMP/EA describes a number of species specific management treatments that have been found to be the most effective for the biology and growth characteristics of a number of invasive plant species that are found at FLAG. This document

will be used as a reference as well as soliciting guidance from NPS Integrated Pest Management staff.

The treatments fall into five basic categories: prevention, manual/mechanical, chemical, cultural, and biological. Each category is described below and provides the definitions for impact analysis in the Environmental Consequences Chapter.

Prevention
IPM also includes actions that don't directly impact invasive plant populations and don't require environmental analysis (and thus are not analyzed in the impact analysis in the Environmental Effects Chapter), but are nevertheless an integral part of a successful invasive plant management plan. These actions include prevention and early detection of invasive plant introductions and spread, inventory, monitoring, and education.

Prevention is generally agreed to be the most effective and economic form of invasive plant management (Sheley et al. 1999). There are countless ways of preventing invasive plant introductions, such as minimizing unnecessary soil disturbance, containing neighboring invasive plant infestations, establishing and properly maintaining desirable vegetation, using only barren or sterile fill and gravel in park construction and maintenance activities, cleaning park vehicles and equipment after working in an infested area, and landscaping only with non-invasive native plants.

Manual/Mechanical Control
Manual/mechanical techniques for control of invasive plants in FLAG include mowing, cutting/ sawing, digging, pulling, spudding (severing of roots below the root crown), discing/plowing and smothering. Mechanical techniques can be especially effective in preventing seed production in annual and biennial forbs and in exhausting root reserves in perennial plants (Meunscher 1980). Timing of these controls can be extremely important in determining outcome.

Manual/mechanical control of some species such as annual forbs has proven to be very effective. For species that reproduce vegetatively from root parts (such as tamarisk and toadflax), manual/mechanical treatments are generally not expected to provide complete control, even when repeated. Most often, they can be used as a tool for stressing the plants to make other treatments more effective (Derscheid et al. 1961, Renz and DiTomaso 1998).

Cultural Control
Cultural controls consist of actions that managers can take to indirectly impact invasive plant populations. They can often be very cost-effective and therefore useful on large scales. Proposed treatments that have been shown to be effective on invasive plants in other areas include: prescribed fire, implementation of Best Management Practices, and restoration/ revegetation.

Prescribed burning consists of planning, setting, and managing fire to accomplish resource management objectives. Fire may be necessary to prompt germination of some plants, but it can also reduce the abundance of some species. The most successful uses of fire for invasive species control result from burns that try to mimic or restore historical (natural) fire regimes, which have been disrupted by land use changes, suppression practices, fire breaks, or

development (Tu et al. 2001). Prescribed burns would be applied only after developing site specific burn plans in cooperation with NPS Flagstaff Headquarters, through the FLAG Fire Management Plan, and Coconino National Forest Fire Management Staff.

Some studies have shown success using domestic livestock to selectively overgraze certain invasive plant species to prevent seed set or weaken plant structure. A review of available literature did not find successful results in xeric ecosystems. Generally, positive research results were limited to leafy spurge, yellow star-thistle and spotted knapweed in the mesic climates of Montana and Wyoming (Williams and Prather 2006, DiTomaso et al 2000, Walker et al 1994, and Olson 1999). Because of the lack of research on ecosystems similar to those of Arizona and the uncertainty of the environmental effects without conclusive research results, this treatment was eliminated from further consideration. This treatment may be reconsidered in the future as part of a research study on site specific effects, but it is doubtful that it will be successful due to the documented extensive negative impacts of livestock grazing on soil structure and biological soil crusts.

Restoration can be defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed (SER 2002). In the context of this EA, damage or degradation refers to the presence of invasive plants, while the establishment of desirable native vegetation is the recovery that we are trying to assist. Assisting the establishment of desirable vegetation through revegetation practices contributes to the larger goal of restoration as well as the goal of invasive plant management (Jacobs et al. 1998). The establishment of a diverse community of desirable vegetation can prevent invasive plant encroachment by utilizing all, or most, available resource niches (Sheley et al. 1996). Revegetation practices include seedbed preparation, broadcast seeding, drill seeding, container planting and sprigging live branches (Roundy 1996). Following successful treatment of invasive species, restoration practices may be implemented. Recent roadside weed treatment and revegetation at Wupatki National Monument is an example where restoration is planned under Alternative II.

Chemical Control

Chemical control in this document refers to the use of herbicides to kill or injure target plants, as well as chemicals applied along with herbicides that improve their efficacy (adjuvants). Chemical treatments include the use of a number of recommended herbicides including both pre- and post-emergent herbicides. Herbicides that are most commonly recommended for use are outlined below. Others may be used, including known herbicides found to be effective on additional species and herbicides that may be developed in the future, provided that their impacts are equal to or less than those described in this document. For example, a recently developed herbicide, aminopyralid (Milestone™), is currently recommended as effective on a number of broadleaf species. Other herbicides that will be considered for use are the relatively new 'smart herbicides' such as Habitat™ that provide 'intelligent', long-term vegetation control by affecting enzymes found only in plants – not in birds, mammals, fish, insects or humans. Habitat™ breaks down quickly in water, allowing desirable vegetation to germinate and repopulate a treated site. Because it is considered a low volume herbicide, it provides more control with less chemical load on the environment, compared to other herbicides. Some techniques used for mechanical, cultural, and chemical applications involve the use of motorized vehicles, such as ATV's.

Table 3: Herbicides that may be Used

Herbicides	Trade Name
1) 2,4-D	Invasive Plantone™, Aqua-Kleen™
2) Clopyralid	Transline™
3) Chlorsulfuron	Telar XP
4) Dicambia	Clarity™, Banvel™
5) Glyphosate	RoundUp™ or Rodeo™
6) Imazapic	Plateau™, Cadre™
7) Imazapyr	Habitat™
8) Metsulfuron methyl	Escort XP, Metsulfuron Methyl 60 DF
9) Picloram	Tordon* K, Tordon* 22K
10) Sulfometuron methyl	Oust XP, SFM 75
11) Triclopyr	Garlon 3A or 4™, Access™

Biological Control

Biological control can be defined as the deliberate introduction or manipulation of an invasive plant's natural enemies (such as insects and pathogens) with the goal of suppressing the invasive population (Wilson and Huffaker 1976). The theoretical framework for the use of biological controls is based on the hypothesis that the success of many non-native invasive plants is the result of their release from predators or pathogens found in their native range when introduced in a new range (Cronk and Fuller 1995). By introducing predators or pathogens, usually from the invasive plants' native range, their success can be curbed, allowing native plants to compete on more equal terms. Bio-control agents are not capable of completely eradicating an invasive plant population, because as the number of host plants declines, so does the population of bio-control agents. However, bio-control can be a useful tool in reducing the initial size or density of an invasive plant infestation, making other treatments more efficacious.

At his point, biological controls for most of the invasive species found in the Flagstaff Area National Monuments are very limited, with unknown or low effectiveness. If biological controls are selected for invasive plant treatments, only biological control agents approved by the USDA Animal and Plant Health Inspection Service (APHIS) would be considered for use. Additional consultation with US Fish and Wildlife Service would be conducted prior to the release of biological control agents to ensure there are no unintended impacts to non-target species.

Evaluation of Control Techniques

Control techniques will be evaluated based on the following attributes:

a. The control technique poses little to no risk to native vegetation, wetlands, wildlife, or other natural resources.

FLAG will continue to make a good faith effort and use extreme care in evaluating treatment options and ensuring all environmental compliance standards are met, especially in protecting water quality and aquatic resources. FLAG will continue to review new relevant scientific literature, references, and support research to ensure a control technique is biologically sound. FLAG efforts to prevent/reduce risks to natural resources include active cooperation

with NPS professional Exotic Plant Management Teams assigned to this area, and frequent consultations with NPS Integrated Pest Management program.

Label directions must be strictly followed. No open containers of herbicides are allowed in areas of native vegetation, in riparian areas, or near areas of open water. All refilling of herbicide tanks and sprayers will be conducted in designated staging areas where there is no risk to native vegetation or water quality.

b. The control technique poses little to no risk to cultural resources.

FLAG will continue to make a good faith effort to evaluate treatment options and ensure all Section 106 compliance standards are met. If a control technique is determined to affect a cultural resource, site specific compliance will be initiated by the park staff in consultation with affiliated tribes and the state historic preservation office. Staff will continue to review new relevant scientific literature and references to ensure control techniques are sound for use in areas of cultural significance.

c. The control technique poses little to no risk to the human environment or to the safety of park visitors or park employees.

Some techniques have the potential to harm humans. Injuries can occur when using everything from a shovel or saw to fire and herbicides. Visitors and other staff can be harmed as well if management is occurring in areas frequented by the public. For this reason, extensive use of the NPS Job Safety Analysis Program will be consulted to develop Job Hazard Analyses (JHAs) which will be developed for activities such as sawing and using herbicides. The purpose of these analyses is to define the techniques and tools required for the activity, identify potential hazards for each step or phase of the activity, and mitigate the potential for problems and injuries during each step or phase. JHAs are reviewed every year for thoroughness and are required reading for everyone (volunteer or staff) participating in the activity. Larger infestations may be treated by professional NPS Exotic Plant Management Team's trained and certified in the application and safe use of pesticides.

Other precautions for reducing and eliminating risk to humans during invasive plant activities include posting notice of the activity in high use areas or scheduling the activity (when possible) during periods of low visitor use in the area (both time of day and time of year). FLAG will continue to review and refine treatment activities to avoid negatively impacting human use and safety in and near treatment areas.

d. The control technique is cost-effective to implement.

Cost is not the only driving factor in selecting control techniques, but is considered in the context of size, location, integrity of resources threatened, and management goal (eradication, suppression, containment) for a particular infestation or area. Choice of techniques and management strategy has both short- and long-term cost implications. Short-term impacts are mostly negative and include the cost of the initial treatments and possibly foregoing an activity (such as closing a hiking trail) while the area recovers. However, in the long-term, protecting surrounding non-infested areas and ecosystem functions is key to realizing and understanding the actual versus potential future costs of invasive plant management; not just for the acreage actually infested but for the entire monument and the surrounding lands.

9. Create annual work plans to guide invasive plant management activities

There are specific recommended control techniques for a number of invasive species found at this FLAG *Invasive Plant Management Plan*. Using this guidance, as well as considering the size, location, and management objective for an area, an annual work plan for all three monuments will be created to guide control, monitoring, restoration, and prevention/education efforts. If complete eradication is not feasible, the management objective will be to suppress or contain the infestation below the threshold level with consideration to any federal and state management directives on the particular species. The annual work plan will also be used to guide sources of labor to invasive plant projects of appropriate size and nature. While staff and volunteers are the primary source of invasive plant management labor in the park, adoption of an invasive species work plan will also enable the park to make better use of the NPS EPMT's.

10. Restoration

Restoration is defined as a method to mitigate disturbed areas or control invasive plant problems by restoring native vegetation communities to conditions existing prior to disturbance or invasion. In many cases, no active restoration may be necessary if bare ground/rock is the desired condition or if there is enough desired vegetation in proximity to occupy niches opened by invasive plant control procedures. However, when desired vegetation canopy is nonexistent or inadequate for the site conditions, active site restoration is required to speed recovery to a healthy and competitive plant community.

Many invasive plant management efforts focus on simply controlling invasive plants, with limited regard to the existing or resulting native plant community. Before any invasive plant control takes place, a stewardship plan that establishes desired future condition objectives relevant to anticipated land use must be considered. Simply killing invasive plants is not an adequate objective, especially for large-scale infestations. However, a generalized objective might be to develop a healthy native plant community that is relatively invasive plant-resistant, while meeting other land-use objectives such as listed species habitat, roadside and recreational use maintenance (Jacobs et. al. 1998).

In dry, desert environments like those at FLAG, restoration in general has the potential to be costly and has a high risk of failure, even when properly implemented (Allen 1995). Depending on the site and characteristics of the infestation(s) to be treated, staff will identify a strategy for larger, active restoration projects that consider factors such as creating a self-sustaining and persistent desirable plant community that meets management objectives. Planning considerations would include involving neighboring landowners/managers when necessary, species and seeding methods, and follow-up treatments that will best achieve desired conditions (Jacobs et. al. 1998). Restoration techniques used in FLAG may include, but are not limited to, seeding, shrub/sapling plantings, soil amendments, tilling, and/or irrigation. Areas that are expected to be re-colonized from seed in the soil and the spread of native plants from nearby undisturbed areas will be allowed to naturally succeed to desired conditions.

2.3 ALTERNATIVES

2.3.1 Alternatives Considered

Alternatives were framed through discussion among NPS staff, EPMT's from Petrified Forest NP, NPS Intermountain Region planning staff, and Integrated Pest Management staff. The alternatives cover the range of what is physically possible, acceptable by policy, and feasible for local managers; i.e. all reasonable alternatives. Criteria used in the selection of reasonable alternatives include:

- Potential for protecting natural and cultural resources
- Effectiveness, efficiency, and economy in eradicating or controlling invasive plant infestations
- Ability to ensure human health and safety

Alternative I: *No Action - Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

This alternative represents the No Action Alternative and proposes a continuation of current management practices using mechanical, cultural and limited chemical treatments to control invasive plant infestations. This alternative would implement the 10 Steps of Invasive Plant Management up to a point, however, the implementation of Step 8, selection of the most appropriate treatments methods, would be limited. Without effective invasive plant control, the ability to implement Step 10, restoration, would also be limited.

Current management practices are not able to fully address the invasive species problem. Treatments using only manual/mechanical methods cannot be fully implemented because of their high labor cost. Therefore, relatively little effort can be focused on the less invasive species such as sweet clover, and field bindweed, etc., where mechanical treatments would be effective. At best, these less invasive species are sometimes treated using volunteer labor. Mowing is effective and is currently being used along roadsides. Manual/mechanical methods are not effective long-term treatments for such highly invasive species as tamarisk, toadflax, and Russian olive. If current practices were to be fully implemented, manual/mechanical treatments would remain the primary method of invasive weed control.

Restoration is limited under this alternative because treatments have been limited to relatively small patches of tamarisk. The small areas currently being treated using chemical treatments are in riparian areas where revegetation is expected to occur from adjacent native plant communities. Without the use of chemicals toadflax, and camelthorn would not be effectively treated or restored. Toadflax, tamarisk, camelthorn and a number of other invasive species are expected to continue to expand.

If this alternative is selected, the monument's would continue to conduct small-scale invasive plant control management using mechanical, cultural, and chemical control techniques within the framework of Catagorical Exclusions's and programmatic compliances. Chemical treatments would be limited to small infestations/populations of highly invasive species that threaten special

status species habitats. Other invasive species with less potential to spread and displace native plants may be treated using mechanical and cultural methods, and would be treated as volunteer labor is available.

This alternative does not provide for the proactive or full implementation of the Integrated Pest Management approach, using the most effective treatment method for each species. Therefore, it offers a limited ability to successfully address individual and/or unique invasive species situations in both infestation size and potential combinations of available techniques.

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

The preferred alternative proposes to consider the implementation of the full range of appropriate IPM techniques available and fully implement the 10 Steps for Integrated Plant Management. This alternative would provide for proactive, responsible, and adaptive integrated invasive species management. The integrated approach is defined as a system for the planning and implementation of a program, using an interdisciplinary approach, to select a method for containing or controlling an undesirable plant species or groups of species using all available methods including education; prevention; physical or mechanical methods; biological control agents; herbicide methods; cultural methods; and general land management. It is a multidisciplinary, ecological approach to managing unwanted plant species. This more integrated approach that incorporates current management practices with the use of chemical treatments on additional invasive species, and the ability to use biological control agents. It is anticipated that more acres will be treated and restored under this alternative than under either Alternatives I or III since staff would have the option of selecting the most effective treatment(s) from the full range of available management techniques and strategies. Many of the invasive species are not effectively treated using mechanical and cultural methods especially since there are a number of species that are stimulated to sprout and sucker following mechanical disturbance. Under this alternative chemical herbicides could be used for the treatment of species such as tamarisk and camelthorn that have the ability to root sprout and are not effectively treated with mechanical methods. Mechanical methods would be used to reduce invasive plant species and maintain visual resources along roadways, visitor use areas and trails. The restoration of native plant communities following IPM treatments is an important aspect of this alternative.

Little Colorado River Riparian Restoration. IPM techniques would be used to restore the riparian area along the Little Colorado River. Approximately 100 acres of riparian are now infested in a dense thicket of tamarisk. Invasive species would be mechanically and chemically treated and native plant species are expected to re-colonize the area. If monitoring indicates that the site is not recovering to desired, native plant communities active restoration practices would be implemented. These practices may include seed bed preparation, seeding of native plant species, transplanting pole and deep root plants, irrigation to help seed germination and establishment, and additional treatments of invasive plants. Irrigation would be discontinued when native plants become established. This project would serve to control invasive species, expand the riparian habitat connected to the Little Colorado River, enhance increasingly rare riparian wildlife habitat, and provide for visitor enjoyment of these areas.

With the use of chemical treatments, it is possible to begin controlling the less invasive species not currently being addressed. Following chemical treatments, these areas may be maintained using mechanical and/or cultural methods. Many of these areas with high visibility to visitors would eventually be restored to native species.

This alternative is most likely to be successful in preventing increased levels of invasive plants using the most effective and economical means while posing the least hazard to people, property, and the environment.

This alternative most clearly meets the directive established in DO 77-7 that calls for "IPM procedures to be used to determine when to control invasives and other pests and whether to use mechanical, physical, chemical, cultural, or biological means…". It allows the most flexibility and creativity in using available techniques to address invasive species situations in both size and scope of infestations. Each infestation, or common areas of infestations, would have a treatment implementation plan, which in turn will direct the development of annual operating plans to achieve desired management objectives.

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

This alternative proposes the consideration of a more limited range of management tools, eliminating potentially controversial techniques such as chemical herbicides and biological control. Implementation of the 10 Steps for Invasive Plant Management would be limited under this alternative. Restrictions on the ability to integrate a full range of treatment methods would restrict the implementation of **Step 8** (selection of the most appropriate treatments methods). Restrictions on the use of treatments would in turn reduce our ability to work with cooperators and could hamper the ability to track the spread of invasive plants. Without effective treatment of invasive plant species, restoration of native plant communities would have limited success.

Because of its labor-intensive nature, and site and species-specific limitations of mechanical and cultural control techniques, it is anticipated that under this alternative considerably fewer acres will be treated annually than under either of the other two alternatives. Mechanical and cultural control methods are not effective on a number of invasive species such as tamarisk, camelthorn, toadflax, and Russian olive. These species are stimulated by mechanical removal of above ground portions. For mechanical removal to be effective, all roots must be removed to prevent re-sprouting otherwise, these and other highly invasive species will continue to spread.

The monuments will not be able to successfully implement several of the proposed management actions under this alternative. For example, it would not be possible to apply the most appropriate control technique if chemical and/or biological controls were found to be most effective and appropriate for the level of control desired. The monuments may also have difficulty developing and maintaining invasive species partnerships and maintaining cooperative management agreement goals with surrounding landowners and agencies if effective techniques and strategies are limited. Restoration of native plant communities would be limited under this alternative to small mechanically treated areas. Tamarisk along the Little Colorado River could not be effectively treated. Camelthorn at the Heiser Spring area and along the highway could also not be effectively treated.

Table 4: Summary of how each alternative implements the Invasive Plant Management Plan

Alternative Elements/Actions	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II: Preferred Alternative*** *– Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Prevention of new infestations by employing prevention and early detection techniques	**FULL IMPLEMENTATION:** A comprehensive set of prevention protocols would be adopted (which includes existing prevention measures) and proactive early detection efforts (rapid assessment inventory, education, tracking) would be implemented.	**FULL IMPLEMENTATION:** A comprehensive set of protocols for prevention would be adopted (which includes existing prevention measures) and proactive early detection efforts (rapid assessment inventory, education, tracking) would be implemented.	**FULL IMPLEMENTATION:** A comprehensive set of protocols for prevention would be adopted (which includes existing prevention measures) and proactive early detection efforts (rapid assessment inventory, education, tracking) would be implemented.
Educate visitors and staff about invasive plants and their management	**FULL IMPLEMENTATION:** FLAG would expand current education and outreach programs to improve visitor, staff, partner, and stakeholder awareness of park and regional invasive species issues.	**FULL IMPLEMENTATION:** FLAG would expand current education and outreach programs to improve visitor, staff, partner, and stakeholder awareness of park and regional invasive species issues.	**FULL IMPLEMENTATION:** FLAG would expand current education and outreach programs to improve visitor, staff, partner, and stakeholder awareness of park and regional invasive species issues.
Inventory invasive plants	**FULL IMPLEMENTATION:** FLAG Area-wide inventories completed as soon as possible. Continued cooperation with SCPN on invasive species vital sign monitoring.	**FULL IMPLEMENTATION:** FLAG Area-wide inventories completed as soon as possible. Continued cooperation with SCPN on invasive species vital sign monitoring.	**LIMITED IMPLEMENTATION:** FLAG Area-wide inventories completed as soon as possible While the park will continue cooperation with SCPN on invasive species vital sign monitoring. It may be difficult to keep inventories up to date as invasive species are expected to spread under this alternative.

Alternative Elements/Actions	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II: Preferred Alternative –*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Monitor effectiveness of control efforts	**FULL IMPLEMENTATION:** Monitoring programs would be designed for all major treatment projects to determine whether management objectives are being met. Treatment success and the ability to use adaptive management to modify treatments would be reduced as the ability to use chemical controls would be limited.	**FULL IMPLEMENTATION:** Monitoring programs would be designed for all major treatment projects to determine whether management objectives are being met. Overall treatment success would be evaluated, and adaptive management would be used to modify treatments as appropriate.	**FULL IMPLEMENTATION:** Monitoring programs would be designed for all major treatment projects to determine whether management objectives are being met. Treatment success and the ability to use adaptive management to modify treatments would be limited by elimination of chemical and biological control methods.
Track invasive plant management efforts	**FULL IMPLEMENTATION:** In addition to annual pesticide reporting, FLAG would continue cooperation with SCPN on invasive species vital signs monitoring and EPMT tracking and effectiveness monitoring.	**FULL IMPLEMENTATION:** In addition to annual pesticide reporting, the park would continue cooperation with SCPN on invasive species vital signs monitoring and EPMT tracking and effectiveness monitoring.	**FULL IMPLEMENTATION:** In addition to annual pesticide reporting, the park would continue cooperation with SCPN on invasive species vital signs monitoring. EPMT involvement would be limited due to the lack of chemical treatments.
Prioritize both invasive plant species and locations to be controlled	**LIMITED IMPLEMENTATION:** Current prioritizations for some species and locations would be focused on highly invasive riparian species. Efforts to reprioritize would be considered following new infestations and spread of existing populations.	**FULL IMPLEMENTATION:** All species considered invasive in the monuments will be prioritized using an established ranking protocol to create a list that is park specific. Treatment locations would be identified and prioritized based on supporting documentation.	**LIMITED IMPLEMENTATION:** Availability of techniques will have an influence on the sites and species able to be treated, thereby limiting the utility and purpose of the ranking process.

Alternative Elements/Actions	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II: Preferred Alternative –*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Work with adjacent landowners, local, state and federal agencies, local interest groups, invasive plant cooperative networks, and others to develop and achieve common goals of invasive plant management	**LIMITED IMPLEMENTATION:** FLAG staff would seek to expand collaboration efforts and new partnerships with interested parties, however it will likely be limited in its ability to create, fulfill, and maintain these partnerships because of a limited use of techniques.	**FULL IMPLEMENTATION:** FLAG staff would expand collaboration efforts and new partnerships with neighboring landowners, other parks, park visitors, invasive plant management experts, other resource managers, and local, state, and federal officials.	**LIMITED IMPLEMENTATION:** FLAG staff would seek to expand collaboration efforts and new partnerships with interested parties, however it will likely be limited in its ability to create, fulfill, and maintain these partnerships because of a limited use of techniques. There is the threat of invasive populations expanding from the park and infesting adjacent lands.
Identify control techniques most appropriate for each species	**LIMITED IMPLEMENTATION:** FLAG would conduct invasive plant management using only a portion of all treatments and techniques available. These techniques would be implemented in accordance with mitigation measures identified in this chapter and **Appendix D.**	**FULL IMPLEMENTATION:** FLAG would continue invasive plant management, but use the most effective and integrated pest management techniques. The park would coordinate knowledge of invasive plant biology, the environment, and all available technology to prevent increased levels of invasive plant damage, using environmentally sound, cost-effective management strategies that pose the least possible risk to people, park resources, and the environment. These techniques would be implemented in accordance with mitigation measures identified in this chapter and **Appendix D**.	**LIMITED IMPLEMENTATION:** FLAG would conduct invasive plant management using only mechanical treatments and techniques, and would not focus on invasive species requiring chemical treatments. These techniques would be implemented in accordance with mitigation measures identified in this chapter and **Appendix D.**

Alternative Elements/Actions	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II: Preferred Alternative –*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Create annual work plans to guide invasive plant manage-ment activities	**FULL IMPLEMENTATION:** FLAG resource managers would have a standardized process in place to assist with invasive plant manage-ment. However, treatments would be less under this alternative because of the limited use of IPM techniques. The process will guide annual work or site-specific plans to identify invasive plants, determine invasive plant management priorities, identify and evaluate the efficacy and environmental effects of the limited treatment(s).	**FULL IMPLEMENTATION:** FLAG resource managers would have a standardized process in place to assist with invasive plant management planning. The process will guide annual work or site-specific plans to identify invasive plants, determine invasive plant management priorities, identify and evaluate the efficacy and environmental effects of the proposed treatment(s), and be able to utilize these treatments fully.	**FULL IMPLEMENTATION:** FLAG resource managers would have a standardized process in place to assist with invasive plant management. However, treatments would be very limited under this alternative because of the limited use of IPM techniques. The process will guide annual work or site-specific plans to identify invasive plants, determine invasive plant management priorities, identify and evaluate the efficacy and environmental effects of the limited treatment(s).
Restoration	**LIMITED IMPLEMENTATION:** Restoration would be limited under this alternative as riparian areas treated are expected to naturally revegetate. Mechanical treatments may include hand seeding of small areas, but these treatments are not expected to effectively control many of the invasive populations. It is less likely that the riparian area on the Little Colorado River would be restored as invasive species would not be effectively treated.	**FULL IMPLEMENTATION:** Additional emphasis on restoration planning and implementation following treatments as part of IPM planning would occur. The camelthorn around Heiser Spring and along the highway may be effectively treated and the area restored as chemicals are expected to effectively control the invasive species.	**LIMITED IMPLEMENTATION:** Restoration would be very limited under this alternative and may include hand seeding of small areas as mechanical treatments are not expected to effectively control many of the worst invasive populations. It is unlikely that Heiser Spring and the riparian area along the Little Colorado River would be restored as invasive species would not be effectively treated with only mechanical and cultural methods.

2.3.2 Alternatives Considered and Rejected

One additional alternative was identified and considered in the scoping process. Alternative IV was called the "no invasive plant management or control" (or "do nothing") alternative. It was regarded as unreasonable within the context of NPS policies (Director's Order 12, Section 2.7B) and was therefore eliminated from further analysis. Section 2.7B identifies as unreasonable those alternatives that could not be implemented if they were chosen, that cannot be implemented for technical or logistical reasons, that do not meet park mandates, that are not consistent with management objectives, or that may have severe environmental impacts.

Without active management or control, invasive species would continue to cause irrevocable damage to FLAG resources, and severely degrade visitor use and enjoyment, as well as surrounding and adjacent land uses and values. This alternative was rejected because it does not meet the requirements of FLAG Area National Monuments enabling legislation to protect natural resources, the NPS Organic Act, and NPS policies. Nor does it consider other federal, state, and county noxious invasive plant acts and provisions.

2.4 Mitigation Measures Common to All Alternatives

There are a number of mitigation measures common to all alternatives. Mitigation measures are related to a number of resource areas. A mitigation checklist has been prepared and must be reviewed prior to any treatments (see **Appendix B**).

- **Cultural Resources**

  Mechanical treatments in proximity to historic and prehistoric cultural resource sites will only be implemented under the supervision of a cultural resource specialist to avoid the possibility of disturbing subsurface archeological material or undermining remaining standing architecture. Prescribed burns will only be implemented after the approval of a burn plan, and only used in areas away from cultural resource sites. Should any treatment be determined to potentially affect cultural resources, site specific compliance with Section 106 of the National Historic Preservation Act will be initiated with affiliated tribes as well as the state historic preservation office.

  FLAG archeologists will work closely with the biologist and invasive species treatment crews in the location and identification of historic and prehistoric structures. FLAG staff and EPMT crews conducting invasive plant management work will be trained yearly in cultural site awareness to learn how to identify and avoid archeological and historical resources on the ground. This training has been very successful in other parks to assure the protection of park cultural resources. Should presently unidentified archeological resources be discovered during project implementation, work in that location would stop until the resources are properly recorded by an NPS archeologist and evaluated under National Register of Historic Places eligibility criteria in consultation with the Arizona State Historic Preservation Officer (AZ SHPO) and affiliated tribes as appropriate. If the resources are determined eligible, appropriate measures would be implemented either to avoid resource impacts or to mitigate disturbance. In compliance with the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), the NPS would also notify and consult affiliated tribal representatives for proper treatment of human remains, funerary, and sacred objects, should these be discovered. All workers would be informed of penalties for illegally collecting artifacts or

intentionally damaging any archeological or historic property in the vicinity. Should any unusual treatment conditions or locations arise related to cultural resources, FLAG staff would contact the park archeologist to determine how to proceed.

- **Mapping of Invasive Plant Species**
  Newly discovered invasive plant species and infestations will be mapped with a GPS unit, and the FLAG resource staff will be notified. All workers' clothing and footwear and all tools and equipment shall be cleaned at the treatment sites to ensure that seeds or propagules (any plant part that can give rise to new individuals) from invasive plant plants are not transported to new locations. FLAG staff will continue to work with SCPN on their invasive species vital sign monitoring and to store GIS data.

- **Job and Tool Use Safety**
  A job hazard analysis (JHA) that outlines job hazards and safety precautions will be developed for each project, and all project participants will receive tool safety training and will be required to use the appropriate Personal Protective Equipment (PPE) for each associated task. The tools would be kept in appropriate and assigned storage locations at all times. The use of tools would follow procedures outlined in the JHA.

- **Visitor Experience**
  NPS staff will be available to provide educational and informational messages to any groups encountered during project implementation. Infestations located near heavily used areas will be mechanically controlled, if feasible, and the work will be completed when visitors will be least impacted.

- **Native Plant Restoration**
  Active native species restoration must be used in all project areas. All restoration efforts will use native species. Restoration will seek to restore the natural conditions prior to invasive plant species arrival or to prevent re-invasion after removal. Active restoration will include the collection of seed and/or cuttings from native plants in the project area. Any seed spreading or planting of cuttings would seek to replicate the composition and structure of the untrammeled native plant communities. Effective monitoring and maintenance must be conducted in these areas to ensure project success.

- **Soil Compaction and Biotic Community Disturbance**
  To minimize soil compaction, the following mitigation measures will be incorporated into all action alternatives:
    - The project leader will determine the access route that would cause the least disturbance to sensitive cultural resources, soils, and vegetation. Access to areas should include existing wildlife or hiking trails wherever possible. If no trails exist, the project leader will determine whether single or multiple paths can be used depending on which would cause the least impact.
    - The least amount of people and the minimum number of trips will be conducted into sensitive areas for follow-up treatments and/or monitoring.
    - If equipment such as an Off-Road Vehicle (ORV), utility vehicle (UV), or tractor is used for invasive plant treatments or restoration, the lightest/smallest equipment shall be used. No such equipment will be used on wet soils or cryptobiotic soil

crusts that could be subject to long-term compaction impacts. Equipment will be cleaned on-site to prevent the transport of invasive species into new areas.

- **Special Status Species**
  There are a number of special status species known or suspected to occur within FLAG National Monuments. A complete list is found in **Appendix H**. FLAG staff conducted formal consultation with the US Fish and Wildlife Service to ensure protection of these species (USFWS April, 2009). Specific mitigation measures for special status species are listed in **Appendix C**.

  The following mitigation measures would be incorporated into all action alternatives:
  1. The proposed project would include provisions for the discovery of previously unknown or undiscovered threatened, endangered, or special status species. These provisions require the complete stop of project activities until FLAG staff evaluates the project impact on the discovered species and conducts additional Section 7 consultation with the U.S. Fish and Wildlife Service, if necessary.
  2. All project participants would be informed about special status species and what actions should occur if any special status species is encountered.
  3. Work involving string trimmers or chainsaws will not occur within sensitive habitat during breeding and dispersal periods for threatened, endangered, or special status species.
  4. Southwestern willow flycatcher: formal consultation with USFWS allows for treatment of invasive plant species at any time of year, if necessary to make use of seasonal work crews. Treatment during times of flycatcher migration will be avoided if possible.
  5. Yellow-billed cuckoo: this is a migratory species; therefore work in riparian gallery forests will be conducted in the fall/winter to avoid disturbing yellow-billed cuckoos.

- **Best Management Practices (BMPs)**
  Best management practices for soil erosion control, as outlined in Director's Order 77 –1 *Natural Resource Protection,* and for protecting wetlands, as outlined in Director's Order 77-1 – *Wetlands Protection* will be adhered to in the implementation of all projects.

2.5 Mitigation Measures Common to Alternatives I & II

FLAG has adopted the policy of requiring a trained and certified applicator on site during projects involving herbicides. Arizona State pesticide application certification, including herbicide training and safety, must be renewed annually. All project participants will receive herbicide training from the certified project leader. Project participants will understand and abide by the established Personal Protective Equipment (PPE) requirements and rules outlined on the product label. Rubber gloves, long sleeve shirts, and goggles may be required PPE for application of herbicides. Job hazard analyses (JHA) for invasive plant removal and herbicide application have already been prepared and would be reviewed frequently with all project participants.

All information and instructions on the herbicide label shall be strictly followed. All herbicide containers will show the product label and will be leak- and spill-resistant. All application equipment and chemicals will be stored in appropriate storage facilities. Material Safety Data

Sheets (MSDS) will be maintained for all chemicals. The MSDS contains fire and explosive hazard data, environmental and disposal information, health hazard data, handling precautions, and first aid information. All participants will review the MSDS with the project leader and understand first aid instructions described on the MSDS. All herbicide and application equipment will be stored separately from food and personal items.

If the label instructions for the herbicide and application method recommend limiting exposure to humans and pets, the area will be closed during treatment. Treatments will occur when the least number of visitors would be impacted by the closure. Treatments that pose no risk to humans may be done at any time and may be interpreted for visitors. All herbicide mixing and loading of sprayer tanks will occur in designated staging areas where there will be no impacts to native plant communities, surface water, or groundwater.

If invasive plant infestations occur in areas with archeological sites, the preferred control method may be chemical control to avoid disturbance of the artifacts. Because it is not known how these chemicals will react with historic and prehistoric materials they will be applied in the most precise manner possible. For instance, brushing onto the stumps of cut shrubs and trees to prevent resprouting is preferable to spraying due to overspray issues. All mechanical treatments will be pre-approved by the FLAG archeologist when used in areas with known cultural resources. Treatment operations will be subject to monitoring by the park archeologist or other cultural resource specialist at any time. Should any treatment be determined to potentially impact cultural resources, site specific compliance with section 106 of the National Historic Preservation Act will be initiated with affiliated tribes as well as the state historic preservation office.

2.6 Environmentally Preferred Alternative

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA), which is guided by the Council on Environmental Quality (CEQ). The CEQ provides direction that "the environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101" (Forty Most Asked Questions Concerning Council on Environmental Quality's National Environmental Policy Act Regulations, 1981).

Section 101 of the National Environmental Policy Act states that "…it is the continuing responsibility of the Federal Government to:

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

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of resources."

Alternative II is the environmentally preferable alternative because it surpasses both the continuation of current management alternative (Alternative I) and Alternative III in realizing the full range of national environmental policy goals as stated in Section 101 of the National Environmental Policy Act, see **Table 5**. Alternatives I and III do not provide for comprehensive invasive plant management treatments on a large scale across the three FLAG monuments. Invasive plant species populations are expected to continue to spread under Alternatives I and III. While Alternative III does result in the least amount of public controversy over perceived potential impact to resources and humans, it does not result in decreased risk to the long-term health of native communities and natural processes in comparison with Alternative II, see **Table 6** on page 54. A discussion of how each alternative relates to these goals follows:

Alternative I: *No Action - Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

This alternative seeks to meet the environmental policy goals by using several, but not all, of the available IPM techniques to manage invasive plant species. With limited use of chemical treatments and biological control agents, certain invasive species are likely to be introduced and/or spread more widely throughout the park. Environmental degradation already occurring as a result of the spread and eventual dominance of several particular species is likely to increase, which fails to meet three of the environmental policy goals.

For example, tamarisk is currently known to infest the riparian area at Wupatki National Monument. This is a highly invasive species that prefers moist soil conditions. It is allelopathic, meaning the plant produces chemicals and sheds them into the environment where they inhibit growth or survival of other plant species, in this case salts. It will naturally form monocultures that are resistant to re-colonization by native species. It has the potential to spread to adjacent public and private lands. A combination of mechanical and chemical treamens has been a cost and labor intensive but effective control technique used by a number of agencies for years. New invasive species are expected to continue to appear on a regular basis (despite the use of spot control using mechanical and chemical techniques) as visitors, equipment, and animals visit, move, and migrate to and from places outside of Wupatki.

Therefore, this alternative would not result in the same level of protection of natural and cultural resources and people over the long-term as would occur with the preferred alternative. Consequently, the continuation of the current management practices alternative does not satisfy provisions 1-5 of NEPA's Section 101.

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

This alternative provides the greatest flexibility in mitigating and responding to the unique and individual nature of all invasive species problems that are present in FLAG by using the full range of available IPM techniques, including those available now and those shown as effective in the future. Using true Integrated Pest Management strategies reduces dependence on one or few

techniques to manage invasive species, thereby lessening any repetitive and potentially cumulitive adverse impacts of those same techniques to the safety, health and integrity of resources, visitors, and staff.

This alternative provides opportunities for selecting and tailoring individual or combined treatments against specific invasive species, and thus should be most effective in managing the largest number of infestations. Using IPM to protect and restore native vegetative communities and natural processes altered by invasive species will ultimately provide for better health, safety, and enjoyment of visitors and employees, and protect natural and cultural resources for succeeding generations. This alternative further provides for invasive species management prescripttions intended to contribute to the maintenance of the long-term stability and diversity of native vegetation communities, and will protect people and cultural and natural resources with minimum disturbance. This alternative would satisfy all of the provisions of the national environmental policy goals.

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Like Alternative I, this alternative also seeks to meet environmental policy goals using a limited range of available IPM techniques to manage invasive plants. Several species currently exist across relatively large areas within FLAG, and in some cases they dominate the communities in which they occur. The use of chemicals is eliminated under this alternative, and chemical control is considered the most useful and efficient for managing large and/or widespread invasive plant infestations. Herbicide applications are also very useful when applied in spot treatments to small, isolated infestations for many species of new invaders.

This alternative limits the use of potentially controversial management techniques in recognition of their potential to damage resources and people if used or considered improperly. However, implementation of this alternative is expected to increase the rate of natural and cultural resource degradation and decrease visitor safety and enjoyment due to its inability to fully control invasive species. New exotic plant invaders will gain a foothold in the monuments, and already widespread invasive plant species will increase their range and amplitude both within and outside park boundaries. Consequently, Alternative III does not satisfy any provisions of NEPA's Section 101.

Table 5: Invasive Plant Management Plan Objectives

Plan Objective	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Preserve, protect, and restore natural conditions and ecological processes of FLAG by eradicating, significantly reducing, or containing infestations of known invasive plants.	Implementation of Alternative I will partially meet this objective. Some resources and natural processes will be protected and expansion of some invasive populations already present may be slowed, but likely only for the short-term. The continuation of current management practices alternative does not provide the guidance for the long-term preservation, protection, and restoration of resources degraded by invasive species.	Alternative II will fully meet this objective. The maximum number and type of resources and processes will be preserved, protected, and restored over the long-term through the implementation of a flexible and comprehensive invasive species management planning process.	Implementation of Alternative III will minimally meet this objective. Riparian resources would be at risk as existing invasive populations would not be effectively treated. Some resources and natural processes will be protected, and expansion of some invasive plant populations may be slowed, but only for the short-term. This alternative does not provide for the long-term preservation, protection, and restoration of resources degraded by invasives.
Prevent further introduction of invasive species already present in the monument as well as new species introductions by increasing visitor and staff awareness and cooperation with adjacent landowners.	Implementation of Alternative I will partially meet this objective. Prevention and education are a part of this alternative. It does not provide for integrated management using the most effective treatments for a number of invasive species. The lack of integrated methods would limit the cooperation with other neighbors.	Implementation of Alternative II will meet this objective. Prevention and education are a part of this alternative. Management activities and planning efforts would involve implementation of the most effective and efficient integrated treatment methods. The use of a full range of integrated pest management techniques would result in the fullest cooperation with adjacent landowners.	Implementation of Alternative III will minimally meet this objective. Prevention and education are a part of this alternative. It does not provide for integrated management using the most effective treatments for a number of invasive species. The lack of integrated methods would result in the spread of some species to adjacent lands interfering with cooperation with adjacent landowners.

Table 5 (cont.): Invasive Plant Management Plan Objectives

Plan Objective	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Establish protocols, decision-making tools, schedules, and treatment methods for routine invasive plant management activities.	Implementation of Alternative I will partially meet this objective. Annual operating plans under this alternative would guide and utilize resources to the fullest extent possible. The full use of integrated treatments would be limited by restrictions on the use of herbicides and other integrated management techniques, thereby limiting treatment areas.	Implementation of Alternative II will fully meet this objective. Annual operating plans under this alternative would guide and utilize treatment resources to the fullest extent possible using the full range of IPM management techniques and tools and maximizing the areas that would be treated.	Implementation of Alternative III would minimally meet this objective. Annual operating plans under this alternative would guide and utilize treatment resources to a limited extent. Mechanical treatments and the need to retreat areas frequently, and the lack of use of herbicides and integrated methods will limit the efficiency of treatment methods and routine invasive plant management activities.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

NEPA requires that environmental documents disclose the environmental impacts of the proposed federal action, reasonable alternatives to that action, and any adverse environmental effects that cannot be avoided should the preferred alternative be implemented. This chapter identifies the impacts to the physical, biological, and human aspects of the environment that could be affected by the alternatives. The effects of project alternatives on each resource are also described.

This chapter analyzes the potential environmental consequences, or impacts, that would occur as a result of implementing the 10 steps to implement invasive plant management described in the previous chapter. Topics analyzed in this chapter include:

3.7 Natural Resources
- 3.7.1) Geologic Resources and Soils
- 3.7.2) Vegetation
- 3.7.3) Wildlife
- 3.7.4) Special Status Species
- 3.7.5) Water Resources
- 3.7.6) Wetlands, Floodplains, and Riparian areas

3.8 Cultural Resources
- 3.8.1) Archeological and Historic Resources
- 3.8.2) Cultural Landscapes
- 3.8.3) Ethnographic Resources

3.9 Social Issues
- 3.9.1) Visitor Use Experience
- 3.9.2) Adjacent Land Use
- 3.9.3) Public Health

3.1 Methodology

Resource topics were developed by the interdisciplinary IPMP team based on the results of internal scoping and input received during the public scoping process. The definition of an environmental impact is the change in condition of the resource or environment under examination due to the proposed action. Direct, indirect, and cumulative effects, as well as impairment are analyzed for each resource topic that has been carried forward. Potential impacts are described in terms of type, context, duration, and intensity. Specific impact thresholds are given for each resource at the beginning of each resource section.

General definitions are defined as follows:

- ***Type***
  Describes the classification of the impact as either beneficial or adverse, direct or indirect:

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

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

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

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

- ***Context***
  Describes the area or location in which the impact will occur. Are the effects site-specific, local, regional, or even broader?

  Site-specific impacts - the action would affect areas within a park unit boundary.

  Local impacts - the action would affect areas within a park unit boundary and land adjacent (sharing a boundary) to a park unit.

  Regional impacts - the action would affect the park, land adjacent to the park, and surrounding communities.

- ***Duration***
  Describes the length of time an effect will occur, either short-term or long-term:

  Short-term impacts generally last only during treatment and 1-3 years thereafter. The resources resume their pre-treatment conditions after this period. Some impact topics will have different short-term duration measures and these will be listed with the resource.

  Long-term impacts last beyond 3 years after the treatment period. The resources may not resume their pre-treatment conditions after 3 years following completion of the project, and for all practical purposes is considered permanent. Some impact topics will have different short-term duration measures and these will be listed with the resource.

  In the case of cultural resources, while damage that results in the loss of, or damage to historic fabric can be physically repaired, that loss or damage constitutes a permanent impairment of the resource.

- **Intensity**
  Describes the degree, level, or strength of an impact. For this analysis, intensity has been categorized into ***negligible, minor, moderate, and major***. Because definitions of intensity vary

by resource topic, intensity definitions are provided separately for each impact topic analyzed in this Environmental Assessment.

3.2 Cumulative Effects

The Council on Environmental Quality (CEQ) regulations, which guide the implementation the National Environmental Policy Act of 1969 (42 USC 4321 et seq.), require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results 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 considered for all Alternatives.

Cumulative impacts were determined by combining the impacts of the Preferred Alternative with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects within the parks and, if applicable, in the surrounding region. The geographic scope for this analysis includes elements within monument boundaries and areas adjacent. The temporal scope includes projects within a range of approximately ten years. Given this, the following projects, listed from past to future, have been identified for the purpose of conducting this cumulative effects analysis:

Urbanization: The Flagstaff area continues to experience urban development and expansion. The monuments are all within easy commuting distance of the city of Flagstaff. The population of Arizona and the Flagstaff area is expected to increase almost two-fold by 2025 (ADWR 2008). A number of landscaping ornamentals have 'escaped' and are now considered invasive species including toadflax and tamarisk. Residential and commercial development near park boundaries would increase the possibility for the introduction of additional invasive ornamentals. Ground disturbance associated with construction activities creates a suitable seedbed and establishment sites for invasive species.

Roads: Roads are a major source of invasive species transport and invasion. In addition to the roads into the parks themselves, State Highway 89 travels through part of Wupatki NM and near Sunset Crater NM. The monuments are surrounded by myriad networks of secondary roads, and Sunset Crater Volcano National Monuments directly abuts an area where off-road travel is permitted and encouraged by the Forest Service.

Flooding: Floodwaters carry invasive plant materials from outside the boundaries into the monuments. The Little Colorado River in Wupatki NM and Walnut Canyon at WACA frequently experience flood conditions, and there are numerous normally dry washes the will flash-flood during monsoonal rains.

Agriculture: There are large ranching operations in the vicinity of the monuments. Intensive livestock grazing continues right up to the monument borders. Trespass livestock at all the FLAG monuments continues to be a problem. Invasive species thrive on the impacts of overgrazing, and livestock are known to transport and spread invasive species.

Recreation: Recreation access provides a transport mechanism for invasive species. There are a number of existing hiking, biking, and off-road vehicle (ORV) trails in and adjacent to the FLAG

monuments. Seeds often attach to hikers clothes and the wheels and bodies of bikes and ORV's, or may come from livestock such as horses. These activities is expected to increase as the word spreads about the opportunities now available at the FLAG monuments and as the population of the area continues to grow.

Park Development and Construction: Construction and renovation projects within the FLAG monuments creates disturbance that could, without proper precautions, enhance invasive species spread. Additional construction projects are planned in many areas throughout the FLAG monuments.

3.3 Impairment

NPS's *Management Policies* (2006) require analysis of potential effects to determine whether or not actions would impair park resources (NPS 2006). The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the NPS 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 NPS the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the NPS must leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise. Prohibited impairments are impacts that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values. While any impact to any park resource or value may constitute an impairment, an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value when the conservation of that resource 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.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. A determination on impairment is made in the Conclusion section for each of the resource topics carried forward in this chapter.

3.4 Unacceptable Impacts

The impact threshold at which impairment occurs is not always readily apparent. Therefore, the Park Service applies a standard that offers greater assurance that impairment will not occur by avoiding unacceptable impacts. These are impacts that fall short of impairment, but are still not acceptable within a particular park's environment. Park managers must not allow uses that would cause unacceptable impacts; they must evaluate existing or proposed uses and determine whether the associated impacts on park resources and values are acceptable.

Virtually every form of human activity that takes place within a park has some degree of effect on park resources or values, but that does not mean the impact is unacceptable or that a particular use must be disallowed. Therefore, for the purposes of these policies, unacceptable impacts are impacts that, individually or cumulatively, would:

- be inconsistent with a park's purposes or values, or
- impede the attainment of a park's desired future conditions for natural and cultural resources as identified through the park's planning process, or
- create an unsafe or unhealthful environment for visitors or employees, or
- diminish opportunities for current or future generations to enjoy, learn about, or be inspired by park resources or values, or
- unreasonably interfere with:
    - park programs or activities, or
    - an appropriate use, or
    - the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park
    - NPS concessioner or contractor operations or services.

In accordance with Management Policies, park managers must not allow uses that would cause unacceptable impacts to park resources. To determine if unacceptable impacts could occur to the resources and values of Flagstaff Area National Monuments, the impacts of proposed actions in this environmental assessment were evaluated based on the above criteria. A determination on unacceptable impacts is made in the Conclusion section for each of the resource topics carried forward in this chapter.

3.5 Impacts to Cultural Resources and Section 106 of the National Historic Preservation Act

In this Environmental Assessment, impacts to historic properties are described in terms of type, context, duration, and intensity, as described above, which is consistent with the regulations of the Council on Environmental Quality (CEQ) that implement the National Environmental Policy Act (NEPA). This Environmental Assessment is intended, however, to comply with the requirements of both NEPA and §106 of the National Historic Preservation Act (NHPA). To achieve this, a §106 summary is included under the Preferred Alternative for each of the cultural resource topics carried forward including Historic Structures. The topics of cultural landscapes, ethnographic resources, and museum collections were dismissed from further consideration because none were identified in the project area. Should any treatment be determined to potentially affect cultural resources, site specific compliance with §106 of the National Historic Preservation Act will be initiated with the park's affiliated tribes as well as the Arizona State Historic Preservation Officer (AZSHPO).

Under the Advisory Council's regulations, a determination of either *adverse effect* or *no adverse effect* must be made for affected historic properties that are eligible for or listed on the National Register of Historic Places. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the National Register (e.g. diminishing the integrity of the resource's location, design, setting, materials,

workmanship, feeling, or association). *Adverse effects* also include reasonably foreseeable effects caused by the Preferred Alternative that would occur later in time; be farther removed in distance; or be cumulative (36 CFR Part 800.5, Assessment of Adverse Effects). A determination of *no adverse effect* means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion in the National Register of Historic Places.

In accordance with the Advisory Council's regulations implementing §106 of the NHPA (36 CFR Part 800, Protection of Historic Properties), impacts to historic properties for this project were identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that were either listed on or eligible for the National Register of Historic Places; (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.

CEQ regulations and the NPS*'s Conservation Planning, Environmental Impact Analysis and Decision-Making* (Director's Order #12) 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). Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. It does not suggest that the level of effect as defined by §106 is similarly reduced. Although adverse effects under §106 may be mitigated, the effect remains adverse.

In order for a historic property to be listed on the National Register of Historic Places, it must meet one or more of the following criteria of significance: A) associated with events that have made a significant contribution to the broad patterns of our history; B) associated with the lives of persons significant in our past; C) embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value, or represent a significant and distinguishable distinction; D) have yielded, or may be likely to yield, information important in prehistory or history. In addition, the historic property must possess integrity of location, design, setting, materials, workmanship, feeling, association (*National Register Bulletin, How to Apply the National Register Criteria for Evaluation*).

3.6 Summary of Environmental Consequences of the Alternatives

Table 6 summarizes the environmental consequences of the alternatives on the topics analyzed in this chapter.

Table 6: Environmental Impact Summary by Alternative

Environmental Impact Topic	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
NATURAL RESOURCES			
Geologic and Soil Resources	**Cumulative impacts will be direct and indirect, adverse, local, short- and long-term, and negligible.** These minor impacts are from soil disturbance primarily associated with mechanical treatments, and also from minimal persistence of herbicides in the soils. Long-term impacts are expected to be minor and beneficial as mechanically treated areas eventually stabilize and as soil conditions improve, resulting in indirect benefits to the soil resource.	**Cumulative impacts will be direct and indirect, adverse, local, short- and long-term, and negligible**. This alternative results in minor, adverse short-term impacts due to mechanical treatments, land restoration, and minimal persistence of chemicals in the soil. Long-term impacts would be moderate and beneficial as more areas would be treated using chemical methods with less soil disturbance, and from the recovery of vegetation on these sites.	**Cumulative impacts will be direct and indirect, adverse, local, short- and long-term, and negligible.** Widespread impacts are expected to be minor and localized as few areas would be treated due to the high cost of treatments. Impacts in the long-term would be moderate and adverse as soils are frequently disturbed from repeated treatments. Thus many populations would not be treated and would continue to spread, including allele-pathic species.
Vegetation	**Cumulative Impacts will be direct, adverse, site specific, short and long-term, and minor to moderate.** This alternative is intermediate between Alternatives II and III. Short-term impacts would be minor and beneficial as large populations of highly invasive plants would be treated and native plants (especially in riparian areas) are expected to re-colonize the sites. Long-term impacts would be minor and beneficial from treatment of the larger populations, but reduced due to the continued spread of smaller populations of less invasive species.	**Cumulative Impacts will be direct, adverse, site specific, short and long-term, and minor to moderate.** Benefits to vegetation would be greatest under this alternative. Implementation of integrated treatments would result in the most areas effectively treated, and revegetated by native species. Impacts to vegetation would be moderate and beneficial in the short and long-term. Restoration of the riparian areas and roadsides would result in additional long-term benefits.	**Cumulative Impacts will be direct, adverse, site specific, short and long-term, and minor to moderate.** This alternative will result in the least benefits to native vegetation as the fewest invasive plant populations will be treated and many invasive populations are predicted to continue to spread and displace native plants. Impacts would be moderate and adverse in the long-term as many invasive plant populations would continue to increase due to the lack of effectiveness and time and money to implement mechanical treatments.

Table 6 (cont.): Environmental Impact Summary by Alternative

Plan Objective	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Wildlife	**Cumulative Impacts will be direct and indirect, adverse, local, short- and long-term, and negligible.** Controlling invasive plants and promoting healthy native plant communities would rehabilitate wildlife habitat. However, Alternative II would likely achieve the desired condition before it would be reached under this alternative. The overall success of exotic plant management programs would vary among monuments.	**Cumulative Impacts will be direct and indirect, adverse, local, short- and long-term, and negligible.** IPM would help the FLAG monuments achieve the desired condition to have, as parts of the natural ecosystems of parks, all native animals maintained. By controlling invasive and exotic plants and promoting healthy native plant communities, wildlife habitat would be rehabilitated at all 3 monuments.	**Cumulative Impacts will be direct and indirect, adverse, local, short- and long-term, and negligible.** Being limited to only mechanical and cultural control methods would seriously hamper the ability to control invasive plants effectively. Thus, the overall success of exotic plant management programs would vary between monuments, and the impacts on wildlife would therefore also vary between monuments.
Special Status Species	**Cumulative impacts will be direct and indirect, adverse, short-term, localized, and minor**. Impacts to special status species are intermediate of all alternatives. Short-term impacts would be minor and beneficial. Long-term benefits would continue for these species, but overall fewer areas would be treated due to the limited use of integrated pest manage-ment techniques.	**Cumulative impacts will be direct and indirect, adverse, short-term, localized, and minor**. Benefits to special status species would be greatest under this alternative. Short-term impacts are minor and beneficial due to the focus on riparian habitats. Long-term benefits would be moderate as more areas and other less invasive species would be treated with integrated pest management techniques.	**Cumulative impacts will be direct and indirect, adverse, short-term, localized, and minor to moderate**. Special status species would be adversely impacted by this alternative. Ongoing chemical treatments would be discon-tinued and native habitats would decline resulting in minor adverse impacts. As invasive species continue to spread there would be a greater loss of native habitats resulting in moderate, adverse impacts.

Plan Objective	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Water Resources	**Cumulative impacts will be direct and indirect, adverse, local, short and long-term, negligible to minor** Impacts of this alternative are intermediate to the other alternatives. Short-term impacts to water quality are minor and adverse from sedimentation that could result from soil erosion from mechanical treatments and from the potential for chemical drift into surface waters or leaching into ground water. Long-term impacts would be minor and beneficial as treated areas would revegetate resulting in reduced sedimen-tation. There would be no impact on water quantity.	**Cumulative impacts will be direct and indirect, adverse, local, short and long-term, negligible.** Impacts from this alternative would benefit water quality in the long-term. Short-term impacts are similar to Alternative I from sedimentation and chemical drift or leaching. Long-term impacts would be moderate and beneficial as more areas would be treated with chemicals reducing the potential sedimentation from repeated mechanical treatments. There would be no impact on water quantity.	**Cumulative impacts will be direct and indirect, adverse, local, short and long-term, negligible to minor.** Alternative III would have minor and adverse impacts to water quality. Mechanical treatments would be the primary treatment method and would result in increased risk of soil erosion and sedimentation. There would be no impact on water quantity.
Wetlands/ Floodplains and Riparian Areas	**Cumulative impacts will be direct, adverse, site-specific, long-term, and moderate.** Beneficial effects to wetlands, floodplains, and riparian areas would vary between monuments and areas within each monu-ment. The overall success of invasive plant management within the wetlands, floodplains, and riparian areas would likely be lower than Alternative II. Exotic plant management would help management achieve the desired condition to maintain and preserve these ecologically important areas.	**Cumulative impacts will be direct, adverse, site-specific, long-term, and minor to moderate.** In most areas, IPM will enhance the existing wetland area or floodplain/ riparian function. Removal of invasives would help enhance ripar-ian habitat. Effects to wetlands and floodplains would be detectable and readily apparent. Impacts would be site-specific and effects to individual plants could be long-term. USACE 404 permits would not be required for any proposed IPM treatments. Overall beneficial effects to wet-lands would be greater under Alternative II. The minor short-term adverse impacts would be greatly outweighed by the long-term benefits of habitat rehabilitation.	**Cumulative impacts will be direct, adverse, site-specific, long-term, and minor.** The impacts from Alternative III are similar to Alternative I except that less area would be treated . Thus cumulative impacts would be direct, adverse, site-specific, long-term, and minor.

Table 6 (cont.): Environmental Impact Summary by Alternative

Plan Objective	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
CULTURAL RESOURCES			
Archeological and Historic Resources	**Cumulative impacts will be direct and indirect, adverse, site-specific, short- to long-term, minor to moderate.** Removal of invasive species using these techniques would result in some level of improvement to soil and vegetation communities that supports historic structure pre-servation, but because of the lack of expanded prevention techniques or bio-control agents, remaining techniques available would not be the most effective at adequately preventing new species introductions or managing range expansions of existing species that continue to de-stabilize and degrade structure context. Overall effects to resource would be moderate, adverse, and long term. Current management practices would help in preventing or reducing invasive species poten-tial to destabilize and degrade archeological sites and artifacts, though effects may not be as long-lived or as wide-spread as in Alternative II. Overall effects to resource would be moderate, adverse, and long term.	**Cumulative impacts will be direct and indirect, adverse, site-specific, short- to long-term, negligible to minor.** Control of invasives would improve or restore conditions and context for the archaeological and historic structures. Techniques available are expected to most effectively and efficiently treat the most acres of species that compro-mise archaeological sites and historic structures. Over-all effects to resource would be long-term, moderate, and beneficial. Removal of invasive species using the full range of tools would have long-term benefits for the protection, stabilization, and context of archeological resources and historic structures by enhancing pre-European plant and soil com-munities. Overall effects to resource would be long-term, moderate, and beneficial.	**Cumulative impacts will be direct and indirect, adverse, site-specific, short- to long-term, minor to moderate.** Likelihood of damage to archaeological and historic sites is increased due to necessity of repeated con-trol as well as the relative inability to treat species within culturally sensitive areas. Overall effects to resource would be mod-erate, adverse, and long term. Potential for damage to archeological resources is increased due to necessity for more frequent treatments using available techniques. Mechanical treatments would be discouraged in culturally sensitive areas, allowing the overgrowth of invasive species. Maintenance or improvement of stabilizing environment is reduced. Overall effects to resource would be moderate, adverse, and long term.

Plan Objective	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Cultural Landscapes	**Cumulative impacts will be direct and indirect, adverse, site specific, short-term, and minor to moderate.** Under Alternative I, adverse impacts to cultural landscapes from vegetation changes would continue to be negligible and short- to long-term. Beneficial impacts including restoration of native plants and removal of non-native plants not key features in the landscape would be minor and long-term.	**Cumulative impacts will be direct and indirect, adverse, site specific, short-term, and minor.** Under Alternative II adverse impacts to cultural landscapes from vegetation changes would be negligible short- to long-term. Beneficial impacts including restoration of native plants and removal of nonnative plants not key features in the landscape would be minor long-term.	**Cumulative impacts will be direct, adverse, site-specific, long-term, and minor to moderate.** Under Alternative III adverse impacts to cultural landscapes from vegetation changes would continue to be negligible and short- to long-term. Beneficial impacts including restoration of native plants and removal of non-native plants not key features in the landscape would be minor and long-term. Without chemical control most control efforts will need additional work and attention, thus increasing impacts.
Ethnographic Resources	**Cumulative impacts will be direct, adverse, site-specific, long-term, and minor to moderate.** Under Alternative I, the continuation of current exotic plant management, adverse impacts to ethnographic resources from increased erosion and soil compaction would be short- to long-term minor. Beneficial impacts including soil protection and stabilization from vegetative material left onsite would be short- to long-term minor.	**Cumulative impacts will be direct, adverse, site-specific, long-term, and minor.** Under Alternative II adverse impacts to ethnographic resources from increased erosion and soil compaction would be short- to long-term minor. Beneficial impacts including soil protection and stabilization from new native vegetation and vegetative material left onsite would be short- to long-term minor.	**Cumulative impacts will be direct, adverse, site-specific, long-term, and minor to moderate.** Under Alternative III, the continuation of current exotic plant management, adverse impacts to ethnographic resources from increased erosion and soil compaction would be short- to long-term minor. Beneficial impacts including soil protection and stabilization from vegetative material left onsite would be short- to long-term minor.

Table 6 (cont.): Environmental Impact Summary by Alternative

Plan Objective	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
SOCIAL ISSUES			
Vistor Use Experience	**Cumulativer impacts will be direct, adverse, site-specific, short- to long-term, and minor to moderate.** The quality of visitor experience has been reduced due to infestations of exotic plants. However, exotic plant management at FLAG (cutting, pulling, and chemical application) has helped to improve the quality of visitor experience. Under Alternative I, visitor experience would be expected to improve at current levels. Continuation of current exotic plant management programs would have negligible adverse additive impacts on visitor use and experience. Some treatment methods, such as prescribed fire and equipment operation, may be noticeable and could have short-term, adverse impacts on visitor experience.	**Cumulativer impacts will be direct, adverse, site-specific, short- to long-term, and minor.** IMP invasive plant manage-ment at FLAG (cutting, pulling, chemical application, and biocontrols) will help to improve the quality of visitor experience. During periods of high exotic plant management activity, minor short-term cumulative impacts may occur. Prescribed burns may also adversely affect visitors if not planned for appropriate periods. Equipment operation may also be noticeable to visitors and could have short-term, adverse impacts on visitor experience. Under Alternative II, the long-term quality of visitor experience would be improved by treating exotic plants.	**Cumulativer impacts will be direct, adverse, site-specific, short- to long-term, and minor to moderate.** The quality of visitor experience has been reduced due to infestations of exotic plants that could not be effectively treated using only mechanical and cultural methods. However, some exotic plant management using only mechanical means has helped to improve the quality of visitor experience. Under Alternative III, visitor experience would be expected to improve at current levels but not nearly as well as for Alternative II.
Adjacent land use	**Cumulative impacts will be direct and indirect, adverse, site-specific and local, short-term, and minor to moderate.** Implementation or continuation of invasive plant management activities under alternative I would have minor to moderate beneficial additive effects to invasive management efforts by neighbors throughout the area. It is expected that NPS managers will be constrained in the selection of treatments under Alternative I, which will result in decreased effectiveness and less acreage treated.	**Cumulative impacts will be direct, adverse, site-specific, short-term, and negligible to minor.** Implementation or continu-ation of invasive plant man-agement activities under any of the alternatives would have minor to moderate beneficial additive effects to invasive management efforts of neighbors throughout the area. It is expected that under Alternative II managers will have the most flexibility in treating the more acres and the most invasive species. Alternative II will be most effective and efficient in treating species that move across boundary lines.	**Cumulative impacts will be direct and indirect, adverse, site-specific and local, short-term, and minor to moderate.** Implementation under alternative III would have minor to moderate beneficial additive effects to invasive management efforts by neighbors throughout the area. It is expected that managers will be constrained in the selection of treatments under Alternative III, which will result in decreased effect-tiveness and less acreage treated.

Plan Objective	***Alternative I:*** *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*	***Alternative II:*** ***Preferred Alternative*** *Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants*	***Alternative III:*** *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*
Public Health and Safety	**Cumulative impacts will be direct and indirect, adverse, long-term, and minor.** Cumulatively, effects of Alternative I, when combined with other past, present, and reasonably foreseeable actions, would be similar to those described for Alternative II. Except that Alter-native II would be more effective in controlling invasive species.	**Cumulative impacts will be direct and indirect, adverse, long-term, and minor.** Toxicological problems are not expected as they relate to the application of herbicides in any of the alternatives, but especially in Alternative II. Recommended application rates are, at both the minimum and maximum levels, generally considerably below the maximum rate recommended on the label. The individuals most likely to be exposed for any duration are the applicators of the herbicide themselves. Use of personal protective gear and BMP's will reduce the probability of ever exceeding safe levels. The general public, even though they may have traveled through a recently treated zone, would not have the exposure time or levels to create potential problems related to human health. Signing and other mitigation practices would reduce this probability even lower since the general public can avoid the treatment area altogether and avoid exposure to the products.	**Cumulative impacts will be direct and indirect, adverse, long-term, and negligible to minor.** Similar as Alternative I. Under Alternative III, effects to public health and safety from use of hand tools and mechanized tools would be about the same, but there would be no impacts from chemical treatments because they would not be allowed.

3.7 Natural Resources

3.7.1 Geologic and Soil Resources

Section 4.8 of NPS 2001 Management Policies addresses geologic resource management including geologic features and processes. This policy states that NPS will maintain, preserve, and protect geologic resources as integral components of park natural systems. Measures to protect geology resources vary from park to park. Management practices typically include measures to avoid impacts to sensitive geological resources, such as paleontological resources. These practices include avoiding operation of heavy equipment in areas where sensitive resources are known or potentially present.

Section 4.8 of NPS 2001 Management Policies addresses soil resource management including soil features and processes. This policy states that NPS will maintain, preserve, and protect soil resources as integral components of park natural systems. Soil resources may be directly impacted from surface disturbances that alter soil structure and from the application of pesticides.

3.7.1.1 Affected Environment

The natural weathering of exposed geologic outcrops in the monuments under the prevailing arid climate has led to the formation of thin, sparsely vegetated soils. Large areas within the monuments harbor fragile soils that are sensitive to trampling, visitor use, and park development. Historic livestock grazing and heavy visitor use in local areas has resulted in soil compaction, vegetation loss, accelerated wind and storm erosion, and altered sediment deposition patterns. In the vicinity of all three park units the soils are typical of floodplains, alluvial fans, and valley slopes of this semi-desert region; they are deep and well drained, with a high water-holding capacity (NPS 1996).

Walnut Canyon National Monument Geologic Resources and Soils

The geology of Walnut Canyon is not complex and is described and mapped by Darton (1910), Vandiver (1936), and Benfer (1971). The canyon is eroded into sedimentary rock layers of the Kaibab Limestone and Coconino Sandstone formations. The drainage of Walnut Creek became entrenched in the canyon as the formations were locally uplifted. More recent volcanic events within the San Francisco Volcanic Field have influenced the drainage pattern of Walnut Canyon and surrounding canyons. Soil types also vary within the region, depending on whether they are derived from weathered limestone, sandstone, shale, or volcanic bedrock. Unique areas of relatively young, deep cinders are also present, where soils are still forming and vegetation is colonizing. Various dams upstream and within the park have impacted natural drainage patterns and there are areas within the canyon bottom where the sediment has accumulated unnaturally and exotic vegetation communities have established.

The major geologic and topographic feature of WACA is the canyon itself (Walnut Canyon), an entrenched segment of Walnut Creek whose walls rise 300 feet above the narrow canyon floor. The canyon cuts through the southeastern Coconino Plateau, a broad uplift that extends from the South Rim of the Grand Canyon to Flagstaff. Rising above the Coconino Plateau, south of Walnut Canyon in the southwestern section of the WACA project area, is an uplifted mesa referred to as Anderson Mesa. Cherry Canyon is the second largest canyon in the project area and is a major side canyon to the southeast of Walnut Canyon.

The upper walls of Walnut Canyon are comprised of the Kaibab Formation, a resistant gray limestone that caps not only the canyon but also the rims of the Grand Canyon to the northwest. It forms characteristic ledges and slopes, and includes massive layers of limestone and dolomite as well as some thin siltstones and sandstones. Many of the layers are fossiliferous, bearing small clams, snails, and brachiopods. This unit also caps the higher, relatively flat mesas surrounding the narrow canyon within the Monument. More recent Mesozoic and Cenozoic rocks, such as the Chinle Formation seen in the Painted Desert and at Petrified Forest National Park, have been eroded away as this portion of the Colorado Plateau has risen slowly over time. Southward, the Colorado Plateau ends abruptly along the Mogollon Rim, a roughly 200 mi long faulted escarpment that cuts across much of central Arizona.

Lying stratigraphically beneath the Kaibab Formation are the light tan cliffs of the Coconino Sandstone. This distinctive unit is comprised of cross-bedded sandstones that developed as a regressive sea laid bare vast tracts of sand that were later reworked into large dune fields. Evidence of these dunes has been preserved as the striking bedding patterns seen in the rock. Much later in time faulting "broke up" these massive sedimentary units, forming small joints in the rocks that have commonly served as erosion channels. These small faults and joints likely influenced development of the canyon as these areas of fractured rock are much more easily eroded. Presumably beneath the Coconino Sandstone are additional Paleozoic rock units, such as those seen in the Grand Canyon, but the small watershed of the creek has not yet cut down into these older units. To the southwest is Anderson Mesa which is composed of younger basaltic soils that lie on the surface of the Mesa as a result of geologically recent eruptions of Mormon Mountain.

Sunset Crater Volcano National Monument Geologic Resources and Soils

SUCR lies near the northeastern edge of the San Francisco volcanic field, which covers approximately 1,800 square miles of the southern Colorado Plateau in north-central Arizona (Priest et al. 2001). The volcanic field, whose major feature is the 12,600 foot high San Francisco Peaks, formed during the latter part of the Cenozoic era. Lava flows, cinders, tuffs, and other volcanic units are well exposed throughout the monument (NPS 1997 and Zion Natural History Association 1985). The monument's namesake landform, Sunset Crater, is a cinder cone that is a relatively recent landscape feature that formed during an eruption period that began sometime between 1040 and 1100 A.D. (Ort et al. 2002). This period of activity, which was short-lived from a period of days to years, blanketed much of the surrounding area in a thick bed of cinders and produced two contemporaneous lava flows, the Kana-a and the Bonito flow (Ort et al. 2002).

The volcanic units comprising the San Francisco Peaks Volcanic Field overlie a sequence of ancient, sedimentary rock formations. These Precambrian and Paleozoic strata are the same or similar units seen in the Grand Canyon to the northwest. Many of the sedimentary rocks underlying the region formed in a number of environments associated with ancient seas. Sandstones formed as outwash deposited on low-lying plains or as remnants of ancient sand dunes. Shales and limestones formed as the region was periodically submerged under a transgressing sea. Subsequent uplift of this massive sequence of rocks promoted erosion that later exposed several of these older sedimentary units. These are most readily seen in the Painted Desert to the north and east of SUCR, but also can be seen in other localities to the west and south.

The SUCR landscape contains outcrops and slopes of both basalt and more silicic rocks, exposed beds of volcanic tuff, some with high iron concentrations, aa lava flows, and cinder hills and beds ranging from black to reddish brown in color. Because of northern Arizona's relatively cool dry climate, Sunset Crater and other volcanic features of the monument have not weathered significantly since their formation. The porous nature of the cinders resists furrowing by runoff. However, long-lived lichens now cover much of the lava, and areas of vegetation occur in pockets where humus has built up from wind-blown pine needles, cinders, and decayed plant matter.

Wupatki National Monument Geologic Resources and Soils

WUPA's geology and topography are complex and diverse with varied substrates that influence plant species and vegetation communities found within the monument. WUPA is well known for the deep red siltstones which were used to construct the monument's ancient ruins; however, it also includes a number of other geologic units, including basalt flows, cinder cones, and extensive gravel fans.

WUPA is situated at the western edge of the Painted Desert between the Little Colorado River Valley to the east and the Coconino Plateau to the west. This plateau, a broad anticlinal fold, stretches northwestward toward the Grand Canyon and southward to Flagstaff. The Kaibab Formation, a gray limestone which caps the plateau in many areas, dips gently to the northeast below the younger Mesozoic rocks of the Painted Desert. The most striking of these colorful Mesozoic units is the Moenkopi Formation, a brick red rock consisting largely of shale with interbedded sandstone and badland forming mudstone. Some of the layers within this unit show ample evidence of an ancient sea that once covered the region. Cross-bedding, mudcracks, and ripple marks can be seen within this unit. Lying stratigraphically above the Moenkopi is a thin gravel, the Shinarump Conglomerate. This unit, which interestingly includes rounded pebbles of hard Precambrian rock, caps several mesas within the monument.

In contrast to these ancient rocks of sedimentary origin, basalt flows and a few cinder cones dot the landscape. These flows and cones are northeastern outliers of the San Francisco Volcanic Field, a large center of volcanic activity extending to the south and west. The field is approximately 6 million years old, and it is thought that eruptive activity has migrated from the southwest toward the northeast over time. The volcanoes and flows at WUPA and those of nearby Sunset Crater National Monument are geologically quite young, and are the youngest in the entire volcanic field. A few lava flows extend down to the Little Colorado River, and pockets of cinders deposited by the eruption of Sunset Crater approximately 1,000 years ago are also evident.

WUPA lies near the northeastern edge of the San Francisco volcanic field, which covers approximately 1,800 sq mi of the southern Colorado Plateau in north-central Arizona (Priest et al. 2001). The volcanic field, whose major feature is the 12,600 foot high Humphery's Peak, formed during the latter part of the Cenozoic era. San Francisco Mountain, the highest and most massive volcano in the region, is readily visible from the monument. During the Pleistocene Epoch, which ended approximately 15,000 years ago, glaciers covered the upper reaches of the 12,000 foot high cone. Outwash gravels associated with these masses of ice extend all the way down to WUPA. These are characterized by volcanigenic sand, pebbles, and cobbles whose origin is the high slopes of the peak.

Topography of WUPA consists of steep cinder cones, cliffs, rolling hills, broad flats, drainages, small canyons, and mesas. WUPA's elevation ranges from a high of 6,279 feet and a low of 4,226 feet. The Wupatki Basin is a low-lying area in the eastern portion of WUPA. Black Falls Crossing is the main road crossing on the Little Colorado River. Major ruins in the WUPA are Wupatki, Wukoki, Lomatki, Citadel, and Crack-in-the-rock. Several man-made stock tanks occur throughout the monument. Three major springs occur at WUPA, including Peshlakai Spring, Heizer Spring, and Wupatki Spring.

3.7.1.2 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to geologic and soil resources were derived from the available information and park staff's past observations of the effects on geology and soils from visitor use, construction activities, and invasive plant removal. The thresholds of change for the intensity of an impact are defined as follows:

Impact Intensities and Definitions – Geologic Resources and Soils

IMPACT INTENSITY	INTENSITY INFORMATION
Negligible	Soils would not be affected or the effects to soils would be below or at the lower levels of detection. Any effects to soils would be slight and erosion would not be noticeable.
Minor	The effects to soils would be detectable. Effects to soil area, including soil disturbance and erosion, would be small and localized. Minimal soil loss would occur. Mitigation may be needed to offset adverse effects and would be relatively simple to implement and likely be successful.
Moderate	The effect on soils would be readily apparent and result in a change to the soil character over a relatively wide area, soil disturbance over a wide area, or erosion that extends beyond the project site and/or results in some soil loss. Mitigation measures would be necessary to offset adverse effects and likely be successful.
Major	The effect on soils would be readily apparent and substantially change the character of soils over a large area, and substantial erosion would occur resulting in a large soil loss. Mitigation measures to offset adverse effects would be needed, would be extensive, and their success could not be guaranteed.

Duration

Short- term If geology and soil resource impacts recover in 3 years or less.
Long- term If geology and soil resource impacts recover in more than more than 3 years.

3.7.1.3 Analysis of Alternatives and Impacts on Geologic Resources and Soils

Impacts of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis

Manual/Mechanical Treatments
Limited mechanical and chemical treatments would be conducted under this alternative. Since mechanical methods have only partial effectiveness, herbicides would need to be used on a limited basis, primarily in riparian areas and only on highly invasive plants, such as tamarisk and camelthorn. Under this alternative, mechanical treatment would be the primary method and areas of large infestations would incur widespread soil disturbance. There would also be additional soil impacts in areas where species that tend to re-sprout need to be re-treated. These areas may need to be frequently retreated and there would be some soil instability until native plants have reestablished on these sites. On areas of small infestations, soil impacts would be mitigated by tamping and raking the soil back into place, and depending on the site, there may be some seeding and/or shrub and tree planting. Manual and mechanical treatments could cause negligible, temporary disturbance to soil. Operation of equipment for activities such as tilling could be conducted when soil is either too wet or too dry under this alternative. Effects could include compaction of soil and disturbance to upper soil profiles and geological features. The effects to soil and geologic resources may be detectable in some areas. However, these changes would be small, short-term, and the effects would be site-specific. Surface disturbing activities may physically impact geology resources. Equipment could potentially impact unknown geology resources in un-surveyed areas. In general, potential impacts to geologic resources would be minor. Some minor impacts to paleontological resources could also occur from exotic plant management activities. The impacts of manual and mechanical treatments on geological and soil resources could therefore be ***direct, adverse, site-specific, short-term, and negligible***.

Intrusion into parks by personnel conducting exotic plant management would cause short-term, direct impacts to soil from ORV traffic en route to exotic plant populations. In some instances, ORV's would also used for the application of pesticides. Effects could include compaction of soil and disturbance to upper soil profiles. ORV tracks that are visible to recreationists can attract ORV riders, which can encourage additional off-trail use and impacts. The effects to soil may be detectable in some areas. No ORV's would be allowed where cryptobiotic soil crusts are present. The impacts of ORV traffic on soil resources would therefore be ***direct, adverse, site-specific, short-term, and minor.***

Chemical Treatments
Herbicides used for chemical control can bind with soils or destroy soil microorganisms resulting in short-term, minor, localized, adverse impacts on soils. Declining numbers of some macro-organism species have been observed at herbicide application test sites. These effects, however, are not expected to persist because the negative effects are temporary and populations generally recover after a few days or weeks (Brady and Weil 1999). These impacts would be mitigated by

requiring application methods, such as backpack sprayers and cut-stump treatment that minimizes the amount of chemical that comes in contact with soils. Impacts to soils would also be mitigated by the careful selection of herbicides that readily break down and do not persist in the environment. There is a low potential for accidental spills of pesticides that could temporarily contaminate soils. Potential impacts of accidental spills at monuments with Emergency Response Plans would be minor and short-term. Accidental spills could have moderate impacts to soils at those monuments that do not have a standardized approach for clean-up of spilled pesticides. Individuals involved with exotic plant management also may not be aware of procedures for clean-up of pesticides, which could reduce response time and increase potential impacts. Impacts could be long-term and localized. The impacts of accidental chemical spills on geologic and soil resources would therefore be ***direct, adverse, site-specific and local, short-term to long-term, and minor to moderate.***

Some pesticides have the potential to persist in soils, which could lead to pesticide buildup in soils. Coarse to medium-textured soils are less likely to retain pesticides. Medium and fine-textured soils with higher organic matter content have a greater potential to retain pesticides. There is some potential for the build-up of pesticides in soils for parks that do not account for pesticide and soil properties. The impacts of pesticide treatments on geologic and soil resources would therefore be ***direct, adverse, site-specific, long-term, and minor***.

Biological Treatments

Biological control would not have any measurable or perceptible effects on geologic and soil resources. It is not likely to be used, but could include introducing insects or pathogens to reduce invasive plant infestations. Insects and pathogens are unlikely to cause impacts on soils. The impacts of biological treatments on geologic and soil resources would therefore be ***direct, adverse, site-specific, long-term, and negligible***.

Cultural Treatments

Cultural control could have a beneficial impact on soils by returning native vegetation. When prescribed fire is used as a cultural treatment there would be a short-term adverse impact to soils from scorching and the removal of plant material and organic matter. Required mitigation measures would be applied to reduce soil erosion and promote native plant establishment. Restoration activities, such as reseeding, could cause negligible, temporary disturbance to soil. Effects could include compaction of soil and disturbance to upper soil profiles. The effects to soil may be detectable in some areas. However, these changes would be small, short-term, and the effects would be site-specific. Impacts under this alternative may be relatively higher than Alternative II because of the need for increased mechanical treatments. The impacts of restoration activities on geologic and soil resources would therefore be ***direct, adverse***, ***site-specific, short-term, and negligible.***

Low-risk methods may be used, which could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. These methods will not impact geology and soil resources if applied properly. Soil microorganisms may be negatively impacted (especially with the plastic sheeting), but the impacts would be short-term, localized, and negligible.

Prescribed Fire Treatments
Prescribed fires would increase nutrient availability in soil at only those parks that currently have an approved fire management plan. The beneficial effects on soil productivity would be readily apparent for one to several growing seasons at these parks. The impacts of prescribed fire on geologic and soil resources would therefore be ***direct, beneficial, site-specific, long-term, and negligible to moderate***. Loss of vegetation from fire could cause negligible temporary increases in erosion and sedimentation at those parks that currently have an approved fire management plan. Mechanical disturbance to soils during fire fighting or cleanup would be negligible. The impacts of vegetation loss on soil resources would therefore be ***direct adverse, site-specific, short-term, and negligible to minor.***

Fire may cause minor changes to some geological resources. Effects could include some deposition of carbonaceous residue and carbonaceous blackening of the upper surfaces. However, these changes would be small and localized, site-specific, and of little consequence. Negligible mechanical disturbance would occur during fire fighting or cleanup. The impacts of prescribed fire on geologic resources would therefore be ***direct, adverse, site specific, short-term, and minor.***

Cumulative Effects
Cumulative impacts are similar to Alternative II. Thus, when combined with the widespread past, present, and foreseeable future actions that may result in increased negative impacts to soils, this alternative would have ***direct and indirect, adverse, local, short- and long-term negligible*** cumulative impacts to the geologic features and soil resources.

Conclusion
Exotic plant management would not affect the desired condition of maintaining, preserving, and protecting geologic and soil resources. Invasive plant infestations would not be as effectively managed under this alternative because mechanical treatments are very time consuming and not effective on a number of invasive species currently present in the monuments and chemical treatments are limited. Over the long-term, infestations that are not treated could see negative changes in soil chemistry, texture, stability, and nutrient availability, when compared to soils with native vegetation. These impacts will be mitigated by the soil improvements expected as areas re-colonize with native plant species and form naturally balanced habitats.

Invasive plant management will have overall long-term beneficial effects from rehabilitating native plant communities, which could reduce the potential for soil erosion, rock damage, and sedimentation in disturbed areas. The impacts of invasive plant management on soil resources would therefore be ***direct, beneficial, site-specific, short- and long-term, and negligible to minor.*** These minor impacts are from soil disturbance primarily associated with mechanical treatments, and also from minimal persistence of herbicides in the soils. Long-term impacts are expected to be minor and beneficial as mechanically treated areas eventually stabilize and as soil conditions improve, resulting in indirect benefits to the soil resource. Cumulative impacts would be negligible and diminish over time as conditions improve and the native communities mature.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other

relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Impacts of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis

Using an integrated approach to manage invasive plant infestations will allow FLAG management to minimize the amount of soil impact caused by mechanically treating invasive populations. The amount of soil disturbance will be less for the preferred alternative when compared to Alternatives I and III because mechanical control methods would be reduced and combined with other methods under this alternative. The potential for herbicide persistence in the soil could be greater under this alternative due to increased use of chemical control. However, the chemicals selected will always be those that have low ecotoxicity and naturally degrade quickly.

Manual /Mechanical Treatments

Manual/mechanical control can be very effective for new infestations of invasive plants and when plants are few in number. The localized soil disturbance from mechanical removal of invasive plants could reduce soil stability until plants have reestablished on the disturbed sites. This would be minimized by tamping and raking the soil back into place after removal of the invasive plants, and seeding and re-vegetation when appropriate. The impacts of manual and mechanical treatments on geological and soil resources would therefore be ***direct, adverse, site-specific, short-term, and negligible***.

Chemical Treatments

Chemical control can be very effective for large infestations of invasive plants and for plants with growth characteristics that make mechanical control methods ineffective. Herbicides used for chemical control can bind with soils or destroy soil microorganisms and could have impacts on the soils. This would be mitigated by using low-impact application methods like backpack sprayers and cut-stump treatment to minimize the amount of chemical that comes in contact with rocks and soils. Impacts to soils would also be mitigated by selection of herbicides that do not persist in the environment as described in the mitigation section of this document. An integral part of the preferred alternative is the selection of the most appropriate and least toxic method to control an invasive plant infestation. The impacts of pesticide treatments on geologic and soil resources would therefore be ***directly adverse, site-specific, long-term, and minor***.

Biological Treatments

Biological control would not have any measurable or perceptible effects on geologic and soil resources. It is not likely to be used, but could include introducing insects or pathogens to reduce invasive plant infestations. Insects and pathogens are unlikely to cause impacts on soils. Low-risk methods may be used, which could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. These methods will not impact soils if

applied properly. Soil microorganisms may be negatively impacted (especially with the plastic sheeting), but the impacts would be short-term, localized, and negligible.

Cultural Treatments
Cultural control could have a beneficial impact on soils by destroying invasive species and returning native habitat. When prescribed fire is used as a cultural treatment there would be a ***short-term adverse*** impact to soils from the destruction and removal of plant material and soil surface organic matter. Appropriate mitigation measures would be applied to reduce soil erosion and promote native plant establishment.

Additional impacts would incur to the soil resource if active restoration techniques, such as disc plowing or plowing, are selected for use in order to incorporate surface organic material, reduce invasive plants, or prepare a seedbed for native plant seeding. The impacts of restoration activities on geologic and soil resources would therefore be ***direct, adverse***, ***site-specific, short-term, and minor to moderate.*** In the long-term, soil impacts from restoration are expected to be moderate and beneficial as the organic matter and stability of soils would improve over time.

Prescribed Fire Treatments
Same as alternative I.

Cumulative Effects
Increased urban expansion, recreation development, and agricultural operations adjacent to the monuments result in substantial soil disturbance and increases the potential for the spread of invasive species. There would also be small, localized areas of soil disturbance from park development and construction activities. Increasing recreation and road traffic will continue to spread invasive species. Thus, when combined with the widespread past, present, and foreseeable future actions that may result in increased negative impacts to soils, this alternative would have ***direct and indirect, adverse, local, short- and long-term negligible*** cumulative impacts to the geologic features and soil resources.

Conclusion
Short-term impacts to the geologic and soil resources from the implementation of the preferred alternative are expected to be ***minor, adverse*** and ***direct***; primarily due to the localized impacts of mechanical treatments. If mechanical methods are applied to prepare the seedbed for restoration, this would result in additional adverse impacts in the short term. The short-term impacts from mechanical and chemical treatments are expected to be minimal due to required mitigation guidelines.

In the long-term, impacts to geologic and soil resources would be the least under the preferred alternative due to the ability to select a site-specific invasive plant control method that is best for each individual infestation. Long-term geologic and soil resource impacts are expected to be direct, beneficial***, and minor to moderate*** as more areas would be treated using alternative methods that result in reduced soil disturbance. Because chemical treatments are more effective and less expensive, we expect more populations would be treated and restored to native plant populations, resulting in indirect benefits to the soil resource from decreased alellopathy and increased soil organic matter and stability. Cumulative impacts would be ***direct and indirect, adverse, local, short- and long-term, and negligible*** when considered in the context of ongoing

disturbances in areas surrounding the monuments, primarily from rapid urban development and agricultural activities.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Impacts of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis

Under this alternative, invasive plant species would be primarily controlled by mechanical methods, including some cultural methods such as prescribed burning. No pesticide use will be allowed.

Manual/Mechanical Treatments

The treatment of larger areas would be reduced due to the labor intensiveness of mechanical treatments. Soil disturbance and potential for erosion would be high. The localized soil disturbance from mechanical removal of invasive plants would reduce soil stability until plants have reestablished on the disturbed sites. This would be minimized by tamping and raking the soil back into place after removal of the invasive plants. Mechanical treatments are not effective on a number of species (i.e. tamarisk, camelthorn, and toadflax) and this could result in the need to treat some populations several times in order to reduce these populations, resulting in recurring disturbance to the soil resource and the probable inability to completely control the targeted populations.

Most invasive plant infestations would not be effectively managed under this alternative because of the large amount of time it takes to mechanically remove populations; therefore locations that did not receive treatment would continue to experience reduced soil stability and nutrient availability when compared to soils with native vegetation. Some of our most serious infestations would not be effectively treated because mechanical methods are not effective on these species and because of the amount of time needed to conduct thorough treatments. These species would be expected to re-sprout and need repeated treatments. Opportunities to restore native vegetation and the subsequent improvement in soil condition would be reduced as many of the larger infestations would not be effectively treated, such as the camelthorn, toadflax, and tamarisk. Several of the invasive species currently present in FLAG monuments exhibit allelopathic characteristics which impact soils and inhibit the growth of vegetation in adjacent areas. These species are generally not effectively treated with mechanical methods. These populations would continue to spread and displace native species, negatively impact soil chemistry, texture, and stability. Impacts to geologic and soil resources would be ***direct, adverse, short-term, site-specific, and minor.***

Chemical Treatments
No chemical treatments would be allowed under this alternative.

Biological Treatments
No biological treatments would be allowed under this alternative.

Cultural Treatments
Same as alternative I. The impacts of restoration activities on geologic and soil resources would therefore be ***direct, adverse***, ***site-specific, short-term, and negligible.***

Prescribed Fire Treatments
Same as alternative I. The impacts of prescribed fire on geologic and soil resources would therefore be ***direct, beneficial, site-specific, long-term, and negligible to moderate***.

Cumulative Effects
Cumulative impacts are similar to Alternative II. Thus, when combined with the widespread past, present, and foreseeable future actions that may result in increased negative impacts to soils, this alternative would have ***direct and indirect, adverse, local, short- and long-term negligible*** cumulative impacts to the geologic features and soil resources.

Conclusion
Widespread impacts are expected to be minor and localized as few areas would be treated due to the high cost of treatments. Impacts in the long-term would be moderate and adverse as soils are frequently disturbed from repeated treatments. Thus many populations would not be treated and would continue to spread, including allelopathic species. Restoration of native plant communities would be less than with the other alternatives. The short and long-term impacts of this alternative would have ***negative, direct*** impacts on the soil resource resulting from frequent re-treatments and the spread of allelopathic species. Cumulative impacts would be negligible when considered in the context of ongoing disturbances in areas bordering the monuments, primarily from rapid urban development, increased recreation, and agricultural activities. The impacts of implementing this alternative would be ***direct, adverse, short-term, site-specific, and minor*** from geologic and soil disturbance resulting from primarily mechanical treatments.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.7.2 Vegetation

There are no federal laws governing vegetation in general; however, the NPS has developed policies and guidance on vegetation management. Section 4.4 of NPS 2001 Management Policies addresses biological resource management, including general vegetation management. This policy states that NPS will maintain all native plants as parts of the natural ecosystems of parks. Management practices to limit potential impacts to vegetation vary amongst NPS units. However, parks generally have management practices to minimize potential impacts to vegetation and to protect sensitive vegetation resources.

3.7.2.1 Affected Environment

Walnut Canyon National Monument Vegetation

"Vegetation of WACA and the environs is diverse and ecotonal in nature. It ranges from low elevation grasslands to high elevation woodland and forest communities. Species that are often specific to a vegetation community more frequently intermix in WACA than other areas on the Colorado Plateau, forming a broad transition zone. Species that often co-dominate in the same habitat are pinyon pine (*Pinus edulis*), Gambel oak (*Quercus gambelii*), Utah juniper (*Juniperus osteosperma*), and ponderosa pine (*Pinus ponderosa*). High elevation species, riparian obligates, and more mesic species occur in high abundance in WACA due to north facing slopes and mesic canyon walls and canyon bottoms. These mesic environments have species that are typically found at higher elevation such as dense patches of Rocky Mountain juniper (*Juniperus scopulorum*), Douglas-fir (*Pseudotsuga menziesii*), and New Mexican locust (*Robinia neomexicana*). The canyon floor has a rich vegetation community with the overstory composed mainly of deciduous trees and shrubs, primarily box elder (*Acer negundo*), dogwood (*Cornus stolonifera*), New Mexican olive (*Forestiera pubescens*), Arizona walnut (*Juglans major*), New Mexican locust (*Robinia neomexicana*), Arizona rose (*Rosa arizonica*), and snowberry (*Symphoricarpos rotundifolius*)." (Hansen et al. 2004)

"Approximately less than 1% of the monument consists of sparsely vegetated areas occurring on steep canyon walls or in intermittent stream channels. On the canyon walls the two main geologic formations (Kaibab Formation and Coconino Sandstone) often occur in large rock outcrops on the steep slopes of Walnut Canyon with sparse to no vegetation. Hanging garden species can occur on the steep vertical canyon walls, especially in areas of water seepage. On the canyon bottom of Walnut Canyon and in the side canyons, intermediate stream flow can limit vegetation growth. Prior to damming, the vegetation was much sparser in the canyon bottom due to higher stream flow and regular flooding events (Brian 1992). The sparse vegetation that often persists in the intermittent stream channel can consist of disturbance thriving forbs (annuals and perennials) and grasses. Disturbance-thriving species in unique communities of grassland, shrubland, and steppe types occur in the northeastern section of WACA. The vegetation in this area was chained in an attempt to increase the forage potential of the area. Gunnison's prairie dog (*Cynomys gunnisoni*) colonies also thrive in this area. The results of these activities are a recently disturbed diverse community of fernbush (*Chamaebatiaria millefolium*), snakeweed (*Gutierrezia sarothrae*), horehound (*Marrubium vulgare*), western wheatgrass (*Pascopyrum smithii*), little hogweed (*Portulaca oleracea*), and cliffrose (*Purshia stansburiana*). (Hansen et al 2004)

Grasslands in WACA are often only a small patch amidst woodlands or shrublands. Most of the herbaceous species co-occur with shrubs to form a steppe-like (grasses dominant with >10% shrub cover) appearance. Blue grama and mountain muhly (*Muhlenbergia montana*) typically dominate small meadows that are often adjacent to ponderosa pine, pinyon pine, and Utah juniper woodlands. In the moister areas in the uplands, muttongrass (*Poa fendleriana*), little bluestem (*Schizachyrium scoparium*), and squirreltail (*Elymus elymoides*) commonly occur. In the mesic canyon bottoms of Walnut Canyon fringed brome (*Bromus ciliatus*) is often the main grass species. In disturbed areas in the northeastern section of the park native grasses include blue grama, Fendler's threeawn (*Aristida purpurea*), and black grama (*Bouteloua eriopoda*). Non-native grasses in these areas include the invasive cheatgrass (*Bromus tectorum*) and western wheatgrass (*Pascopyrum smithii*), a grass often used in reseeding efforts.

Shrublands commonly occur in the disturbed area and along the canyon bottom. Shrubs that are typical of the previously disturbed areas include rabbitbrush (*Ericameria nauseosa*) and snakeweed. These species are both native to the area; however, they thrive in areas of disturbance. Shrublands often occur on the limestone terraces on the north rim with a warm southern exposure, with common species including fernbush, barberry (*Mahonia fremontii*), banana yucca (*Yucca baccata*), cliffrose, and mountain mahogany (*Cercocarpus montanus*). Shrub species also occur in small patches that are inter-fingered as mosaics on the canyon bottom. Historical photography of the canyon bottom suggests that much of the riparian vegetation has increased substantially over the last 50 years, due to dams eliminating the natural scouring action of the water flow through the canyon (Brian 1992). Common species on the canyon bottom include riparian obligates such as dogwood and willows (*Salix* spp.) as well as species that prefer mesic habitats such as gambel oak, New Mexico locust, New Mexico olive, chokecherry (*Prunus virginiana*) and roundleaf snowberry.

Woodlands are the most common vegetation type in WACA and range from dense stands of trees on north-facing canyon walls, canyon bottoms, and in fire-suppressed areas to open stands of sparse trees in meadow-like areas. The most common trees in the upland environments are ponderosa pine, ranging from mid to high elevation areas in the monument, with pinyon pine and Utah juniper occurring mainly in the mid to low elevation areas. In the early 1900's large ponderosa pines were logged and the natural fire regime was altered, allowing for ponderosa pine to regenerate quickly and change the vegetation community from open meadows with low densities of ponderosa pine to areas of high density of ponderosa pine with a sparse understory community (Covington and Moore 1994). Much of WACA has a dense ponderosa pine stand structure due to these past activities; however, some of WACA has larger ponderosa pines that have withstood these management activities. In the more mesic areas, Douglas-fir (*Pseudotsuga menziesii*) and Rocky Mountain juniper are the most common species, occurring in vegetation types with higher densities than woodlands, and are considered a forest vegetation type. A wide range of tree species occur in smaller patches in the linear corridors of the canyon bottom; including willow, box elder, narrow leaf cottonwood (*Populus angustifolia*) and Arizona walnut. Many of these species are restricted to mesic sites and require intermittent water flow or at least a high water table. These community types typically have high cover and diversity of shrubs and understory species due to the additional water flow in these areas. Riparian obligate species include sedges (*Carex* spp.) and willows. Four plant species of special concern also are suspected to occur in the monument. These species include Arizona bugbane (*Cimicifuga arizonica*), Arizona leatherflower (*Clematis hirsutissima* var. *arizonica*), Flagstaff pennyroyal (*Hedeoma diffusa*) and Chiricahua dock (*Rumex orthoneurus*).

Sunset Crater Volcano National Monument Vegetation
"Vegetation of SUCR and its environs is diverse, including nearly barren beds of cinder or lava and rock outcrops, to grassy meadows, open stands of trees with sparse understory shrublands, and dense forests on more moist aspects of the highest slopes, drainages, and ridges. SUCR is probably most noted for the sparsely vegetated cinder cones, lava beds, and lava rock outcrops. Most of these geologically dominated landform features consist of very sparse to no vegetation." (Hansen et al 2004c)

Woodlands, which are open forest canopies, dominate the project area and occur on flats, slopes, hills, drainages, and ridges. The most common tree species in the project area is ponderosa pine (*Pinus ponderosa*). Ponderosa pine woodlands are typically found on cinder soils with little to no understory cover. Ponderosa pine may be present in nearly pure stands or may intermix with other coniferous trees common to the area, including Douglas-fir (*Pseudotsuga menziesii*), limber pine (*Pinus flexilis*), pinyon pine (*Pinus edulis*), and Utah juniper (*Juniperus osteosperma*). The second most common tree species is pinyon pine and often co-occurs with Utah juniper. Limber pines and Douglas-fir are confined to a mixed conifer zone on O'Leary Peak and Darton Dome. Small stands of quaking aspen (*Populus tremuloides*) are present throughout the monument. Quaking aspen grow along the edges of lava beds, within the lava beds, and in small stands on O'Leary Peak and Darton Dome, often adjacent to stands of Douglas-fir.

Shrublands occur mainly in small patches on rock outcrops, on sparse cinder slopes, in the openings of woodland canopies, and can co-dominate with grasses in open meadows. Shrublands are rarely observed without seedling or sapling trees present. The most widely distributed and common shrub is Apache plume (*Fallugia paradoxa*); it occurs on sparse cinder slopes and is also a common understory shrub. Other shrubs which dominate small stands or patches in lava outcrops, on scree, and rock outcrops include rabbitbrush (*Ericameria nauseosa*), three-leaved sumac (*Rhus trilobata*), ocean spray (*Holodiscus dumosus*), pericome (*Pericome caudata*), brickellbush (*Brickellia californica*), and wax currant (*Ribes cereum*).

Grasses commonly occur as the understory in tree canopies, in smaller patches between tree canopies, as well as in more open meadow-like areas. Blue grama (*Bouteloua gracilis*) and mountain muhly (*Muhlenbergia montana*) are the dominant species in these grassland areas. Blue grama is the most common grass species. It occurs in larger meadows or parks, such as Bonito Park (an open-grassland area west of SUCR that is co-managed by the USDA-FS) and often is in vegetation co-dominated by rabbitbrush (*Ericameria nauseosa*). Less common in the grassland patches are western wheatgrass (*Pascopyrum smithii*) and sand bluestem (*Andropogon hallii*). Sand bluestem is a bunchgrass that occurs mostly in sparse patches in the eastern section of the project area. Western wheatgrass is often used in re-seeding efforts (FEIS 2001) and is found mainly in the recently burned areas northwest of the monument. Disturbed areas also facilitate introduced annual grasses, particularly cheatgrass (*Bromus tectorum*), native forbs such as meadow-rue (*Thalictrum fendleri*) and Carruth's sagewort (*Artemisia caruthii*), and non-native species such as toadflax (*Linaria dalmatica* ssp. *dalmatica*) and mullein (*Verbascum thapsus*). Blue grama is the most common grass species. It occurs in larger meadows or parks, such as Bonito Park (an open-grassland area west of SUCR that is co-managed by the USDA-FS) and often is in vegetation co-dominated by rabbitbrush (*Ericameria nauseosa*). Less common in the grassland patches are western wheatgrass (*Pascopyrum smithii*) and sand bluestem (*Andropogon hallii*). Sand bluestem is a bunchgrass that occurs mostly in sparse patches in the eastern section

of the project area. Western wheatgrass is often used in re-seeding efforts and is found mainly in the recently burned areas northwest of the monument. Disturbed areas also facilitate introduced annual grasses, particularly cheatgrass (*Bromus tectorum*), native forbs such as meadow-rue (*Thalictrum fendleri*) and Carruth's sagewort (*Artemisia caruthii*), and non-native species such as toadflax and mullein.

Wupatki National Monument Vegetation

"Vegetation of WUPA and its environs is diverse and unique, including nearly barren beds of cinder and rock outcrops, grassy prairie, open one-seed juniper (*Juniperus monosperma*) savanna, sparsely vegetated badlands, sand dunes, and densely vegetated riparian corridors. Although much of the project area of WUPA is sparsely vegetated, less than one percent is considered barren (< 2% total vegetation cover)." (Hansen et al. 2004a)

"Barren areas include cinder barrens, basalt outcrops, and active river channels near the Little Colorado River. Cinder barrens may have only a single species, often Apache plume (*Fallugia paradoxa*). Basalt outcrops, if vegetated at all, may include a sparse shrub cover of California brickelbush (*Brickellia californica*) and skunkbush sumac (*Rhus trilobata*). Active river channels have continuous scouring of the surface and often are barren of vegetation, with the exception of persistent annual and perennial riparian species, some non-native, that arise in the intermittent periods between flooding." (Hansen et al. 2004a)

Sparsely vegetated areas (ranging between two and 15% vegetative cover) at WUPA are dominated by the substrate and range from Moenkopi shale badlands, Moenkopi sandstone outcrops, to cinder sparse flats. Vegetation, although sparse, is unique to these areas. Mound saltbush (*Atriplex obovata*) dominates cover in the badlands on the Navajo Reservation. In the badlands adjacent to the monument, the most commonly seen species are crispleaf buckwheat (*Eriogonum corymbosum*), Torrey's joint-fir (*Ephedra torreyana*), fourwing saltbush (*Atriplex canescens*), and shadscale (*Atriplex confertifolia*). Cinder sparse areas often contain a mix of Apache plume, annual herbaceous species and crispleaf buckwheat. Moenkopi sandstone rock outcrops typically contain a few species in the crevices of the rocks, including fourwing saltbush, Mormon tea (*Ephedra viridis*), and bush muhly (*Muhlenbergia porteri).*

Grassland species at WUPA include those common to the Great Basin and Great Plains. Livestock grazing was eliminated in the park in the early 1980's (see NPS WUPA General Management Plan 2002). The major herbaceous species include black grama (*Bouteloua eriopoda*), galleta (*Pleuraphis jamesii*), needle-and-thread (*Hesperostipa comata*), and alkali sacaton (*Sporobolus airoides*). All of the species occur in pure and mixed stands. Many of these grassland species are also often the dominant understory species in wooded and shrubby areas. Bush muhly is a common grass species that grows on and inside many of the shrubs. It commonly occurs at WUPA, however, it does not spread across the landscape as seen with the other dominant grasses. Isolated stands in WUPA also contain grasslands dominated by sand bluestem (*Andropogon hallii*) and Indian ricegrass (*Achnatherum hymenoides*).

Shrublands are common at WUPA and occur throughout the park as sparse shrublands in the badlands and gradate elsewhere from moderately dense stands of mixed shrubs to dense riparian and wash shrublands. Many shrub species also commonly co-dominate in grasslands and form a steppe type structure. Shrubs that are often observed to co-occur with the herbaceous communities to form steppe vegetation include snakeweed (*Gutierrezia sarothrae*), rabbitbrush

(*Ericameria nauseosa*), shadscale, fourwing saltbush, and Mormon tea. Moderately dense stands of shrublands include hummocks of cinders that support Torrey's joint-fir, crispleaf buckwheat, and Apache plume. The most common upland shrubs in the moderately dense shrubland areas include fourwing saltbush, Mormon tea, Torrey's joint-fir, snakeweed, and Apache plume. These shrubs often intermix in the uplands depending on substrate and other abiotic factors. In the sand dunes an indicator species, hoary rosemary-mint (*Poliomintha incana*), often occurs. Matted crinklemat (*Tiquilia latior*) is a small sub-shrub that is commonly found on the basalt lava flows on the eastern part of the monument. In the drainages and the floodplains a higher density of shrubs often occurs along the banks and in the washes including, fourwing saltbush, snakeweed, Apache plume, and rabbitbrush. Although many of these species are common to WUPA, they often form denser stands in the washes, including fourwing saltbush that is known to form thick monocultures in these wash systems. Invasive shrubs, tamarisk (*Tamarix* spp.) and camelthorn (*Alhagi maurorum*), occur in dense stretches along the Little Colorado River and are starting to invade up the drainages connecting the Little Colorado River. The native riparian obligate coyote willow (*Salix exigua*) still persists on the banks of the Little Colorado River and in some areas dominates vegetation cover.

Woodlands at WUPA are most commonly observed as an open savanna with the most common tree species being one-seed juniper. This vegetation type commonly occurs on cinder substrate in the southwestern section of the project area. The only true woodlands at WUPA are seen along the banks of the Little Colorado River with a Fremont cottonwood (*Populus fremontii*) canopy and a mix of saltcedar and coyote willow in the understory.

Non-native plants were recently mapped in some areas in WUPA (Brehl et al. 2008). Nonnative plant infestations include predominantly Tamarisk along the Little Colorado River and Camelthorn (*Alhagi maurorum*) in patches throughout the monument. Russian thistle (*Salsola* spp.) and a few other small annual plant species are generally confined to road corridors, developed areas, or areas of heavy visitation. These species benefit from the additional runoff associated with paved surfaces and often out-compete native vegetation along road shoulders. Nonnative plants may also rapidly colonize areas where the ground surface is heavily disturbed by equipment or heavy foot traffic. Annual brome-grasses (*Bromus* spp.) have been observed at Wupatki, but the area of infestation has yet to be assessed. There is no feasible method for controlling these small, weedy annual grasses. Camelthorn, a tenacious shrub species, has also invaded an estimated 20 acres of intermittent drainages within Wupatki. Some nonnative species have been planted by employees around residences, but none of these are believed to be naturalizing and/or escaping into the surrounding environment.

3.7.2.2 Invasive Species

A list of invasive species is presented in **Table 2** on page 25. The most serious infestations are tamarisk, camelthorn, and toadflax. Tamarisk is a highly invasive species that is present along the banks of the Little Colorado River and some tributaries. Tamarisk populations continue to expand and threaten the riparian area that provides habitat for a wide variety of wildlife and a number of special status species. Russian olive has also been recorded along the Little Colorado River. This species is currently present in low densities. However, it can spread rapidly through riparian areas and displace native species. Camelthorn is a native species that becomes invasive in riparian areas and on disturbed areas including roads and trails. Observations note that it is prevalent on the areas of abandoned development, along roads, and along the edges of the riparian area where it is displacing native herbaceous species.

3.7.2.3 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to vegetation were derived from the available scientific data and literature and staff's past observations of the effects on vegetation from visitor use, construction activities, and invasive plant removal. The thresholds of change for the intensity of an impact are defined as follows:

Impact Intensities and Definitions - Vegetation

Impact Intensity	Intensity Definition
Negligible	No native vegetation would be affected or some individual native plants could be affected as a result of the alternative, but there would be no effect on native plant species' populations. The effects would be on a small scale.
Minor	The alternative would affect some individual plants and would also affect a relatively limited portion of that species' population. Mitigation to offset adverse effects could be required and would be effective.
Moderate	The alternative would affect some individual native plants and would also affect a sizeable segment of the species' population over a relatively large area within the park. Mitigation to offset adverse effects could be extensive, but would likely be successful.
Major	The alternative would have a considerable effect on individual native plants and affect a sizeable segment of the species' populations over a relatively large area in and out of the park. Mitigation measures to offset the adverse effects would be required, extensive, and success of the mitigation measures would not be guaranteed.

Duration

Short- term If vegetation resource impacts recover in 3 years or less.
Long- term If vegetation resource impacts recover in more than more than 3 years.

3.7.2.4 Analysis of Alternatives and impacts on Vegetation

Impacts of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis

Manual /Mechanical Treatments

Manual and mechanical methods would be the primary treatment method when this alternative is fully implemented. There would be limited beneficial impacts from mechanical treatments on small populations where it is effective. Intrusion into parks by personnel conducting exotic plant management would cause short-term, direct impacts to vegetation from foot and off-road vehicle traffic en route to exotic plant populations. Individual plants would be trampled resulting in no effect, reduced vigor, or death depending on the stature and structure of the plant and the amount and duration of pressure applied. These impacts would be adverse, short-term, and negligible to

moderate to individual plants. Infrequent impacts to individual plants generally do not affect plant populations, plant communities, or ecological processes. The impacts of intrusion into parks on vegetation resources would therefore be ***direct, adverse, site-specific, short-term, and negligible to moderate.***

Ground disturbing activities may cause minor mechanical disturbance to individual native plants. These impacts would be adverse, short-term, and moderate to individual plants. However, infrequent impacts to individual plants generally have negligible to minor impacts to plant populations, plant communities, or ecological processes.

Chemical Treatments
Chemical treatments under this alternative are limited to tamarisk, toadflax, and camelthorn. These are highly invasive species that are not effectively treated using other methods. By using herbicides that are selective (that target the specific characteristics of the invasive plant such as broadleaves, monocots, etc.) and by using hand application methods that minimize chemical drift, the impacts to non-target species would be reduced. Species other than tamarisk, toadflax, and camelthorn would not be treated with chemical methods and would continue to spread. There is a low risk that non-target species would be affected by herbicide application as populations of tamarisk tend to form a monoculture and because the hand treatment prevents herbicide drift issues.

Non-target plants subjected to pesticide drift could experience no effect, reduced vigor, or death depending on the sensitivity of the plant species to the specific pesticide and the dose the plant was subjected to. Overall, use of chemical controls would have infrequent adverse, short-term, minor impacts on individual plants due to drift or non-target treatment during the course of spraying targeted species. Infrequent impacts to individual plants generally have negligible to minor impacts on plant populations, plant communities, or ecological processes. The impacts of pesticide use on vegetation resources would therefore be ***direct, adverse, site-specific, short-term, and negligible to minor.***

Biological Control Treatments
Any biological control agent released would be approved by APHIS and would have no demonstrated affinity for native plant species. However, the National IPM Coordinator currently needs to approve release of biological control agents per NPS-77. Because biological control agents are specific to a species of exotic plant, there would be negligible adverse impacts to non-target plant species. No specific measures would be implemented to contain biological control agents. However, any biological control agent used would be host-specific so each biological control agent would only attack one plant species (the host, or the target exotic plant). Impacts to target plants would be direct and beneficial. The impacts of biological treatments on vegetation resources would therefore be ***direct, beneficial, site-specific, short-term to long-term, and moderate.***

Cultural Treatments
Limited cultural treatments would be implemented. Irrigation will be used on a very limited basis and only on small projects. If seeding is planned only local native plant material would be required. Reseeding and irrigation could have a beneficial effect of promoting the reestablishment of native vegetation at any of the 3monuments. The impacts of cultural treatments on

vegeta-tion resources would be ***direct, beneficial, site-specific and local, long-term, and minor to moderate.***

Prescribed Fire Treatments

Prescribed fire provides an overall benefit to the continued growth, health, and maintenance of the grasslands and ponderosa pine forest ecosystems (NPS 2005). Prescribed fire would benefit the monuments from the direct effects of removing stagnant, dead plant accumulations while converting that mass to ash and charcoal. Fires tend to increase species diversity and reduce woody species relative to grass and forbs species. The beneficial effects on soil productivity would be readily apparent for one to several growing seasons. The impacts of prescribed fire on vegetation resources would therefore be ***direct, beneficial, site-specific, short-term, and moderate.***

The effect of fire on plants is species-specific. Fire may either increase or reduce germination and vigor of plants. Prescribed fire may have adverse impacts on some individual plants, but would affect a relatively small portion of the overall population. Overall, prescribed fire would have infrequent adverse, short-term, minor impacts on individual plants. Infrequent impacts to individual plants generally do not impact plant populations, plant communities, or ecological processes. Prescribed fire could encourage the establishment of exotic plants following fires. However, follow-up treatments would be used to control exotic plants after fires, as needed. The impacts of fire on vegetation resources are therefore ***direct, beneficial and adverse, site-specific, short- to long-term, and minor.***

Cumulative Impacts

Urban development, and recreation activities adjacent to the monuments is resulting in the gradual loss of native plant communities and the introduction of a number of potentially invasive plants. Monument development and construction projects would have localized impacts on native vegetation. Increasing recreation and road traffic will continue to spread invasive species and potentially impact native plant communities. If allelopathic species such as tamarisk continue to spread there will be additional adverse impacts to native vegetation. Thus, when combined with other past, present, and foreseeable future actions that would result in impacts to native plant species, Alternative II would have ***direct, adverse, site specific, short and long-term, minor to moderate*** cumulative impacts to the vegetation resource.

Conclusion

Exotic plant management would help FLAG monuments achieve the desired condition to have all native plants and ecosystems maintained. However, Alternative II would likely achieve the desired condition before it would be reached under this alternative. Impacts to vegetation under this alternative would be minor and beneficial in the short-term as large populations of highly invasive species would be effectively treated and native riparian plants are expected to re-colonize many of the treated areas. The beneficial impacts are minor in the long-term. While tamarisk would continue to be treated using chemicals, small populations of less invasive species would continue to spread. This alternative would directly benefit the vegetation of the park by reducing competition and displacement from non-native species. However, benefits are less than Alternative II because fewer acres would be treated and possibly restored. Cumulative impacts would be ***negligible*** when considered in the context of ongoing loss of native plant communities in the vicinity of the park, primarily from rapid urban development, and recreation and agri-cultural activities. The impacts of exotic plant management on vegetation resources would

therefore be ***direct, beneficial and adverse, site-specific, short- to long-term, and negligible to moderate.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Impacts of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis

Using an integrated approach to manage invasive plant infestations will allow the FLAG monuments to maximize the areas treated using the most effective methods including: mechanical, chemical, cultural and biological and any combination thereof.

Manual/Mechanical Treatments

Mechanical control can be very effective for new infestations of invasive plants when populations are small and individuals are few in number. The localized soil disturbance from manual/mechanical removal of invasive plants could impact adjacent native plants by direct damage and cutting and trampling underground root systems. This impact would be minimized by raking and tamping the soil back into place after removal of the invasive plants and by some seeding and/or replanting of native species, if appropriate.

Tilling or other ground disturbing activities may cause minor mechanical disturbance to individual native plants. These impacts would be adverse, short-term, and moderate to individual plants. However, infrequent impacts to individual plants generally have negligible to minor effects on plant populations, plant communities, or ecological processes. Impacts of this alternative would be comparable to Alternative I.

Intrusion into parks by personnel conducting IPM would cause short-term, direct impacts to vegetation from foot and off-road vehicle traffic enroute to exotic plant populations. These may be relatively lower than Alternative I because standardized BMPs would be implemented to minimize potential impacts. Individual plants would be trampled, resulting in no effect, reduced vigor, or death depending on the stature and structure of the plant and the amount and duration of pressure applied. These impacts would be adverse, short-term, and slight to individual plants. Infrequent impacts to individual plants generally have negligible to minor effects on plant populations, plant communities, or ecological processes. The impacts of intrusion into parks on vegetation resources would therefore be ***direct, adverse, site-specific, short-term, and minor.***

Chemical Treatments
Chemical treatments have the potential to impact non-target species. It is possible that native overstory species could be damaged or killed using herbicide treatments on understory species, and vice-versa. However, these impacts are expected to be ***minor, adverse*** and ***short-term*** because overspray will be restricted by established best management practices (BMP's). In the future, the potential to impact native overstory riparian species exists should these areas become infested with understory invasive species. The risk is reduced because the areas where we would treat understory vegetation that contains an overstory layer is negligible compared to the overall potentially treatable area. The use of backpack sprayers to target the application would also help mitigate risks and reduce drift as little chemical would contact foliage or reach the ground to be taken up by non-target species. This would be minimized by the application methods, chemical selected for use, and by the implementation of required mitigation measures. An integral part of the preferred alternative is the selection of the most appropriate and least toxic herbicide to control an invasive plant infestation.

Non-target plants subjected to pesticide drift could experience no effect, reduced vigor, or death depending on the sensitivity of the plant species to the specific pesticide and the dose to which the plant was subjected. Overall, use of chemical controls would have infrequent adverse, short-term, minor impacts on individual plants because of drift or non-target treatment during the course of spraying targeted species. Infrequent impacts to individual plants generally have negligible to minor effects on plant populations, plant communities, or ecological processes. The impacts of pesticide use on vegetation resources would therefore be ***direct, adverse, site-specific, short-term, and minor.***

Biological Treatments
All biological control methods would be chosen with extreme caution to ensure they do not impact non-target plant species or any other vital ecological processes. Because biological control agents are specific to individual species of exotic plant, there would be negligible impacts to non-target plant species. Impacts to target plants would be direct and beneficial. No specific measures would be implemented to contain biological control agents. However, any biological control agent used would be host-specific so each biological control agent would only attack one plant species (the host, or the target exotic plant). The National IPM Specialist would also further review and approve the release of any proposed biological control agents, which would help to confirm that the use of these agents would be appropriate. The impacts of biological treatments on vegetation resources would therefore be ***direct, beneficial, site-specific, local and regional, long-term, and moderate.***

Cultural Treatments
Irrigation, hydro-mulching, and seeding are just a sampling of the techniques that will be used to enhance restoration efforts. Reseeding and irrigation could have a beneficial effect of promoting the reestablishment of native vegetation. The impacts of cultural treatments on vegetation resources would therefore be ***direct, beneficial, site-specific and local, short- and long-term, and negligible to moderate.***

Prescribed Fire Treatments
Prescribed fire provides an overall benefit to the continued growth, health, and maintenance of the native grassland and ponderosa pine forest ecosystems (NPS 2005). Fires have the direct effect of removing stagnant, dead plant accumulations while converting that mass to ash and

charcoal. Fires tend to increase species diversity and reduce woody species relative to grass and forbs species. The beneficial effects on soil productivity would be readily apparent for one to several growing seasons. The impacts of prescribed fire on vegetation resources would therefore be ***direct, beneficial, site-specific, short- to long-term, and moderate.***

The effect of fire on plants is species-specific. Fire may either increase or reduce germination and vigor of plants. Prescribed fire may have adverse impacts on some individual plants, but would affect a relatively small portion of the overall population. Overall, prescribed fire would have infrequent adverse, short-term, minor impacts on individual plants. Infrequent impacts to individual plants generally do not impact plant populations, plant communities, or ecological processes. Prescribed fire could encourage the establishment of exotic plants following fires. However, infestations would be evaluated prior to the burn to determine whether exotic plants are present that may increase following fire. These areas may be excluded, or follow-up treatments would be used to control exotic plants after fires, as needed. The impacts of prescribed fire on vegetation resources would therefore be ***direct, beneficial, site-specific, short- to long-term, and moderate.***

This alternative is expected to maximize the stability of restored sites and to increase the resistance of native vegetation to reinvasion by invasive species.

Cumulative Impacts

Impacts are similar to Alternative I. Thus, when combined with other past, present, and foreseeable future actions that would result in impacts to native plant species, Alternative II would have ***direct, adverse, site specific, short and long-term, minor to moderate*** cumulative impacts to the vegetation resource.

Conclusion

IPM would help parks achieve the desired condition to have natural ecosystems and native plants maintained. By controlling exotic plants using IPM, native plant communities would be rehabilitated, thus benefiting native plant species and the habitat they provide. The minor short-term adverse impacts would be outweighed by the long-term benefits to vegetation.

The benefits to the vegetation resource are greatest under this alternative as the most effective, integrated treatment methods would be implemented. This alternative would likely treat the most acres of invasive plants. Restored areas would require less re-treatment due to the increased ecological integrity and stability of the restored native plant community. This alternative would directly benefit the vegetation of the park reducing competition and displacement from non-native species. Cumulative impacts would be negligible when considered in the context of ongoing loss of native plant communities in the surrounding environs of the monuments, primarily from rapid urban development and agricultural activities. The overall impacts of this alternative on vegetation resources would therefore be ***direct, adverse and beneficial, site-specific, short- to long-term, and minor to moderate.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the

monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Impacts of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis

Manual/Mechanical Treatments

Under this alternative, invasive plant species would be primarily controlled by manual/ mechanical methods, some using cultural methods. Most invasive plant infestations would not be effectively managed under this alternative because of the large amount of soil disturbance and time it takes to mechanically remove populations; therefore populations not treated could easily spread to adjacent areas further reducing native plant communities. The most serious infestations would not be effectively treated because mechanical methods are not effective on tamarisk and camelthorn. Many species are stimulated to sprout with mechanical disturbance and would require numerous re-treatments and repeated disturbances. Opportunities to restore native vegetation would be reduced as many of the larger infestations would not be effectively treated. No chemical herbicides would be used and therefore there would be no risk of killing non-target species. Impacts to vegetation would be ***direct and indirect, beneficial, site-specific, local and regional, short- and long-term, and minor to moderate.***

Chemical Treatments

No chemical treatments would be allowed under this alternative.

Biological Treatment

No biological treatments would be allowed under this alternative.

The allelopathic effects of some invasive species such tamarisk, would be greatest under this alternative as these species would not be effectively controlled with mechanical and cultural methods. Allelopathic species would continue to spread, and would displace native species communities and inhibit their growth in the vicinity of the infestation.

Prescribed Fire Treatments

Prescribed fire would be used as a cultural control method on some invasive populations and reduce accumulations of invasive plant materials. Native vegetation adapted with fire and is expected to recover. Restoration is limited under this alternative to small treatment areas to be reseeded by hand after mechanical removal of invasive plants. Invasive species in a large area would not be effectively treated under this alternative, therefore, no large active restoration projects would be implemented. No biological controls would be used under this alternative.

Cumulative Impacts

The cumulative impacts are similar to Alternative I. Thus, when combined with other past, present, and foreseeable future actions that would result in impacts to native plant species, Alternative III would have ***direct, adverse, site specific, short and long-term, minor to moderate*** cumulative impacts to the vegetation resource.

Conclusion

The impacts of implementing this alternative would be ***direct, adverse, local, short-term, and minor*** as few invasive populations would be treated. Impacts would be moderate and adverse in the long-term as many invasive plant populations would continue to increase due to the lack of effectiveness and time and money to implement mechanical treatments. Many highly invasive species that are not effectively treated with mechanical methods (tamarisk, camelthorn, and toadflax) would continue to spread and impact native vegetation, habitat, and natural ecological processes. Implementation of this alternative would have direct adverse impacts on native vegetation communities within the monuments from the continued displacement and competition from invasive species, and the allelopathic effect of some invasive species. Cumulative impacts would be minor when considered in the context of ongoing loss of native plant communities in the vicinity of the park, primarily from rapid urban development and agricultural activities.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.7.3 Wildlife

The Migratory Bird Treaty Act (16 USC 703-71L and the Eagle Protection Act (16 USC I.S.C. 668a-668b) protect sensitive wildlife species that could occur in the proposed project area. The NPS has also developed policies and guidance on wildlife management. Section 4.4 of 2001 Management Policies addresses biological resource management, including general wildlife management. This policy states that NPS will maintain all animals as parts of the natural ecosystems of parks. Management practices to limit potential impacts to wildlife vary from park to park. However, parks generally have management practices that are designed to minimize potential impacts to wildlife, especially during sensitive periods of the year such as during mating or nesting seasons.

3.7.3.1 Affected Environment

Walnut Canyon National Monument Wildlife

"In light of its proximity to Flagstaff suburban development, the variety of large mammals at WACA is remarkable. Mountain lions (*Puma concolor*), and occasional black bears (*Ursus americanus*) prowl the canyon and surrounding forest, and elk (*Cervus elaphus*) and mule deer (*Odocoileus hemionus*) are common. Collared peccaries (*Pecari tajacu*) are common, and are noteworthy because this is near the northern edge of their range. Among smaller mammals, Abert's or tassel-eared squirrels (*Sciurus abertii*) and gray-collared chipmunks (*Tamias cinereicollis*) are most likely to be seen because of their diurnal habits. Other mostly nocturnal small and medium-sized mammals include little brown myotis (*Myotis lucifugus*) and big brown bat (*Eptesicus fuscus*); deer mouse, brush mouse, and pinyon mouse (*Peromyscus maniculatus, P. boylii*, and *P. truei*); Stephens' woodrat (*Neotoma stephensi*), porcupine (*Erethizon dorsatum*), ringtail (*Bassariscus astutus*), hog-nosed skunk (*Conepatus mesoleucus*), gray fox (*Urocyon cinereoargenteus*), and bobcat (*Lynx rufus*). Cattle graze on adjacent United States Department

of Agriculture – Forest Service (USDA-FS) and State lands and sometimes trespass onto the monument." (Hanson et al 2004a)

"WACA supports a wide variety of birds of prey, including such rare or special interest species as Bald Eagle (*Haliaeetus leucocephalus*; in winter), Golden Eagle (*Aquila chrysaetos*), Northern Goshawk (*Accipiter gentilis*), Peregrine Falcon (*Falco peregrinus*), and Mexican Spotted Owl (*Strix occidentalis*). Other birds of prey at the Monument include Turkey Vulture (*Cathartes aura*), Sharp-shinned Hawk (*Accipiter striatus*), Cooper's Hawk (*A. cooperii*), Red-tailed Hawk (*Buteo jamaicensis*), American Kestrel (*Falco sparverius*) and Great Horned Owl (*Bubo virginianus*). Other medium-sized and large birds that inhabit the Monument are Wild Turkey (*Meleagris gallopavo*), Band-tailed Pigeon (*Columba fasciata*), and the ubiquitous Common Raven (*Corvus corax*). Smaller birds characteristic of the coniferous forest and canyon habitats of Walnut Canyon include Lewis' Woodpecker (*Melanerpes lewis*), Pinyon Jay (*Gymnorhinus cyanocephalus*), Steller's Jay (*Cyanocitta stelleri*), Pygmy Nuthatch (*Sitta pygmaea*), Black-throated Gray Warbler (*Dendroica nigrescens*), Grace's Warbler (*Dendroica graciae*), and Red-faced Warbler (*Cardellina rubrifrons*). Other common small birds are Mourning Dove (*Zenaida macroura*), Northern Flicker (*Colaptes auratus*), Hairy Woodpecker (*Picoides villosus*), Western Wood-pewee (*Contopus sordidulus*), Ash-throated Flycatcher (*Myiarchus cinerascens*), Violet-green Swallow (*Tachycineta thalassina*), Mountain Chickadee (*Poecile gambeli*), Rock Wren (*Salpinctes obsoletus*), and Canyon Wren (*Catherpes mexicanus*)." (Hansen at al 2004a)

Amphibians are rarely encountered at WACA because of the general scarcity of surface water. Canyon treefrogs (*Hyla arenicolor*) and New Mexico spadefoot toads (*Spea multiplicata*) have been recorded from the canyon bottom and around artificial water impoundments. Among reptiles, there are several common lizard species. Eastern fence lizards (*Sceloporus undulatus*) and tree lizards (*Urosaurus ornatus*) are abundant in rocky and cliff habitats throughout the area, and the greater short-horned lizard (*Phrynosoma hernandesi*) is fairly common. The little striped whiptail (*Cnemidophorus inornatus*), and the plateau striped whiptail (*C. velox*) are both fairly common in the canyon bottom area, but are not found on the rims. Of the snakes that are known to occur in the Monument, the brightly-colored Sonoran mountain kingsnake (*Lampropeltis pyromelana*) is easily the most distinctive. The gopher snake (*Pituophis catenifer*) and the western terrestrial garter snake (*Thamnophis elegans*) are also fairly common throughout the Monument. The western rattlesnake (*Crotalus viridis*) is the only venomous snake that occurs at WACA.

Sunset Crater National Monument Wildlife

"The ponderosa pine (*Pinus ponderosa*) woodland that covers much of SUCR strongly influences the fauna of the area. This is particularly true for the birds, with many of the common and most conspicuous species at the monument being those typical of ponderosa pine woodlands. Such species include Lewis' Woodpecker (*Melanerpes lewis*), Steller's Jay (*Cyanocitta stelleri*), Mountain Chickadee (*Parus gambeli*), Pygmy Nuthatch (*Sitta pygmaea*), Yellow-rumped Warbler (*Dendroica coronata*), and Grace's Warbler (*Dendroica graciae*). Other common and frequently seen small birds in and around the monument include Williamson's Sapsucker (*Sphyrapicus thyroideus*), Pinyon Jay (*Gymnorhinus cyanocephalus*), Clark's Nutcracker (*Nucifraga columbiana*), Western Bluebird (*Sialia mexicana*), Western Tanager (*Piranga ludoviciana*), and Dark-eyed Junco (*Junco hyemalis*). Among larger birds, the most commonly seen species are Common Raven (*Corvus corax*), Turkey Vulture (*Cathartes aura*), and Red-

tailed Hawk (*Buteo jamaicensis*). Occasional Golden Eagles (*Aquila chrysaetos*) may be seen at any time of year, and Bald Eagles (*Haliaeetus leucocephalus*) are present in small numbers during the winter." (Hansen et al 2004c)

The most conspicuous small mammal at the monument, the Abert's squirrel (*Sciurus aberti*), is also closely associate with ponderosa pine for both food and nest sites. Although not as frequently seen, porcupines (*Erethizon dorsatum*) are also fairly common and frequently found in ponderosa pine. Other common small mammals include desert cottontail (*Sylvilagus audubonii*), deer mouse (*Peromyscus maniculatus*), and pinyon mouse (*P. truei*). Among larger mammals, there are a variety of small and medium-sized carnivores in and around SUCR. Most frequently seen are coyotes (*Canis latrans*) and raccoons (*Procyon lotor*), particularly around the campground and housing area. The gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*) and long-tailed weasel (*Mustela frenata*) are also present. Black bears (*Ursus americanus*) and mountain lions (*Felis concolor*) are both present at least occasionally, but are rarely seen. Among ungulates, mule deer (*Odocoileus hemionus*) are the most common native species at SUCR. Elk (*Cervus elaphus*) were not originally native to northern Arizona, but introduced animals have expanded into the area and small numbers are now seen seasonally. Herds of pronghorn (*Antilocapra americana*) occur in grasslands and one-seed juniper (*Juniperus monosperma*) savannas at lower elevations, and migrate seasonally to the vicinity of SUCR. Javelina are a new addition to the mammal list. This species has been expanding its range northward from southern and central Arizona, and individuals have recently been recorded within the monument boundaries.

The amphibian and reptile fauna at SUCR is depauperate, because of the relatively high elevation and dry conditions. No amphibian species have been positively documented at the monument, though there is an unconfirmed report of tiger salamander. The most conspicuous lizard species in and around the monument are the eastern fence lizard (*Sceloporus undulatus*) and tree lizard (*Urosaurus ornatus*). The greater short-horned lizard (*Phrynosoma hernandesi*) and plateau striped whiptail (*Cnemidophorus velox*) are also present, but are not as frequently seen. Only two snakes are known from the immediate area of the monument: the gopher snake (*Pituophis melanoleucus*) and the western rattlesnake (*Crotalus viridis*); although both are rare at this elevation.

Wupatki National Monument Wildlife

"The grasslands and desert shrub areas at WUPA support a variety of mammal species characteristic of these lower elevation habitats. Pronghorn (*Antilocapra americana*) are frequently seen in grasslands, and mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), and porcupine (*Erethizon dorsatum*) are also common. Although rarely seen, both kit fox (*Vulpes macrotis*) and badger (*Taxidea taxus*) are present at WUPA. Desert cottontail (*Sylvilagus auduboni*) and black-tailed jackrabbit (*Lepus californicus*) are common to abundant, and gunnison's prairie dog (*Cynomys gunnisoni*) is found in a few grassland areas of the monument. Many of the most common small mammals at WUPA are rodents of the family Heteromyidae (kangaroo rats and pocket mice), and are characteristic of deserts and grasslands in the region. Species at WUPA include Ord's kangaroo rat (*Dipodomys ordii*), rock pocket mouse (*Chaetodipus intermedius*), silky pocket mouse (*Perognathus flavus*), plains pocket mouse (*P. flavescens*), and Arizona pocket mouse (*P. amplus*). The Arizona pocket mouse is represented at WUPA by a locally-distributed subspecies, the Wupatki pocket mouse (*P. a. cineris*), with distinctive dark pelage. Other common rodents include the pinyon mouse

(*Peromyscus truei*), deer mouse (*P. maniculatus*), western harvest mouse (*Reithrodontomys megalotis*), northern grasshopper mouse (*Onychomys leucogaster*), and three species of woodrats (*Neotoma*). Although most small mammals at WUPA are nocturnal, white-tailed antelope squirrels (*Ammospermophilus leucurus*) and rock squirrels (*Spermophilus variegatus*) are commonly seen diurnal species. Many species of bats have been recorded from the monument, including such special interest species as Townsend's big-eared bat (*Corynorhinus townsendii*) and spotted bat (*Euderma maculatum*)." (Hansen et al 2004b)

Breeding birds are not very abundant at WUPA, due to the sparse vegetation cover and dry conditions at the monument. Relatively common breeding species include Mourning Dove (*Zenaida macroura*), Common Poorwill (*Phalaenoptilus nuttallii*), Common Nighthawk (*Chordeiles minor*), Say's Phoebe (*Sayornis saya*), Loggerhead Shrike (*Lanius ludovicianus*), Common Raven (*Corvus corax*), Horned Lark (*Eremophila alpestris*), Rock Wren (*Salpinctes obsoletus*), Northern Mockingbird (*Mimus polyglottos*), Black-throated Sparrow (*Amphispiza bilineata*), Western Meadowlark (*Sturnella neglecta*), Scott's Oriole (*Icterus parisorum*), and House Finch (*Carpodacus mexicanus*). In winter, Mountain Bluebirds (*Sialia currucoides*) and Townsend's Solitaires (*Myadestes townsendi*) are sometimes present in flocks numbering in the thousands, and many other species pass through the monument during migration. Raptors that breed at or near WUPA include Golden Eagle (*Aquila chrysaetos*), Red-tailed Hawk (*Buteo jamaicensis*), Ferruginous Hawk (*Buteo regalis*), Cooper's Hawk (*Accipiter cooperii*), Prairie Falcon (*Falco mexicanus*), American Kestrel (*Falco sparverius*), Great-horned Owl (*Bubo virginianus*), and Long-eared Owl (*Asio otus*). Burrowing Owls (*Athene cunicularia*) are known to breed just north of the monument. Bald Eagles (*Haliaeetus leucocephalus*) are sometimes seen in winter.

WUPA has an impressive diversity of amphibian and reptile species, due to the meeting of major habitats (grassland and desert shrub) within the monument. Another important factor influencing the distribution of species at WUPA is its location within the Little Colorado River valley, which has likely acted as a corridor for the migration of desert species from the Grand Canyon region to the north. For amphibians, summer monsoon rains produce temporary pools used for breeding by New Mexico and plains spadefoot toads (*Spea multiplicata* and *S. bombifrons*), Great Plains toad (*Bufo cognatus*), red-spotted toad (*B. punctatus*), and Woodhouse's toad (*B. woodhousii*). Although rarely encountered, tiger salamanders (*Ambystoma tigrinum*) also occur at WUPA. Common lizard species found throughout most of the monument include common collared lizard (*Crotaphytus collaris*), longnose leopard lizard (*Gambelia wislizenii*), side-blotched lizard (*Uta stansburiana*), eastern fence lizard (*Sceloporus undulatus*), lesser earless lizard (*Holbrookia maculata*), and plateau striped whiptail (*Cnemidophorus velox*). In the grasslands and juniper woodlands greater short horned lizard (*Phrynosoma hernandesi*), tree lizard (*Urosaurus ornatus*), and little striped whiptail (*Cnemidophorus inornatus*) are also present. Lizard species restricted to the desert habitats in Wupatki Basin include desert spiny lizard (*Sceloporus magister*), western whiptail (*Cnemidophorus tigris*), and western banded gecko (*Coleonyx variegatus*), all of which are associated with the Little Colorado River valley and are near the terminus of their local distribution at WUPA. The most commonly observed snake species at WUPA are the gopher snake (*Pituophis catenifer*), striped whipsnake (*Masticophis taeniatus*), and western rattlesnake (*Crotalus viridis*). Other species found less frequently include western patch-nosed snake (*Salvadora hexalepis*), common kingsnake (*Lampropeltus getula*), glossy snake (*Arizona elegans*), and night snake (*Hypsiglena torquata*), while the milk snake

(*Lampropeltis triangulum*) and ground snake (*Sonora semiannulata*) have each been recorded only once.

3.7.3.2 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to wildlife were derived from the available scientific data and literature and park staff's past observations of the effects on wildlife from visitor use, construction activities, and invasive plant removal. The thresholds of change for the intensity of an impact are defined below:

Impact Intensities and Definitions - Wildlife

Impact Intensity	Intensity Definition
Negligible	No native vegetation would be affected or some individual native plants could be affected as a result of the alternative, but there would be no effect on native plant species' populations. The effects would be on a small scale.
Minor	The alternative would affect some individual plants and would also affect a relatively limited portion of that species' population. Mitigation to offset adverse effects could be required and would be effective.
Moderate	The alternative would affect some individual native plants and would also affect a sizeable segment of the species' population over a relatively large area within the park. Mitigation to offset adverse effects could be extensive, but would likely be successful.
Major	The alternative would have a considerable effect on individual native plants and affect a sizeable segment of the species' populations over a relatively large area in and out of the park. Mitigation measures to offset the adverse effects would be required, extensive, and success of the mitigation measures would not be guaranteed.

Duration

Short- term If wildlife resource impacts recover in 3 years or less.
Long- term If wildlife resource impacts recover in more than more than 3 years.

3.7.3.3 Analysis of Alternatives and impacts on Wildlife

Impacts of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis

Intrusion into FLAG monuments by personnel conducting exotic plant management would cause short-term, negligible harassment to wildlife species. There may be some escape flight response from wildlife during these activities, but this would produce negligible short-term adverse impacts in the form of unnecessary energy expenditures. Overall effects would be slight and of little consequence to wildlife populations. The impacts of intrusion into parks on wildlife would therefore be infrequently ***direct, adverse, site-specific, short-term, and negligible***.

Manual/Mechanical Treatments
Manual or mechanical treatments could have site-specific adverse impacts on ground nesting birds or burrowing animals or their food source. Management practices and BMP's would limit these effects to being short-term and of little consequence to the species' population. The impacts of manual or mechanical treatments on terrestrial wildlife would therefore be ***direct, adverse, site-specific, short-term, and negligible.***

Chemical Treatments
It is unlikely that terrestrial wildlife species would receive direct exposure to pesticides during application due to required application methods. It is also unlikely that wildlife would be overexposed over time if the pesticides are used as required and according to label specifications. Wildlife species would most likely flee the area or escape to a belowground burrow/den upon the arrival of personnel conducting exotic plant management. Impacts would be small, short-term, and site-specific. The impacts of chemical treatments on terrestrial wildlife would therefore be ***direct, adverse, site-specific, short-term, and minor.***

Biological Treatments
The additional biomass created by the introduction of biological control agents may benefit mammal and bird species that prey on terrestrial insects. Impacts would be beneficial, short-term, and site-specific. Impacts would be similar to Alternative II. The impacts of biological treatments on terrestrial wildlife would therefore be ***beneficial, site-specific, short-term, and*** minor.

Cultural Treatments
Reseeding and irrigation could have a beneficial effect of promoting the reestablishment of wildlife habitat at any of the FLAG monuments. The impacts of cultural treatments on vegetation resources would therefore be directly ***beneficial, site-specific and local, long-term, and moderate.***

Prescribed Fire Treatments
Fire can have direct mortality on small mammals, some invertebrates, reptiles, and amphibians, and non-mobile species of wildlife. Effects to some wildlife may be detectable, but would be small and would not lead to population-level effects. Direct mortality from fire probably does not usually occur to most ungulate or bird species because they are able to move to other areas quickly. Wildlife may be indirectly impacted by fire through reduction of potential nesting, resting, and foraging habitat and by increased predation. Fire may also cause mobile animals such as ungulates to concentrate in specific areas immediately after the burn to search for food or cover. Impacts would be detectable, site-specific, and short-term. The impacts of prescribed fire on terrestrial wildlife would therefore be ***directly and indirectly adverse, site-specific, short-term, and minor.***

Fires that create a mosaic of burned and unburned areas may directly benefit ground nesting bird, small mammal, and ungulate populations. Fire is an important factor in creating and maintaining ground nesting bird habitat (NPS 2003). Fire may also indirectly benefit carnivorous species that feed on small mammals or ungulates. Impacts would be detectable, site-specific, and short-term. The impacts of fire on terrestrial wildlife would therefore be ***direct and indirect, beneficial, site-specific, short-term, and moderate.***

Cumulative Impacts

Urban development, and recreation activities adjacent to the monuments is resulting in the gradual loss of native wildlife and wildlife corridors and the introduction of a number of potentially invasive plants. Park development and construction projects would have localized impacts on wildlife. Increasing recreation and road traffic will continue to spread invasive species and potentially impact wildlife habitat availability. When combined with other past, present, and foreseeable future actions that would result in impacts to native wildlife species, all three alternatives would have ***direct and indirect, adverse, local, short- and long-term, and negligible*** cumulative impacts to the wildlife resource.

Conclusion

Controlling invasive plants and promoting healthy native plant communities would rehabilitate wildlife habitat. Exotic plant management would help FLAG monuments achieve the desired condition to have, as parts of the natural ecosystems of parks, all native animals maintained. However, Alternative II would likely achieve the desired condition at parks before it would be reached under this alternative. The overall success of exotic plant management programs would vary among monuments. These beneficial effects would be detectable in some areas over the long-term, and may benefit wildlife populations using these areas. The overall success of this alternative would likely be lower than Alternative II. The impacts of exotic plant management on wildlife would therefore be ***direct, adverse and beneficial, local, short- and long-term, and negligible to moderate.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Impacts of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis

Intrusion into parklands by personnel conducting IPM would cause short-term negligible harassment to wildlife species. There may be some escape flight response exhibited by wildlife during these activities, but this would produce negligible short-term, site-specific, adverse impacts in the form of unnecessary energy expenditure. Overall effects would be slight and of little consequence to wildlife populations. The impacts of intrusion into parks on terrestrial wildlife would therefore be ***direct, adverse, site-specific, short-term, and negligible.***

Manual/Mechanical Treatments
Manual or mechanical treatments could have site-specific adverse impacts on ground nesting birds or burrowing animals. BMPs, see **Appendices C** and **D**, would keep these effects site-specific and of little consequence to the species' population. The impacts of manual or mechanical treatments on terrestrial wildlife would therefore be infrequently ***direct, adverse, site-specific, short-term, and negligible.***

Chemical Treatments
It is unlikely that terrestrial wildlife species would receive direct exposure to pesticides during application because they would likely leave the area or would return to burrows during periods of increased human activity. However, insects and small mammals may be directly exposed to pesticides on rare occasions. Pesticides will be applied in accordance with label specifications, and because any nests or burrows encountered would be avoided, there is low potential for exposure to acute levels of pesticides. It is also unlikely that wildlife would be overexposed over time if the pesticides are used according to label specifications and BMPs. Resource managers and Regional and National IPM Coordinators would strive to stay up-to-date on available toxicity research and would use this information to refine BMPs for application of pesticides in prairie dog towns or other wildlife concentration areas. Impacts from chemical treatments would be small, infrequent, site-specific, and short-term. The impacts of chemical treatments on terrestrial wildlife would therefore be infrequently ***direct, adverse, site-specific, short-term, and minor.***

Biological Treatments
The additional biomass created by the introduction of biological control agents may benefit mammal and bird species that prey on terrestrial insects. Impacts would be beneficial, short- or long-term, and site-specific. Impacts would be similar to Alternative I. The impacts of biological treatments on wildlife would therefore be ***indirect, beneficial, site-specific, short-term to long-term, and minor.***

Cultural Treatments
Reseeding and irrigation could have a beneficial effect of promoting the reestablishment of wildlife habitat at any of the FLAG monuments. The impacts of cultural treatments on wildlife resources would therefore be ***direct, beneficial, site-specific and local, long-term, and moderate.***

Prescribed Fire Treatments
Fire can cause direct mortality to small mammals; some invertebrates, reptiles, and amphibians; and non-mobile species of wildlife. Effects to some wildlife would be detectable, but would be small and would not lead to population-level effects. Direct mortality from fire does not usually occur to most ungulate or bird species because they are able to move to other areas. However, less mobile species such as small mammals, reptiles, amphibians, and invertebrates may experience individual mortalities during fires. Because the intensity, duration, and timing of prescribed fires would be controlled, population-level effects would not be likely. Wildlife may also be indirectly impacted by fire through reduction of potential nesting, resting, and foraging habitat, and increased predation. Fire may also cause mobile animals, such as ungulates, to concentrate in specific areas immediately after the burn to search for food or cover. Impacts would be site- specific and short-term. The impacts of prescribed fire on wildlife would therefore be ***direct and indirect, adverse, site-specific, short-term, and minor.***

Fires that create a mosaic of burned and unburned areas may directly benefit ground nesting bird, small mammal, and ungulate populations. Fire is an important factor in creating and maintaining ground nesting bird habitat (NPS 2003h). Fire may also indirectly benefit carnivore species that feed on small mammals and ungulates. Some species would therefore experience ***direct and indirect, beneficial, site-specific, short-term, and moderate effects.***

Cumulative Impacts

Impacts are similar to Alternative I. When combined with other past, present, and foreseeable future actions that would result in impacts to native wildlife species, Alternative II would have ***direct and indirect, adverse, local, short- and long-term, and negligible*** cumulative impacts to the wildlife resource.

Conclusion

IPM would help the FLAG monuments achieve the desired condition to have, as parts of the natural ecosystems of parks, all native animals maintained. By controlling invasive and exotic plants and promoting healthy native plant communities, wildlife habitat would be rehabilitated at all 3 monuments. These beneficial effects would be detectable in some areas, and may benefit wildlife populations that use these areas over the long-term. The minor, short-term, adverse impacts would be outweighed by the long-term benefits of habitat rehabilitation. The impacts of exotic plant management on terrestrial wildlife would therefore be ***direct, beneficial, site-specific and local, long-term, and moderate***.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Impacts of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis

Intrusion into FLAG monuments by personnel conducting exotic plant management would cause short-term, negligible harassment to wildlife species. There may be some escape flight response from wildlife during these activities, but this would produce negligible short-term adverse impacts in the form of unnecessary energy expenditures. Overall effects would be slight and of little consequence to wildlife populations. The impacts of intrusion into parks on wildlife would therefore be infrequently ***direct, adverse, site-specific, short-term, and negligible***.

Manual/Mechanical Treatments

Manual or mechanical treatments could have site-specific adverse impacts on ground nesting birds or burrowing animals or their food source. Management practices and BMP's would limit these effects to being short-term and of little consequence to the species' population. The

impacts of manual or mechanical treatments on terrestrial wildlife would therefore be ***direct and adverse, site-specific, short-term, and negligible.***

Chemical Treatments
No chemical treatments would be allowed under this alternative.

Biological Treatments
No biological treatments would be allowed under this alternative.

Cultural Treatments
Reseeding and irrigation could have a beneficial effect of promoting the reestablishment of wildlife habitat at any of the FLAG monuments. The impacts of cultural treatments on vegetation resources would therefore be ***directly beneficial, site-specific and local, long-term, and moderate.***

Prescribed Fire Treatments
Fire can have direct mortality on small mammals, some invertebrates, reptiles, and amphibians, and non-mobile species of wildlife. Effects to some wildlife may be detectable, but would be small and would not lead to population-level effects. Direct mortality from fire probably does not usually occur to most ungulate or bird species because they are able to move to other areas quickly. Wildlife may be indirectly impacted by fire through reduction of potential nesting, resting, and foraging habitat and by increased predation. Fire may also cause mobile animals such as ungulates to concentrate in specific areas immediately after the burn to search for food or cover. Impacts would be detectable, site-specific, and short-term.

Fires that create a mosaic of burned and unburned areas may directly benefit ground nesting bird, small mammal, and ungulate populations. The Flag monuments have an approved fire management plan and would benefit from prescribed fire treatments. Fire is an important factor in creating and maintaining ground nesting bird habitat. Fire may also indirectly benefit carnivorous species that feed on small mammals or ungulates. Impacts would be detectable, site-specific, and short-term. The impacts of prescribed fire on terrestrial wildlife would therefore be ***direct and indirect, adverse, site-specific, short-term, and minor.***

Cumulative Impacts
The cumulative impacts are similar to Alternative I. When combined with other past, present, and foreseeable future actions that would result in impacts to native wildlife species, all three alternatives would have ***direct and indirect, adverse, local, short- and long-term, and negligible*** cumulative impacts to the wildlife resource.

Conclusion
Controlling invasive plants and promoting healthy native plant communities would rehabilitate wildlife habitat. Exotic plant management would help FLAG monuments achieve the desired condition to have, as parts of the natural ecosystems of parks, all native animals maintained. However, Alternative II would likely achieve the desired condition at parks before it would be reached under this alternative. Being limited to only mechanical and cultural control methods would seriously hamper the ability to control invasive plants effectively. Thus, the overall success of exotic plant management programs would vary between monuments, and the impacts on wildlife would therefore also vary between monuments. Beneficial effects would be detect-

able in some areas over the long-term, and may benefit wildlife populations using these areas. However, the overall success of these programs would likely be lower than Alternative II. The impacts of exotic plant management on terrestrial wildlife would therefore be ***direct, adverse and beneficial, local, short- and long-term, and negligible to moderate***.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.7.4 Special-Status Species (Threatened, Endangered, and Species of Concern)

The Endangered Species Act (ESA) of 1973, as amended, requires federal agencies to ensure that any action authorized, funded, or carried out does not jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modifications of critical habitat. Section 7 of the ESA requires that a federal agency consult with the USFWS or the National Marine Fisheries Service on any action that may affect federal threatened or endangered species or proposed species for federal listing, or that may result in adverse modification of critical habitat to "...insure that any action authorized, funded or carried out by such agencies...is not likely to jeopardize the continued existence or destruction or adverse modification of habitat of such species which is...critical."

According Section 4.4.2.3 in NPS 2001 Management Policies, the NPS will survey for, protect, and strive to recover all species native to National Park System units that are listed under the ESA. NPS-77 addresses the management of federally listed threatened, endangered, and candidate species, as well as state species of concern. It also addresses the management of state ***species of concern*** identified by other groups such as locally designated species or those established by organizations such as The Nature Conservancy (TNC).

To protect any unknown or undiscovered threatened, endangered, or special status species, any work implementation or contracts would include provisions for discovery of such. Provisions would require cessation of exotic plant management activities until FLAG staff evaluated the impact, and would allow modifications to any contracts or work plans for any measures determined necessary to protect the discovery.

Mitigation measures for special status species including Mexican spotted owl, southwestern willow flycatcher, western yellow-billed cuckoo, bald eagle, and Fickeisen plains cactus are evaluated in detail in a project specific Biological Assessment (BA) (Schelz 2009). All mitigation measures developed through the BA will be adhered to for this project and incorporated into the decision document. These are listed in **Appendix C**.

3.7.4.1 Affected Environment

The Arizona Heritage Database (Arizona Game and Fish Department 2009) was consulted via the internet to generate a list of threatened and endangered species and other species of concern (TES) for Coconino County, Arizona. This list was compared with the inventory of natural resources within Wupatki completed by Bateman (1976, 1979) and by the extensive inventory of the Flagstaff area Monuments recently completed by the NPS Southern Colorado Plateau Inventory and Monitoring Network (NPS 2000). In addition, there is a completed 2000 survey for special status plants at the Flagstaff Area National Monuments (Huisinga et al. 2000).

Walnut Canyon National Monument Special Status Species

Walnut Canyon provides habitat for a few threatened and several sensitive species. The Arizona Heritage Data Management System (Arizona Game and Fish Department 2001) was consulted via the Internet to generate a list of threatened and endangered species, and other "species of concern" for Coconino County, Arizona, see **Table 7** below). Plant species on the list were compared with the flora summary checklist recently compiled by the NPS (2001). In addition, a survey for special status plants at the Flagstaff Area National Monuments, including Walnut Canyon, was recently completed by Huisinga and others (2000).

Currently, no federally listed threatened or endangered plant species are known to occur in Walnut Canyon National Monument. One plant species, *Rumex orthonuerus*, currently listed as threatened, occurs in wetland meadows in the Mogollon Highlands southeast of the Coconino Plateau. The species could potentially occur at wetter sites along the Walnut Canyon floor. However, it has not been discovered during numerous botanical inventories of the monument, and likely does not occur because of the relative scarcity of deep soil terraces adjacent to perennial waters. Although not formally protected under the Endangered Species Act, two plant species of concern occur within the monument: *Aquilegia desertorum* and *Erigeron saxatalis*. Several populations of *Aquilegia desertorum* are documented within the monument. The species inhabits shaded sites in rocky limestone terrain. Several populations of *Erigeron saxatalis* are documented within in the monument along the canyon bottom. Another three plant species of concern have not been documented but could potentially occur within the monument: Arizona bugbane (*Cimicifuga arizonica)*, Arizona clematis (*Clematis hirutissima* var. *arizonica)*, and Flagstaff pennyroyal (*Hedeoma diffusum)*.

Arizona bugbane occurs within the Mogollon Highlands region in deep, narrow canyon habitats on moist, loamy soil and beneath heavily shaded riparian and coniferous forest canopy cover. This species has not been discovered during several field surveys and probably does not occur within the monument because of the relative scarcity of deep soil terraces adjacent to perennial waters. Arizona clematis occurs in the Walnut Canyon watershed upstream from the monument. The subspecies grows in groves under shaded forest and woodland vegetation, on gentle slopes with well- developed, limestone - derived soils. This subspecies has yet to be discovered during botanical surveys of the monument, but likely occurs because of the presence of good habitat. The Flagstaff pennyroyal grows along limestone bluffs in Walnut Canyon, and has been documented near the monument boundary on the Coconino National Forest. This species has yet to be discovered during botanical surveys of the monument, but likely occurs because of the presence of good habitat.

The Mexican spotted owl (*Strix occidentalis lucida*), listed as threatened under the Endangered Species Act, is known to live and nest within Walnut Canyon National Monument. Mexican

spotted owl breeding activity has been monitored at various times between 1989 and 1998. The U.S. Fish and Wildlife Service recently designated the entire monument as critical habitat for the species. The NPS is cooperating with the U.S. Fish and Wildlife Service and U.S. Forest Service to implement the management actions identified in the Mexican Spotted Owl Recovery Plan (U.S. Fish and Wildlife Service 1995). Specific actions include monitoring nesting activity and breeding success, protecting critical habitat from wildfire, and managing forest vegetation to conserve specific microhabitat attributes.

Bald eagles (*Haliaeetus leucocephalus*) routinely spend the winter in the Mogollon Highlands area. Although bald eagles are not known to regularly use winter roost sites within the monument, individual birds are occasionally observed perching in dead tree snags and feeding on elk carrion within the monument. In 2007, the Interior Department took the American bald eagle off the Endangered Species List. The bald eagle is still be protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The Bald Eagle Protection Act prohibits the take, transport, sale, barter, trade, import and export, and possession of eagles, making it illegal for anyone to collect eagles and eagle parts, nests, or eggs without a permit. The nearest active bald eagle nesting areas are along the Verde River and large lakes on the Coconino National Forest south of the monument. There are a number of regularly used winter roosting sites on surrounding forested lands.

The peregrine falcon (*Falco peregrinus* ssp. *anatum*) occurs within Walnut Canyon. Peregrines breed on steep cliff faces within the monument. One of the aeries lies within the backcountry closure area. The other is within the 1996 western boundary expansion area, and is located on a cliff that has been subject to recreational climbing activity in the past. No NPS management activities, including visitor activities, are currently occurring or proposed on or above known peregrine aerie cliffs.

The northern goshawk (*Accipiter gentilis*) also inhabits the monument area. Northern goshawks are relatively solitary raptors that prefer forest interior habitats. Two nest sites have been documented within the monument in the backcountry closure area.

Bat species are considered to have specialized habitat requirements and sensitivity to environmental impacts. Twelve species are currently monitored within Coconino County as species of concern. Old trees, large dead snags, and the fractured limestone faces of Walnut Canyon provide ample bat habitat, and the Townsend's big- eared bat and other sensitive species potentially occur within the monument.

Sunset Crater Volcano National Monument Special–Status Species

The Arizona Heritage Database (Arizona Game and Fish Department 2001) was consulted via the Internet to generate a list of threatened and endangered species and other species of concern for Coconino County, Arizona. This list was compared with the inventory of natural resources within Sunset Crater Volcano completed by Bateman (1976, 1979), which remains the best available documentation of the monument's flora and fauna. In addition, Husisinga et al. (2000) surveyed for special status plants at the Flagstaff Area National Monuments, including Sunset.

Currently, no federally listed threatened or endangered plant or animal species are known to occur in Sunset Crater Volcano National Monument. One endangered species, the Mexican spotted owl, is known on nearby U.S. Forest Service lands. The species lives and nests in dense,

old-growth forest on steep mountain slopes or in deep canyons. Suitable habitat conditions are not likely found within the monument, but the Mexican spotted owl may sometimes cross into the monument in search of prey. The U.S. Fish and Wildlife Service recently proposed to designate critical habitat for the species, but did not include any forest lands in proximity to the monument.

At Sunset Crater, there are two plant species of concern, the Sunset Crater penstemon (*Penstemon clutei)* and the cinder phacelia (*Phacelia serrata)*. Both are short-lived wildflowers that are only found on cinder deposits within the San Francisco Volcanic Field. Populations of both species have been documented from numerous locations within the monument. Recent studies have shown that the Sunset Crater penstemon is adapted to fire and other types of disturbance within ponderosa pine forest (Maschinsky et al. 2000). However, the NPS is uncertain about potential impacts resulting from current visitation and only recently proposed routine monitoring of these species.

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

Although they are not formally listed as a species of concern, the status of the golden eagle within the region was identified during the public and agency scoping process. There are no records of golden eagle nests within Sunset Crater Volcano, but suitable nesting habitat is found on nearby U.S. Forest Service lands, and they probably forage within the monument. They are known to be sensitive to human activities. If disturbed by noise or rapid movements, adult birds may fail to use a nest site or temporarily abandon their eggs or chicks, which exposes them to undue cold temperatures and/or predators. Some biologists recommend establishing a ¼- to 2-mile diameter buffer zone around nests.

Although not formally listed as a species of concern, pronghorn antelope herd within the region. This species is being affected by large-scale habitat fragmentation and loss, and the regional pronghorn population has declined during the last few decades (Bright and Van Riper III 2000). Although pronghorn are not known to occur within the existing boundary of the monument, they are known to use nearby Bonito Park as a fawning ground, although this activity has not been observed in a number of years.

Wupatki National Monument Special–Status Species

Currently, no federally listed threatened or endangered plant or animal species are known to occur in Wupatki National Monument. However, there are three plant species of concern for which there are historic or recent records: Simpson's hedgehog cactus (*Pediocactus simpsoni* var. *simpsonii),* cinder phacelia *(Phacelia serrata),* and Whiting's indigo bush *(Psorothamnus thompsoniae* var. *whitingii)*. The distribution of these within the monument is not well known. Another six species of concern are known from similar habitats nearby the monument, including specklepod milkvetch (*Astragalus lentiginosus* var. *ambiguous)*, largeleaf springparsley (*Cymopterus megacephalus),* roundleaf dunebroom *(Errazurizia rotunda)*, Fickeisen pincushion cactus (*Pediocactus peeblesianus* var. *fickeiseniae),* Welsch's phacelia *(Phacelia welshii)*, and

bog alkali grass (*Puccinelila parishii)*. Additional field searches and mapping efforts are needed to assess the distribution and status each species. In addition to these, other plants at Wupatki, including Peebles amsonia (*Amsonia peeblesiana),* common reed *(Phragmites communis),* and purple sage *(Poliomintha incana)*, are considered to be increasingly threatened by over-collection for traditional uses by Native Americans. Common reed occurs at only one location in the monument and could easily be eliminated by over-collection. Although little is known about these plants, existing roads, trails, and facilities in the monument are limited in extent and avoid most available habitat. Site-specific surveys are required prior to any ground or vegetation disturbing activity to ensure they are not impacted.

Three animal species of concern are known to occur within the monument, including Wupatki pocket mouse (*Perognathus amplus cineris*), spotted bat (*Euderma maculatum*), and Townsend's big-eared bat (*Corynorhinus townsendii*).

The Wupatki pocket mouse is documented in grasslands in the western half of the monument. Very little is known about the distribution or status of this subspecies, but it is presumed that it would be impacted by development and land use activities in similar ways as other grassland-dependent small mammals. At Wupatki, this would include disturbance from the entrance road and from visitor activities.

Spotted bats and Townsend's big-eared bat occur in several of the cave-like karst features in the Lomaki/Box Canyon area. These geologic features may also serve as unique habitats for other rare species, especially invertebrates, and preliminary surveys and biological inventory efforts are needed. Some of these features are near popular visitor use areas, and have been impacted from prior activities and NPS management activities, including attempts to block entrances as a public safety precaution. However, most visitor use and support facilities that avoid karst habitats, and the NPS is planning to restore the historically impacted entrances.

Two bird species of concern, the ferruginous hawk (*Buteo regalis*) and burrowing owl (*Athene cunicularea* ssp. *hypugaea*) are known from similar habitats adjacent to the monument. The ferruginous hawk inhabits open grassland surrounding Wupatki. The burrowing owl inhabits burrows constructed by many mammals. Although some burrowing mammal communities have been observed within the monument, the presence of burrowing owls has not been confirmed, but it has been found nesting within 300 meters of the boundary (Schelz 2008, personal communication). Very little is known about the distribution or status of either species, but it is presumed that both would be impacted by development and land use activities in similar ways as other grassland-dependent wildlife.

Although golden eagles (*Aquila chrysaetos*) are not formally listed as a species of concern, their status within Wupatki was identified during the public and agency scoping process. Golden eagles have historically nested within Wupatki, though no nesting pairs were discovered during recent surveys (Britten 1999, Drost 2000, Schelz 2008). Like the burrowing owls active nests have been found very close to the boundary of WUPA. The best nesting habitat, as evidenced by the presence of numerous historic nests, is in the Citadel Sink, Doney Mountain, and Doney Anticline areas. In the past, highway construction and public visitation, especially to the Citadel Pueblo area, may have interfered with breeding eagles. They are known to be highly sensitive to human activities. If disturbed by noise or rapid movements, adult birds may fail to use a nest site or temporarily abandon their eggs or chicks. This exposes them to undue cold temperatures

and/or predators. Some biologists recommend establishing a 1/4- to 2-mile-diameter buffer zone around nests.

Although not formally listed as a species of concern, the pronghorn antelope (*Antilocapra americana*) herd within Wupatki was identified as a manage-ment issue during the public and agency scoping process. The pronghorn population has declined in and around Wupatki during the last few decades (Bright and Van Riper III 2000). The species is being affected by regional habitat fragmentation and loss, including loss of habitat within the monument as juniper woodland moves into available grassland. The boundary fence confined the herd within Wupatki during heavy snows in the mid-1970s and was blamed for a number of deaths. Perennial water sources are scarce, and the animals must move back and forth to water on adjacent lands. Recent boundary fence modifications should allow the animals to move between neighboring lands. Existing roads within the monument are not fenced, and from time to time animals are killed by automobiles.

In addition to grasslands, riparian areas, and karst features, other unique plant communities were identified by Bateman (1976). The first is the alluvial fan of vegetated cinder dunes to the east of Woodhouse Mesa. The second is the massive, exposed limestone faces of the Doney Anticline, in the center of the monument, including Antelope Canyon, which bisects the anticline. Although these areas are generally not critical habitat for the sensitive plants or animals listed above, they harbor numerous plants not otherwise found, for example cottontop cactus (*Echinocactus polycephalus*), and greatly contribute to overall biodiversity within the monument. The cinder dune fan is bisected by the entrance road, but is mostly within the area that is closed to general visitor access. The established backcountry hiking route to Crack-in-Rock Pueblo follows along the base of the Doney Anticline and near the mouth of Antelope Canyon. Although dispersed hiking is encouraged instead of hiking on a developed trail, hikers are narrowly confined by rugged terrain in certain reaches, and short trail segments are evident. Some visitor use impacts are locally evident around the Crack-in-Rock area, including unplanned trails, localized vegetation trampling, soil compaction, accelerated erosion, and patches of nonnative Russian thistle (*Salsola* spp.). Although these impacts are localized, they illustrate how sensitive the desert environment can be to low levels of human activity.

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

Other localized vegetation “islands” of ponderosa pine, pinyon pine, and aspen effectively float on the relatively young, deep cinder deposits. Soil formation is precarious on the cinder deposits because weathered soil particles must accumulate between the cinders in order for plants to germinate and survive. During early stages of development, this process is easily disrupted by disturbance that dislodges the particles and causes them to sift into the cinders too deep to support plant germination and establishment. Around the “toe” of the lava flows, areas of water seepage may provide a unique microhabitat for plants. Water likely collects upon the hardened lava surface and is channeled through fracture systems to the perimeter of the flow where it may

Table 7. Threatened, Endangered and Sensitive Wildlife Species at Flagstaff Area Monuments

COMMON NAME	SCIENTIFIC NAME	STATUS	LOCATION
1) Mexican Spotted Owl	*Strix occidentalis* ssp. *lucida*	ESA Threatened	WACA (confirmed)
2) Bald Eagle	*Haliaeetus leucocephalus*	USFWS Recovered	WACA SUCR WUPA (No confirmed nests)
3) Peregrine Falcon	*Falco peregrinus* ssp. *anatum*	USFWS Recovered	WACA (confirmed)
4) Yellow-billed Cuckoo	*Coccyzus americanus*	Candidate	WUPA (potential)
5) Northern Goshawk	*Accipiter gentilis*	USFWS SC	WACA (confirmed)
6) Golden Eagle	*Aquila chrysaetos*	NPS SC	WUPA (confirmed)
7) Western Burrowing Owl	*Athene cunicularia* ssp. *Hypugaea*	USFWS SC	WUPA (confirmed)
8) Ferruginous Hawk	*Buteo regalis*	USFWS SC	WUPA (potential)
9) Wupatki Pocket Mouse	*Perognathus amplus* ssp. *cinerus*	USFWS SC	WUPA (confirmed)
10) Gunnison's Prairie Dog	*Cynomys gunnisoni*	AZ WSC	WUPA (confirmed) SUCR (confirmed) WACA (adjacent)
11) American Pronghorn	*Antilocapra americana*	NPS SC	WUPA (confirmed) SUCR (confirmed)
12) Townsend's Big-eared Bat	*Corynorhinus townsendii* spp. *pallescens*	USFWS SC	WUPA (confirmed) SUCR (potential) WACA (potential)
13) Spotted Bat	*Euderma maculatum*	USFWS SC	WUPA (confirmed) WACA (potential)
14) Allen's Big-eared Bat	*Idionycteris phyllotus*	USFWS SC	SUCR (potential) WACA (confirmed)
15) Western Small-footed Myotis Bat	*Myotis ciliolabrum*	USFWS SC	WUPA (confirmed) SUCR (confirmed) WACA (confirmed)
16) Long-eared Myotis Bat	*Myotis evotis*	USFWS SC	SUCR (confirmed) WACA (confirmed)
17) Arizona Myotis Bat	*Myotis occultus*	USFWS SC	SUCR (potential) WACA (confirmed)
18) Fringed Myotis Bat	*Myotis thysanodes*	USFWS SC	WUPA (confirmed) SUCR (confirmed) WACA (confirmed)
19) Long-legged Myotis Bat	*Myotis volans*	USFWS SC	SUCR (confirmed) WACA (potential)
20) Big Free-tailed Bat	*Nyctinamops macrotis*	USFWS SC	WUPA (confirmed) SUCR (potential) WACA (confirmed)
21) endemic pseudoscorpion Wupatki Earthcrack System	*Archeolarca welbourni*	NPS SC	WUPA (confirmed)
22) endemic pseudoscorpion Wupatki Earthcrack System	*Pseudogarypus hypogeus*	NPS SC	WUPA (confirmed)

Table 8. Sensitive Plant Species at Flagstaff Area Monuments

COMMON NAME	SCIENTIFIC NAME	STATUS	LOCATION
1) Peeble's bluestar	*Amsonia peeblesii*	NPS SC	WUPA (confirmed)
2) Beath milkvetch	*Astragalus beathii*	BLM Sensitive	WUPA (potential)
3) Marble Canyon milkvetch	*Astagalus cremnophylax* var. *hevronii*	USFS Sensitive	WUPA (potential)
4) Mogollon columbine	*Aquilegia desertorum*	AZ SR	WACA (confirmed)
5) Arizona bugbane	*Cimicifuga arizonica*	USFWS SC	WACA (potential)
6) Cameron water parsley	*Cymopterus megacephalus*	USFWS SC	WUPA (confirmed)
7) Cottontop cactus	*Echinocactus polycephalus*	AZ SR, NPS SC	WUPA (confirmed)
8) Rock fleabane	*Erigeron saxatalis*	USFS Sensitive	WACA (confirmed)
9) Roundleaf dunebroom	*Errazurizia rotundata*	BLM Sensitive	WUPA (confirmed)
10) Flagstaff pennyroyal	*Hedeoma diffusum*	USFS Sensitive	WACA (potential)
11) Arizona walnut	*Juglans major*	NPS SC	WACA (confirmed) WUPA (confirmed)
12) Fickeisen pincushion cactus	*Pediocactus peeblesianus* var. *fickeiseniae*	ESA Candidate	WUPA (potential)
13) Simpson plains cactus	*Pediocactus simpsonii*	AZ SR	WUPA (confirmed)
14) Sunset Crater penstemon	*Penstemon clutei*	USFWS SC	SUCR (confirmed)
15) Cinder phacelia	*Phacelia serrata*	USFWS SC	SUCR (confirmed) WUPA (confirmed)
16) Welsh's phacelia	*Phacelia welshii*	USFWS SC	WUPA (confirmed)
17) Common reed	*Phragmites australis*	NPS SC	WUPA (confirmed)
18) Whiting's indigo bush	*Psorothamnus thompsoniae* var. *whitingii*	USFWS SC	WUPA (confirmed)

locally benefit plant life before quickly percolating deep into the adjacent cinder barrens. These isolated vegetation island habitats likely support the Sunset Crater penstemon and the cinder phacelia. All three unique habitats likely harbor numerous plants, provide scarce wildlife habitat that would not otherwise be found, and greatly contribute to overall biodiversity within the monument.

3.7.4.2 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to special status species were derived from a review of available literature, regulatory agencies, IDT expert input, and from a number of sources including other successful invasive management plans. The thresholds of change for the intensity of an impact are defined below:

Impact Intensities and Definitions - Special Status Species

Impact Intensity	Intensity Definition
Negligible	No special-status species would be affected or some individuals could be affected as a result of the alternative, but there would be no effect on special-status species' populations. Impacts would be well within natural fluctuations.
Minor	The alternative would affect some special-status individuals and would also affect a limited portion of that species' population. Mitigation measures, if needed to offset adverse effects, would be simple and successful.
Moderate	The alternative would affect some special-status individuals and would also affect a sizeable segment of the species' population over a relatively large area within the park. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.
Major	The alternative would have a considerable effect on special-status individuals and affect a sizeable segment of the species' population over a relatively large area in and out of the park. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.

Duration

Short- term One year or less for an individual or habitat; five years or less for a population

Long- term Greater than one year for individual or habitat; greater than five years for a population

Context

Regional Impacts would affect a widespread area of suitable habitat or the range of the population or species. If species only occur in one area and that entire area is affected, impact is considered regional since it impacts the entire population of the special status species.

Localized Impacts are confined to a small part of the population, habitat or range.

3.7.4.3 Analysis of Alternatives and impacts on Special Status Species

Impacts of Alternative I

Alternative I: ***Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.***

Direct/Indirect Impacts: Under Alternative 1, current exotic plant management would continue. Crews would be used to survey for and/or treat exotic plant species throughout the monuments and could disturb special status wildlife. Mechanical/manual, cultural, and chemical treatments, and prevention would be used to control exotic plants. Mitigation measures developed in the project-specific BA and best management practices identified in **Appendix C** would be followed to minimize impacts to special status species that could result from any current treatment method. Impacts to all special status species are anticipated to be direct and indirect, beneficial, site-specific, long-term and minor based on the overall objective of exotic plant management to restore native plant communities that provide habitat and support native wildlife.

Impact Analysis

Under Alternative 1, current exotic plant management would continue. Crews would be used to survey for and/or treat exotic plant species throughout the monuments and could disturb special status wildlife. Mechanical/manual, cultural, and chemical treatments, and prevention would be used to control exotic plants. Mitigation measures developed in the project-specific BA and best management practices identified in **Appendix C** would be followed to minimize impacts to special status species that could result from any current treatment method. Impacts to all special status species are anticipated to be direct and indirect, beneficial, site-specific, long-term and minor based on the overall objective of exotic plant management to restore native plant communities that provide habitat and support native wildlife.

Many of the potential impacts to special status species would be addressed through mitigation measures and terms of the formal consultation with USFWS. (USFWS 5/24/2009). See **Appendix C** for specific mitigation measures for individual species.

Manual/Mechanical Treatments

Using primarily mechanical and manual treatments is limiting and has not been implemented in special status species habitats because these techniques are not fully effective on many of the invasive species that we are trying to control at FLAG, such as tamarisk, toadflax, and camelthorn. When extensive manual and mechanical treatments are used, they have the potential to cause widespread soil disturbance, which increases erosion and sedimentation, and the susceptibility of the area to invasion. Soil disturbance and other impacts are further exacerbated by the need for repeated treatments that this technique requires. This could adversely impact native terrestrial and riparian habitat, and aquatic species. Potential short- and long-term impacts could occur under this alternative. No escape flight response is expected because the monuments are required to perform prior inventories and consult with the USFWS and, based on the results of these, establish buffer areas as appropriate. The impacts of manual and mechanical treatments on special status species would therefore be ***direct and indirect, site-specific, short- and long-term, and minor to moderate.***

Chemical Treatments

Herbicides would not be applied during the breeding season or during times of high stream flow to reduce the likelihood of contaminating surface waters and impacting aquatic species. Herbicides selected for use and the application methods would reduce the impacts as described in the required mitigation measures listed in **Appendix C**. In the unlikely event of herbicide drift or runoff into aquatic habitats, the flow volume in the Little Colorado River is expected to rapidly dilute the chemical, minimizing/ eliminating adverse, short-term impacts to aquatic species. Most treatments have used herbicide applications on highly invasive riparian species, and were

designed to limit their spread and their impacts on special status species habitats. The herbicides proposed for use as a method of chemical control will be selected because of their low toxicity. They will also be applied manually which will limit chemical drift. By this plan, application conditions would be negligible to minor. Long-term persistence of herbicides in the food chain, bioaccumulation, and subsequent toxic effects are not expected to occur because these types of substances will not be allowed for use. The requirements for selecting the chemicals proposed for use specify that they must break down naturally in a short time, that they will be applied only at low rates, and only small quantities of herbicides will be used. The chemicals proposed for use cannot contain organo-chlorines that can cause egg-shell thinning and other harmful effects to wildlife. In the unlikely event of herbicide drift or spill into aquatic habitats, the flow volume through the Little Colorado River is expected to immediately dilute the chemical, minimizing/eliminating any impacts to aquatic species. If flow is small or in some cases non-existent, any required pesticide selected will degrade quickly in the soil.

It is highly unlikely that special status species would receive direct exposure to pesticides during chemical application, and it is also unlikely that they would be overexposed to pesticides over time when used under label specification and best management practices, as required. Since no pesticides will be applied within buffer areas during sensitive periods potential risks to special status species from pesticide exposure is unlikely. The impacts of chemical treatments on special status species would therefore be ***direct and indirect, site-specific, short-term, and minor***.

Biological Treatments

Any biological control agent released in a park must be approved by APHIS and would have no demonstrated affinity for native plant species. However, the Regional IPM Coordinator currently does not need to approve release of biological control agents. Because biological control agents are specific to a target exotic plant, there would be no known direct impacts to non-target special status species. The impacts of biological treatments on special status species would therefore be minor. The additional biomass created by the introduction of biological control agents may indirectly benefit mammal and bird species that prey on terrestrial insects. The impacts of biological treatments on special status species would therefore be ***indirectly beneficial, site specific, short-term, and minor***.

Cultural Treatments

TES species will directly benefit from the restoration of native plant communities and wildlife habitat. Restoration activities, such as reseeding and irrigation, would have the direct beneficial effect of promoting the reestablishment of native vegetation. Beneficial effects may be detectable in some areas, and would benefit special status species populations using those habitats. The impacts of exotic plant management cultural treatments on special status species would therefore be ***directly and indirectly beneficial, site-specific, short- and long-term, and minor.***

Displacement

Displacement of special status species would be limited by timing treatments to avoid Southwest willow flycatcher migration and breeding period, Mexican spotted owl breeding period, and yellow-billed cuckoo breeding period. However, because field crews are often only available during migration and breeding periods, we conducted formal consultation with the USFWS for the southwestern willow flycatcher in order to be approved to apply treatments (mechanical, herbicide and prescribed fire) at anytime during the year. USFWS determined tamarisk removal throughout the year *may affect, or is likely to adversely affect* the flycatcher (USFWS 5/24/

2009). Since no Southwest willow flycatchers have been documented breeding in the area no incidental take is anticipated. Since breeding activity is subject to change, especially as native habitat is improved, additional inventory surveys must be performed prior to any new control projects.

ANIMALS

Mexican spotted owl

Mexican spotted owl (MSO) restricted, protected, or critical habitat occurs primarily in remote backcountry sections of Walnut Canyon National Monument where mechanized equipment would generally not be used nor would motorized equipment be used to access treatment areas. For these reasons, potential for noise impacts are limited. However, there may be specific instances over the life of plan implementation where mechanized or motorized equipment might be necessary; in this case a site-specific analysis would occur to ensure potential for noise impacts are minimized.

Exotic plant management activities have potential to impact the MSO through direct noise disturbance during surveys, treatment, or accessing work sites in critical, protected, or predicted habitat. Surveys and manual and cultural treatments would create noise from crews. Mechanized equipment, especially use of brush cutters would have a greater noise impact. Indirect impacts could also occur through disturbance of habitat for prey species and thus the quality of potential foraging habitat. Impacts to foraging habitat would occur through all treatment types – manual/ mechanical, chemical, biological, cultural, and prescribed fire.

Treatments would be focused on exotic species only and would not alter in any substantial way, the native species in these areas. No treatment would disturb or alter primary elements of MSO habitat. While use of herbicides to treat exotic plant infestations in the monuments is a component of this plan, use in or near MSO habitat would be limited due to location, terrain, and presence of exotic plant species. USFWS Pesticide Protection Measures (United States Fish and Wildlife Service & United States Department of the Interior, 2007) have been reviewed for applicability to MSO and included in **Appendix C**. To minimize potential for adverse impacts, all relevant MSO protective measures guiding use of herbicides would be followed as part of this plan. Chemical treatments could have potential for secondary poisoning (i.e., poisoning of prey); however, no herbicides that can cause secondary poisoning will be used.

Implementation of Alternative 1 would result in ***minor adverse short-term impacts*** to Mexican spotted owls.

Bald Eagle

Bald eagles do not breed in the FLAG monuments, but are occasionally present in riparian habitats along the Little Colorado River and in Walnut Canyon during the wintering season. Exotic plant surveys and treatments may be necessary in these areas to treat tamarisk and other exotic species. For this reason, impacts to wintering eagles are possible.

Wintering eagles usually select riparian habitat for roosting, and typically select large trees in the overstory. All potential treatment sites will be surveyed prior to treatment in order to determine if roost trees are present. If roost trees exist then those areas will be withdrawn from treatment until summer and fall when bald eagles will not be present. If other winter roosts are located in areas where they have been occasionally observed in the past, these areas would also be avoided

during winter months. In these areas as well, eagles typically select tall snags or other tall trees in the overstory for roosting and perching and these trees would not be affected by any planned or foreseeable exotic plant treatments.

Exotic plant management activities have potential to impact wintering bald eagles by disturbing feeding activities and roosting while activities are taking place. Impacts to roosting and foraging habitat are not expected, as described above, but crews, if present in large enough numbers or if working in close proximity to bald eagle foraging areas or winter roost sites, have potential to create noise above ambient conditions and can disturb eagles. Flushing due to human intrusion has been shown to interrupt feeding activities and can displace eagles. Steidl and Anthony (1995) studied effects of recreation on non-breeding bald eagles in Alaska and found that 50% flushed in response to nearby disturbances. Crews hiking or working in morning and evening hours are more likely to flush perched or foraging eagles. December through March is the time of year when bald eagles may be most sensitive to disturbance.

Use of herbicides to treat exotic plant infestations in the park is a component of this plan; the primary potential for chemicals to impact bald eagles is secondary poisoning through prey species. Chemicals with potential for secondary poisoning will not be used.

Implementation of Alternative 1 would have ***negligible to minor short-term localized adverse impacts*** to bald eagles.

Yellow-billed cuckoo

It is generally unknown but thought unlikely that the FLAG monuments provide nesting habitat for yellow-billed cuckoos, but information indicates they have used riparian habitat along the Little Colorado River and tributary confluences in the past. The range of the species overlaps to some extent with the southwestern willow flycatcher and it appears that habitat preferences may also be similar, at least in terms of preferred riparian tree species. Cuckoos are riparian obligates known to use tamarisk, cotton-wood, and willow habitats. Alternative 1 includes treatment of tamarisk along the Little Colorado River and some of its tributaries. This has potential for impact to cuckoos since they are known to use tamarisk in Arizona for breeding and migration.

As with other bird species, cuckoos may be disturbed due to increased human-generated noise during the breeding season. Exotic plant treatments will not be planned for any areas where breeding areas have been identified. However, activities associated with exotic plant management actions have potential for indirect increased noise from travelling through areas to get to treatment or survey sites and/or congregating near occupied or suitable habitat. Use of herbicides to treat exotic plant infestations in the monuments would be subject to limitations because of its similarity to southwestern willow flycatcher habitat and associated restrictions on exotic plant management activities. While manual treatments will be the preferred method for treating small seedling and sapling tamarisk, herbicide is the most effective way of treating larger tamarisk and may be used. All relevant southwestern willow flycatcher protective measures guiding herbicide use would be followed as part of this plan, to minimize potential for adverse impacts. USFWS Recommended Protection Measures for Pesticide Applications (United States Fish and Wildlife Service, 2007) have been reviewed for applicability to the yellow-billed cuckoo and included in **Appendix C**.

Impacts to the yellow-billed cuckoo would be ***adverse negligible to minor short term localized***. Long-term minor beneficial impacts could result from removal of exotic plant species and restoration of riparian vegetation in FLAG.

Southwestern willow flycatcher
Tamarisk removal, primarily along the Little Colorado River and side canyons at Wupatki National Monument, has potential to impact the southwestern willow flycatcher (SWWF). This species commonly uses nonnative tamarisk in Arizona for breeding and migration.

As with other bird species, SWWF may be disturbed by increased human-generated noise during the breeding season. No SWWF breeding locations have been identified in the FLAG monuments. However, activities associated with exotic plant management actions have potential for indirect increased noise from travelling through areas to get to treatment or survey sites and/or camping or congregating near occupied or suitable habitat for SWWF.

Use of herbicides to treat exotic plant infestations is a component of this plan. While manual treatments will be the preferred method for treating small seedling and sapling tamarisk, herbicide is an effective way of treating larger tamarisk and may be used as part of this project. Tamarisk will probably be treated in tributaries to the Little Colorado River as well as other areas where it is found. Treatment areas will be evaluated for flycatcher habitat prior to treatment. Herbicides will also be considered for other exotic plant species when manual removal is not an effective option. USFWS Recommended Protection Measures for Pesticide Applications have been reviewed for applicability to SWWF and all relative protective measures would be followed as part of this plan to minimize potential for adverse impacts, see **Appendix C**.

Removal of tamarisk and other riparian exotic plant species could have ***direct and indirect adverse localized short-term minor effects*** on SWWF habitat. To avoid adverse impacts, habitat assessments and surveys would be completed prior to exotic plant treatment and no work would occur in areas where SWWF activity is found. If potential suitable habitat is identified through habitat assessment, project managers would consult with USFWS and adhere to survey procedures outlined in the recovery plan before implementation of exotic plant treatment. Project managers would use treatments to control exotic plants in riparian ecosystems consistent with the August 2002 Southwestern Willow Flycatcher Recovery Plan (United States Fish and Wildlife Service, 2002). Removal of exotic plant species would have ***beneficial localized long-term minor to moderate effects*** on SWWF through restoration of riparian ecosystems and native plant species such as willows which is their primary habitat choice.

Raptors *(American peregrine falcon, golden eagle, northern goshawk, western burrowing owl, ferruginous hawk)*
Crews surveying for and/or treating exotic plant species could disturb special status bird species, but cliff nesting habitat used by peregrine falcon ensures disturbance will be minimal. Human presence and increased noise within goshawk territories could result in disturbance and cause a flush response or induce birds to modify behavior. Due to the aggressive nature of goshawks, crews will know when a goshawk's territory has been invaded during nesting season. Crews will be instructed to finish work quickly or abandon treatment if nesting goshawks are present and agitated. Locations of most goshawk and peregrine falcon nesting territories are known in the FLAG monuments, and annual coordination with the FLAG Wildlife Program Manager will limit impacts to this species. USFWS Recommended Protection Measures for Pesticide

Applications (United States Fish and Wildlife Service, 2007) have been reviewed for applicability to the peregrine falcon, golden eagle, western burrowing owl, ferruginous hawk, and northern goshawk, and included in **Appendix C**.

Implementation of Alternative I would result in **negligible to minor adverse short-term localized impacts** to peregrine falcon, the golden eagle, western burrowing owl, ferruginous hawk, and northern goshawk.

Mammals (*American pronghorn, Gunnison's prairie dog, Wupatki pocket mouse Allen's big eared bat, Towndsend's big-eared bat, western small footed myotis bat, long-legged myotis bat, Arizona myotis bat, Townsend's big-eared bat, big free-tailed bat, Arizona myotis bat, long-eared myotis bat, spotted bat, fringed myotis bat*)

Pronghorn antelope are moderately intolerant of human disturbance. This can lead to increased adverse interactions with humans and disruptions of normal foraging and breeding patterns. Crews will be instructed to refrain from interactions with pronghorn. Additionally, USFWS Pesticide Protection Measures for mammals will be followed to minimize adverse impacts.

The long-legged myotis, southwestern myotis, and other bats generally roost in snags or live damaged trees. It is unlikely that presence of crews near roost trees will disturb these species as they are well concealed and protected by the roost tree. Crews will be instructed to avoid camping and prolonged activities near snags or live damaged trees. Allen's big-eared bat, Townsend's big-eared bat, and spotted bats roost in mines or rock crevices and consequently are not likely to be disturbed by crews. It is possible that bats will occasionally forage on herbicide-laden insects, but it is unlikely they will encounter enough insects to ingest a lethal dose of herbicide. Implementation of Alternative 1 would result in ***negligible to minor adverse short-term localized impacts*** to special status mammal species.

A majority of exotics treatments are planned for park developed areas and conducted manually (i.e., manual tools, manual herbicide application). These non-mechanized treatments, including surveys, are not expected to impact nesting and/or roosting sites, key foraging areas, key calving or fawning areas, primary habitat for Federally listed plants, or primary wildlife travel corridors.

PLANTS

Fickiesen pincushion cactus

Fickeisen pincushion cactus is a small solitary or clustered globose cactus with corky spines (Benson 1962). It retracts into the soil during periods of drought. The habitat of this plant is gravelly soils derived from Kaibab limestone on flat ridgetops and benches, from 4,200 to 5,400 feet (Phillips et al. 1982b). This species mostly occurs in scattered populations on the canyon rims of the Little Colorado and Colorado Rivers on the Navajo Reservation and on Bureau of Land Management lands in House Rock Valley and Mohave County.

Fickeisen pincushion cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) is not known to occur in Flagstaff Area Monuments boundaries, but occurs in close proximity north of Wupatki National Monument and in the Marble Canyon area; it is possible that unsurveyed suitable habitat exists within the monument. However, there appears to be little need for exotic plant management activities in its known habitat type within Wupatki. If treatments are necessary, surveys would be performed before any action, and NPS staff would avoid all known occupied

habitat when accessing treatment locations. This is a small, very inconspicuous cactus and easily missed; it is sensitive to trampling and especially to off-road vehicle use. All access through areas where this species has been found will be allowed only on established roads. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully avoid occupied habitat. Surveys for this species would be conducted wherever treatments and activities are proposed within suitable habitat.

Impacts to Fickeisen pincushion cactus from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Sunset Crater Beardtongue

Sunset Crater beardtongue is a perennial herb 12 to 30 inches tall with bright pink flowers in June and July (Nelson 1927). The soil in which it grows is typically a layer of cinders 2 to 5 inches deep with a layer of silty soil below, important for water retention at the root level of this species (Phillips et al. 1992). The habitat is flat or gently sloping sites in open ponderosa pine forest between 6,500 and 8,500 feet in the Sunset Crater volcanic field near Flagstaff.

The Sunset Crater beardtongue (*Penstemon clutei*) is a narrow endemic of volcanic cinder areas in north-central Arizona. The Sunset Crater beardtongue is a distinct species in a genus of about 300 species indigenous to America from Alaska to Guatemala (AGFD 2003). Usually found in and around volcanic cinder cones, either in open areas or under ponderosa pine trees in spots without leaf litter. There are approximately 36 known populations, mostly small clusters of plants in scattered pockets in Sunset Crater Volcano National Monument and the surrounding area (Center for Plant Conservation).

Threats include off-road vehicles, herbivory by domestic and wild ungulates, and timber salvage operations (Center for Plant Conservation; AGFD 2003). This species may be threatened by horticultural collecting (AGFD 2003). No Sunset Crater beardtongue has been found in the project area.

If invasive plant treatments are necessary, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. The Sunset Crater beardtongue is a conspicuous penstemon that is easily identified and located during the growing season, from May through October. It is sensitive to trampling and especially to off-road vehicle use. All vehicular access through areas where this species has been found will be allowed only on established roads. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully avoid occupied habitat. Most treatments in this sparse habitat will be manual pulling of invasive species due to the lack of density of vegetation and the ease of control with this method. Before any treatments are initiated, surveys for this species will be conducted during the growing season wherever treatments and activities are proposed within suitable habitat.

Impacts to the Sunset Crater beardtongue from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Cinder Phacelia
The cinder phacelia (*Phacelia serrata*) is a rare annual forb. The species is designated a "Species of Concern" or "Species at Risk" by the US Fish and Wildlife Service. It was originally designated a Category One "Candidate Species" (Federal Register 41 p. 242 1980). The cinder phacelia is endemic to volcanic cinders in only two disjunct regions of the world, approximately 260 miles apart, in Arizona and New Mexico. Although locally abundant, its presence is dependent upon volcanic cinders as its specific substrate. The populations of cinder phacelia appear to be stable. It occurs in Sunset Crater Volcano National Monument where it is protected. It is often locally abundant in both Arizona and New Mexico. However, its abundance is dependent upon precipitation, and in drought years it will be scarce to rare even in prime habitat (NatureServe 2008).

Limited research has been conducted on the reproduction of this species. Flowering takes place from mid-June to mid-September and the species takes advantage of the monsoon rains to flower and set seed late in the year (Huisinga et al. 2000). Seeds lay dormant in the ground until favorable environmental conditions. This is an important survival mechanism that is an adaptation to the variable precipitation of the arid southwest. Specific pollinators of this species have not been identified.

Road construction and maintenance are serious threats. Volcanic cinders are quarried in the area for road construction materials and this is a potential threat to its critical habitat. If invasive plant treatments are necessary, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. The Cinder phacelia is a conspicuous plant that is easily identified and located during the growing season, from June through October. It is sensitive to trampling and especially to off-road vehicle use. All vehicular access through areas where this species has been found will be allowed only on established roads. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully avoid occupied habitat and damaging the loose soil substrate. Before any treatments are initiated, surveys for this species will be conducted during the growing season wherever treatments and activities are proposed within suitable habitat. Most treatments in this sparse habitat will be manual pulling of invasive species due to the lack of density of vegetation and the ease of control using this method.

Impacts to cinder phacelia from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Welsh's Scorpionweed
Welsh's scorpionweed (*Phacelia welshii*) is an herbaceous annual found within the Flagstaff Area Monuments from Wupatki National Monument and Sunset Crater Volcano National Monument. It is also found north to Cameron and The Gap in northeastern Coconino County. This species is usually found in the red shale outcrops of the Moenkopi Formation, along roadside edges and gravelly washes. However, it has also been collected on black, sandy, volcanic ash (Phillips et al. 1982), such as those found in the project area.

Populations vary from rare to abundant based on the amount of winter and spring precipitation (Phillips et al. 1982). There are ten recorded occurrences in Arizona and six in the Navajo Nation, some of which may overlap with Arizona's (NatureServe 2003).

If invasive plant treatments are necessary, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. The Welsches scorpionweed can be located during the growing season, from June through October. It is sensitive to trampling and especially to off-road vehicle use. All vehicular access through areas where this species has been found will be allowed only on established roads. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully avoid occupied habitat and damaging the loose soil substrate. Before any treatments are initiated, surveys for this species will be conducted during the growing season wherever treatments and activities are proposed within suitable habitat. Most treatments in this sparse habitat will be manual pulling of invasive species due to the lack of density of vegetation and the ease of control using this method.

Impacts to Welch's scorpionweed from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Whiting's Indigo Bush

Whiting's Indigo Bush (*Psorothamnus thompsoniae* var. *whitingii),* which is listed as a "species of concern" by the USFWS, is found on sandy, gravelly soils within Wupatki National Monument. It grows from 3700-5100 feet on slopes of low hills and ridgetops sometimes moving into arroyos and floodplains. It occurs in mixed desert shrub communities and is often associated with saltbush, sand sagebrush, and Mormon tea (AGFD, 1993; Roth, 1999). In Wupatki it is only found near the Little Colorado River.

This variety is known only from the Monument Valley region in southwestern San Juan County, Utah (Copper Canyon, Paiute Canyon) southwest to Navajo Mountain and Wupatki National Monument along the Little Colorado River drainage (Coconino County, Arizona). It was reported from Grand Canyon National Park at Kanab Creek although this locality is questionable (Kearney & Peebles, 1960; McDougall, 1973; AGFD, 1993). A population just south of the Little Colorado River on Wupatki National Monument is extensive with over 1500 plants occurring on the slopes and tops of rocky ridges. However, it is abundant in a very specific, local area and is not generally abundant at all.

If invasive plant treatments are necessary within Whiting's indigo bush habitat, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. This species can be easily located during the growing season, from May through October. It is sensitive to trampling and especially to off-road vehicle use. All vehicular access through areas where this species has been found will be allowed only on established roads. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully delineate and avoid occupied habitat and damaging the loose soil substrate. Most treatments in this sparse habitat will be manual pulling of invasive species due to the lack of density of vegetation and the ease of control using this method. However, camelthorn may be present and must be treated chemically in order to be fully effective. If this is the case, camelthorn will be either manually removed or spot treated with herbicide.

Impacts to Whiting's Indigo Bush from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Arizona bugbane
Arizona bugbane is a large perennial herb up to 6 feet tall with ternately compound (divided into three parts) leaves, flowering in July and August (Phillips and Popowski 1995). Habitat includes canyon bottoms and lower canyon slopes and seeps and springs in moist loamy soil of the ecotone between the coniferous forest and riparian habitat. The known elevation range is between 4,800 and 8,600 feet. This species is known only from Bill Williams Mountain, Kaibab National Forest, and Oak Creek Canyon and West Clear Creek Canyon in the Coconino National Forest (Phillips and Popowski 1998). It is also known from the Sierra Ancha Mountains on the Tonto National Forest (USDA Forest Service 1993a).

Arizona bugbane (*Cimicifuga arizonica)* is listed as a "candidate" species by the Endangered Species Act (ESA), and has not yet been found in Walnut Canyon National Monument. However, habitat exists within the monument and WACA is within the range of the species. It has never been observed there although it was on the search list because it occurs in many of the waterways along the Mogollon Rim. It seems unlikely that it will be found at Walnut Canyon because of the lack of perennial water.

Arizona bugbane grows in moist, loamy soil of ecotones between coniferous forest and riparian habitat. Most of the known populations are located in northern Arizona between 4800-8600 feet along canyon bottoms and lower canyon slopes (at times under overhangs) in association with Douglas fir, Rocky Mountain maple, and sometimes aspen. Some populations are found on mountains at seeps and springs, in drainages and on shaded north slopes. It appears to require deep shade from forest or riparian overstory, high relative humidity and cold air drainage. Canyon direction and aspect do not appear to be a big factor as long as the canyons are deep and narrow enough to provide shade for a large part of the day (Phillips et al., 1996; AGFD, 1997).

If invasive plant treatments are necessary within Arizona bugbane habitat, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. Herbicides selected to be used in the project area would also be chosen for their low ecotoxicity to the Arizona bugbane. This species can be located during the growing season, from May through October. All vehicular access through areas where this species has been found will be allowed only on established roads. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully delineate and avoid occupied habitat.

Impacts to Arizona bugbane from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Peeble's bluestar
Peebles bluestar (*Amsonia peeblesii*) is an herbaceous perennial that is found principally in shrubland and shrubland-grassland with a few populations in the grasslands at Wupatki National Monument. Substrate types range from strongly alkaline sedimentary conglomerates to volcanic cinders. The plant's elevational range is from 4000-6000 feet.

Peebles bluestar is found only in Arizona in Apache, Coconino, Navajo Counties. Except for the Lee's Ferry collection, the plant occurs entirely within the Little Colorado Valley from Winslow to Cameron (Reichenbacher, 1986). Although Peebles bluestar and other Amsonia species are

found in Coconino County, none of these species are common. They may be abundant in a local area but their populations are very scattered and rare.

In 1980 (Bateman), Peebles bluestar was discovered at four locations at Wupatki National Monument. In Section 7 approximately 0.4 miles south of Citadel Sink and halfway between the base of South Mesa and the road, 116 individual clusters were counted. At the merging of two jeep trails in Section 13 of Wupatki National Monument, 42 clusters were counted at the base of a rocky ledge. Approximately 100 m northwest of this location, 106 additional clusters were counted in a small unnamed wash. Finally, 324 clusters of Amsonia peeblesii were found in Sections 1 and 6 at the base of Cedar Canyon near the Borrow Pit, in the grass-Atriplex-Fallugia association adjacent to the Juniper-Grassland, but none were found in association with junipers. The soil (sandy base with a light cinder cover) in all locations was bare except for a few four-winged saltbushes and some grasses (Bateman, 1980). In 1986, Reichenbacher noted that no systematic, broad-scale searches for the species had been done and he believed that there were many undiscovered populations. However, during the 1999 field season, systematic surveys for this species were conducted and several new populations within Wupatki National Monument were discovered. New locations were documented at Crack-In-Rock ruin and along the southern end of the dirt road that leads from the Monument north to this ruin. The localities in Citadel Wash, South Mesa Wash, Wukoki Ruin, and "Peshlakai Wash" (a small wash north of Deadman Wash) were confirmed in 1999. All of these plants were mapped using GPS and GIS. The plant was not relocated at the south end of Doney Mountain Wash though it may occur further north in the wash. The original collection at this locality stated only that it grew in Doney Mountain Wash and did not give its exact location. After the 1999 fieldwork, it is estimated that approximately 1500 individuals of Peebles bluestar in 7 distinct areas are growing at Wupatki National Monument. Refer to the map for exact localities.

Most of the 52 known extant Peebles bluestar localities occur at Wupatki National Monument. The Monument has acknowledged the presence of a Peebles bluestar population adjacent to the paved parking area at Wukoki Ruin but otherwise has not developed an active management plan for the species. Outright habitat destruction (clearing of vegetation, trampling by cattle) is the only known threat to Peebles bluestar. It is extremely unpalatable to cattle. Most of its range lies in remote or sparsely settled regions where such destruction is not likely to occur very often (Reichenbacher, 1986). However, Bateman (1976) recommends prohibiting entrance of livestock from the adjacent Navajo Reservation to the east and private lands to the north of Cedar Canyon to protect A. peeblesii from elimination through livestock overgrazing or habitat alteration.

Over-collection of this species is a significant concern. It is highly regarded by the Western Navajo and is difficult to find outside of Wupatki National Monument. It was extensively used by the Wupatki Navajo especially when they inhabited the Monument. Due to the fact that the whole plant is collected including the roots, this plant could easily be eradicated if over-collected.

If invasive plant treatments are necessary within Peebles bluestar habitat, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. Herbicides selected to be used in the project area would also be chosen for their low ecotoxicity to the Peebles bluestar. This species can be located during the growing season, from May through October. It is sensitive to habitat alteration, trampling, and

especially to off-road vehicle use. All vehicular access through areas where this species has been found will be allowed only on established roads. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully delineate and avoid occupied habitat. Most treatments in this sparse habitat will be manual pulling of invasive species due to the lack of density of vegetation and the ease of control using this method.

Impacts to Peebles bluestar from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Camaroon water parsley

Camaroon water parsley (*Cymopterus megacephalus*) is a perennial herb, with a taproot and subterranean crown from which the leaves and scapes (a leafless flower stalk) arise individually.

Camaroon water parsley is separated from similar species by its globose head inflorescence, its small involucral bracts, its non-mat-forming habit, its lack of stem pubescence, its simple surficial or subterranean crown on the taproot, and its fruit without a carpophore (a slender prolongation of the receptacle between the carpels as a central axis) (Cronquist, 1997). This species is found only in northern Arizona (Kearney & Peebles, 1951). In Arizona, it occurs in Apache, Navajo and eastern Coconino counties at elevations between 4500 to 7000 feet (McDougall, 1973).

The Endangered Species Act (ESA) lists this species as a "species of concern" noting that its habitat and limited populations may be at risk. The Global (G) and State (S) Rankings indicate that this species is rare or local throughout its range and is vulnerable to extinction globally and statewide. This species flowers from April to June and its seeds mature shortly after flowering. It is one of the first plants to emerge in the early spring. During the course of a rare plant survey in 1999, no localities of Camaroon water parsley were observed in Wupatki National Monument. It seems highly likely that this species grows on the Monument because of its nearby locality at Spiderweb Ranch where it has been found. In addition, it is found in gravelly banks of which there are an abundance along the Little Colorado River.

If invasive plant treatments are necessary within Camaroon water parsley habitat, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. Herbicides selected to be used in the project area would also be chosen for their low ecotoxicity to the Camaroon water parsley. This species can be located during the growing season, from April through July. It is sensitive to habitat alteration, trampling, and especially to off-road vehicle use. All vehicular access through areas where this species has been found will be allowed only on established roads. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully delineate and avoid occupied habitat. Most treatments in this sparse habitat will be manual pulling of invasive species due to the lack of density of vegetation and the ease of control using this method.

Impacts to Camaroon water parsley from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Arizona Walnut
Arizona Walnut (*Juglans major*) is a deciduous tree growing to 15m at a fast rate. It is in flower from May to June, and the seeds ripen from October to December. The flowers are monoecious (individual flowers are either male or female, but both sexes can be found on the same plant) and are pollinated by Wind. The plant is self-fertile. This tree prefers light (sandy), medium (loamy) and heavy (clay) soils and requires well-drained soil. It also prefers acid, neutral and basic (alkaline) soils. It cannot grow in the shade and requires moist soil.

Arizona walnut is the plant that Walnut Canyon National Monument is named after and is found in the riparian zone at the bottom of Walnut Canyon. It is also sometimes found growing within moist seeps along the canyon walls.

Arizona walnut is an NPS "species of concern" primarily because of the loss of vital riparian habitat due to dams and water diversions within Walnut Canyon. Due to these impacts from upstream and downstream sources the Arizona walnut appears to be diminishing, although no thorough surveys have been completed.

If invasive plant treatments are necessary within Arizona walnut habitat, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. Herbicides selected to be used in the project area would also be chosen for their low ecotoxicity to the Arizona walnut. This species can be located throughout the year. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully delineate and avoid occupied habitat. Most treatments in this riparian habitat will be manual pulling of invasive species and spot treatments of herbicide so any impacts from overspray would be minimal.

Impacts to the Arizona walnut from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Common reed
Common reed (*Phragmites australis*), an NPS "species of concern", is a tall, coarse perennial with stout rhizomes to 2 cm across, deep seated in the substrate. Common reed is found in marshes and in shallow water along the shoreline of lakes, ponds, swamps, springs, seeps, ditches, streams, canals, rivers, and estuaries. It may produce large quantities of seed, but in many cases very few are viable. The seed will not germinate in more than about 5 cm of water (Marks et al. 1994). Once established, Phragmites spreads by rhizomes and stolons and often forms dense, monospecific colonies along shorelines and shallow water areas. Rhizomes are reported to grow up to about 2 m per year and be as long as 20 m (Batterson & Hall 1984). Common reed is only found at one or two spring-related sites in Wupatki National Monument.

Common reed is a cosmopolitan species occurring throughout the world. It is thought to be the most widely distributed flowering plant. It lives in temperate zones, from the Sahara to the Arctic, as well as in tropical wetlands, with the exception of the Amazon Basin and central Africa. Common reed is a native of the Americas and Eurasia but the highly invasive form that is taking over U.S. wetlands originated in Europe. The invasive form is found in every state of the U.S. Examples of the native form are reputed to be less dense and generally smaller than the invasive European form. The common reed in Wupatki National Monument is thought to be the native form and genetic studies are now underway in order to be certain.

If invasive plant treatments are necessary within common reed habitat, surveys would be performed before any action, and NPS staff would avoid all known occupied habitat when accessing treatment locations. Herbicides selected to be used in the project area would also be chosen for their low ecotoxicity to the common reed. This species can be located throughout the year. Crews would be instructed in species identification so any off-road hiking to survey or treatments sites would carefully delineate and avoid occupied habitat. Most treatments in this riparian habitat will be manual pulling of invasive species and spot treatments of herbicide so any impacts from overspray would be minimal. If tests show that the common reed found at Wupatki is the Eurasion aggressive form steps will be taken to control it. These will probably include manual and chemical treatments.

Impacts to the common reed from Alternative I would be ***direct, beneficial, site specific, long-term, and minor.***

Cumulative Impacts

Cumulative impacts on special status species were determined by combining impacts of Alternative II with other past, present, and reasonably foreseeable future actions having impacts in priority areas for exotic plant management described at the beginning of this chapter (i.e., trails, roads, entrance stations, heavily trafficked areas).

Past activities considered in this analysis include fire management actions including prescribed and wildland fires, trespass cattle grazing, human presence and activities, construction projects, and ongoing exotic plant management efforts in the FLAG monuments and on adjacent lands. These actions have caused adverse impacts such as vegetation loss, habitat modification, species competition, decreased wildlife security, and noise disturbance. Beneficial impacts to special status species, specifically to habitat and food sources, have resulted from ongoing exotic plant management efforts. Beneficial impacts have also occurred from fire activities that reduce fuel loads. Several of these activities, including prescribed and wildfire, stock use, human activities, and exotic plant management in the park and on adjacent lands are ongoing and considered in this analysis as in-progress and future actions as well as past activities. Adverse impacts to special status species from these activities are localized short- to long-term negligible to moderate. Beneficial impacts from ongoing exotic plant management efforts are long term negligible to moderate.

Recently completed and in-progress projects could have a cumulative effect when combined with Alternative II. Removal of native vegetation has been or will be required in each of these projects resulting in loss of habitat or potential habitat, and greater potential for habitat fragmentation. Impacts to special status species from these projects would be generally direct, adverse and indirect, long-term, and minor. Short-term minor adverse impacts would occur to some species during construction.

Foreseeable future projects include: road widening and shoulder repair, facility maintenance and improvements, and facility infrastructure upgrades including water, electricity, and sewer systems. Similar to projects described above, vegetation removal will be required for these future projects. Therefore, impacts would be long-term minor adverse. Short-term minor adverse impacts would occur to some species during construction.

Cumulatively, effects of Alternative II, when combined with other past, present, and reasonably foreseeable actions, would result in ***direct and indirect, adverse, short-term, localized, and minor impacts*** on special status species. Alternative I would have a negligible contribution to this cumulative adverse effect because the goals of exotic plant management is beneficial to special status animal and plant species and their natural habitats.

Conclusions

Invasive plant management would help parks maintain the desired condition that has populations of native plant and animal species functioning in as natural condition as possible and restores extirpated native plant and animal species to the monuments. However, Alternative II would likely achieve the desired condition at the FLAG monuments before it would be reached under Alternatives I and III. Potential negative impacts may be higher than Alternative II because this alternative does not include species-specific management practices. Exotic plant management may indirectly affect individuals of a listed species or its critical habitat, but the change would be minor and would not result in take. Exotic plant management may affect, but would not adversely affect federally listed threatened and endangered species. This alternative would not result in impairment to TES species or associated habitat.

The preferred alternative would have ***direct beneficial short and long-term, minor impacts*** to special status species as these are the habitats being targeted for priority treatments and restoration/ maintenance of native plant communities. The long-term impacts will be minor and beneficial as there will be continued chemical treatments in riparian areas, but overall fewer areas will be treated and less invasive species will continue to spread and degrade habitat. Impacts to special status species would be indirect and result from degradation of habitat, not from direct impacts to any special status species. Cumulative impacts would be negligible when considered in the context of ongoing loss of special status species habitats, primarily in riparian areas. Rapid urban development, impacts from introduced non-native species, and disturbances from increasing human recreation are causing the greatest impacts to special status species.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Impacts of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Mitigation Measures Required by Alternative II for Special Status Species

Mitigation measures for specific species and general situations are listed in **Appendix B**. A number of BMPs would be implemented to minimize potential impacts to all special status

species under this alternative. BMPs developed to minimize potential impacts to these species include:

1) Personnel would be trained to identify and avoid special status species. If any species are identified in the field, treatments would be halted until buffer areas are established. Livestock, such as horses, and ATVs and off-road vehicle traffic would not be allowed in areas where special status plants are known to occur or have the potential to occur.
2) Restoration activities, such as reseeding, re-vegetation, and irrigation, would only be used where necessary to promote the reestablishment of native plant communities. To avoid take, activities near special status species habitat would be avoided during sensitive periods. Any manual or mechanical methods would be highly selective for individual exotic plants to minimize the potential for impacting special status plants. Personnel would be trained to identify and avoid special status species if encountered. Tilling would not be used in areas where special status plants are known to occur or have the potential to occur, and any ground disturbance will be kept to an absolute minimum.
3) Cultural treatments would not likely have any measurable impacts on native fish or aquatic wildlife species, their habitats, or natural processes sustaining them. Impacts would be site-specific and short-term.
4) Chemicals would only be used when determined necessary, or if there are no other acceptable or feasible treatment options. Species-specific BMPs have been developed, in addition to general BMPs, to minimize the potential exposure of special status species to pesticides. These can be found in **Appendix C**. Application of pesticides near special status species' habitat would be avoided during sensitive periods. In most situations hand applications will be required to apply pesticides, a 40-foot radius no-spray zone shall be established around special status plants. Hand spraying allows for treatment of individual plants and minimizes overspray and drift. The spray can be directed within an inch of the target plant. If boom treatments are used (ATVs or aircraft) to apply pesticides, a 100-foot no-spray zone would be established around these plants.
5) Any biological control agents released in a park must be approved by APHIS and have no demonstrated affinity for special status plant species or close relatives.
6) Project-specific prescribed fire plans would be developed for each prescribed fire to limit the potential for high-intensity fires. Prescribed fires would not be conducted in special status species' habitat during active breeding periods. Project specific prescribed fire plans would be designed to prioritize the protection of habitat for special status species.
7) In addition, species-specific BMPs shall be implemented for each special status species. These can be found in **Appendix C**.

Impact Analysis

Exotic plant management activities under Alternative II would have similar impacts to special status species as for Alternative 1 and the same mitigation measures would be implemented to minimize disturbance.

Under Alternative II, more in-depth and extensive annual surveys would occur, a greater variety of hand and mechanized tools would be used, additional coordination efforts with FLAG's fire program and project managers would occur, use of fire would be added as a treatment method for exotic plant species, and additional herbicides would be used as appropriate. Crews would continue to survey for and/or treat exotic plant species throughout the park, and could disturb special status species. As discussed in Alternative 1, prevention, mechanical, manual, cultural,

and chemical treatments would continue to be used to control exotic plants. Beneficial impacts to all special status species are anticipated to be ***direct and indirect, long-term, and mino***r based on the overall objective of exotic plant management to restore native plant communities that provide habitat and support native wildlife.

Manual/Mechanical Treatments
Short-term impacts to special status species from the implementation of manual and mechanical treatments are very similar between this alternative and Alternative I. All treatments will be targeted to protect special status species habitats. The preferred alternative would have additional benefits from its ability to integrate treatment methods and to treat additional, less invasive species that are not currently being treated. This alternative would allow treatment of more species with the most effective and efficient treatment methods. The impacts of manual and mechanical treatments on special status species would therefore be ***direct and indirect, site-specific, short- and long-term, and minor to moderate.***

Chemical Treatments
The impacts of chemical applications to special status species are similar to Alternative I. Although additional acres would be treated under this alternative, no additional impacts are predicted due to the strict mitigation measures that would be implemented during application. The least amount of the least toxic chemical would be applied. The impacts of chemical treatments on special status species would therefore be ***direct and indirect, site-specific, short-term, and minor***.

Biological Treatments:
Biological control is not likely to be used, but could include introducing insects to reduce invasive plant infestations. Using biological control could have minor, short-term, adverse impacts on special-status wildlife (e.g. through competition for food) if the method is not selected and monitored very carefully. No biological controls would be implemented without further consultation with USFWS. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting and would not be implemented if there is a risk of negatively impacting a special status species population or their habitat.

Because biological control agents are specific to a target exotic plant, there would be no known direct impacts to non-target special status species. The additional biomass created by the introduction of biological control agents may indirectly benefit special status mammal and bird species that prey on terrestrial insects.

The additional biomass created by the introduction of biological control agents may benefit special status species that prey on terrestrial insects. Impacts would be beneficial, short- or long-term, and site-specific. Impacts would be similar to Alternative I. The impacts of biological treatments on special status species would therefore be ***indirect, beneficial, site specific, short- and long-term, and minor.***

Cultural Treatments
Cultural treatments would be enhanced under this alternative as more acres are expected to be treated and restored. This alternative has the potential to restore important wildlife habitat adjacent to the riparian areas. BMPs have been implemented to minimize the potential for

adverse impacts to special status species. Special status species will likely benefit from the restoration of native plant communities and wildlife habitat. These direct beneficial effects may be detectable in some areas, and would benefit special status populations using those areas. The minor and short-term impacts would be out-weighed by the long-term benefits of habitat rehabilitation. Restoration activities, such as reseeding and transplanting, would have a direct beneficial effect of promoting the reestablishment of native vegetation. The impacts of cultural treatments on special status would therefore be ***direct, adverse, site-specific, short-term, and minor***.

Prescribed Fire Treatments

Prescribed fire may be used under this alternative in fire adapted plant communities such as Ponderosa pine, provided research shows it is an effective treatment for the invasive plant species present. Prescribed fire may also be used to reduce accumulations of invasive plant biomass that result in hazardous fuels. Formal consultation has been conducted with USFWS for the use of prescribed fire, and a FLAG Prescribed Management Plan was completed in 2008. Fire would not directly affect special status species because it will not be used in areas that could affect these species during sensitive periods of the year. Fire will only be used in areas that are naturally adapted to it for ecological health. Fire could have limited direct mortality on sensitive small mammals, some invertebrates, reptiles, and amphibians and other non-mobile species of wildlife. However, impacts to special status species would not lead to population level effects. The impacts of prescribed fire on special status species would therefore be ***direct and indirect, adverse, site specific, short-term, and minor.***

Impacts of Alternative II on Specific Special Status Species

ANIMALS

Mexican spotted owl: Exotic plant management activities proposed under Alternative II would have similar impacts to Alternative 1. Additional techniques and treatments are not expected to add adverse impacts on MSO. Additional mechanized equipment is proposed; however, MSO restricted, protected, or critical habitat occurs primarily in remote areas of the monuments where mechanized equipment would not be used. Additional indirect impacts could occur through increased surveys and could disturb habitat for prey species and thus quality of potential foraging habitat. Impacts would be similar to those described under Alternative I. Use of additional chemicals to treat exotic plants has potential to impact MSO; however, impacts would be the same as described for Alternative I. Again, no herbicides that cause secondary poisoning (i.e., poisoning of prey) will be used. Use of fire to treat invasive plants is not currently planned in MSO habitat; however, the park's Wildlife Biologist will be consulted each year to determine if fire would affect special status species at specific locations. Alternative II implementation would result in ***direct, adverse, short-term, localized, minor impacts*** to MSO.

Bald eagle: As described under Alternative 1, bald eagles do not breed in the FLAG monuments, but are present in riparian habitats along the Little Colorado River and Walnut Canyon during the wintering season. Exotic plant surveys and treatments would have similar impacts on bald eagles as those described for Alternative I. An increase in surveys and treatment types would slightly increase potential adverse impacts to the bald eagle. Fire use as proposed in Alternative II is not expected to have additional impacts on bald eagle beyond those described for Alter-

native I. Alternative II implementation would have ***direct, adverse, short-term localized negligible to minor impacts*** to bald eagles.

Yellow-billed cuckoo: Potential impacts to the yellow-billed cuckoo under Alternative II would be similar to those described under Alternative I. Fire use is not expected to have additional impacts on the yellow-billed cuckoo. Impacts to the yellow-billed cuckoo under Alternative II would be ***direct, adverse, short-term, localized, negligible to minor***. The removal of exotic plant species and restoration of riparian vegetation in FLAG monuments would result in direct, indirect, long-term, moderate beneficial impacts.

Southwestern willow flycatcher: Alternative II implementation would result in similar impacts on SWWF to those described for Alternative I. Removal of tamarisk and other riparian exotic plant species could have direct and indirect adverse localized short-term minor effects on SWWF habitat. To avoid adverse impacts, habitat assessments would be completed prior to exotic plant treatment. If potential suitable habitat is identified through habitat assessment, project managers would consult with USFWS and adhere to survey procedures outlined in the recovery plan before implementation of exotic plant treatment. Project managers would use treatments to control exotic plants in riparian ecosystems consistent with the Southwestern Willow Flycatcher Recovery Plan (United States Fish and Wildlife Service, 2002) and the USFWS Recommended Protection Measures for Pesticide Applications for the SWWF (United States Fish and Wildlife Service, 2007). Removal of exotic plant species would have ***direct and indirect, beneficial, long-term, localized, minor to moderate beneficial impacts.***

Raptors *(American peregrine falcon, golden eagle, northern goshawk, western burrowing owl, ferruginous hawk)*

Increased use of chemicals could impact the food base for birds but it is unlikely because the types of chemicals selected will be those that are not harmful to wildlife and degrade quickly in the natural environment. Similar to Alternative I, impacts on peregrine falcon and northern goshawk would be direct, short-term, localized, minor and adverse. Impacts would result in behavior modification in the birds and potential to leave a roosting or nesting area. See analysis under Alternative I for detailed information. USFWS Recommended Protection Measures for Pesticide Applications (United States Fish and Wildlife Service, 2007) have been reviewed for applicability to the peregrine falcon, golden eagle, western burrowing owl, ferruginous hawk, and northern goshawk, and included in **Appendix C**.

Implementation of Alternative II would result in **direct, adverse, short-term, localized, negligible to minor impacts** to peregrine falcon, the golden eagle, western burrowing owl, ferruginous hawk, and northern goshawk.

Mammals (*American pronghorn, Gunnison's prairie dog, Wupatki pocket mouse Allen's big eared bat, Towndsend's big-eared bat, western small footed myotis bat, long-legged myotis bat, Arizona myotis bat, Townsend's big-eared bat, big free-tailed bat, southwestern myotis bat, long-eared myotis bat, spotted bat, fringed myotis bat*)

Pronghorn antelope are moderately tolerant of human disturbance. This can lead to increased adverse interactions with humans and disruptions of normal foraging and breeding patterns. Crews will be instructed to refrain from interactions with pronghorn and to haze any individuals that approach. Additionally, USFWS Pesticide Protection Measures for mammals will be followed to minimize adverse impacts.

Long-legged myotis, southwestern myotis, and other bats generally roost in snags or live damaged trees. It is unlikely that presence of crews near roost trees will disturb these species as they are well concealed and protected by the roost tree. Crews will be instructed to avoid camping and prolonged activities near snags or live damaged trees. Allen's big-eared bat, Townsend's big-eared bat, and spotted bats roost in mines or rock crevices and consequently are not likely to be disturbed by crews. It is possible that bats will occasionally forage on herbicide-laden insects, but it is unlikely they will encounter enough insects to ingest a lethal dose of herbicide.

Impacts to mammals under Alternative II would be negligible to minor adverse short term localized. Bats are unlikely to be disturbed through exotic plant management activities based on their ability to be concealed and protected by their roost tree or rock crevice, depending on species. Best management practices would be followed to minimize interactions with bighorn sheep.

Implementation of Alternative II would result in ***negligible to minor adverse short-term localized impacts*** to special status mammal species.

A majority of exotics treatment is planned for park developed areas and conducted manually (i.e., manual tools, manual herbicide application). These non-mechanized treatments, including surveys, are not expected to impact nesting and/or roosting sites, key foraging areas, key calving or fawning areas, primary habitat for Federally listed plants, or primary wildlife travel corridors.

PLANTS

Fickiesen pincushion cactus

See species description and impacts described for Alternative I. Impacts to Fickeisen pincushion cactus from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Sunset Crater Beardtongue

See species description and impacts described for Alternative I.beardtongue from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Cinder Phacelia

See species description and impacts described for Alternative I. Impacts to cinder phacelia from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Welsh's Scorpionweed

See species description and impacts described for Alternative I. Impacts to Welch's scorpion-weed from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Whiting's Indigo Bush

See species description and impacts described for Alternative I. Impacts to Whiting's Indigo Bush from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Arizona bugbane

See species description and impacts described for Alternative I. Impacts to Arizona bugbane from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Peeble's bluestar
See species description and impacts described for Alternative I. Impacts to Peebles bluestar from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Camaroon water parsley
See species description and impacts described for Alternative I. Impacts to Camaroon water parsley from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Arizona Walnut
See species description and impacts described for Alternative I. Impacts to the Arizona walnut from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Common reed
See species description and impacts described for Alternative I. Impacts to the common reed from Alternative II would be ***direct, beneficial, site specific, long-term, and minor.***

Cumulative Impacts
The cumulative impacts are similar to Alternative I.

Conclusions
The preferred alternative would have ***direct and indirect, beneficial, short-term, minor impacts*** to special-status species as native habitats are treated and restored. The long-term impacts would be moderate and beneficial as integrated treatment methods will be used to treat more species and more populations using the most effective and efficient methods. Impacts to special status species would be indirect and result from improvement of habitat, not from direct impacts to any special status species individuals. Cumulative impacts would be negligible when considered in the context of ongoing loss of special status species habitats in the vicinity of the monuments. Rapid urban development and disturbances from increasing human recreation in the Flagstaff area are causing the greatest impacts to special status species.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Impacts of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis
Alternative III has the most potential to adversely impact special status species as many are dependent on riparian and/or aquatic habitats, and that is where the park's most highly invasive species are common. Mechanical and cultural treatments are not effective on many of these

invasive species, and the inability to use chemical treatments would result in the spread of invasive plants and the loss of special status species habitats. Mechanical control methods have the greatest risk of soil erosion and sediment delivery to aquatic habitats, particularly from the need to frequently re-treat a number of invasive species.

The lack of chemical treatments under this alternative would eliminate the risk of herbicide drift into aquatic habitats. There are a number of invasive species in riparian habitats that would not be treated due to the high expense and ineffectiveness of implementing only mechanical methods. Left untreated, these species have the potential to impact special status species habitat in the future.

Manual/Mechanical Treatments
Using primarily mechanical and manual treatments is limiting and has not been implemented in special status species habitats because these techniques are not fully effective on many of the invasive species that we are trying to control at FLAG, such as tamarisk, toadflax, and camel-thorn. Impacts of Alternative III would be similar to those described for Alternative I. The impacts of manual and mechanical treatments on special status species would therefore be ***direct and indirect, site-specific, short- and long-term, and minor to moderate.***

Cultural Treatments
Sensitive status species will directly benefit from the restoration of native plant communities and wildlife habitat. Impacts of Alternative III would be similar to those described for Alternative I. The impacts of exotic plant management cultural treatments on special status species would therefore be ***directly and indirectly beneficial, site-specific, short- and long-term, and minor.***

Prescribed Fire Treatments
It is unlikely that prescribed fire would be used as an invasive plant control method under alternative III. Fire it is not an effective stand-alone treatment for the invasive species currently present, but is most effective in combination with chemical and other treatments. Restoration would be limited under this alternative and many areas would not be effectively restored. Mechanical and cultural methods are not sufficient to remove most of the invasive populations present and restoration would be ineffective without these treatments.

ANIMALS
Mexican spotted owl: Exotic plant management activities proposed under Alternative III would have similar impacts to Alternative 1. Additional mechanized equipment is proposed; however, MSO restricted, protected, or critical habitat occurs primarily in remote areas of the monuments where mechanized equipment would not be used. Additional indirect impacts could occur through increased surveys and could disturb habitat for prey species and thus quality of potential foraging habitat. Impacts would be similar to those described under Alternative I. Not using chemicals to treat exotic plants has potential to impact MSO in that treatments would not be effective and continued habitat degradation would proceed. Use of fire to treat invasive plants is not currently planned in MSO habitat; however, the park's Wildlife Biologist will be consulted to determine if fire would affect special status species at specific locations. Alternative III implementation would result in ***direct, adverse, short-term, localized, minor impacts*** to MSO.

Bald eagle: As described under Alternative 1, bald eagles do not breed in the FLAG monuments, but are present in riparian habitats along the Little Colorado River and Walnut Canyon during

the wintering season. Exotic plant surveys and treatments would have similar impacts on bald eagles as those described for Alternative I. An increase in surveys and treatment types would slightly increase potential adverse impacts to the bald eagle. Fire use as proposed in Alternative III is not expected to have additional impacts on bald eagle beyond those described for Alternative I. Alternative III implementation would have ***direct, adverse, short-term localized negligible to minor impacts*** to bald eagles.

Yellow-billed cuckoo: This species has not been found in the Flagstaff Area Monuments but there is the potential that it could be found due to available habitat. Potential impacts to the yellow-billed cuckoo under Alternative III would be similar to those described under Alternative I except that chemical and cultural treatments would not occur and treatment would not be as effective. Fire use is not expected to have additional impacts on the yellow-billed cuckoo. Impacts to the yellow-billed cuckoo under Alternative III would be ***direct, adverse, short-term, localized, negligible to minor***. The removal of exotic plant species and restoration of riparian vegetation in FLAG monuments would result in direct, indirect, long-term, moderate beneficial impacts, but not as beneficial as Alternative II.

Southwestern willow flycatcher: Alternative III implementation would result in similar impacts on SWWF to those described for Alternative I. Removal of tamarisk and other riparian exotic plant species could have direct and indirect adverse localized short-term minor effects on SWWF habitat. To avoid adverse impacts, habitat assessments would be completed prior to exotic plant treatment. If potential suitable habitat is identified through habitat assessment, project managers would consult with USFWS and adhere to survey procedures outlined in the recovery plan before implementation of exotic plant treatment. Project managers would use treatments to control exotic plants in riparian ecosystems consistent with the Southwestern Willow Flycatcher Recovery Plan (United States Fish and Wildlife Service, 2002) and the USFWS Recommended Protection Measures for Pesticide Applications for the SWWF (United States Fish and Wildlife Service, 2007). Removal of exotic plant species would have ***direct and indirect, beneficial, long-term, localized, minor to moderate beneficial impacts.*** However, these beneficial impacts would not be as great nor last as long under Alternative III because the effectiveness of using only manual and cultural treatments is not as great and re-invasion is likely.

Birds *(American peregrine falcon, golden eagle, northern goshawk, western burrowing owl, ferruginous hawk)*

Similar to Alternative I, impacts on peregrine falcon and northern goshawk would be direct, short-term, localized, minor and adverse. No use of chemicals and biological treatments would ensure the safety of birds from possible direct and indirect chemical contamination impacts but invasive plant treatments would not be as effective and habitats would continue to degrade

Implementation of Alternative III would result in **direct, adverse, long-term, localized, negligible to minor impacts** to peregrine falcons, the golden eagles, western burrowing owls, ferruginous hawks, and northern goshawks because of the continued degradation of habitat due to the long-term ineffectiveness of only mechanical and cultural treatments.

Mammals (*American pronghorn, Gunnison's prairie dog, Wupatki pocket mouse Allen's big eared bat, Towndsend's big-eared bat, western small footed myotis bat, long-legged myotis bat, Arizona myotis bat, Townsend's big-eared bat, big free-tailed bat, southwestern myotis bat, long-eared myotis bat, spotted bat, fringed myotis bat*)

Pronghorn antelope are moderately tolerant of human disturbance. This can lead to increased adverse interactions with humans and disruptions of normal foraging and breeding patterns. Crews will be instructed to refrain from interactions with pronghorn and to haze any individuals that approach. Additionally, USFWS Pesticide Protection Measures for mammals will be followed to minimize adverse impacts.

Long-legged myotis, southwestern myotis, and other bats generally roost in snags or live damaged trees. It is unlikely that presence of crews near roost trees will disturb these species as they are well concealed and protected by the roost tree. Crews will be instructed to avoid camping and prolonged activities near snags or live damaged trees. Allen's big-eared bat, Townsend's big-eared bat, and spotted bats roost in mines or rock crevices and consequently are not likely to be disturbed by crews. Using only manual and cultural treatments will not be as effective in eliminating invasive species so critical habitat my continue to degrade.

Bats are unlikely to be disturbed through exotic plant management activities based on their ability to be concealed and protected by their roost tree or rock crevice, depending on species. Best management practices would be followed to minimize interactions with bighorn sheep.

Implementation of Alternative III would result in ***indirect, adverse, site specific and localized, negligible to minor impacts*** to special status mammal species due to the ineffectiveness of using only manual and cultural treatments.

PLANTS

Fickiesen pincushion cactus

See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to Fickeisen pincushion cactus from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Sunset Crater Beardtongue

See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to the Suset Crater beardtongue from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Cinder Phacelia
See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to cinder phacelia from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Welsh's Scorpionweed
See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to Welch's scorpionweed from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Whiting's Indigo Bush
See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to Whiting's Indigo Bush from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Arizona bugbane
See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to Arizona bugbane from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Peeble's bluestar
See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to Peebles bluestar from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Camaroon water parsley
See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to Camaroon water parsley from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Arizona Walnut
See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to the Arizona walnut from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Common reed
See species description and impacts described for Alternative I. Alternative III is different in that the use of chemical or biological treatments is not allowed. This alternative limits the treatment options and thus takes the risk of not being as effective in controlling invasive species over the long term. This would have short- and long-term adverse impacts due to the continued degradation and loss of native habitat and the inability of the NPS to effectively eliminate invasive species.

Impacts to the common reed from Alternative III would be ***direct, adverse, site specific, long-term, and minor.***

Cumulative Impacts
The cumulative impacts would be similar to Alternative I except that only manual and cultural treatments would not be as effective and invasive species would likely continue to degrade native habitat. Cumulative impacts would be **direct and indirect, adverse, short-term, localized, and minor to moderate.**

Conclusion
This alternative would have minor, adverse impacts as chemical and biological treatments would no longer be an option to control invasive populations in habitats used by special status species. Long-term impacts would be moderate and adverse as invasive species would expand because mechanical and cultural methods alone are not fully effective treatments for most invasive species.

Impacts to special status species would be indirect and adverse, and result from the degradation of native habitat, not from direct impacts to any special status species. Cumulative impacts would be negligible when considered in the context of ongoing loss of special status species habitats in neighboring lands. Rapid urban development and disturbances from increasing human recreation are causing the greatest impacts to special status species.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.7.5 Water Resources

3.7.5.1 Affected Environment
"The combined extreme nature of summer thunderstorms, rapid spring snowmelt during some years, reduced herbaceous cover, and thin hydrophobic soils over much of the region make flash flooding a common safety threat. Many of the major washes and the Little Colorado River flood quite frequently following these events. Storm runoff patterns have also been influenced by the construction of numerous stock tank impoundments in support of ranching operations

All perennial streams and ephemeral tributary washes are heavily impacted by human uses, primarily livestock grazing, but also by damming, diversion, and groundwater withdrawals for public water supply, hydropower generation, limited agriculture and industry, and public recreation. Narrow galleries of cottonwood, willow, and sycamore trees once dominated most stream banks, but are now almost entirely replaced by thickets of nonnative tamarisk and desert scrub. Available riparian habitat and natural stream and spring waters for wildlife have also diminished during the last century, especially for birds." (USDI 2007)

Walnut Canyon National Monument Water Resources
See description of water related resources at WACA in the Wetlands, Floodplains, and riparian area Section below.

" Walnut Canyon National Monument (WACA) is located near Flagstaff in the Mogollon highlands-Coconino Plateau region of northern Arizona. Walnut Canyon is eroded into sedimentary rock layers of the Kaibab Limestone and Coconino Sandstone formations. The drainage of Walnut Creek became entrenched in the canyon as the formations were locally uplifted. Surface-water flow through the canyon has been severely altered by two dams constructed in 1897 and in 1941 (USGS 2001; Brian 1992). Prior to 1900, the creek is believed to have intermittently flowed through the bottom of Walnut Canyon on a biannual cycle. Reliable flows typically occurred early each year during the period of spring snowmelt, and less predictable flows likely occurred later each year during the summer and fall monsoon season. Presently, snowmelt and rainfall support the very limited flow that occur in the canyon (Brian 1992)." (USDI 2006)

Currently, there are no NPS visitor facilities within the Walnut Canyon bottom or near the perennial seeps. Riparian resources are buffered from water quality degradation by surrounding undeveloped Coconino National Forest and Arizona State trust lands. However, the city of Flagstaff has annexed all lands to the north and west boundary of Walnut Canyon National Monument, including a relatively large area contiguous to the canyon rim and tributary canyons upstream of the monument. Presumably this is to protect the watershed, but development of these lands within the relatively pristine canyon watershed could occur and would significantly increase non-point source pollution, such as motor and exhaust residue from streets, and fertilizers, herbicides, and pet waste from lawns. The occurrence of shallow groundwater is expressed only via the many seeps within the widespread sedimentary rock fractures and bedding planes within WACA. It is believed that the seeps are recharged via local fractures and limestone "karst" erosion features in the watershed, and there is little threat of contamination or aquifer depletion under current land uses within the watershed. The only reliable groundwater beneath the monument is found at a depth greater than 1,500 feet within the regional Coconino Aquifer. The NPS maintains a well into the aquifer to supply operations at the monument, and the water table has declined about 10 feet over the last 30 years.

Sunset Crater National Monument Water Resources

Sunset Crater Volcano National Monument (SUCR) is dominated by a volcanic landscape. The Sunset Crater cinder cone, a very recent geological feature, and the northern half of Lenox Crater cinder cone lie at the southeastern and southwestern corners of SUCR respectively. The Bonito Lava flow and deep volcanic cinder deposits cover most of the area north of these cones. The process that created the volcanoes left many other volcanic features including spatter cones around now dormant gas vents, wedge-shaped squeeze-ups, lava tubes, and ice caves.

Surface water resources are virtually non-existent within SUCR, with the exception being local catchments upon lava flows and seepage areas around the perimeter of lava flows. The regional C aquifer is relatively deep beneath SUCR. This aquifer has been the subject of recent and continuing studies of regional hydrogeology (USGS 2002) and is the source of SUCR's drinking water supply. Water collects briefly in depressions on the lava flows, but soon evaporates or infiltrates into the aquifer below. Ephemeral waters in the park are important for wildlife such as pronghorn, and for small groves of plants at the toes of lava flows. There are no known springs or intermittently flowing washes or drainages. SUCR obtains its drinking water from Doney Park Water, a private water supplier. The company operates wells developed in the C aquifer.

Key values associated with water quality and aquatic ecosystems:

- Ice cave physical and ecological systems

Since water resources are limited at SUCR, threats are limited as well. Development for visitor access, visitor use, and administrative activities within SUCR may threaten seeps and the fauna and flora they support at the base of lava flows. Cinder Lake landfill is 3.2 km south of SUCR. Staff are concerned that leachate from the landfill may contaminate the regional aquifer. Severe drought and climate change are of importance to this park unit and others in the SCPN.

Threats/concerns related to water quality and aquatic ecosystems:

- Visitor use, especially off-highway vehicle impacts
- Air quality impacts, dust and particulates
- Climate trends and extreme events

The USGS/WRD monitors depth to water in numerous wells near Flagstaff, including Doney Park Water's Bonito Well #2. The water quality data inventory and analysis (NPS 1996) found no water quality data records for the monument.

Wupatki National Monument Water Resources

"Wupatki National Monument (WUPA) is largely included within the upland watershed that drains the east and northeast San Francisco Mountain slopes. WUPA overlays the Doney Fault and Black Point Monocline and is roughly divided in half by the Doney Fault, with each half having distinct geology, elevation, and dominant vegetation. At lower elevations to the east of the fault, WUPA is dominated by sandstone and shale geologic formations, saline soils, and open desert scrub vegetation. At higher elevations to the west of the fault, WUPA is dominated by limestone and volcanic formations, fertile soils, and juniper savanna and grassland vegetation. The primary bedrock layers exposed at WUPA are the Kaibab Limestone and Moenkopi Formation (Blyth 1995; McCormack 1989). Unique local subterranean features, described as "karst" or "earthcracks", are found within the western half of WUPA. These sinkholes and earthen crack features provide local conduits for groundwater recharge. The Little Colorado River flows intermittently along the northeast corner of WUPA. This river drains a large area in northeastern Arizona and carries a large and saline sediment load." (Thomas et al. 2006)

"Surface water resources in WUPA include the Little Colorado River; several springs, seeps, and washes; and tinajas and rock pools. The only perennial water sources within WUPA are Peshlaki and Heiser Springs, both located in the southeastern portion of the Monument. Peshlaki Spring provides the only perennial source of water for wildlife, although it is only accessible through a deep dug-out hole that may pose a hazard to small animals. Heiser spring has good water quality and flow and has been developed as three cased wells. WUPA has proposed to restore the historic state of the 3 spring boxes and remove the wells. Six thousand years of recorded use has occurred at this spring. A third spring, Wupatki Spring, was active and flowing until the mid-1950s when the water flow began to diminish for unknown reasons, eventually drying up completely." (Thomas et al. 2006)

"The intermittent Little Colorado River flows for approximately 2.0 kilometers along the northeast boundary of WUPA. The Little Colorado River supports a degraded riparian area. Antelope, Citadel, Deadman and Kanaa Washes are the largest drainage corridors that run through WUPA, and they may have water running in them during and after large rain events.

Deadman Wash has a very high potential for riparian restoration; currently it supports tamarisk near the mouth and in patches upstream. There are also about 20 smaller washes and arroyos throughout WUPA that have similar drainage patterns. WUPA also supports tinajas and rock pools which serve as ephemeral sources of water. There are two wells within WUPA: the Visitor Center's well, which serves as a water supply but is brackish, and the unused Citadel well." (Thomas et al. 2006)

Summary of key values and resources associated with water quality and aquatic ecosystems:

- Water sources for wildlife
- Riparian and wetland habitat
- Historical association of springs with human occupation

"Of great concern to WUPA is the degradation of riparian habitat along the Little Colorado River. Upstream impoundments, irrigation diversions, groundwater withdrawals, livestock grazing, uranium mining, and invasion by non-native tamarisk (*Tamarix* spp.) and camelthorn (*Alhagi maurorum*) have altered the riparian corridor along the Little Colorado River. External to WUPA, general trampling and lack of care for the riparian area of the Little Colorado contributes to vegetation loss, further erosion, and sedimentation. Livestock trespass and sheep grazing within the park affect the Little Colorado River by removing vegetation and thereby increasing erosion and sedimentation. Depletion of water resources by water impoundment, diversion, and pumping are problems identified by park staff. The springs within WUPA are degraded resources, as they were developed to provide drinking water for historic ranching and NPS operations. The quantity of water available to the WUPA area may be decreased, since a part of the recharge area is the San Francisco Mountains and most water within the Inner Basin of this range is utilized as part of the public water supply system for the City of Flagstaff." (Thomas et al. 2006)

"Potential development along Hwy 89 may contribute to further depletion. The USGS (2000) and Hart et al. (2002) focused on the hydrogeology of the Flagstaff area and the Little Colorado River. Potential mineral (oil, natural gas, uranium) and geothermal development on State Trust lands within WUPA and on surrounding Trust, Federal, Tribal, and private lands, is a concern. Mineral extraction can deplete and pollute water resources and release contaminated soils to the ground surface. Uranium test pits on adjacent Navajo lands east of the Little Colorado River may impact river water quality. The discharge path of the Luepp or Winslow sewage treatment plant is unknown and WUPA is interested in investigating this concern. Additionally, any future discharge of the coal-fired power plant at Winslow or Luepp may increase atmospheric deposition of mercury. As with other NPS units, WUPA has concerns regarding drought and global climate change. WUPA staff encourages studies to increase understanding of the hydrology of the springs, the Little Colorado River, and other drainages. NPS would also like to continue monitoring of the Citadel well with or without USGS involvement, initiate long-term monitoring of water quality and quantity at Peshlaki and Heiser springs, and follow up on water quality testing at Black Falls Crossing on the Little Colorado River The monument would like to conduct geomorphological studies of Deadman Wash, remove exotic plants, and restore cienega and riparian corridor areas." (Thomas et al. 2006)

List of threats/concerns related to water quality and aquatic ecosystems:

- Livestock grazing impacts
- Resource extraction - uranium and/or coal

- Municipal effluent - Leupp or Winslow
- Road widening
- Encroachment of development on west side of U.S. Highway 89
- Future industrial discharges at Leupp or Winslow
- Increased sediment from continued loss of vegetation in watershed
- Exotic plant and animal invasion
- Climate trends and extreme events
- Reduced flows in all springs, complete loss of flow at Wupatki Spring
- Modified channel of Little Colorado River

The USGS/WRD monitors selected wells developed in regional and perched aquifers in northern Arizona (USGS 2002). Heiser Spring, Peshlaki Spring, and the Little Colorado River were included in a recent Level 1 Water Quality Inventory (Thomas 2003). The USGS/WRD maintained a stream gage on Little Colorado River (USGS 09401000) near WUPA. The General Management Plan (WUPA 2001) lists restoration of springs and seeps as water sources for wildlife and to enhance wildlife habitat as one of its objectives. This objective stems from the plan's recognition of wetland and riparian values along the Little Colorado River, and at other washes, seeps and springs.

Related to these objectives, WUPA has taken part in and has documented water quality and quantity through various efforts. They include the baseline study completed by the WRD (NPS 1996) and archived quality and quantity data (WUPA archives) in superintendent's reports, dissertations, and Steve Cinnamon's work. The USGS (2000) studied the hydrogeology of the regional aquifer near Flagstaff, AZ, the C aquifer of the Little Colorado River (Hart et al. 2002), and is currently studying the geology and hydrology of the Coconino Plateau (USGS 2002).

3.7.5.2 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to water resources were derived from a review of available literature, regulatory agencies, IDT expert input, and from a number of sources including other successful invasive management plans. The thresholds of change for the intensity of an impact are defined below:

Impact Intensities and Definitions – Water Resources

Impact Intensity	Intensity Definition
Negligible	There would be no observable or measurable impacts to water quantity or quality. Impacts would be well within natural fluctuations.
Minor	Impacts would be detectable and/or localized, but they would not be expected to be outside the natural range of variability. Mitigation measures, if needed to offset adverse effects, would be simple and successful.
Moderate	The impact to water quality or quantity would be readily apparent and result in a change over a relatively wide area. Mitigation measures would be necessary to offset adverse effects and likely be successful.
Major	The impact to water quality or quantity would be readily apparent and substantially change over a wide area. Mitigation measures to offset adverse effects would be necessary, extensive, and their success could not be guaranteed.

Water Resource impacts are considered ***short-term*** if conditions recover in less than one year, and ***long-term*** if it takes longer than one year for conditions to recover.

Duration

Short term One day or less for water quality; one year or less for aquatic resources
Long term Greater than one day for water quality; greater than one year for aquatic resources

Context

Localized A single seep, spring, wetland, or tributary
Regional Aquatic and water resources covering several park seeps, springs, wetlands and tributaries

3.7.5.3 Analysis of Alternatives and impacts on Water Resources

Effects of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis
Under this alternative, mechanical and chemical treatments would be the primary methods used.

Manual/Mechanical Treatments
The soil disturbance from mechanical removal of invasive plants could reduce soil stability until plants have reestablished on the disturbed sites, which could result in sedimentation and reduced water quality in water bodies after rain events. This potential impact would be reduced by raking and tamping the soil back into place after removal of the invasive plants and implementation of other mitigation practices. Using solely mechanical treatment is not effective on many of the highly invasive riparian species such as tamarisk and camelthorn resulting in the need to re-treat populations in these areas. This would result in additional soil disturbance and the risk of increased soil erosion that could impact water quality with each treatment. Mechanical treatments of species such as tamarisk and camelthorn near the active channel of the Little Colorado River could result in a loss of soil stability and increased sediment in the water. Thus impacts are expected to be ***indirect, adverse, local, short-and long-term, and negligible to minor.***

Chemical Treatments
Chemical treatments have been used to treat tamarisk and camelthorn, two highly invasive riparian species. A number of mitigation measures including the use of the most effective application method and the least harmful herbicide are being applied to reduce the potential impacts of this treatment method (Alternatives Chapter and **Appendix D**). However, there will always be the risk of drift or runoff of chemicals when applied near water even with the most careful application methods. In the unlikely event that this would happen, the flow volume of the Little Colorado River is expected to quickly dilute the chemical and have negligible to minor short-term impacts. Thus impacts are expected to be ***indirect, adverse, local, short-and long-term, and negligible to minor.***

Cultural Treatments
Cultural treatments such as prescribed fire could have an adverse, short-term impact on water quality following the erosion from run-off events. Site specific mitigation measures to reduce soil erosion shall be implemented through the prescribed fire burn plan. Thus impacts are expected to be ***indirect, adverse, local, short-and long-term, and negligible.***

Cumulative Impacts
Urban and recreational development adjacent to the monuments may result in an overall reduction of water quality. Water quality is impacted from the effluent release from communities, recreational, and agricultural activities upstream of the Little Colorado River and Walnut Canyon. Trash and sewage from adjacent tributaries, soil erosion from construction sites, septic systems, livestock operations and other urban contaminants all contribute to total water resource impacts. Recreation is increasing in the Flagstaff Area and the waste from recreational users and their pets may pose a threat to water quality. When combined with other past, present, and foreseeable future actions that would result in impacts to water quality and quantity, this alternative would have ***direct and indirect, adverse, local, short and long-term, negligible cumulative*** impacts to water resources.

Conclusion
Continuation of current exotic plant management under Alternative I would result in localized short- to long-term ***minor adverse effects*** to water resources from increased turbidity, erosion, soil-stabilizing plant loss, and changes to water quality parameters. These would result from mechanical treatments and the potential risk for herbicide drift, spilling, and leaching from chemical treatments. Long-term impacts are expected to be ***minor and beneficial*** as treated areas would be restored or quickly re-vegetate to natural communities, resulting in improved soil stability, and reduced sedimentation. Any chemical contamination would be quickly diluted and not be a long-term concern. No changes to water quantity are expected under this alternative because invasive species would be quickly replaced by native species that are expected to have similar evapo-transpiration rates. Water quality would not be directly impacted from implementtation of this alternative as no chemicals would be applied to surface waters. There may be indirect effects to water quality from chemical drift, spilling, and leaching, and from sedimentation that results from soil erosion. Cumulative impacts would be ***direct and indirect, adverse, local, short and long-term, negligible to minor*** when considered in the context of the number of pollutants already present in the water, ongoing urbanization, and nearby agricultural activities such as farming and grazing that are ongoing in the watershed and are directly and indirectly impacting water quality and quantity.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis
Using an integrated approach will allow the parks to use the most appropriate treatment methods and minimize the adverse impacts of the treatments.

Mechanical and Chemical Control
Long- and short-term impacts of the preferred alternative would result in the additional use of chemical herbicides and less soil disturbance than the other two alternatives. The risks associated with the use of herbicides would be offset by a decrease in the amount of soil disturbance from mechanical treatments and the careful selection of the appropriate herbicides and application methods to minimize impacts to water quality. Thus impacts are expected to be ***indirect, adverse, local, short-and long-term, and negligible to minor.***

Cultural Control
Cultural treatments such as prescribed fire would have an adverse impact on water quality following run-off events. Site specific mitigation measures to reduce soil erosion would be developed and implemented through the prescribed fire burn plan. Thus impacts are expected to be ***indirect, adverse, local, short-and long-term, and negligible to minor.***

Biological Control
Biological control is not likely to be used but if it is it would need to be approved by APHIS and the USFWS. Low-risk methods are not likely to be used, but could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. These methods will not impact water quality or quantity if applied properly. Thus impacts are expected to be ***indirect, adverse, local, short-and long-term, and negligible to minor.***

Cumulative Impacts
The cumulative impacts of this alternative are similar to Alternative I. When combined with other past, present, and foreseeable future actions that would result in impacts to water quality and quantity, this alternative would have ***direct and indirect, adverse, local, short and long-term, negligible to minor cumulative*** impacts to water resources.

Conclusion
The impacts of this alternative are predicted to be minor in the short-term from the risk of soil erosion from mechanical treatments and the potential for herbicide drift that could adversely affect water quality. Application of a number of mitigation measures will serve to reduce or eliminate these risks. Long-term impacts are expected to be moderate and beneficial as more areas would be treated and restored to natural communities, reducing the potential for soil erosion. Any chemical contamination would be quickly diluted and not detectable in the system in the long-term. Little changes to water quantity are expected under this alternative because invasive species would be quickly replaced by native species that are expected to have similar evapo-transpiration rates.

Water quality would not be directly impacted from implementation of this alternative as no chemicals would be applied to surface waters, and mitigation requirements regarding chemical application rates, drift, and spills will be closely followed. There may be indirect effects to water quality from small amounts of chemical drift, spilling, and leaching, and from sedimentation that results from soil erosion. Cumulative impacts would be minor in the short-and long-term when considered in the context of the number of pollutants already present in the river, ongoing urbanization, and upstream agricultural activities such as farming and grazing that are ongoing in the watershed and are impacting water quality and quantity.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis

Mechanical/Manual Treatments

Reliance on only mechanical and cultural treatment methods could result in an adverse impact to water quality from soil disturbance and erosion. Some of the most highly invasive species are found in riparian areas, and mechanical treatment methods are not effective against these species as they readily re-sprout following treatment and disturbance. The need to apply frequent mechanical re-treatments would result in increased negative impacts including a loss of soil stability and potential for high sediment delivery to Walnut Canyon and the Little Colorado River. While mechanical treatments would result in a loss of soil stability on the treated areas, this would be offset by the small amount of area that would be treated under this alternative due to its ineffectiveness and high expense. Impacts to water resources under Alternative III are expected to be ***indirect, adverse, local, short-and long-term, and minor to moderate.***

Chemical Treatments

No chemical treatments would be allowed thus the risk of chemical drift, spills, and leaching would be eliminated under this alternative.

Cultural Treatments

Cultural treatments such as prescribed fire could have an adverse, short-term impact on water quality following run-off events. The use of fire would be limited under this alternative as this method is most successful when used in an integrated method with other treatments, such as herbicides. Cultural treatments such as restoration of native plant communities would be limited under this alternative. Few areas would be restored as mechanical methods would not effectively remove many of the existing invasive species populations, however, limited restoration of treated areas may be applied under this alternative. Low-risk methods are not likely to be used, but

could include hot water/steam, vinegar or sugar compounds, or covering plants with plastic sheeting. These methods will not impact water quality if applied properly. Impacts are expected to be ***indirect, adverse, local, short-and long-term, and negligible to minor.***

Cumulative Impacts
These impacts are similar to Alternative I. When combined with other past, present, and foreseeable future actions that would result in impacts to water quality and quantity, this alternative would have ***direct and indirect, adverse, local, short and long-term, negligible to minor cumulative*** impacts to water resources.

Conclusion
The short and long-term impacts of this alternative are expected to be minor and adverse as mechanical methods would increase the risk of sediment delivery to the water bodies, however, fewer areas would be treated under this alternative, reducing the impacts from sedimentation on water quality. No impacts to water quantity are expected. Water quality would not be directly impacted from implementation of this alternative as no chemicals would be applied. There may be indirect effects to water quality from sedimentation that results from increased erosion. Cumulative impacts would be negligible to minor when considered in the context of the number of pollutants already present in the water, ongoing urbanization and agricultural activities such as farming and grazing that are ongoing in the watershed that are currently impacting water quality and quantity.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.7.6 Wetlands, Floodplains, and Riparian Areas

The NPS 2001 Management Policies provides guidance for protection of wetlands, floodplains and riparian areas. Section 4.6.5 requires the NPS to manage these areas in accordance with NPS mandates and the requirements of E.O. 11990 (Wetland Protection), the Clean Water Act, the River and Harbors Appropriation Act of 1899, and procedures described in Director's Order 77-1: Wetlands Protection. The NPS is required to protect, preserve, and restore the natural resources and functions of floodplains; avoid the long-term and short-term environmental effects associated with the occupancy and modification of floodplains; and, avoid the direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks (Section 4.6.4, pages 39-40).

3.7.6.1 Affected Environment

Walnut Canyon National Monument Wetlands, Floodplains and Riparian Areas
Wetland, floodplain, and riparian resources within Walnut Canyon National Monument are restricted to the narrow canyon bottom and a number of perennial seeps found in the tributary

canyons on the south side of the monument. The floor of Walnut Canyon within the monument harbors approximately 80 acres of well- developed riparian vegetation, which is locally dominated by stands of Arizona walnut and cottonwood trees. Box elder, New Mexico locust, Arizona wild rose, and red osier dogwood are also common. The riparian plant community is very rich in shrub, wildflower, vine, and a few obligate wetland species. In the narrow reaches of the drainage, water catchment basins are scoured into Coconino Sandstone bedrock. These are filled seasonally by local snowmelt and rainfall and provide important water sources for wildlife. In addition, numerous localized seeps have been recorded in the fractures and bedding planes of the steep canyon walls. Prominent seeps are also found in the tributary canyons on the south side of the monument. These provide localized microhabitats for a number of plants not found elsewhere within the monument. Wetlands that meet U.S. Fish and Wildlife Service jurisdictional criteria under Section 404 of the Clean Water Act are likely restricted to the narrow canyon drainages and perennial seeps. The Walnut Canyon watershed drains an area of approximately 170 square miles. The headwaters of Walnut Creek are found in the Mormon Mountain-Mormon Lake area more than 20 miles south of the monument. Prior to 1900, the creek is believed to have ephemerally flowed through the bottom of Walnut Canyon on a biannual cycle. Reliable flows typically occurred early each year during the period of spring snowmelt, and less predictable flows likely occurred later each year during in the summer and fall thunderstorm season.

The natural hydrology within the Walnut Canyon drainage was severely altered when the city of Flagstaff began impounding Walnut Creek for use as its public water supply. Around 1900, the first dam was built upstream of the monument to create Lower Lake Mary. The dam signifycantly disrupted seasonal water flow through the canyon. A second dam was built in 1941 to create Upper Lake Mary, at which time Walnut Creek ceased flowing. Since 1941, the canyon has flooded only a few times during extremely wet seasons that completely filled both reservoirs. Flows of lesser magnitude occur about once a decade from smaller tributary watersheds below the lakes. The impoundment and diversion of Walnut Creek for the last century has greatly impacted the wetland, floodplain, and riparian resources within the monument. The processes of stream channel scouring, sediment transport, terrace formation, and local spring and seep recharge have been altered in ways that may never be fully understood.

Riparian vegetation is also changing in the absence of seasonal flows. Historic photographs from the 1940s show an open, well- defined stream channel along the canyon bottom. Today, the channel is obscured by dense vegetation. Deciduous tree species, including the Arizona walnut, for which the canyon is named, are believed to be decreasing in number, and New Mexico locust now dominates the former open drainage channel. Most of the riparian species that have persisted for the last four decades are expected to survive, albeit in different proportions than prior to the construction of the dams. Local wildlife populations have almost certainly adapted to less reliable surface water. Aquatic invertebrates and amphibians were likely impacted the most. The NPS believes that the riparian system is still changing in response to dewatering of the drainage, and long- term trends have yet to be fully assessed. The restoration of wetland, floodplain, and riparian resources is predicated upon cooperation by the city of Flagstaff to provide seasonal water releases from Upper and Lower Lake Mary.

Another relatively small impoundment exists near the downstream end of the canyon, on the private inholding within the monument. The Santa Fe Dam was built around1885 to supply water to the Santa Fe Railway, and has locally impacted riparian resources especially the native

riparian plant communities. The former reservoir area is now almost entirely filled with sediment, and some local storm flows pass through the dam's spillway. The Walnut Creek stream channel and sediment plain behind the dam are dominated by both native and nonnative weedy annual species, such as Russian thistle (*Salsola iberica*), cheatgrass (*Bromus tectorum*), horehound (*Marrubium vulgare*), sweet clover (*Melilotus albus*), field bindweed (*Convovulus arvensis*), and various non-native grasses. The reservoir area appears to have been silted in for several decades. With the diminished water storage capacity, storm flows readily pass over the spillway and into the lower drainage channel much as they would have before the dam was built. The canyon bottom vegetation and drainage channel downstream from the reservoir appear to be in stable condition in equilibrium with the current flow regime. The canyon floor area around the reservoir is seasonally used by wildlife for both browse and water. If the NPS eventually acquires the private parcel of land on which the dam and reservoir lie, the agency would likely conduct resource assessments and explore ways to mitigate the effects of the impoundment on the canyon riparian corridor.

Sunset Crater Volcano National Monument Wetlands, Floodplains, and Riparian Areas
Sunset Crater Volcano National Monument contains no wetlands, floodplains, nor riparian areas. Few water resources exist at SUCR and documentation is limited to data collected as part of the regional aquifer monitoring program (USGS 2002). The Resource Management Plan and the General Management Plan (SUCR 1996; 2001) have brief sections on water resources but do not list any wetlands, floodplains, or riparian areas within SUCR boundaries.

Wupatki National Monument Wetlands, Floodplains, and Riparian Areas
Wupatki National Monument is largely included within the upland watershed that drains the east and northeast San Francisco Mountain slopes, including the San Francisco Volcanic Field. Wetland, floodplain, and riparian resources at Wupatki are restricted to banks of the Little Colorado River, two perennial springs-Peshlaki Spring and Heiser Spring and various scattered seeps. Approximately 1.5 to 2 miles of the Little Colorado River flow along the monument's eastern boundary. Wetlands that meet U.S. Fish and Wildlife Service jurisdictional criteria under Section 404 of the Clean Water Act are likely only found on the bed of the intermittently flowing Little Colorado River. Here, jurisdictional wetlands are probably restricted to the scoured cobble and stone riverbed, which is almost devoid of vegetation and may be dry for months at a time during an average year.

The Little Colorado River floodplain is very distinct, and supports a narrow band of riparian vegetation. Until the introduction of livestock grazing it was likely dominated by cottonwood-willow gallery forest. Now, the floodplain is mostly dominated by nonnative tamarisk thickets, likely as a result of long-term grazing pressure and altered flood regimes from upstream impoundments and diversions. Local Navajo residents continue to graze livestock on both banks upstream and downstream from the monument, and the NPS is prevented from fencing the sizeable riparian area within the monument because annual large flood events would likely destroy any fence structures near the riverbed. At a few areas where large tributary washes meet the Little Colorado River, such as Deadman Wash, a high water table supports tamarisk thickets. These areas may be far enough removed from river flooding that they can be effectively fenced to exclude livestock and restored to native vegetation.

Currently the only human development within the floodplain at Wupatki is the Black Falls Crossing. Local Navajo residents cross the river at this location year-round, except during high

water. Continual use and maintenance has caused ruts, erosion, and gradual widening of the crossing, which locally influences hydrology and sediment movement for less than 100 feet downstream within the river channel. During the 1940s, the Black Falls Dam was built 1/8 mile upstream from the crossing. At one time the dam site and affected river reach were within the monument boundary, but the lands were withdrawn to the Bureau of Reclamation. The Black Falls Dam silted up several years ago and now holds only a small amount of water. The Bureau of Reclamation has administratively transferred jurisdiction of the site to the Bureau of Land Management. The riverbed crossing and dam have locally altered this reach of the Little Colorado River floodplain.

There are three natural springs within Wupatki National Monument: Peshlaki, Heiser, and Wupatki. All of them were modified historically by native occupants, ranchers, and the NPS, and they are likely the most severely impacted natural resources within the monument. Peshlaki and Heiser Springs have no measurable surface flow, and surface water is typically available only if a shallow basin is dug and maintained. Above Peshlaki Spring, common reed, *Phragmites communis,* grows over approximately 750 square feet. Although extremely limited in area, Peshlaki Spring may also meet jurisdictional wetland criteria.

Prior to the arrival of Anglo culture, the springs were undoubtedly used by American Indian peoples and would have been critical water sources for wildlife. Water flow at all three is believed to have steadily diminished during the 20th century. The reasons for this are not known, but it is likely a combined result of long-term weather and vegetation changes within the recharge area. Peshlaki Spring was heavily relied upon by local Navajo sheepherders, and still has an installed water containment and animal trough system. Heiser Spring was first modified by the Heiser family ranching operation, and was later distributed to NPS residences for drinking water. Installed "spring-boxes" divert water through piping to a local Navajo property inholder, leaving no surface water at the spring site. Wupatki Spring was also developed by the NPS as the original water supply for the visitor center. Wupatki Spring ceased flowing during the 1950s, possibly as a result of NPS efforts to stimulate its flow using dynamite. Peshlaki Spring is the only remaining perennial spring with available surface water for wildlife within the monument. The NPS began restoring Heiser Spring in FY2009, including removing containment and diversion structures and planting riparian vegetation.

Several intermittent seeps have also been recorded in the monument, but a full inventory and condition assessment is needed for seeps and ephemeral water sources. There is a shallow water table along the river, but the water is highly gypsiferous and very poor in quality. Peshlaki Spring, Heiser Spring, and the former Wupatki Spring flow from a local, perched aquifer within interbedded sandstone and shale in the Moenkopi Formation. Spring flows are highly variable, increasing during winter and spring, and declining through the summer and fall. Flows do not correlate directly with annual precipitation amounts. The aquifer is recharged within the area of heavily fractured surface basalts from Woodhouse Mesa southward of the monument boundary at least five miles to the Strawberry Crater area. Most of the recharge area is managed by the U.S. Forest Service. Land use and vegetation condition within the recharge area likely affects the spring flows. Five major intermittent drainage systems traverse the eastern half of the monument: Citadel Wash, Antelope Wash, Doney Mountain Wash, Deadman Wash, and Kana-a Wash. Each drains a sizeable area, and all are subject to infrequent, but intense flash flooding. The wash beds are characteristic braided sand sands and gravels. Thicker desert scrub vegetation lines the drainages. Except for a few road crossings, there are no NPS facilities within the

intermittent drainage floodplains. None of the washes possesses hydrologic, soil, or vegetation characteristics indicative of jurisdictional wetlands. Except for their respective confluences with the Little Colorado River, none would be considered riparian habitat. There are a few human-made earthen stock tank impoundments within the monument, which are left over from former ranching operations. Several abandoned gravel and cinder quarries also seasonally hold water. All of these are used by wildlife, including pronghorn, cougars, bobcat, coyotes etc.

3.7.6.2 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to wetlands, floodplains, and riparian areas were derived from a review of available literature, regulatory agencies, IDT expert input, and from a number of sources including other successful invasive management plans. The thresholds of change for the intensity of an impact are defined below:

Impact Intensities and Definitions – Wetlands, Floodplains, and Riparian Areas

Impact Intensity	Intensity Definition
Negligible	Any effects to wetlands or floodplains would be below or at the lower levels of detection. There would be no long-term effects to wetlands or floodplains, and any detectable effects would be slight. No USACE 404 permit would be necessary.
Minor	The effects to wetlands or floodplains would be detectable and relatively small and short-term to individual plants. No effects would be detectable to populations of plants. The effect would be site-specific. A USACE 404 permit would not be required. No long-term effects to wetlands or floodplains would occur.
Moderate	The effects to wetlands or floodplains would be detectable and readily apparent, including a long-term effect on individual plants and short- or long-term effect on populations of plants. The effect could be site-specific or local.
Major	Effects to wetlands or floodplains would be observable over a relatively large localized or regional area and would be long-term. The character of the wetland or floodplain would substantially change its functions over the long-term.

Duration

Short term One year or less for wetland, floodplain, or riparian resources

Long term Greater than one year

Context

Localized A single wetland, floodplain, or riparian area

Regional Wetland, floodplain, or riparian area resources covering several areas and drainages

3.7.6.3 Analysis of Alternatives and impacts on Wetlands, Floodplains, and Riparian Areas

Effects of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis
Invasive plant management would not be as effective under this alternative because of constraints on treatment methods.

Mechanical/Manual Treatments
Ground disturbing activities may cause direct impacts to native plants. Physical disturbance to wetlands could result in relatively higher impacts to these wetland communities compared to Alternative II. Impacts would be adverse, short-term and site-specific. Wetland or floodplain functions could be temporarily reduced. A USACE 404 permit would not be required since no activities that involve dredging or filling of waters of the U.S. are proposed. The impacts of manual and mechanical treatments on wetland and floodplains would therefore be ***direct, adverse, site-specific, short-term, and minor.***

Chemical Treatments
Non-target plants subjected to pesticide drift could experience no effect, reduced vigor, or death depending on the sensitivity of the plant species to the specific pesticide and the dose the plant was subjected to. Overall, use of chemical controls would have infrequent adverse, short-term, minor impacts on individual wetland plants due to drift or non-target treatment during the course of spraying targeted species. Infrequent impacts to individual plants generally have negligible to minor effects on plant populations, wetland communities, or wetland processes. The impacts of chemical treatments on wetlands and floodplains would therefore be ***direct, adverse, site-specific, short-term, and negligible to minor.***

Biological Treatments
Any biological control agent released must be approved by APHIS and have no demonstrated affinity for native wetland species. The National IPM Coordinator would also continue to approve release of biological control agents per NPS-77. Because biological control agents are specific to a unique exotic plant, there would be no impacts to non-target wetland plant species. Impacts to target plants would be direct and beneficial. The impacts of biological treatments on wetlands and floodplains would therefore be ***direct beneficial effects, site-specific, short-term to long-term, and moderate.***

Cultural Treatments
In wetlands, fire may be used to remove undesirable vegetation. Prescribed fires have the direct effect of removing stagnant, dead plant accumulations while converting that mass to ash and charcoal. Fires tend to increase species diversity, and reduce woody species relative to grass and forb species. Wetland or floodplain functions may also be increased through restoring native vegetation. A USACE 404 permit would not be required for any activities associated with a prescribed fire.

The effect of fire on plants varies by species. Fire may either increase or reduce germination and vigor of plants. Prescribed fire would have no effects at those monuments that do not use this treatment. Prescribed fire may have minor adverse impacts on some individual plants but would affect a relatively small portion of the population. Overall, prescribed fire would have infrequent adverse, short-term, minor impacts on individual wetland plants. Infrequent impacts to individual plants generally do not impact plant populations, plant communities, or ecological

processes. The impacts of fire on wetlands and floodplains would therefore be ***direct, beneficial and adverse, site-specific, short-term, and minor.***

Cumulative Impacts
Not many projects are planned for the limited amount of wetlands, floodplains, and riparian resources that are found in the FLAG monuments. However, this could change depending on new invasions. At this point projects are likely in Walnut Canyon and its tributaries (WACA), and in WUPA, Deadman Wash and its tributaries, Heiser, Spice, and Peshlakai Springs. Localized infestations of invasive plants would be targeted in wetland, floodplain, and riparian resources and only targeted spot manual and chemical treatments would be applied. Thus cumulative impacts would be ***direct, beneficial, site-specific, long-term, and moderate.***

Conclusion
Beneficial effects to wetlands, floodplains, and riparian areas would vary between monuments and areas within each monument. The overall success of invasive plant management within the wetlands, floodplains, and riparian areas would likely be lower than Alternative II. Exotic plant management would help management achieve the desired condition to maintain and preserve these ecologically important areas. The impacts of exotic plant management on wetlands, floodplains, and riparian areas would therefore be directly adverse and beneficial, site-specific, short- and long-term, and negligible to moderate.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis
Using an integrated approach will allow the parks to choose the most appropriate treatment methods or mix of methods, and minimize the adverse impacts of treatments.

Mechanical/Manual Treatments
Ground disturbing activities may cause negligible mechanical disturbance to individual native plants. These impacts would be adverse, short-term, and negligible to individual plants because activities that would have greater impacts, such as tilling, would not be used in wetland or riparian areas. Individual plants may be directly and indirectly affected by disturbance resulting from mechanical treatment of target plants. Infrequent impacts to individual plants generally have negligible to minor effects on plant populations, plant communities, or ecological processes. A USACE 404 permit would not be required for mechanical treatment because these

activities would not involve dredging or filling waters of the U.S. The impacts of manual and mechanical treatments on wetlands, floodplains, and riparian areas would therefore be ***direct, adverse, site-specific, short-term, and negligible.***

Chemical Treatments
Non-target plants subjected to pesticide drift may experience either no effect, reduced vigor, or death depending on the sensitivity of the plant species to the specific pesticide and the dose to which the plant was subjected. Overall, with the implementation of BMPs, chemical controls would have infrequent adverse, short-term, minor impacts on individual plants caused by drift or non-target treatment while spraying targeted species. Infrequent impacts to individual plants generally do not impact plant populations, plant communities, or ecological processes. A USACE 404 permit would not be required.

If ATVs or similar equipment is used they would be routed to avoid palustrine wetlands. In rare occasions ATVs may be used to cross intermittent drainages to access exotic plant populations. Stream crossings could potentially increase site-specific sedimentation in standing or shallow flowing water at the crossing. However, most drainages are dry during the summer when the majority of exotic plant control efforts occur. A USACE 404 permit would not be required for any chemical treatments because these activities would not involve dredging or filling of waters of the U.S. The impacts of chemical treatments on wetlands, floodplains, and riparian areas would therefore be ***direct, adverse, site-specific, short-term, and negligible.***

Biological Treatments
Because biological controls target a specific exotic plant, there would be no expected impacts to non-target wetland plant species. Impacts to target plants would be direct and beneficial to wetland communities. A USACE 404 permit would not be required for any activities associated with biological control treatments. The impacts of biological treatments on wetlands, floodplains, and riparian areas would therefore be ***direct, beneficial, site-specific, short-term to long-term, and moderate.***

Cultural Treatments
Restoration activities, such as reseeding and irrigation, could have beneficial effects of promoting the reestablishment of native wetland vegetation. Effects to wetlands and floodplains would be detectable and readily apparent. Impacts would be site-specific or local, and effects to individual plants would be long-term. USACE 404 permits would not be required for any proposed IPM treatments. The overall impacts of cultural treatments on wetlands and floodplains would therefore be ***direct, beneficial, site-specific, long-term, and moderate.***

Prescribed Fire
In wetlands, fire may be used to remove undesirable vegetation, especially tamarisk. Fires have the direct effect of removing stagnant, dead plant accumulations while converting that mass to ash and charcoal. Fires tend to increase species diversity and reduce woody species relative to grass and forb species. Wetland or floodplain functions would be increased. A USACE 404 permit would not be required.

The effect of fire on plants is species-specific. Fire may either increase or reduce germination and vigor of plants. Prescribed fire may have adverse impacts on some individual wetland and floodplain plants, but this would affect a relatively small portion of the population. Overall,

prescribed fire would have adverse and beneficial, short-term, minor impacts on individual plants. Infrequent impacts to individual plants generally do not impact plant populations, plant communities, or ecological processes. The impacts of prescribed fire on wetlands, floodplains, and riparian areas would therefore be ***direct, adverse and beneficial, site-specific, short- and long-term, and minor to moderate.***

Cumulative Impacts
The cumulative impacts of this alternative are similar to Alternative I. Thus cumulative impacts would be ***direct, adverse, site-specific, long-term, andminor to moderate.***

Conclusion
By controlling exotic plants, wetland and riparian communities and floodplains would be rehabilitated, thus benefiting native plant species and the habitat they provide. In most areas, IPM will enhance the existing wetland area or floodplain/riparian function. Removal of exotic plants that affect riparian areas (such as Russian olive and tamarisk) would help enhance riparian habitat. Effects to wetlands and floodplains would be detectable and readily apparent. Impacts would be site-specific and effects to individual plants could be long-term. USACE 404 permits would not be required for any proposed IPM treatments. Overall beneficial effects to wetlands would be greater under Alternative II. The minor short-term adverse impacts would be greatly outweighed by the long-term benefits of habitat rehabilitation. The overall effects of exotic plant management on wetlands and floodplains would therefore be ***direct, beneficial, site-specific, long-term, and moderate.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis
Impacts would be similar to Alternative I except that treatments would be manual and expensive, which would limit the total area treated to a fraction of that in Alternative I and II.

Cumulative Impacts
These impacts are similar to Alternative I except that less area would be treated . Thus cumulative impacts would be ***direct, adverse, site-specific, long-term, and minor.***

Conclusion
Same as Alternative I. The impacts of exotic plant management on wetlands, floodplains, and riparian areas would therefore be ***direct, adverse and beneficial, site-specific, short- and long-term, and negligible to moderate.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.8 Cultural Resources

3.8.1 Archeological and Historic Resources

The NPS is mandated to preserve and protect cultural resources through the Organic Act of 1916 and through specific legislation such as the Antiquities Act of 1906, the National Environmental Policy Act of 1969 (as amended), the National Historic Preservation Act of 1966 (as amended through 2000), NPS Management Policies, NPS Director's Order 28 (Cultural Resource Management Guidelines), and the Advisory Council on Historic Preservation's implementing regulations regarding Protection of Historic Properties.

FLAG cultural resources reflect the region's long history of human presence, and reveal the changing human relationship with landscape.

To minimize impacts on cultural resources, the following mitigation measures would be incorporated into the action alternative (these are also listed in **Appendix C**):

1. If previously unknown cultural resources are discovered during a project, a Cultural Resources specialist would be contacted immediately. All work in the immediate vicinity of the discovery would be halted until resources could be identified and documented and an appropriate mitigation strategy developed, if necessary, in accordance with stipulations of the Programmatic Agreement among the National Park Service, Arizona State Historic Preservation Officer, and Advisory Council on Historic Preservation.
2. All workers would be informed of penalties of illegally collecting artifacts or intentionally damaging any cultural property. Workers would also be informed of correct procedures if previously unknown resources were uncovered during construction activities.
3. Areas selected for equipment and materials staging in developed areas are expected to be in existing disturbed areas or existing paved overlooks where there is no potential for disturbance to cultural resources. If sites selected for these activities change during later design phases for implementation of any of the alternatives, additional surveys would be conducted.
4. Vegetation Program Crew Leaders would attend one-day training in recognition of archaeological sites and associated sensitivities in field work conditions. This training will be provided by Flagstaff Area Monuments Cultural Resources staff and will include

methods for planning ahead and preparing field crews for work around archaeological sites, identification of historic and prehistoric artifacts and features, and avoiding site disturbances.

5. Annual work plans would be reviewed by FLAG Cultural Resources staff to evaluate project areas, crew size, and invasive vegetation treatment types and associated ground disturbing activities.
6. FLAG Cultural Resources staff would provide maps to Vegetation Program Crew Leaders showing location of archaeological sites in relation to vegetation treatment areas in the monuments. Maps showing location of archaeological sites would be returned at the end of the project.
7. **In areas proposed for invasive plant treatment, an archeologist or other specialist would need to review mechanical subsurface treatment of plants prior to implementation. Mechanical subsurface treatment includes any ground disturbance greater than 6 inches deep and 12 inches in diameter.** An archeologist would review mechanical subsurface treatment (digging) in sensitive areas of known archaeological sites (constructed features, middens, artifact concen-trations) prior to implementation. All such activities would be documented and filed with site records. Loosening soil with hand tools while hand-pulling herbaceous plants and shrubs is allowable, provided the ground disturbance would not exceed 6 inches deep and 12 inches in diameter, and soil would not be removed from the area of treatment
8. Accessing work / treatment areas will be planned with an archaeologist to avoid walking through archaeological sites whenever possible.
9. Work crews would be split into small teams of two to four people when working around archaeological sites.
10. Work crews would not walk across archaeological features such as constructed features, middens, or artifact concentrations.
11. Work crews would avoid creating paths and trails in loose soils and sand.
12. Work crews would avoid walking on bedrock surfaces that contain artifact concentrations to avoid crushing artifacts.
13. Work crews would report all previously unrecorded archaeological sites.
14. All inadvertent damage to archaeological sites would be documented by recording GPS coordinates, map location, photographs and description of damage.
15. If vegetation removal or herbicide use were anticipated at historic wall foundations or mortar joints, the FLAG Chief of Cultural Resources would be consulted prior to treatment to avoid any adverse impacts to these resources

3.8.1.1 Affected Environment

Walnut Canyon National Monument

Walnut Canyon National Monument on the southern edge of the Colorado Plateau was specifically created to preserve and interpret some exceptional prehistoric archeological sites. The primary archeological remains of Walnut Canyon are unique, in that the monument preserves the only known concentration of northern Sinagua cliff dwellings in the region. These well preserved architectural sites, situated in alcoves below the canyon rim, were constructed by the Sinagua primarily between A.D. 1100 and A.D. 1250. In addition, this monument contains a representative cross section of the types and variety of archeological sites found throughout the Four Corners area, including small and large masonry pueblos, rock shelters, open campsites, agricultural field systems, ceremonial shrines, historic cabins, rock art panels, miscellaneous

artifact scatters, and a variety of other physical remains reflecting the diverse cultures and economic strategies of the various people who have attempted to make a living in this beautiful yet challenging environment.

The site density in the monument averages almost 100 sites per square mile, compared with typical densities of 40 sites per square mile in other areas of the ponderosa pine forest near Flagstaff. The high site density in Walnut Canyon reflects the area's biological richness. The canyon's natural abundance and diversity of plant and animal species provided a storehouse of resources that attracted and sustained the prehistoric inhabitants of Walnut Canyon.

About 45 percent of the approximately 3,600 acres in Walnut Canyon National Monument have been intensively inventoried for archeological resources. All of the inventoried areas are within the old (pre- 1996) boundaries of the monument. Areas that have been specifically inventoried for archeological resources include the fence line along the entrance road, the north and south rim areas, plus approximately half of the inner canyon zone. None of the private inholding (approximately 291 acres), or any of the new lands added to the monument in 1996, have been surveyed for archeological resources. A total of 251 archeological sites have been recorded within the inventoried areas. Of this total, 87 are classified as cliff dwellings. In addition, the monument includes 5 "forts" (walled, defensible sites located on promontories within the canyon), 5 lithic scatters, 87 one- and two- room field houses (some with associated field complexes), 18 pithouses, and 11 multiroom pueblos. Several historic sites (a cabin, a dam, plus several trash dumps) are also present in the monument.

The dense concentration of prehistoric ruins, their exceptional state of preservation, and their unusual and highly scenic setting in sheltered alcoves along the canyon walls, coupled with the threat of imminent destruction by commercial looters and misguided tourists, were key factors influencing the creation of Walnut Canyon National Monument in 1915. These original core values persist to the present day. Approximately 40 of the 251 archeological sites in the monument have been stabilized to some degree, in order to withstand impacts from visitation and weathering, but many still retain a high degree of integrity, including substantial amounts of original masonry architecture and a more or less complete assemblage of artifacts.

Sunset Crater National Monument

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

The area retains importance to numerous American Indian tribes living in the area today. Therefore, although only a handful of archeological sites have been documented within the

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

Three prehistoric archeological sites are located within the maintenance yard behind the visitor center and two others are in close proximity to the visitor center. A prehistoric pottery cache was found by visitors within the Bonito Lava Flow, and at least one Hopi shrine is known to exist in the Lava Flow area. Undoubtedly, there are additional post-eruptive archeological sites within the monument boundaries that await future discovery. Approximately 68 archeological sites have been recorded within one mile of the current monument boundaries. The majority of these sites are buried Sinagua pit structures dating between A.D. 650 - 1065. In addition, there are at least five prehistoric masonry structures, one cave containing a prehistoric pottery cache, and 13 artifact scatters without associated architecture. There are also several historic sites, including a logging railroad grade, a collapsed homestead cabin, and a shade structure.

Wupatki National Monument

At Wupatki, archeological remains associated with prehistoric ancestral Puebloan groups Cohonina, Sinagua, and Anasazi) are well represented, along with historic Navajo and Anglo ranch sites. Lt. Lorenzo Sitgreaves, who passed through the region in 1851, first brought the remarkable prehistoric ruin now known as Wupatki Pueblo to the attention of Euro-Americans. John Wesley Powell, founder of the Bureau of American Ethnology, reported on the presence of prehistoric ruins near the Citadel area in 1885. The first formal archeological investigation of the Wupatki area occurred in April 1900, when local prospector Ben Doney guided Jesse Walter Fewkes of the Smithsonian Institution to the ruins. Several additional surveys of the Wupatki area were conducted subsequent to Fewkes's initial study (Barrett in 1924, Colton in the 1920s). The work of Fewkes and Harold Colton, founder of the Museum of Northern Arizona, was instrumental in having the area set aside as a national monument in 1924.

Wupatki NM was originally set aside to preserve and interpret several large pueblos with standing architecture: Wupatki, Wukoki, Citadel, Nalakihu, Lomaki, and the two Box Canyon pueblos. Subsequent legislation added Crack-in-Rock Pueblo to the monument. These eight prominent architectural sites have been the focus of most past and present interpretive efforts and preservation work at Wupatki NM. In addition to the seven front country sites and Crack-in-Rock Pueblo, approximately 45 other sites in the monument have received some form of stabilization treatment. At least 50 additional architectural sites have been identified as needing some form of preservation treatment in the foreseeable future.

A complete inventory of archeological resources within Wupatki NM was completed in the mid-1980s, revealing a total of 2,668 archeological sites (Anderson 1990). This total did not include the four largest front country sites; Wupatki, Wukoki, Citadel, and Nalakihu-which brings the total number of documented sites to 2,672. Of this total, 2,405 are prehistoric or have prehistoric components and 2,214 sites dated between A.D. 1130 and 1160, and 369 sites dated between A.D. 1160 and 1220. There are twice as many sites with ceramic assemblages spanning more

than one period that are not included in these minimum numbers. Of the 2,668 sites recorded during the Wupatki Survey, 2,397 exhibited artifacts, petroglyphs, and/or architecture indicative of prehistoric use, and of these, 977 were datable on the basis of associated ceramics. Of the 977 dated sites, 949 or 97% dated between A.D. 1065± and 1220±.

The vast majority of recorded sites in the monument are small unit pueblos or pithouse villages with fewer than six rooms. Of the recorded prehistoric sites, 1,080 have one room or one pithouse and 723 have two to six rooms or pithouses. The large sites such as Wupatki Pueblo (100+ rooms) and the Citadel (50+ rooms) clearly stand out as unusual structures.

Wupatki Pueblo was apparently a center for trade, ceremonial activity, and cultural interaction within the region. Its prominence is probably due to its strategic location on or near several natural travel corridors. Natural travel routes included the east-west Little Colorado Valley, Deadman Wash (part of an ancient NE-SW trade route linking the Hopi Mesas with the San Francisco Peaks), plus a series of mountain passes to the south and east of Wupatki that allowed travelers to pass from the low country below the Mogollon Rim to the Colorado Plateau highlands. Ideas and trade goods flowed into and out of Wupatki Pueblo, as evidenced by abundant woven cotton fabrics, turquoise and shell jewelry, and the largest concentration of scarlet macaws in the American Southwest. The Pueblo also contains a diverse assortment of ceramics, as well as non-local architectural features, such as the Hohokam-style ballcourt and Chacoanstyle banded masonry. Although the decorated pottery at Wupatki Pueblo is mostly from the Kayenta Anasazi region in NE Arizona, the vast majority of pottery at Wupatki Pueblo is Alameda Brownware, the local Sinagua utility ware. Hence, despite exhibiting numerous outside cultural influences, Wupatki Pueblo is generally considered to be a Sinagua site. In contrast to Wupatki Pueblo and a few other sites in the immediate vicinity, the majority of masonry pueblos in Wupatki National Monument appear to be affiliated with the Kayenta branch of the Anasazi (Ancestral Pueblo) culture. This is based on the predominance of distinctive Anasazi decorated and "corrugated" utility pottery at most prehistoric sites in the monument. Cohonina pottery is common at many of these sites, particularly in the western reaches of the monument, but unequivocal Cohonina residences are quite rare within the monument. It is interesting to note that concentrations of large Cohonina pithouse villages are found only a few miles to the south and west of the monument.

The intense period of building and occupation in the Wupatki area is sometimes referred to as the "Wupatki Phenomenon." The "phenomenon" was relatively short lived, lasting approximately 120-150 years. Site population decreased dramatically after A.D. 1220, and the area was apparently abandoned by the mid-13th century. The ultimate cause of the abandonment is unclear, although climatic deterioration and the accompanying removal and redistribution of water-retaining cinder mulch by wind action has been suggested as one possible cause.
The area continued to be used on a sporadic basis after the 13th century, primarily by Hopi travelers and later by ancestral Havasupai for seasonal hunting and gathering. Beginning sometime in the 1800s, Navajo herders moved into the region and began using the Wupatki Basin as a seasonal residence. Approximately 220 of the 2,668 sites recorded during the Wupatki Survey are attributed to the historic Navajo occupation of the area. Of these 220 sites, approximately 170 have architectural features (hogans, corrals, ramadas, masonry dams, and/or sweat lodges) associated with them.

3.8.1.2 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to archeological resources and historic structures were derived from the available scientific data and literature and park staff's past observations of the effects on archeological resources and historic structures during past stabilization and mitigation projects. The thresholds of change for the intensity of an impact are defined below:

Impact Intensities and Definitions – Archeological and Historic Resources

Impact Intensity	Intensity Definition
Negligible	Impact is at the lowest levels of detection – barely measurable with no perceptible consequences, either adverse or beneficial. For the purposes of Section 106, the determination of effect would be no adverse effect. **Beneficial** Impact – maintenance and preservation of a site(s). For the purposes of Section 106, the determination of effect would be no adverse effect.
Minor	**Adverse impact** - impact would not affect the character defining features of a National Register of Historic Places eligible or listed structure or building. For archeological sites disturbance of a site(s) results in little, if any, loss of integrity For purposes of Section 106, the determination of effect would be no adverse effect. **Beneficial impact** - maintenance and preservation of archeological site(s). Stabilization/preservation of character defining features in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties, to maintain existing integrity of a structure or building. For purposes of Section 106, the determination of effect would be no adverse effect.
Moderate	**Adverse impact** - Disturbance of a site(s) results in a loss of integrity. For the purposes of Section 106, the determination of effect would be adverse effect. A memorandum of agreement (MOA) is executed among the NPS and applicable state or tribal historic preservation officer (THPO) and, if necessary, the Advisory council on Historic Preservation in accordance with 36 CFR 800.6(b). The mitigation measures identified in the MOA reduce the intensity of impact under NEPA from major to moderate. Impact would alter a character defining feature(s) of the structure or building but would not diminish the integrity of the resource to the extent that its National Register eligibility is jeopardized. For purposes of Section 106, the determination of effect would be no adverse effect. **Beneficial impact** – Stabilization of an archeological site. Rehabilitation of a structure or building in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties, to make possible a compatible use of the property while preserving its character defining features. For purposes of Section 106, the determination of effect would be no adverse effect.
Major	**Adverse impact** - Disturbance of a site(s) results in loss of integrity. The NPS and applicable state or tribal historic preservation officer are unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b). Impact would alter a character defining feature(s) of the structure or building, diminishing the integrity of the resource to the extent that it is no longer eligible to be listed in the National Register. For purposes of Section 106, the determination of effect would be adverse effect. **Beneficial impact** – Stabilization of an archeological site and restoration of an historic site in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties, to accurately depict the form, features, and character of a structure or building as it appeared during its period of significance. For purposes of Section 106, the determination of effect would be no adverse effect.

Duration

Short- term All archeological site and historical structure resource impacts are considered long-term.

Long- term Duration of all archeological site and historical structure resource impacts are considered long-term and permanent because, even if the physical damage can be repaired, damage to an archeological or historic site cannot be adequately mitigated.

3.8.1.3 Analysis of Alternatives and impacts on Archeological and Historic Resources

Effects of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis
Under this alternative, manual/mechanical and cultural treatments would be the primary methods used. Cultural treatments will not be implemented adjacent to historic structures, and chemical treatments would only be employed on large infestations of highly invasive plants or as small spot treatments to individual plants. Archaeological sites and historic structures not treated would have adverse, moderate, long-term, direct impacts because of the increased risk of damage from weed growth and because of the risk of wildfires in areas that do not normally have fires.

Prevention
Prevention actions under Alternative I include awareness of exotic plant species on adjacent lands, presentation of educational materials to monument staff and the public, and maintenance of up-to-date information on the websites of the monuments. These actions would have no measurable impact on archaeological or historic resources.

Manual/Mechanical Treatments
Alternative I proposes the same type of manual/mechanical control currently used, therefore effects to archaeological sites and historic resources and mitigation measures would be similar to Alternative II. In addition to power tools described in Alternative II, Alternative I would include use of mowers and chainsaws. However, effects to archaeological and historic resources and mitigation measures would be similar to Alternative II. Overall, impacts from manual/mechanical activities under Alternative I would be ***direct, adverse, site-specific, short-term, and negligible to minor.***

Chemical Treatments
Alternative I would include herbicide spot application on a lesser number of species and on smaller total areas than Alternative II. It would also include limited broadcast spraying, but effects on archaeological and historic resources and mitigation measures would be similar to

Alternative II. Thus, effects of chemical control on archaeological and historic resources would be ***direct, adverse, site-specific, short-term, and minor to moderate.***

Cultural Treatments
Ground disturbance would occur to collect native plant seed. Crews would walk around to access plants as described above. This type of ground disturbance is not generally considered an adverse impact on archaeological and historic resources and therefore would be negligible. Other types of cultural control include restoration of native plant species which would involve digging and have potential to affect cultural resources. However, because Vegetation staff would work closely with Cultural Resource staff to identify archaeological and historic resources in a project area and avoid identified resources, potential for effect would be minimized. Based on this, cultural control would result in ***direct, adverse, site-specific, long-term, negligible to minor effects*** on archaeological and historic resources.

Cumulative Impacts
Cumulatively, effects of Alternative I, when combined with other past, present, and reasonably foreseeable actions, would be similar to Alternative II. Impacts would have indirect, adverse, site-specific, short- to long-term moderate effects on archaeological and historic resources. Alternative II would have a negligible contribution to this cumulative effect. Cumulatively, effects of Alternative II, when combined with other past, present, and reasonably foreseeable actions would have ***direct and indirect, adverse, site-specific, short- to long-term, minor to moderate*** effects on archaeological and historic resources.

Conclusion
Under Alternative I adverse impacts to archaeological and historic resources from increased erosion and soil compaction would continue to be localized short- to long-term minor. Beneficial impacts including soil protection and stabilization from vegetative material left onsite would be localized short- to long-term moderate. Overall, impacts would be ***direct and indirect, adverse, site specific, short- to long-term, and minor to moderate.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis
Using an integrated approach to manage invasive plants will allow FLAG monuments to utilize the greatest number of options to treat invasive species while minimizing impacts to archeo-

logical and historic resources. Compared to other alternatives, impacts are minimized because mechanical control methods like digging plants, mowing, or using string trimmers to cut back plants would be used primarily on small invasive plant infestations. When these treatments, or the cutting of woody invasive species, occur near archeological and historic structures they will be monitored by a cultural resource specialist to ensure no damage is done. Prescribed burns in areas containing historic structures would only be undertaken after developing site-specific burn plans in cooperation with the Flagstaff Area Monuments Fire Management staff.

Prevention
More in-depth and extensive annual invasive plant surveys could slightly increase potential for ground disturbance over other alternatives. No additional prevention actions would impact archaeological and historic resources.

Manual/Mechanical Treatments
Removal of exotic plant species using manual methods could have direct effects on archaeological and historic resources from digging and effects from crew foot travel as described above. Indirect effects of uprooting entire plants using picks, shovels, and pulaskis include potential site destruction and increased erosion from soil-stabilizing plant loss. Mitigation measures including consultation and communication with FLAG Cultural Resource staff to minimize impacts to all cultural resources. Annual work plans prepared by FLAG Vegetation Program staff would be reviewed by Cultural Resource staff to identify areas of concern. If an adverse effect would occur due to proposed manual control, work would not commence. Instead Cultural Resource and Vegetation staff would decide if any type of treatment would be appropriate for the location. If all treatments would result in an adverse effect on archaeological or historic resources, invasive plant treatment would not occur.

Indirect effects to archaeological and historic resources from exotic plant removal above the root crown using brush cutters may include soil erosion due to increased overland water flow and above-ground vegetation loss. Adverse effects to archaeological and historic resources would be short- to long-term negligible to minor. Indirect beneficial effects could include increased water retention and soil protection provided by above-ground plant material left onsite as mulch, having a beneficial short-term negligible effect on archaeological and historic resources.

Tractor use on pre-disturbed construction sites to remove exotic plant species prior to site restoration would disturb, compact, and destabilize soils. Pre-disturbed construction sites would have been previously surveyed for archaeological and historic resources; direct and indirect impacts would have been mitigated. Direct and indirect impacts to sites could be, depending on resource presence, adverse short to long term negligible to minor.

Overall, impacts from manual/mechanical activities under Alternative II would be ***direct, adverse, site-specific, short-term, and negligible to minor.***

Chemical Treatments
Chemical control can be very effective for large infestations of invasive plants and for plants with growth habits that make mechanical control methods ineffective. The use of herbicides can also be an effective control method adjacent to archeological sites and historic structures where the use of hand tools and ground disturbance is restricted or prohibited. Through careful,

controlled spot applications, the use of herbicides to control invasive plants would have a negligible impact on archeological and historic structures.

Manual application of selected herbicides on targeted individual plants has potential to directly affect archaeological or historic resources through direct herbicide application. Foot traffic from crews applying herbicides would have impacts as described above. Pesticide use in boundaries of archaeological or historic sites would be restricted. Due to unknown effects, herbicides would not be directly applied to historic structures with limestone grout, hearth features, or cultural resources comprised of organic material, bone, pollen, seeds, and materials made from plant fiber. Physical disturbance to historic structures would be avoided. Herbicides would not be directly applied to historic structures or building features. Thus, effects of chemical control on archaeological and historic resources would be ***direct, adverse, site-specific, short-term, and minor to moderate.***

Cultural Treatments

Alternative II includes expanded use of mulch and use of barriers, which would not have direct effects on archaeological sites or historic resources. Addition of mulch would promote water retention and minimize erosion. Therefore, negligible beneficial impacts to archaeological sites and historic resources would result.

Cultural control could have an adverse impact on archeological sites and historic structures because of ground-disturbing activities associated with invasive plant control and native plant revegetation. Any revegetation activity would require cultural clearance and supervision by a cultural resource specialist to reduce the likelihood of adverse impacts on archeological sites and historic structures. The removal of exotic plant species will enhance the restoration of native plant communities reducing the risk of wildfire in the monuments. Overall, using cultural treatments under the preferred alternative will have ***direct, beneficial, site-specific, long-term, minor impacts*** on archeological sites and historic structures.

Prescribed Fire Treatment

Alternative II would introduce limited fire use to treat invasive. Fire has potential to directly impact archeological and historic resources. Coordination with cultural resource staff would determine whether sensitive resources exist in the project area and fire use may not be selected as appropriate treatment method based on presence of sensitive materials and projected fire intensity. If possible archeological or historic resources could be prepared (i.e., wrapped or otherwise protected) prior to a burn to avoid impacts. However, previously unidentified sites could be affected and fire has potential to spread. Additionally, any fire treatments would be coordinated with FLAG's fire program to ensure for safety and compliance. If mitigation measures (developed in the FLAG Fire Management Plan to protect these resources) were followed and areas were surveyed prior to burning, fire would have ***direct, adverse, site-specific, short- and long-term, negligible to minor*** impacts on archeological and historic resources.

Cumulative Impacts

Rapid urban development in the Flagstaff area is resulting in the damage and loss of historic and prehistoric sites. In addition, the loss of natural landscapes and viewsheds compromise the "setting" of the remaining sites. Within the monuments, proposed construction projects would take place in areas already disturbed by facilities and would neither disturb archaeological sites? and historic structures nor further impact their viewsheds. Growing recreational pressures

throughout the area will result in increased visitation to the remaining archeological and historic structures resulting in additional damage to sites.

Cumulative impacts on archaeological and historic resources were determined by combining impacts of Alternative I with other past, present, and reasonably foreseeable future actions having impacts in priority areas for exotic plant management (i.e., trails, roads, entrance stations, heavily trafficked areas). Past activities considered in this analysis include fire management actions including prescribed and wild fires, human activities, and construction projects. These actions have caused adverse impacts including direct and indirect damage to these resources through trailing, digging, collection, and erosion. These activities are ongoing and are considered in this analysis as in-progress and future as well as past activities. Impacts to archaeological and historic resources from these activities are adverse long term moderate.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative I include WACA, SUCR, and WUPA road improvements, housing improvements, and waste treatment improvements. Ground disturbance in some of these projects has prompted mitigation of archeological sites through excavation, an adverse effect on these resources. Impacts are adverse long-term moderate. Effects to archaeological and historic resources are considered in all construction projects and mitigation measures are developed to minimize impacts to these resources.

Cumulatively, effects of Alternative II, when combined with other past, present, and reasonably foreseeable actions would have ***direct and indirect, adverse, site-specific, short- to long-term, negligible to minor*** effects on archaeological and historic resources.

Conclusion
The preferred alternative will have moderate beneficial impacts on archeological and historic resources as invasive plant infestations would be treated using the most effective treatment methods with the least destructive impact. The cumulative effects on these resources would be negligible and long term.

Under Alternative II adverse impacts to archaeological and historic resources from increased erosion and soil compaction would be localized and short- to long-term moderate. Beneficial impacts including soil protection and stabilization from vegetative material left onsite would be short- to long-term minor. Impacts to archeological and historic resources from the preferred alternative activities would be ***direct, adverse, localized, short- to long-term, and minor.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Section 106 Summary
A programmatic agreement (PA) was completed for Flagstaff Area Monuments 1995 GMP. This PA is the foundation Section 106 documentation for the Invasive Plant Management Plan.

In addition, assessments of effect will be completed on an annual basis to determine effect on archaeological and historic resources. No adverse effects are anticipated if mitigation measures are followed.

The Flagstaff Area Monuments all contain numerous archeological features and sites, many of which do not retain, or never had, standing architecture. There are also a number of historic structures. All of these sites are included as contributing sites on the National Register of Historic Places nomination and are covered by the provisions of §106 of the National Historic Preservation Act. Any action taken under this project which has the potential to affect either archeological or historic resources on or eligible for the National Register will be subject to individual and separate §106 compliance.

Effects of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis
Adverse impacts to historic structures are expected to be greatest under this alternative. Mechanical methods would be the primary treatment used and would result in limited ability to control invasive species around prehistoric structures. The overgrowth of invasive species in culturally sensitive areas would result in increased bioturbation of sites, mechanical damage from plant growth, and risk of wildfires in areas that do not normally have fires.

Prevention
Prevention actions under Alternative III include awareness of exotic plant species on adjacent lands, presentation of educational materials to monument staff and the public, and maintenance of up-to-date information on the websites of the monuments. These actions would have no measurable impact on archaeological or historic resources.

Manual/Mechanical Treatments
Alternative III proposes the same type of manual/mechanical control currently used, therefore effects to archaeological sites and historic resources and mitigation measures would be similar to Alternative I. In addition to power tools described in Alternative II, Alternative III would include use of mowers and chainsaws. However, effects to archaeological and historic resources and mitigation measures would be similar to Alternative II. Overall, impacts from manual/mechanical activities under Alternative I would be ***direct, adverse, site-specific, short-term, and negligible to minor.***

Cultural Treatments
Ground disturbance would occur to collect native plant seed. Crews would walk around to access plants as described above. This type of ground disturbance is not generally considered an adverse impact on archaeological and historic resources and therefore would be negligible. Other types of cultural control include restoration of native plant species which would involve digging and have potential to affect cultural resources. However, because Vegetation staff would work closely with Cultural Resource staff to identify archaeological and historic resources in a project area and avoid identified resources, potential for effect would be minimized. Based

on this, cultural control would result in ***direct, adverse, site-specific, long-term, negligible to minor effects*** on archaeological and historic resources.

Cumulative Impacts:
Cumulative impacts would be nearly the same as Alternative I. However, this alternative would not be as effective in controlling invasive species and negative impacts on archeological and historic resources would increase. Cumulatively, effects of Alternative III, when combined with other past, present, and reasonably foreseeable actions would have ***direct and indirect, adverse, site-specific, short- to long-term, moderate*** effects on archaeological and historic resources.

Conclusion:
Impacts to archeological sites and historic structures from Alternative III are predicted to be moderate and adverse in the short- and long-term from increased disturbance from invasive plants that were not effectively treated, and from the increased risk of wildfire. Overall, this alternative would have ***direct, adverse, site-specific, long-term, moderate*** impacts on archeological sites and historic structures.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.8.2 Cultural Landscapes

3.8.2.1 Affected Environment

As defined in the Cultural Resource Management Guideline (NPS-28), cultural landscapes are settings humans create in the natural world. They are intertwined patterns of things both natural and constructed, expressions of human manipulation and adaptation of the land. Wupatki and Sunset Crater Volcano National Monuments just recently completed a Cultural Landscape Inventory (CLI) but Walniut Canyon National Monuments still lacks one. CLI are used to assess the character of the natural world that includes and encompasses historic districts. Such inventories describe a landscape's physical development as it evolved over time, and evaluate its significance and integrity. These inventories sometimes include vegetation management recommendations. Characteristics of cultural landscapes include land uses and activities, patterns of spatial organization, response to the natural environment, cultural traditions, circulation networks, vegetation, buildings, structures, and features.

Cultural landscapes would be considered in invasive plant management activities. As described in NPS-28, Cultural Resource Management, "cultural landscapes are complex resources that range from large rural tracts covering several thousand acres to formal gardens of less than an acre. Natural features such as landforms, soils, and vegetation are not only part of the cultural landscape, they also provide the framework within which it evolves. In the broadest sense, a cultural landscape is a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of

circulation, and types of structures built. The character of a cultural landscape is defined both by physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions." Cultural landscape reports and cultural landscape inventories would be used in management of vegetation within historic districts and cultural landscapes throughout the FLAG monuments.

3.8.2.2 Methodology and Intensity Thresholds

Baseline information used to assess impacts to cultural landscapes is as described in the methodology section at the beginning of this chapter and includes park staff knowledge of resources and site, review of existing literature and park studies, information provided by specialists in the National Park Service and other agencies, and professional judgment. Detailed information on natural and cultural resources in the Flagstaff Area Monuments is summarized in their respective General Management Plans was specifically referenced for information on affected resources in the project area. Additional sources of information on cultural landscapes used as a basis for this evaluation are as described above in the affected environment section. The thresholds of change for the intensity of an impact are defined below.

Impact Intensities and Definitions – Cultural Landscapes

Impact Intensity	Intensity Definition
Negligible	Impact is at the lowest levels of detection with neither adverse nor beneficial consequences. For purposes of Section 106, determination of effect would be "no historic properties affected" or "no adverse effect"
Minor	**Adverse -** Alteration of a pattern(s) or feature(s) of landscape would not diminish overall integrity of the landscape. For purposes of Section 106, determination of effect would be "no adverse effect" **Beneficial -** Preservation of landscape patterns and features in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties with guidelines for the treatment of cultural landscapes. For purposes of Section 106, determination of effect would be "no adverse effect"
Moderate	**Adverse -** Alteration of a character-defining pattern(s) or feature(s) of the landscape, but would not diminish overall integrity of the landscape to the extent that its National Register eligibility is jeopardized. For purposes of Section 106, determination of effect would be "adverse effect." A memorandum of agreement is executed among 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 are identified in the MOA to minimize or mitigate adverse impacts **Beneficial -** Rehabilitation of a landscape or its patterns and features in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties with guidelines for the treatment of cultural landscapes. For purposes of Section 106, determination of effect would be "no adverse effect"
Major	**Adverse** Alteration of a character-defining pattern(s) or feature(s) of the landscape that would diminish overall integrity of the landscape and jeopardize its eligibility for listing in the National Register. For purposes of Section 106, determination of effect would be "adverse effect." Measures to minimize or mitigate adverse impacts cannot be agreed on 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 Restoration of a landscape or its patterns and features in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties with guidelines for the treatment of cultural landscapes. For purposes of Section 106, determination of effect would be "no adverse effect"

Duration

Short- term An effect that within five years would no longer be detectable as the resources was returned to its predisturbance condition or appearance (e.g. trash and other items removed or vegetation trampled, but not denuded)

Long- term A change in a resource or its condition that would not return to predisturbance condition or appearance and for all practical purposes would be considered permanent (e.g. damage to elements or removal of artifacts)

3.8.2.3 Analysis of Alternatives and Impacts on Cultural Landscapes

Effects of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis
All methods that include invasive plant removal could have direct effects on cultural landscapes due to an alteration of any feature in the landscape. Plants are features of a landscape and some are important in the sense of the cultural landscape. A plant species may be exotic, and invasive, and of high priority for removal, but the potential importance of the species in a cultural landscape would need to be considered. However, invasive species removal would benefit a cultural landscape by restoring native species to an area and removing those that did not originate in the period of significance.

Prevention
Prevention actions under Alternative I include awareness of invasive plant species on adjacent lands, presentation of educational materials to park staff and the public, and maintenance of up-to-date information on the FLAG monuments websites. These actions would have no measurable impact on cultural landscapes.

Manual/Mechanical Treatments
Control of invasive plant species using manual/mechanical methods could have direct effects on cultural landscapes through actual removal of plants. Additional impacts would be realized from ground disturbance and possible increased erosion. Howerver, the control of invasive species would be beneficial in the long-term because of the restoration of native plant communities. The addition of power tools would include use of mowers and chainsaws in developed areas. Overall, manual/mechanical control would result in ***direct, adverse, site-specific, long-term, negligible to minor effects*** on cultural landscapes.

Chemical Treatments
Manual application of selected herbicides on targeted individual plants has potential to directly affect cultural landscapes through treatment and subsequent elimination of invasive plants. Alternative I would include herbicide application on a lesser number of species than Alternative II. Thus the natural landscape would take longer to become restored. Chemical treatment effects under Alternative II on cultural landscapes would be ***direct, adverse, site-specific, short-term and minor.***

Cultural Treatments
Ground disturbance would occur to collect native plant seed. Crews would walk to access plants as described above. This type of ground disturbance is not generally considered an adverse impact on cultural landscapes. Therefore, cultural control would result in ***direct, adverse, site-specific, short-term, negligible*** effects on cultural landscapes.

Cumulative Impacts
Cumulative impacts on cultural landscapes were determined by combining impacts of Alternative I with other past, present, and reasonably foreseeable future actions having impacts in priority areas for invasive plant management described at the beginning of this chapter (i.e., trails, roads, entrance stations, heavily trafficked areas).

Past activities considered in this analysis include human presence, recreation, construction projects, and rehabilitation projects. These actions have caused adverse impacts by changing significant elements of the cultural landscape. Human presence and recreation are ongoing in the monuments and are considered in this analysis as in-progress and future actions as well as past activities. Impacts to cultural landscapes from these activities are adverse and long-term minor.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative I include road improvements and rehabilitation, upgrade and maintenance of the waste-treatment facilities, and upgrade of general facilities. Ground disturbance in several of these projects has prompted mitigation of archeological sites through excavation, an adverse effect on these resources. Impacts are adverse and long-term moderate. Effects to cultural landscapes are considered in all construction projects and mitigation measures developed to minimize impacts to these resources.

Cumulatively, effects of Alternative I, when combined with other past, present and reasonably foreseeable actions, would result in ***direct and indirect, adverse, site specific, short-term minor*** effects on cultural landscapes. Alternative II would have a negligible contribution to this cumulative adverse effect.

Section 106 Summary
A programmatic agreement was completed for the Flagstaff Area Monuments General Management Plans. This PA is the foundation Section 106 documentation for the Invasive Plant Management Plan. In addition, assessments of effect will be completed on an annual basis to determine effect on cultural landscapes. No adverse effects are anticipated if mitigation measures are followed.

Conclusion
Under Alternative I, adverse impacts to cultural landscapes from vegetation changes would continue to be negligible and short- to long-term. Beneficial impacts including restoration of native plants and removal of non-native plants not key features in the landscape would be minor and long-term. Cumulative impacts would be ***direct and indirect, adverse, site specific, short-term, and minor to moderate***.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis
As described for Alternative I, the removal of exotic plant species could have adverse and beneficial effects on cultural landscapes. The impacts of Alternative II would be similar as those described in Alternative I.

Prevention
More in-depth and extensive annual surveys could slightly increase potential for ground disturbance over the other alternatives. No additional prevention actions would impact cultural landscapes.

Manual/Mechanical Treatments
Invasive plant species removal using manual/mechanical methods could have direct effects on cultural landscapes through actual removal of plants. Effects would be similar to Alternative I. Overall, manual/mechanical control would result in ***direct, adverse, site-specific, long-term, negligible to minor effects*** on cultural landscapes.

Chemical Treatment
Alternative II would include herbicide application on a greater number of species than the other alternatives and would also include limited broadcast spraying, which gives greater control of hitting only target plants. This would result in less overspray and herbicide drift. Chemical treatment effects on cultural landscapes would be ***direct, adverse, site-specific, short-term and minor.***

Cultural Treatments
Alternative II includes addition of carbon sources and expanded mulch use and use of barriers, which would have direct but short-term adverse effects on cultural landscapes. Alternative II would introduce limited use of fire to treat exotic plants. Fire has potential to impact cultural

landscapes. Coordination with cultural resource staff would determine features of the cultural landscape in the project area. Cultural treatments would have ***direct, adverse, lovcalized, long- and short-term, negligible to moderate*** impacts on cultural landscapes if mitigation measures were followed.

Cumulative Impacts
Cumulatively, effects of Alternative II, when combined with other past, present, and reasonably foreseeable actions, would be similar to impacts described for Alternative I. Cumulative impacts to cultural landscapes would be adverse short- to long-term minor. Alternative II would result in a minor contribution to this cumulative effect. Cumulatively, effects of Alternative II, when combined with other past, present and reasonably foreseeable actions, would result in ***direct and indirect, adverse, site specific, short-term minor to moderate*** effects on cultural landscapes.

Section 106 Summary
A programmatic agreement was completed for the Flagstaff Area Monuments General Management Plans. This PA is the foundation Section 106 documentation for the Invasive Plant Management Plan. In addition, assessments of effect will be completed on an annual basis to determine effect on cultural landscapes. No adverse effects are anticipated if mitigation measures are followed.

Conclusion
Under Alternative II adverse impacts to cultural landscapes from vegetation changes would be negligible short- to long-term. Beneficial impacts including restoration of native plants and removal of nonnative plants not key features in the landscape would be minor long-term. Overall, impacts would be ***direct and indirect, adverse, site-specific, short- to long-term minor***.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis
All methods that include invasive plant removal could have direct effects on cultural landscapes due to an alteration of any feature in the landscape. Plants are features of a landscape and some are important in the sense of the cultural landscape. A plant species may be exotic and of high priority for removal, but potential importance of the species in a cultural landscape would need to be considered. However, exotic species removal would benefit a cultural landscape by restoring species to an area and removing those that did not originate in the period of significance. Therefore, impacts would be both adverse and beneficial.

Prevention
Prevention actions under Alternative III include awareness of exotic plant species on adjacent lands, presentation of educational materials to park staff and the public, and maintenance of up-to-date information on the FLAG monuments websites. These actions would have no measurable impact on cultural landscapes.

Manual/Mechanical Treatments
Control Exotic plant species removal using manual methods could have direct effects on cultural landscapes through actual removal of plants as described above. Effects would be similar to Alternatives I and II. Overall, manual/mechanical control would result in ***direct, adverse, site-specific, long-term, negligible to minor effects*** on cultural landscapes.

Cultural Treatments
Ground disturbance would occur to collect native plant seed. Crews would walk to access plants as described above. This type of ground disturbance is not generally considered an adverse impact on cultural landscapes. Therefore, cultural control would result in negligible effects on cultural landscapes.

Cumulative Impacts
Cumulative impacts would be similar to Alternative I. Cumulatively, effects of Alternative III, when combined with other past, present, and reasonably foreseeable actions, would result in ***direct and indirect adverse, site specific, short-term minor*** effects on cultural landscapes. Alternative III would have a negligible contribution to this cumulative adverse effect.

Conclusion
Under Alternative III adverse impacts to cultural landscapes from vegetation changes would continue to be negligible and short- to long-term. Beneficial impacts including restoration of native plants and removal of non-native plants not key features in the landscape would be minor and long-term. Without chemical control most control efforts will need additional work and attention. This would probably result in a decrease in the ability of the NPS to control invasive plants. Cumulative impacts would be ***direct and indirect adverse, site specific, short-term minor***.

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.8.3 Ethnographic Resources

3.8.3.1 Affected Environment

Ethnographic resources are defined by the NPS as any "site, structure, object, landscape, or natural resource feature assigned traditional, legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" [NPS Director's Order 28, (Cultural Resource Management)]. Currently, 13 tribes claim cultural affiliation to Flagstaff Area Monument lands: Hopi, Navajo Nation, Pueblo of Zuni, Fort McDowell Yavapai, Havasupai, Hualapai, Kaibab Paiute, San Juan Southern Paiute, Tonto Apache, White Mountain Apache, Yavapai Apache, and Yavapai-Precott (Ferguson, 1998; Hart, 1995; Hualapai Cultural Resources Division of Hualapai Wildlife Management Department, 1993; Roberts et al., 1995; Stevens, 1996; Stoffle et al., 1996).

A Traditional Cultural Property (TCP) is generally defined as eligible for inclusion in the National Register of Historic Places because of association with cultural practices or beliefs of a living community rooted in that community's history, and are important in maintaining continuing cultural identity of the community. Traditional cultural values are often central to the way a community or group defines itself, and maintaining such values is often vital to maintaining the group's sense of identity and self-respect. Properties to which traditional cultural value is ascribed often take on this kind of vital significance, so that any damage to or infringement is perceived to be deeply offensive to, and even destructive of, the group that values them.

Such places may not necessarily come to light through archaeological, historical, or architectural surveys. Existence and significance of such locations often can be ascertained only through interviews with knowledgeable users or through other forms of ethnography. The subtlety with which significance of such locations may be expressed makes it easy to ignore them; on the other hand, it makes it difficult to distinguish between those properties having real significance and those whose significance is questionable. Due to significance and confidentiality of these TCPs to each individual tribe, it is imperative to continue tribal involvement during development and implementation of this project (i.e., sending list of projects to tribes each year for review), as exact locations of these areas may not be readily known or available to monument staff.

Walnut Canyon National Monument

NPS consulted with many tribes in identification of ethnographic resources. The Hopi, Zuni, and Navajo Tribes conducted field research, using culturally appropriate methods to identify ethnographic resources about which they might have concerns in the context of the Walnut Canyon National Monument General Management Plan. Although tribal representatives identified those resources of particular concern, it should be stressed that the resources identified for this project are not necessarily all the ethnographic resources that exist in the park.

The Navajo Nation identified fourteen culturally significant plant species at Walnut Canyon, in addition to white clay, a culturally significant mineral. The Hopi Tribe and Pueblo of Zuni identified the archeological resources in Walnut Canyon, including pre-Columbian architectural remains and petroglyphs, as part of their traditional histories and contemporary cultural identities.

Sunset Crater Volcano National Monument
In addition to the literature-based overview of tribal associations with the park, the Hopi, Zuni, and Navajo Tribes each conducted fieldwork and provided synopses of sensitive ethnographic resources at the park specifically for this GMP. The Hopi Tribe describes the entire landscape related to the eruption of Sunset Crater as sacred and connected to Wupatki, the Little Colorado River, the San Francisco Peaks, the Grand Canyon and entire surrounding region. Within this landscape, cinder cones are particularly culturally sensitive, as are all cinder cones at Sunset Crater Volcano, particularly Sunset Crater Volcano itself and the lava rock associated with it.

In addition to Sunset Crater Volcano and other cinder cones, the ice cave is an important ethnographic resource, as is O'Leary Peak and eagles that might be associated with it and Bonito Park and particular plant species within it. Similarly to the Hopi Tribe, the Pueblo of Zuni considers the area encompassed by Sunset Crater Volcano National Monument as part of a much larger, interconnected sacred landscape. The Pueblo of Zuni also shares concerns about the places identified by the Hopi Tribe as culturally significant. In addition, the Pueblo of Zuni specifically identified the sensitivity of a particular stand of aspen trees within the boundaries of Sunset Crater Volcano National Monument, as well as any springs that might occur there.

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

Wupatki National Monument
NPS consulted initially with ten tribes and in depth with three tribes in identification of ethnographic resources for the purposes of this plan. The Hopi, Navajo, and Zuni Tribes conducted field research using culturally appropriate methods to identify ethnographic resources about which they might have concerns in the context of the GMP. Although tribal representatives identified those resources of particular concern for the EIS, it should be stressed that the resourcees identified for this project are not necessarily all the ethnographic resources that exist in the three parks. The three tribes identified many ethnographic resources of concern to each tribe and identified several resources in common. Resources identified as culturally significant included archeological sites in general (both pre-Columbian and historic), which include petroglyph panels and pre-Columbian agricultural field features, numerous plant species, and culturally significant natural resources, such as springs, blowholes, and certain geographic features, such as hills, the Little Colorado River, river crossings, trails, and various ceremonial locales.

3.8.3.2 Methodology and Intensity Thresholds
Baseline information used to assess impacts to ethnographic resources includes park staff knowledge of resources and site, review of existing literature and park studies, information provided by specialists in the National Park Service and other agencies, and professional judgment. Detailed information on natural and cultural resources in the Flagstaff Area Monuments is summarized in the respective General Management Plans for each monument. This information was specifically referenced for information on affected resources in the project

area. Additional sources of information on ethnographic resources used as a basis for this evaluation are as described above in the affected environment section.

The thresholds of change for the intensity of an impact are defined below.

Impact Intensities and Definitions – Ethnographic Resources

Impact Intensity	Intensity Definition
Negligible	Impacts would be at the lowest levels of detection; historic properties would receive no change to diagnostic artifacts, defining features, or characteristics that contribute to National Register of Historic Places eligibility. Negligible impacts are barely perceptible and alter neither resource condition, such as traditional access and site preservation, nor relationship between resource and affiliated group's body of practices and beliefs. Determination of effect for Section 106 would be "no historic properties affected" or "no adverse effect"
Minor	**Adverse -** For ethnographic resources, impacts would be slight and noticeable and would neither appreciably alter resource conditions, such as traditional access or site preservation, nor relationship between resource and affiliated group's body of beliefs and practices. Determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be "no adverse effect" **Beneficial -** Impacts would allow access to and/or accommodate a group's traditional practices or beliefs. Determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be "no adverse effect"
Moderate	**Adverse -** For ethnographic resources, impacts would be apparent and alter resource conditions or interfere with traditional access, site preservation, or relationship between resource and affiliated group's practices and beliefs, even though the group's practices and beliefs would survive. Determination of effect on traditional cultural properties for Section 106 would be "adverse effect" In the event of a determination of adverse effect, a MOA would be executed between 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 MOA to minimize or mitigate adverse impacts would reduce intensity of impact under NEPA from moderate to minor **Beneficial -** Impacts would facilitate traditional access and/or accommodate a group's practices or beliefs. Beneficial effects would include maintaining natural ecosystem processes. Determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be "no adverse effect"
Major	**Adverse** Impact(s) would alter resource conditions. Proposed actions would block or greatly affect traditional access, site preservation, or relationship between resource and affiliated group's body of beliefs and practices, to the extent that survival of a group's beliefs and/or practices would be jeopardized. Impacts would result in significant changes or destabilization to defining elements and resource condition and an increase in exposure or vulnerability to natural elements. Determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be "adverse effect." In event of a

	determination of adverse effect, a MOA would be executed between 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 MOA to minimize or mitigate adverse impacts would reduce intensity of impact under NEPA from major to moderate or minor. **Beneficial -** Impacts would encourage traditional practices and/or accommodate a group's beliefs or practices. Beneficial effects would include maintaining natural ecosystem processes. Determination of effect on Traditional Cultural Properties (ethnographic resources eligible to be listed in the National Register) for purposes of Section 106 would be "no adverse effect"

Duration

Short term - An effect that, within five years, would no longer be detectable as the resource was returned to its predisturbance condition or appearance (e.g. trash and other items removed or vegetation trampled, but not denuded)

Long term - A change in a resource or its condition that would not return the resource to predisturbance condition or appearance and for all practical purposes would be considered permanent (e.g., damage to elements or removal of artifacts)

Permanent - Irreversible changes such that ongoing cultural traditions associated with those resources are lost

Timing Ethnographic resources might be more vulnerable to impacts during spring growing season or at other times of year depending on specific tribal traditions

3.8.3.3 Analysis of Alternatives and Impacts on Ethnographic Resources

Effects of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis

All methods that include use of crews for survey or treatment may have direct impacts on ethnographic resources from ground disturbance and resultant trampling, creation of trails, and erosion.

Prevention

Prevention actions under Alternative I include awareness of exotic plant species on adjacent lands, presentation of educational materials to park staff and the public, and maintenance of up-to-date information on the park website. These actions would have no measurable impact on ethnographic resources.

Manual/Mechanical Treatments
Invasive plant removal using manual/mechanical methods could have direct effects on ethnographic resources from digging and from crew foot travel. Indirect effects of uprooting entire plants using picks, shovels, and pulaskis include potential increased erosion from soil-stabilizing plant loss. Adverse impacts to ethnographic resources would be direct, site- specific, short- to long-term, and negligible to moderate. Mitigation measures would be implemented to bring moderate impacts to negligible intensity. These measures would include consultation and communication with FLAG Cultural Resources staff and tribal representatives. Annual work plans prepared by Vegetation Program staff would be reviewed by Cultural Resources staff and tribal representatives to identify areas of concern. If an adverse effect would occur due to manual/mechanical control proposed, work would not commence as proposed. Instead Cultural Resources and Vegetation staff would decide if any type of treatment would be appropriate for the location. If all treatments would result in an adverse effect on ethnographic resource, invasive plant treatment would not occur. A list of proposed treatment areas and treatment types would be sent to each affiliated tribe for review.

Indirect effects to ethnographic resources from removal of exotic plants above the root crown using brush cutters may include soil erosion due to increased overland water flow and loss of above-ground vegetation. Indirect beneficial effects could include increased water retention and soil protection provided by the above-ground plant material left onsite as a mulch layer. This would have a beneficial short-term negligible effect on ethnographic resources

Overall, effects to ethnographic resources would be ***direct, adverse, site-specific, short- to long-term, and negligible to minor***.

Chemical Treatments
Manual spot application of selected herbicides on targeted individual plants has potential to directly affect ethnographic resources through direct application of herbicide. This impact is limited though because of the cultural resource training all applicators must complete before work in the field commences. Foot traffic from crews applying herbicides would have impacts as described above. Adverse impacts on ethnographic resources from chemical control would be short- to long-term, and negligible to minor. Alternative II would include herbicide application on a greater number of species than other alternatives. This alternative would involve primarily spot treatments but would also include limited broadcast spraying. Overall, effects of chemical treatments to ethnographic resources would be ***direct, adverse, site-specific, short- to long-term, and negligible to minor.***

Cultural Treatments
Ground disturbance would occur to collect native plant seed. Crews would walk to access plants as described above. This type of ground disturbance is not generally considered an adverse impact on ethnographic resources. Therefore, cultural control would result in negligible effects on ethnographic resources. Under Alternative I, effects of cultural treatments on ethnographic resources would be ***direct, adverse, site-specific, short-term, and minor.***

Cumulative Impacts
Cumulative impacts on ethnographic resources were determined by combining impacts of Alternative I with other past, present, and reasonably foreseeable future actions having impacts

in priority areas for invasive plant management (i.e., trails, roads, entrance stations, heavily trafficked areas).

Past activities considered in this analysis include fire management actions including prescribed and wild fires, human activities, and construction projects. These actions have caused adverse impacts including direct and indirect damage to these resources through trailing, digging, collection, and erosion. These activities are ongoing and are considered in this analysis as in-progress and future actions as well as past activities. Impacts to ethnographic resources from these activities are adverse long term localized moderate.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative I include road maintenance and improvements, waste treatment upgrades and maintenance, disturbed land rehabilitation, and general development. Ground disturbance in several of these projects has prompted mitigation of archeological sites through excavation which is an adverse effect on these resources. ***Impacts will be direct, adverse, site-specific, long-term, and minor.*** Effects to ethnographic resources are considered in all construction projects, and mitigation measures are developed to minimize impacts to these resources.

Foreseeable future projects include employee housing and visitor center upgrades, and others mentioned above. Ground disturbance has potential to impact archaeological resources, although these projects were designed to avoid sites. Impacts from these projects would be long-term minor adverse. Cumulatively, effects of Alternative I, when combined with other past, present, and reasonably foreseeable actions, would result in adverse short-term minor effects on ethnographic resources. Alternative I would have a negligible contribution to this cumulative adverse effect.

Conclusion

Under Alternative I, the continuation of current exotic plant management, adverse impacts to ethnographic resources from increased erosion and soil compaction would be short to long term minor. Beneficial impacts including soil protection and stabilization from vegetative material left onsite would be short to long term minor. ***Cumulative impacts would be direct, adverse, site-specific, short- to long-term, and minor.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis
As described for Alternative I above, use of crews for survey or treatment may have direct effects on ethnographic resources from foot travel. This would have an adverse short to long-term negligible impact on ethnographic resources.

Prevention
More in-depth and extensive annual surveys could slightly increase potential for ground disturbance over the other alternativees. No additional prevention actions would impact ethnographic resources.

Manual/Mechanical Treatments
Alternative II proposes the same type of manual control currently used, the effects to ethnographic resources and mitigation measures would be similar to Alternative I. Overall, the effects of Alternative II to ethnographic resources would be ***direct, adverse, site-specific, short- to long-term, and negligible to minor***.

Chemical Treatments
Manual spot application of selected herbicides on targeted individual plants has potential to directly affect ethnographic resources through direct application of herbicide. Foot traffic from crews applying herbicides would have impacts as described above. Adverse impacts on ethnographic resources from chemical control would be short- to long-term, and negligible to minor. Effects would be similar to Alternative I. Under Alternative II, effects of chemical treatments to ethnographic resources would be ***direct, adverse, site-specific, short- to long-term, and negligible to minor.***

Cultural Treatments
Alternative II includes addition of carbon sources, use of barriers, and expanded mulch use, which would not have direct effects on ethnographic resources. Addition of carbon sources and mulch would promote water retention and minimize erosion. Therefore, negligible beneficial impacts to ethnographic resources would result. Alternative II would introduce limited use of fire to treat exotic plants. Prescribed fire has potential to directly impact ethnographic resources. Coordination with cultural resource staff and tribal representatives would determine whether resources exist in the project area and fire use may not be selected as the appropriate treatment method based on presence of sites. However, previously unidentified sites could be affected and fire has potential to spread. Fire would have negligible to moderate adverse long-term impacts on archeological and historic resources if mitigation measures were followed. The effects of cultural treatments on ethnographic resources would be ***direct, adverse, site-specific, short-term, and minor.***

Cumulative Impacts
Cumulatively, effects of Alternative II, when combined with other past, present, and reasonably foreseeable actions, would be similar to those described for Alternative I, and would result in an

direct, adverse, local, short- to long-term, minor to moderate effects on ethnographic resources. Alternative II would result in a negligible contribution to this cumulative effect.

Section 106 Summary
A PA was completed for each of the General Management Plans of the Flagstaff Area Monuments. This PA is the foundation Section 106 documentation for the Invasive Plant Management Plan. In addition, assessments of effect will be completed on an annual basis to determine effect on ethnographic resources. No adverse effects are anticipated if mitigation measures are followed.

Conclusion
Under Alternative II adverse impacts to ethnographic resources from increased erosion and soil compaction would be short- to long-term minor. Beneficial impacts including soil protection and stabilization from new native vegetation and vegetative material left onsite would be short- to long-term minor. ***Cumulative impacts would be direct, adverse, local, short- to long-term, and minor.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis
All methods that include use of crews for survey or treatment may have direct impacts on ethnographic resources from ground disturbance and resultant trampling, creation of trails, and erosion.

Prevention
Prevention actions under Alternative III include awareness of exotic plant species on adjacent lands, presentation of educational materials to park staff and the public, and maintenance of up-to-date information on the park website. These actions would have no measurable impact on ethnographic resources.

Manual/Mechanical Treatments
Invasive plant removal using manual/mechanical methods would have effects similar to Alternatives I and II. Overall, the effects of Alternative III to ethnographic resources would be ***direct, adverse, site-specific, short- to long-term, and negligible to minor***.

Cultural Treatments
Invasive plant removal using cultural treatments would have effects similar to Alternatives I and II. Under Alternative III, the effects of cultural treatments on ethnographic resources would be ***direct, adverse, site-specific, short-term, and minor.***

Cumulative Impacts
Cumulative impacts on ethnographic resources would be similar to Alternative I, except that the control of invasive species would be less effective and ethnographic resources might be affected. Cumulative impacts may be ***direct, adverse, site-specific, long-term, and minor to moderate.*** Effects to ethnographic resources are considered in all construction projects, and mitigation measures are developed to minimize impacts to these resources.

Conclusion
Under Alternative III, the continuation of current exotic plant management, adverse impacts to ethnographic resources from increased erosion and soil compaction would be short- to long-term minor. Beneficial impacts including soil protection and stabilization from vegetative material left onsite would be short- to long-term minor. ***Cumulative impacts would be direct, adverse, site-specific, short- to long-term, and minor to moderate.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.9 Social Issues

3.9.1 Visitor Use Experience

Relative to exotic plant management, visitor use experience includes access, visual quality, noise, disturbance encounter levels, and opportunities for solitude. Other aspects of the visitor experience, such as recreation opportunities and comfort levels could also be affected by the actions proposed.

Section 7 of the *2001 Management Policies* states, "Through interpretive and educational programs, the NPS will instill in park visitors an understanding, appreciation, and enjoyment of the significance of parks and their resources. Interpretive and educational programs will encourage the development of a personal stewardship ethic, and broaden public support for preserving park resources."

The Flagstaff monuments have an average annual combined visitation of over 2.5 million people (National Park Service, 2008d). Activities include hiking, camping, viewing (nature, wildlife, cultural sites, canyon vistas, and astronomy), photography, painting, and enjoying wilderness settings.

The following mitigation measures would be incorporated into the action alternative to minimize impacts on visitor use experience:

1. Unless otherwise approved by the park, operation of mechanized equipment would be restricted to dawn to dusk, year-round

2. As time and funding allow, information regarding project implementation and other foreseeable future projects would be shared with the public through park publications and other appropriate means during construction periods. This may include an informational brochure or flyer distributed at the Visitor Centers sent to those with reservations at monument facilities, postings on the monument's website, press releases and/or other methods. The purpose would be to minimize potential for negative impacts to visitor use experience during project implementation and other planned projects during the same construction season

3.9.1.1 Affected Environment

See description of individual FLAG Monuments in the Introduction section of this document.

3.9.1.2 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to visitor use experience were derived from a review of available literature, IDT expert input, and from a number of sources including other successful invasive management plans. The thresholds of change for the intensity of an impact are defined below:

Impact Intensities and Definitions - Visitor Use Experience

Impact Intensity	Intensity Definition
Negligible	Any changes in visitor use or experience would be below or at the level of detection. Any effects would be short-term. The visitor would not likely be aware of the effects associated with the alternative. Any effects would not change their experience of park resources and values. Mitigation would not be necessary
Minor	Changes in visitor use or experience would be detectable, although the changes would be slight and likely short-term. The visitor would be aware of effects associated with the alternative, but the effects would be slight. If mitigation was needed to offset adverse effects to visitor experience, it would be relatively simple to implement and would likely be successful
Moder`ate	Changes in visitor use or experience would be apparent and likely long-term. The visitor would be aware of the effects associated with the alternative and would likely be able to express an opinion about the changes. Mitigation measures would probably be necessary to offset adverse effects and would likely be successful.
Major	Changes in visitor use or experience would be readily apparent and would have important long-term consequences. The visitor would be aware of the effects associated with the alternative and would likely express a strong opinion about the changes. Mitigation measures to offset adverse effects would be needed, they would have to be extensive, and their success would not be guaranteed.

Duration

Short- term If visitor use impacts recover in one year or less.
Long- term If visitor use impacts recover in more than one year.

3.9.1.3 Analysis of Alternatives and impacts on the Visitor Use Experience

Impacts of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis

Section 8.2 of *NPS 2001 Management Policies* states, "Management controls must be imposed on all park uses to ensure that park resources and values are preserved and protected for the future."

Manual/Mechanical Treatments

Operation of equipment would have a short-term effect on visitor experience at those parks where this equipment would be used. Negligible effects would occur at those monuments that have limited equipment use and moderate effects would occur on those projects that use highly visible equipment such as ORVs. The impacts of exotic plant management on visitor use and experience would therefore be ***direct, adverse, site-specific, short-term, and negligible to minor.***

Chemical Treatments

Chemically treated areas that are subject to visitation may require closures for visitor protection during pesticide application and while the pesticide dries. The displacement of visitors would be rare, temporary, and site-specific because of the wide distribution of exotic plants. However, the health and safety benefits to visitors outweigh the short-term impacts of restricting their access to chemical treatment areas. The desired condition to have visitor and employee safety and health protected would not be inhibited by IPM. The impacts of invasive plant management on visitor use and experience would therefore be ***direct, beneficial and adverse, site-specific, short-term, and minor.***

Prescribed Fire Treatments

Visitor access may also be restricted from some areas during prescribed fires. The displacement of visitors would be rare, short-term, and site-specific due to the wide distribution of invasive plants. However, the health and safety benefits to visitors outweigh the short-term impacts of restricting their access to treatment areas. Visitors may be negatively impacted by the presence of smoke in the area. This condition should be temporary as most prescribed fires only last a couple of days at most, and smoke should dissipate quickly during and after the burns. Prolonged exposure to thick smoke is unlikely because weather conditions will be monitored closely and conditions inhibit smoke dissipation will be grounds for canceling further burning. The impacts of prescribed fire treatments on visitor use would therefore be ***direct, adverse, site-specific, short-term, and minor.***

Cumulative Impacts

The quality of visitor experience has been reduced due to infestations of exotic plants. However, exotic plant management at FLAG (cutting, pulling, and chemical application) has helped to

improve the quality of visitor experience. Under Alternative I, visitor experience would be expected to improve at current levels. Continuation of current exotic plant management programs would have negligible adverse additive impacts on visitor use and experience. Some treatment methods, such as prescribed fire and equipment operation, may be noticeable and and could have ***short-term, adverse impacts*** on visitor experience. Cumulative impacts of invasive plant management on visitor use and experience would therefore be ***direct, adverse, site-specific, short-term, and minor to moderate.***

Conclusion of Impacts

In general, exotic plant management would have a long-term, beneficial effect on visitor use and experience. However, the beneficial effects of exotic plant management would vary from park to park. Some of the FLAG Monuments have received complaints from visitors when they observe exotic plants within the park. Rehabilitation of native plant communities at other parks would be readily apparent to some visitors and likely have long-term, moderate, beneficial effects to visitor experience. Exotic plant management would not inhibit the maintenance of the desired condition to have visitor and employee safety and health protected. The impacts of invasive plant management on visitor use and experience would therefore be ***directly beneficial and adverse, site-specific, short-term, and minor.*** Visitors would likely be aware of the beneficial effects of exotic plant management and would also likely express positive opinions about the changes. The impacts of exotic plant management on visitor use an experience would therefore be ***direct, beneficial and adverse, site-specific, short-term to long-term, and negligible to moderate***.

Impacts of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis

Several BMP's would be implemented under this alternative to limit potential impacts to visitor use and experience. These BMPs include the following:

Each park's interpretive services would help visitors understand the need for exotic plant management and how BMP's are used to minimize potential impacts to resources. Off-Road Vehicles and other off-road equipment would be minimally used where possible.

Mechanical/Manual Treatments

Operation of equipment would have a short-term effect on visitor experience at those parks where this equipment would be used. Negligible effects would occur at those monuments that have limited equipment use and moderate effects would occur on those projects that use highly visible equipment such as ORVs. The impacts of exotic plant management on visitor use and experience would therefore be ***direct, adverse, site-specific, short-term, and negligible to minor.***

Chemical Treatments

Same as Alternative I. The impacts of invasive plant management on visitor use and experience would therefore be ***direct, beneficial and adverse, site-specific, short-term, and minor.***

Biological Treatments
The additional biomass created by the introduction of biological control agents may detract from scenic qualities of certain areas. Impacts would be beneficial, short- or long-term, and site-specific. The impacts of biological treatments on visitor use would therefore be ***indirect, beneficial, site-specific, short-term to long-term, and minor.***

Cultural Treatments
DO-83 states that "It is the policy of the NPS to protect the health and well-being of NPS employees and park visitors through the elimination or control of disease agents and the various modes of their transmission to man and to ensure compliance with applicable federal, state and local public health laws, regulations, and ordinances. Implementation of this policy will be tempered by the Organic Act's requirement that the NPS conserve the scenery and natural and historic objects and the wildlife therein in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Chemical treatment may require visitor use closures for visitor protection during pesticide application and while the pesticide dries.

Prescribed Fire Treatments
Same as Alternative I. The impacts of prescribed fire treatments on visitor use would therefore be ***direct, adverse, site-specific, short-term, and minor.***

Cumulative Impacts
The quality of visitor experience has been reduced due to infestations of exotic plants. However, exotic plant management at FLAG (cutting, pulling, chemical application, and biocontrols) will help to improve the quality of visitor experience. Under Alternative II, additional information would be disseminated about IPM programs to educate the public about exotic management programs. These education efforts, coupled with the likely increased success of IPM compared with current invasive plant management programs, would likely help to further improve the quality of visitor experience.

During periods of high exotic plant management activity, minor short-term cumulative impacts may occur. Prescribed burns may also adversely affect visitors if not planned for appropriate periods. Equipment operation may also be noticeable to visitors and could have short-term, adverse impacts on visitor experience. UnderAlternative II, the long-term quality of visitor experience would be improved by treating exotic plants. The cumulativer impacts of invasive plant management on visitor use and experience would therefore be ***direct, adverse, site-specific, short- to long-term, and minor.***

Conclusion of Impacts
In general, IPM would have a long-term, beneficial effect on visitor use and experience by returning FLAG Monuments to a more natural state. The FLAG Monuments have received complaints from visitors when they observe exotic plants within the park. Rehabilitation of native plant communities would be readily apparent to some visitors and likely long-term in some areas. Visitors would likely be aware of the beneficial effects of IPM and would also likely express positive opinions about the changes. The overall impacts of invasive plant management on visitor use and experience would therefore be ***direct, beneficial and adverse, site-specific, short-term to long-term, and negligible to minor.***

Impacts of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis

Operation of equipment would have a short-term effect on visitor experience at those monuments where this equipment would be used. Negligible effects would occur at those parks that have limited equipment use and moderate effects would occur at those parks that use highly visible equipment such as ORVs. The impacts of exotic plant management on visitor use and experience would therefore be ***directly adverse, site-specific, short-term, and negligible to minor.***

Visitor access may also be restricted from some areas during prescribed fires. The displacement of visitors would be rare, short-term, and site-specific due to the wide distribution of exotic plants. Exotic plant management would not inhibit the maintenance of the desired condition to have visitor and employee safety and health protected. The impacts of exotic plant management on visitor use and experience would therefore be ***directly beneficial and adverse, site-specific, short-term, and minor.***

Manual/Mechanical Treatments

Same as Alternative I. The impacts of exotic plant management on visitor use and experience would therefore be ***direct, adverse, site-specific, short-term, and negligible to minor***

Chemical Treatments

Will not be allowed.

Biological Treatments

Will not be allowed.

Prescribed Fire Treatments

Same as Alternative I.

Cumulative Impacts

The quality of visitor experience has been reduced due to infestations of exotic plants that could not be effectively treated using only mechanical and cultural methods. However, some exotic plant management using only mechanical means has helped to improve the quality of visitor experience. Under Alternative III, visitor experience would be expected to improve at current levels but not nearly as well as for Alternative II. Cumulative impacts of invasive plant management on visitor use and experience would therefore be ***direct, adverse, site-specific, short-term, and minor to moderate.***

Conclusion

In general, exotic plant management would have a long-term, beneficial effect on visitor use and experience. However, the beneficial effects of exotic plant management that is limited to only mechanical and cultural methods would vary. Some of the FLAG Monuments have received complaints from visitors when they observe exotic plants within the park. Partial rehabilitation of native plant communities, due to the ineffectiveness of using these methods only, would be readily apparent to some visitors and likely have long-term, moderate, adverse effects to visitor

experience. Visitors would likely be aware of the beneficial effects of exotic plant management and would also likely express positive opinions about the changes, but they would be disappointed that the NPS is limited in doing a complete job. The impacts of exotic plant management on visitor use experience would therefore be ***direct, beneficial and adverse, site-specific, short-term to long-term, and negligible to moderate***.

3.9.2 Adjacent Land Use

3.9.2.1 Affected Environment

Walnut Canyon National Monument
In addition to Federal regulations and USFS management policies, the primary management guidance for lands surrounding the monument is given in the Coconino National Forest Land and Resource Management Plan. Under the umbrella of the forest plan, the USFS plans and implements a wide variety of site specific activities and projects, such as fire hazard reduction, forest health, grazing allotments, firewood cutting, trail and recreational facility development, materials quarries, wildlife habitat management, riparian restoration, invasive weed management, and off- road recreation management.

As Federal agencies, the USFS and NPS routinely communicate and participate in planning for activities which mutually affect resources and agency missions across the monument boundary. Forest resources include ponderosa pine, pinyon pine, and juniper, which attract woodcutters seeking personal firewood. There are antelope, elk, and deer that attract hunters and wildlife viewers. The Coconino National Forest administers several permits for grazing by local ranchers in the lands adjacent to the monument. Traditional and current forest uses by citizens of Flagstaff include: horseback riding, recreational vehicle uses, hiking, camping, hunting, birding, woodcutting, shooting, and mountain biking. A section of the Arizona Trail passes the northwest corner of the monument and is used by local and regional visitors for recreational purposes. Because of this proximity, occasional inappropriate uses occur on monument property, including trespass, shooting, hunting, woodcutting, and vehicle travel.

The northwestern boundary of the monument coincides with the incorporated boundary of the City of Flagstaff, and is currently within two miles of the actual limit of residential development on the edge of town. In addition, unincorporated neighborhoods are rapidly growing outside the city limits north and northwest of the monument. Park Service staff are involved in the long-range planning efforts of the city and county. User and resource protection activities occasionally involve Forest Service, Arizona Game and Fish, City of Flagstaff, Coconino County, and other units of the National Park System. Relationships with these other agencies are strong and cooperation is excellent. Emergency responses in the Walnut Canyon area come from the various land management agencies and public safety organizations. The National Park Service provides assistance with law enforcement, search and rescue, emergency medical assistance, and wild fire management in the immediate area. The county deputizes NPS rangers, and members of the NPS staff serve as crew on national forest fire fighting teams. Coconino County provides law enforcement and search and rescue. The Forest Service provides law enforcement relative to recreation, consumptive uses, grazing, and wild fire suppression. Arizona Game and Fish provides law enforcement relative to hunting activities. The Arizona Department of Public Safety provides law enforcement (traffic) on primary roads and air support in search and rescue

operations. The city of Flagstaff (Guardian Ambulance) provides medical emergency responses (ground and air).

Three state trust sections of land adjacent to, or within two miles of the monument could be offered for sale and development. Development could pose external threats in the form of increased unauthorized uses, trespass by animals, pollution, noise, and degradation of the viewshed. Approximately 291 acres of private land exist inside the eastern area of the monument, and there is potential for development by the owner. The owner is supportive of NPS programs and is very cooperative; however, development of this private property could result in water impoundment behind a historic dam to create a lake that could possibly back up onto monument land.

There is the potential for residential development and increased exposure of cultural resources to trespass and inappropriate uses resulting from residential development and the attraction of a lake. The land protection plan (NPS 1990) recommends acquisition of this inholding, and the owner has expressed willingness to consider NPS acquisition. The NPS money generation model is a formula used to estimate the benefits attributed to the local economy resulting from the number of visitors to National Park System areas. There are several cooperative agreements with other agencies: a multiagency agreement for wild fire management, an agreement with the Coconino National Forest and Coconino County Sheriff's Office for joint law enforcement activity, a cooperative program with Coconino National Forest for educational activities on both forest and park lands, and an annual contract with the city of Flagstaff for structural fire suppression. The canyon has significant biological diversity and concentrations of threatened and endangered species. Additionally, mountain lion, bear, antelope, deer, and elk move through the monument, exemplifying the diverse habitat located so close to city development. Visitation to the canyon itself is not encouraged, and local uses are minimum and seasonal. The monument staff works in cooperation with other land and resource management agencies in inventory and monitoring activities.

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

Sunset Crater National Monument

Sunset Crater Volcano National Monument is entirely surrounded by Coconino National Forest. The NPS visitor center and administrative, housing, and maintenance facilities are situated on Forest Service lands through a memorandum of understanding (MOU). Also through the MOU, NPS has responsibility for maintenance of FR545, the all-weather road serving Sunset Crater and Wupatki National Monuments, and for providing visitor protection and response to traffic incidents. Although both monuments are closed at night, FR545 is open at all times, except immediately following heavy snows or other emergency conditions. Various park neighbors, including residents of Alpine Ranchos (a small community primarily northeast of the monument), the Navajo Reservation, and Chambers, as well as ranch employees of the Coconino Plateau Natural Reserve Lands, use FR545 for commuting to and from Flagstaff to the south and other points to the north. This route is also used by many off-highway vehicle users to reach the USFS Cinder Hills OHV Area. Although several miles distant, the residents of Alpine Ranchos identify with the monument and its services, often stopping at the visitor center to request

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

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

The NPS and USFS enjoy a cooperative relationship in regard to visitor information services. The two agencies have jointly planned exhibits for the visitor center and wayside exhibits along the park road, and share in a joint agency effort that offers interpretive programs at both NPS and USFS facilities. These include Bonito Campground, located across the road from the NPS visitor center. The park has trained and commissioned law enforcement rangers and employees certified in emergency medical response and is usually the initial contact in an emergency. Calls for assistance to Bonito Campground and the Cinder Hills OHV Area are common. Cooperative law enforcement is performed through existing written agreements with the Coconino National Forest and the Coconino County Sheriff's Office. All commissioned park rangers are special deputies of the County Sheriff's Office. Cooperative agreements in fire, facility maintenance, and resources management Wupatki National Monument also result in NPS personnel taking action on USFS lands.

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

Wupatki National Monument

The western two-thirds of Wupatki's south boundary is bordered by the Coconino National Forest. The eastern one-third is predominately privately owned land. State-owned lands border the west boundary. The Coconino Plateau Natural Reserve Lands (CPNRL), formerly known as Babbitt Ranches, and a checkerboard of state-owned sections exist along the north boundary. The east boundary of the monument is bordered by the Navajo Reservation. The east and west sides of the monument are defined by the Little Colorado River and US89, respectively.

Ten affiliated tribes have identified traditional relationships and/or cultural properties within park boundaries and have concerns about public access to sites; some groups need access to restricted use areas for plant gathering and traditional activities. Consultation with these tribes is routine and ongoing.Park neighbors include residents of Alpine Ranchos, a community located south of the monument. Although several miles distant, the residents identify with the monument, often stopping at the visitor center to request assistance from law enforcement rangers, to report crimes, and so on. Many are dependent upon NPS for road access to and from Flagstaff. Small businesses, such as Hank's and Sinagua Trading Post, located along US89 on the

north and south boundaries of the park, also identify with the monument. In many instances, towing services provided by these small businesses are solicited by stranded visitors. Similarly, many Navajo Reservation residents pass through the monument and depend on monument resources to serve a variety of needs, including maintenance of their main travel route. Reservation communities and Alpine Ranchos have expressed some concerns over any plans to terminate roads in the park, particularly as to effects on their quality of life, increased commuting time, and diminished access to conveniences such as gas, phone, mail, and groceries.

Cooperative law enforcement is performed through written agreements with the Coconino National Forest and the Coconino County Sheriff's Office. All commissioned park rangers are special deputies of the County Sheriff's Office. Cooperative agreements in firefighting, law enforcement, and facility maintenance often result in NPS personnel responding to incidents on USFS lands to the south. Hiking, hunting, woodcutting, climbing, mountain biking, horseback riding, and shooting activities within the area sometimes result in physical intrusion onto the monument.

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

3.9.2.2 Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to visitor use experience were derived from a review of available literature, IDT expert input, and from a number of sources including other successful invasive management plans. The thresholds of change for the intensity of an impact are defined below:

Impact Intensities and Definitions - Adjacent Land Use

Impact Intensity	Intensity Definition
Negligible	Any effects to adjacent lands would be at or below the lower levels of detection, and would not have an appreciable effect on park operations.
Minor	The effect would be detectable, but of a magnitude that would not have an appreciable adverse or beneficial effect on adjacent lands. If mitigation were needed to offset adverse impacts, it would be relatively simple and successful.
Moderate	The effects would be readily apparent and would result in a substantial adverse or beneficial change to adjacent lands in a manner noticeable to staff and the public. Impacts would be long-term. Mitigation measures would probably be necessary to offset adverse impacts and would likely be successful.
Major	The effects would be readily apparent and would result in a substantial adverse or beneficial change in park operations and land use in a manner noticeable to staff and the public and would be markedly different from existing operations. Impacts would be long-term. Mitigation measures to offset adverse impacts would be needed, could be expensive, and success could not be assured.

Duration

Short- term If visitor use impacts recover in one year or less.
Long- term If visitor use impacts recover in more than one year.

3.9.2.3 Analysis of Alternatives and impacts on the Visitor Use Experience

Effects of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Existing relations would continue with FLAG Area Monument neighbors, as well as state and local officials, who have expressed concern about exotic plants spreading from each park onto neighboring lands. Due to treatment limitations under this alternative, some landowners may become frustrated by the ineffectiveness of some exotic plant management programs and may express adverse opinions about FLAG's management programs. Other landowners may continue to build relationships with monuments as part of ongoing outreach programs. The impacts of exotic plant management on operations and land use would therefore be ***direct, beneficial and adverse, local and site-specific, long-term, and minor***.

The FLAG Area monuments would collaborate with adjacent land owners and the general public to disseminate consistent information about current and proposed invasive plant management activities. Ongoing collaboration with exotic plant management experts both within and outside the NPS would also be conducted on a regular basis.

Cumulative Impacts
Implementation or continuation of invasive plant management activities under alternative I would have minor to moderate beneficial additive effects to invasive management efforts by neighbors throughout the area of the Flagstaff Group Monuments. It is expected that managers will be constrained in the selection of treatments under Alternative I, which will result in decreased effectiveness and less acreage treated. Cumulative impacts of Alternatives I and III on adjacent lands would therefore be ***direct and indirect, adverse, region-wide, long-term, and minor to moderate.***

Conclusion
Invasive plant management under this alternative would be inhibited in maintaining or restoring the desired condition to the monuments and surrounding lands and communities. The overall impacts of Alternatives I and III on adjacent lands would therefore be ***direct and indirect, adverse, site-specific and local, long-term, and minor.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the

monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis
Using an integrated approach will allow the monumentss to use the most appropriate treatment methods and minimize the adverse impacts of treatments. This alternative will be most beneficial to adjacent land owners because control will be effective but fears of chemical drift or contam-ination will be allayed due to the required selection of the least toxic chemicals and the prevalent use of spot applications as opposed to broadcast methods.

Under this alternative, FLAG management would collaborate with adjacent land owners and the general public to address concerns and disseminate consistent information about current and proposed invasive plant management activities. Collaboration with exotic plant management experts both within and outside the NPS would also be extensive and ongoing. Improved exotic plant management would improve relations with park neighbors as well as state and local officials who have expressed concern about exotic plants spreading from the monuments onto neighboring lands. Collaboration with area invasive plant management specialists would improve information exchange and would help the FLAG monuments stay current on new exotic plant treatment technologies. The impacts of invasive plant management on adjacent lands would therefore be ***direct and indirect, beneficial, region-wide, long-term, and negligible to minor.***

Cumulative Impacts
Implementation or continuation of invasive plant management activities under any of the alternatives would have minor to moderate beneficial additive effects to invasive management efforts by neighbors throughout the area of the Flagstaff Group Monuments. It is expected that under Alternative II, the preferred alternative, managers will have the most flexibility in treating the more acres and the most invasive species than under Alternatives I or III. Alternative II will be most effective and efficient in treating species that move across boundary lines. Cumulative impacts of invasive plant management on visitor use and experience would therefore be ***direct, adverse, site-specific, short-term, and negligible to minor.***

Conclusion
Invasive plant management would not inhibit the maintenance of the desired condition to the monuments and surrounding lands and communities. The overall impacts of Alternatives I and III on adjacent lands would therefore be adverse, region-wide, ongoing and long-term, and minor to moderate. Impacts under Alternative II are expected to be ***direct, beneficial, local, long-term, and negligible to minor.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation

of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

Effects of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis

The risk of chemical drift, spills, and leaching would be eliminated under this alternative. However, this approach will not allow the monuments to use the full range of and most appropriate treatment methods to effectively control invasive plants. This alternative will be less beneficial to adjacent land owners because control will not be as effective as the preferred alternative and the possibility of invasion from the monuments is increased.

Under this alternative, FLAG management would collaborate with adjacent land owners and the general public to address concerns and disseminate consistent information about current and proposed invasive plant management activities. Collaboration with exotic plant management experts both within and outside the NPS would also be extensive and ongoing. Improved exotic plant management would improve relations with park neighbors as well as state and local officials who have expressed concern about exotic plants spreading from the monuments onto neighboring lands. Collaboration with area invasive plant management specialists would improve information exchange and would help the FLAG monuments stay current on new exotic plant treatment technologies. However, treatment methods would be limited under this alternative and may not be as effective or up to the standards developed by neighboring land holders. The impacts of invasive plant management on adjacent lands under this alternative would therefore be ***direct and indirect, adverse, local, long-term, and minor to moderate.***

Cumulative Impacts

Implementation or continuation of invasive plant management activities under alternative III would have minor to moderate beneficial additive effects to invasive management efforts by neighbors throughout the area of the Flagstaff Group Monuments. It is expected that managers will be constrained in the selection of treatments under Alternative I, which will result in decreased effectiveness and less acreage treated. Cumulative impacts of Alternatives I and III on adjacent lands would therefore be ***direct and indirect, adverse, site-specific and local, short-term, and minor to moderate.***

Conclusion

Invasive plant management under this alternative would be inhibited in maintaining or restoring the desired condition to the monuments and surrounding lands and communities. The overall impacts of Alternatives I and III on adjacent lands would therefore be ***direct and indirect, adverse, region-wide, long-term, and minor to moderate.***

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the establishing legislation or proclamation

of the Flagstaff Area National Monuments; (2) key to the natural or cultural integrity of the monuments; or (3) identified as a goal in the monument's general management plans or other relevant National Park Service planning documents, there would be **no impairment** of the monument's resources or values. Implementation of this alternative would not result in any unacceptable impacts and is consistent with §1.4.7.1 of NPS Management Policies 2006.

3.9.3 Public Health and Safety

FLAG managers seek to provide a safe and healthful environment for visitors and employees. A top priority of NPS management and staff is to provide visitors with safety bulletins, press releases, and up-to-date information about management actions and potential risks. Standard Operating Procedures (SOPs) and Job Hazard Analyses (JHAs) guide daily operations in an effort to provide the safest possible environment for visitors and park employees. Managers from each of the FLAG monuments and divisions prepare a comprehensive safety plan, reviewed by the park's Safety Officer, which is updated as new safety information becomes known and as new types of projects are initiated.

Some exotic plant management techniques have potential to harm humans. Injuries can occur when using everything from a shovel or saw to fire and toxic herbicides. Visitors and other staff can be harmed if projects occur in areas the public frequent. For this reason, job hazard analyses are developed for many techniques and activities, such as sawing and using herbicide, see **Appendix C** for some examples. The purpose of these analyses is to define the technique and tools required for the activity, identify potential hazards for each step or phase of the project, and mitigate problems and injuries while performing the particular techniques. These are reviewed every year for thoroughness and are required readings for anyone (volunteer or staff) participating in the activities described.

3.9.3.1 Affected Environment

3.9.3.2 Methodology and Intensity Thresholds

Baseline information used to assess impacts to public health and safety is includes staff knowledge of resources and site, review of existing literature and studies, information provided by specialists in the National Park Service and other agencies, and professional judgment. Additional sources of information on public health and safety used as a basis for this evaluation are as described above in the affected environment section. The thresholds of change for the intensity of an impact are defined below:

Impact Intensities and Definitions – Public Health

Impact Intensity	Intensity Definition
Negligible	A change in public health and safety that is not measurable or perceptible.
Minor	A change in public health and safety that is slight and localized with few measurable consequences.
Moderate	A change to public health and safety that is readily apparent with measurable onsequences.

Impact Intensity	Intensity Definition
Major	A severely adverse or exceptionally beneficial change in public health and safety.

Duration

Short- term A change that would last several minutes to one day.
Long- term A change that would last greater than one day.

Nature of Impact

Beneficial Reduction in safety concerns for visitors and/or park employees
Adverse Increase in safety concerns for visitor and/or park employees

3.9.3.3 Analysis of Alternatives and impacts on Public Health

Impacts of Alternative I

Alternative I: *Continuation of Current Management Practices – Mechanical and cultural treatments would be used to manage invasive plants. Limited chemical treatments would be used on large populations of highly invasive plant species.*

Impact Analysis

All methods that use crews for survey or treatment may have direct effects on public health and safety from use of tools and herbicide. Prevention actions under Alternative I include awareness of exotic plant species on adjacent lands, presentation of educational materials to monument staff and the public, and maintenance of up-to-date information on the park website. These actions may prevent accidents and have a beneficial effect on public health and safety.

Manual/ Mechanical Treatments

Removal of exotic plant species using manual/mechanical methods could have direct effects on public health and safety from actual tool use and potential for injury by the tools themselves. Potential human health risks to workers from manual and mechanical invasive weed control measures are minor and include cuts, burns, allergies and skin irritation to individuals doing the work. The direct effects on human health would be greatest to allergy and contact dermatitis sufferers who are sensitive to invasive weeds or other wild land vegetation. Skin irritations may result from reaction to the sap of various invasive weeds on contact, such as spotted knapweed and leafy spurge, or to the physical parts of the plant itself, such as stickers in thistles. Safety training and adherence to the guidelines in job hazard analyses for work with noxious or invasive weed control would greatly reduce the risk to workers. Gloves, long sleeved shirts and boots would prevent injuries or irritations and, therefore, no serious human health effects are anticipated by manual and mechanical removal of weeds.

Direct effects to public health and safety from use of brush cutters to remove exotic plants above the root crown may include noise and potential injury from tools. Adverse effects to public

health and safety would be short-term and negligible to minor. Impacts to public health and safety would be ***direct, adverse, short-term, and negligible to minor.***

Chemical Treatments

The health risk to herbicide applicators is primarily a function of the amount of chemical handling and length of exposure to the herbicide. The time needed in a given field season to ground apply herbicides is significant. Of the methods used to ground apply herbicides, backpack applications have the greatest potential for worker exposure. Safety training and adherence to the guidelines in job hazard analyses and **Appendix B, and D-F** of this document, for work with noxious or invasive weed control would greatly reduce the risk to workers.

The health risk to the public from herbicides is primarily a function of the amount of inadvertent exposure through contact with treated vegetation, consumption of contaminated vegetation or water, and herbicide drift in the surrounding air. Whether a person is exposed to treated vegetation is largely a function of the probability of a person coming in contact with the treated vegetation within several hours or days of application. Ground treatment requires many small applications and the publics' chance of encountering a sprayed area is low. Additional environmental protection measures developed for the proposed ground treatment such as buffer zones from water bodies and sensitive areas, limited spray zones, public notification prior to application, and weather condition monitoring all reduce the potential for public exposure from herbicide application, see appendices, especially **B,** and **D-F**.

Under any of the alternatives involving herbicide use, the potential for exposure to a herbicide for the worker or general public is estimated to not exceed the daily exposure level determined to be safe by the United States Environmental Protection Agency (EPA) over a 70-year lifetime of daily exposure.

For people, herbicides can cause temporary or permanent damage, or can make pre-existing conditions worse (Munson 2004). In addition to various cancers, herbicides can cause damage to the skin, eyes, lungs, liver, kidneys, muscles, nervous system (including the brain and behavioral changes), hormone systems, immune system, and digestive system. They can also have effects on reproduction and can cause genetic damage. All synthetic herbicides, including glyphosate, can have had serious negative effects on some people. However, when used as labeled, herbicides are normally considered safe to humans and their environment.

Herbicides travel through air, water, and soil, thus they can have effects on people miles away from where they are applied. If they persist (this varies between pesticides), they can have effects long after they are applied. Problems can occur far from the location and time of application, people can be affected without knowing that an herbicide is the cause.
For all of these reasons, the use of measures other than synthetic herbicides or burning is preferable whenever feasible. When synthetic herbicides or burning are used, advance notice and a means of evacuation, with a safe place to evacuate to, can help mitigate the effects for some vulnerable people.

Analysis of herbicide use in this FLAG IPMP assumes compliance with the product label during handling and application. Additional environmental protection measures have been developed to further reduce potential risks to human health and the environment during application of herbicides. These measures are detailed in Appendices **B, and D-F**, and will be implemented

during the planning and application of all chemical weed control methods to further ensure worker and public safety.

Manual application of selected herbicides on targeted individual plants and populations has potential to directly affect public health and safety resources through direct application, overspray, spill, and drift of herbicide. Mitigation measures have been developed and are listed in **Appendices B, and D-F**. These would be followed to minimize potential for adverse effects. Therefore, adverse impacts on public health and safety from chemical control would be ***direct and indirect, adverse, short- to long-term, and minor to moderate.***

Planned Chemicals for Use

2,4-D

This herbicide is one of the most common types prescribed. We anticipate that use will be limited to less than 1000 acres over the life of the plan. This compound will be used to treat leafy spurge (if it becomes established), Russian knapweed (if it becomes established), diffuse knapweed, Scotch thistle, and bull thistle. The average soil half-life of this herbicide is 10 days with the primary breakdown mechanism being microbial degradation. The relatively high mobility of 2,4-D makes it an extremely poor choice where high ground or surface waters occur. Where these conditions prevail, however, an approved form of 2,4-D can be used and potential problems with ground water contamination avoided. The anticipated rate of application ranges from less than 1 pound of active ingredient per acre to just over 2 pounds per acre as the absolute maximum amount. At both the minimum and maximum levels, we see no potential human health impacts since we are well below the maximum application rate on the label of 4 pounds per acre. Contamination of either surface or ground water should not occur at these low application rates, and use of personal protective gear by the applicators as well as other BMPs will reduce the potential for any adverse toxicological problems to very low levels.

Chlorsulfuron

It is expected that there will be very low use of this pesticide, which is used to treat whitetop (not in FLAG monuments yet) and biennial thistles. Chlorsulfuron is broken down to smaller compounds by soil microorganisms with a half-life of 1 month on acidic soils to 3 months on alkaline. The Forest Service has used this herbicide adjacent to FLAG monuments and they recommend the amount needed to achieve control ranges from a minimum of .03 pound of active ingredient per acre to .07 pound per acres, which is well below the label maximum of 3 pounds per acre. Based on the results of animal studies, chlorsulfuron does not cause genetic damage, cancer or birth defects, and has little or no effect on fertility, reproduction, or development of offspring (USDA Forest Service 2003b).

Clopyralid

It is anticipated that there will be a very low overall use of this pesticide and treatments will probably be limited to road shoulders. This herbicide will be used to treat annual and perennial broadleaf weeds like yellow and Malta starthistles. Clopyralid is broken down to inert substances by soil microorganisms with an average half-life of 40 days. The inability of clopyralid to bind with soils and its persistence implies that this herbicide has the potential to be highly mobile and a threat to water resources and nontarget plants, although no extensive offsite movement has been documented. From local Forest Service experience, the amount needed to achieve control ranges from a minimum of .07 pound of active ingredient per acre to a maximum of .47 pound

per acre. It has been documented that clopyralid is not toxic to fish, birds, mammals, and other animals, though it can cause severe eye damage (Washington State DOT, 2006).

Dicamba

This herbicide is used to treat annual and perennial broadleaf brush and weeds (USDA Forest Service 2003c). In the FLAG monuments, it would be used only in waste areas and on road shoulders. It is anticipated that it will be little used. Dicamba is moderately persistent in soil and has a half-life of 1 to 6 weeks and is broken down to inert substances by soil microorganisms (USDA Forest Service 2003c). The local Forest Service recommends the amount needed to achieve control ranges from a minimum of .18 pound of active ingredient per acre to a maximum of 1.87 pounds per acre, which is well below the maximum rate recommended from the risk assessment of 4 pounds per acre. The USDA Forest Service (2003c) also noted that based on the results of animal studies, dicamba does not cause birth defects, cancer or genetic damage, and has little effect on fertility or reproduction. This same study also stated that there have been no reported cases of long-term health effects in humans due to dicamba exposure.

Glyphosate

There is a low probability that this pesticide will be used in the FLAG monuments. Glyphosate is a broad-spectrum, nonselective, systemic herbicide used for control of annual and perennial plants including grasses, sedges, broad-leaved weeds, and woody plants (Extension Toxicology Network 1996). The Extension Toxicology Network (1996) also reported that glyphosate is moderately persistent in soil and has a half-life of about 50 days. They also noted that it has low potential for runoff, and microbes are the primary agent responsible for breakdown. Local Forest Service recommends the amount needed to achieve control ranges from a minimum of .22 pound of active ingredient per acre to a maximum of 1.80 pounds per acre. This range is well below the maximum rate recommended from the risk assessment of 4 pounds per acre (USDA Forest Service and Bonneville Power Administration 1992). The USDA Forest Service (1997b) noted that there is little evidence to suggest that glyphosate will cause adverse effects related to human health or within the environment at the anticipated levels of exposure. Another study concluded that glyphosate is poorly absorbed by the digestive tract and is largely excreted unchanged by mammals (Extension Toxicology Network 1996).

Imazapic

Use of this herbicide in the FLAG monuments would be primarily in waste areas and alonf road shoulders. Imazapic is a selective herbicide for both the pre- and post-emergence control of some annual and perennial grasses and broad-leaved weeds. It is reported that imazapic is moderately persistent in soil with a half-life of about 120 days. It has low potential for runoff, and microbes are the primary breakdown agent. From local users it is estimated that the amount needed to achieve control ranges from a minimum of .10 pound of active ingredient per acre to a maximum of .40 pound per acre. Imazapic is not considered carcinogenic and the Environmental Protection Agency has classed it as a "Group E" compound, or one that has not shown evidence of causing cancer in humans.

Imazapyr

Imazapyr is a broad-spectrum herbicide that can be applied pre- or post-emergence to control many annual and perennial weeds (Tu et al. 2001). The FLAG mouuments anticipate very low use of this product. The Nature Conservancy Weed Control Handbook (Tu et al. 2001) also reported that imazapyr is weakly bound to the soil and has a half-life ranging from 25 to 142

days though it has been reported to be active up to 2 years (USDA Forest Service 2003d). Imazapyr generally remains in the upper 20 inches of soil and did not run off into streams or demonstrate much lateral movement. It should not be applied where runoff water may flow onto agricultural lands or adjacent to wetlands or standing surface water (USDA Forest Service 2003d).

From local experience it is anticipated that the amount needed to achieve control ranges from a minimum of .31 pound of active ingredient per acre to a maximum of 1.2 pounds per acre. This range is below the maximum rate recommended from the risk assessment of 1.5 pounds per acre (USDA Forest Service 2003d). The USDA Forest Service (2003d) noted that imazapyr does not cause genetic damage or birth defects though there is not enough information available to determine whether imazapyr causes cancer or adverse effects on reproduction or fertility.

Metsulfuron methyl

Metsulfuron methyl is a selective pre- and post-emergence herbicide designed to control broad-leaved weeds and some grasses. It will probably be used very little in the FLAG monuments, if at all. The USDA Forest Service (2003e) reported that metsulfuron methyl remains unchanged in the soil although the half-life in a silt loam soil ranged between 120 and 180 days. They also noted that metsulfuron methyl is broken down to nontoxic and nonherbicidal products by soil microorganisms and chemical hydrolysis. The predicted amount needed to achieve treatment objectives ranges from a minimum of .01 pound of active ingredient per acre to a maximum of .09 pound per acre, which is well below the maximum recommended in the risk assessment of 1.8 pounds associated with forested zones. Based on the results of animal studies, metsulfuron methyl is not classed as a carcinogen, mutagen, teratotgen or reproductive inhibitor (USDA Forest Service 2003e).

Picloram

Picloram is a selective herbicide and is used to prevent regrowth of woody plants, noxious weeds and brush. It is not anticipated that this herbicide will be used much within the FLAG monuments. The USDA Forest Service (2003f) reported that picloram can stay moderately active in the soil and may exist at toxic levels in plants for more than a year after application at normal rates. This study also noted that the breakdown of this product is through microorganisms and sunlight with long-term buildup of picloram in the soil is generally not a concern. Picloram cannot be used in areas with shallow water tables. The recommended amount needed to achieve control in this area ranges from a minimum of .15 pound of active ingredient per acre for Alternative 1-Low to a maximum of .74 pound. This is well below the maximum rate identified on the label of 2 pounds per acre of active ingredient. The USDA Forest Service (2003f) noted picloram does not cause genetic damage or birth defects, and has little or no effect on fertility or reproduction. They also stated there is not enough information available to determine whether picloram causes cancer though there have been no reported cases of long-term health problems associated with this product.

Sulfometuron methyl

Sulfometuron methyl is designed to control annual and perennial grasses and mayl be used only to treat cheatgrass in areas where it ha become completely entrenched. The USDA Forest Service (2003g) reported that sulfometuron methyl remains active in the soil with a half-life of about 1 month. They also noted that soil microorganisms and chemical hydrolysis break down to sulfometuron methyl, and after 1 year about 1 percent applied on Eastern soils remained whereas

on Western soils 6 to 18 percent was still found. The amount needed to achieve treatment objectives in this area ranges from a minimum of .09 pound of active ingredient per acre to a maximum of .14 pound. This is well below the maximum recommended in the risk assessment of 9 pounds per acre targeted for rangelands. Animal studies have shown that this herbicide causes skin irritation and is a moderate eye irritant. Sulfometuron methyl is not classed as a carcinogen, mutagen, or teratotgen. Reproductive effects have been observed in rats but only at maternally toxic dose levels.

Triclopyr

This herbicide will be used almost exclusively in treatment of woody invasive trees like tamarisk, tree of Heaven, and Russian olive. Triclopyr is broken down rapidly to inert substances by soil microorganisms with an average half-life of 45 days (USDA Forest Service 2003h). This analysis also stated that triclopyr should not be a leaching problem since it binds tightly with clay as well as organic matter, and its half-life in water is less than 24 hours. It is anticipated that the amount needed to achieve control in this area ranges from a minimum of .68 pound of active ingredient per acre to a maximum of 5.9 pounds per acre. The maximum allowed amount recommended by the label is 8 pounds per acre. Based on the results of animal studies, triclopyr does not cause birth defects or cancer, and has little or no effect on fertility or reproduction. Triclopyr is mildly fetotoxic though there is not enough information to determine if this herbicide causes genetic damage (USDA Forest Service 2003h).

Cultural Treatment

Crews would walk to access plants as described above. This type of ground disturbance is not generally considered an adverse impact on public health and safety. Therefore, cultural control would result in ***direct, adverse, site-specific, short- and long-term, minor*** effects on public health and safety.

Cumulative Impacts

Cumulative impacts on public health and safety were determined by combining impacts of Alternative I with other past, present, and reasonably foreseeable future actions having impacts in priority areas for exotic plant management (i.e., trails, roads, entrance stations, heavily trafficked areas).

Past activities considered in this analysis include fire management actions including prescribed and wild fires and construction projects. These actions have had some adverse impacts on monument operations including increased safety risks in and around profect sites, and inherent risks in fire management and aircraft use. FLAG management is proactive in minimizing risks to visitors and employees, therefore there are beneficial impacts of safety programs and plans in place to limit any hazards. These activities are ongoing and considered in this analysis as in-progress and future actions as well as past activities.

Recently completed and in-progress projects that could have a cumulative effect on park operations when combined with Alternative II include road improvements and maintenance, monument-wide restroom construction and maintenance, trail maintenance, visitor center expansion, rehabilitation, and maintenance. These projects will all be designed to have beneficial impacts on public health and safety, and to address safety concerns. Impacts from these projects are beneficial long term local minor. Some short-term adverse impacts would occur during construction.

The collection of plants by American Indians and others will be only slightly impacted, even when cumulative impacts are considered. At no time will more than 1 percent of any ecosystem be impacted by weed control activities. Thus all ecosystems and watersheds will have low levels of treatments (less than 1 percent and in many cases less than one-tenth or one-hundredth of a percent), so no large losses of native plants used for medical or other purposes are foreseen.

Cumulatively, effects of Alternative I, when combined with other past, present, and reasonably foreseeable actions, would result in ***direct and indirect, adverse, long-term minor effects***. Alternative II would have a negligible contribution to this cumulative adverse effect.

Conclusion of Impacts

Under Alternative I, effects to public health and safety from use of hand tools, mechanized tools, and herbicides would continue to be ***direct or indirect, adverse, localized, short- to long-term, and minor.*** Cumulative impacts would be ***direct, beneficial, localized, long-term, and minor***. No unacceptable impacts to public health and safety would result.

Impacts of the Preferred Alternative

Alternative II: *Preferred Alternative – Full use of Integrated Pest Management techniques (mechanical, cultural, chemical, and biological control) to manage invasive plants.*

Impact Analysis

The use of IPM and adherence to established best management practices and job hazard analyses shoul minimize any public health and safety impacts. More in-depth and extensive annual surveys could slightly increase potential for ground disturbance over Alternative I. No additional prevention actions would impact public health and safety.

Mechanical/Manual Treatments

Alternative II proposes the same type of manual control as alternative I; therefore effects to public health and safety and mitigation measures would be similar. Impacts to public health and safety would be ***direct, adverse, short-term, and negligible to minor.***

Chemical Treatments

Alternative I would include less herbicide application on a smaller number of species than Alternative II, and would include limited broadcast spraying, but effects on public health and safety and mitigation measures would be similar to Alternative I. Therefore, adverse impacts on public health and safety from chemical control would be ***direct and indirect, adverse, short- to long-term, and minor to moderate.***

Biological Treatments

All biological control methods would be chosen with extreme caution to ensure they do not impact non-target species or any vital ecological processes. Because biological control agents are specific to individual species of exotic plants, there would be negligible impacts to non-target species. No specific measures would be implemented to contain biological control agents. However, any biological control agent used would be host-specific so each biological control

agent would only attack one plant species (the host, or the target exotic plant). The National IPM Specialist would also further review and approve the release of any proposed biological control agents, which would help to confirm that the use of these agents would be appropriate. The impacts of biological treatments on public health and safety would therefore be ***direct, beneficial, site-specific, local and regional, long-term, and moderate.***

Cultural Treatments
Alternative II includes addition of carbon sources, use of barriers, and expanded mulch use, which would not have direct effects on public health and safety. Addition of carbon sources and mulch would promote water retention and minimize erosion. The impacts of cultural treatments on public health and safety would therefore be ***direct, adverse, site-specific, local and regional, long-term, and moderate.***

Prescribed Fire Treatments
Smoke from burning weeds spreads over a wide area, causing problems for people with respiratory conditions such as asthma and emphysema, and for those who are reactive to chemicals in the smoke. For example, when poison ivy is burned, problems are especially widespread, with 80 to 90 percent of people in the U.S. allergic to those weeds. Inhaled smoke can cause rapid swelling (like hives) in the lungs and throat (urticaria, pulmonary swelling, and anaphylactic response) and sometimes death.

Fire use treatments would increase safety and health concerns due to smoke and inherent risks associated with fire use. However, if mitigation measures are strictly followed and fire use treatment is coordinated with NPS Fire personnel according to restrictions listed in the FLAG Fire Management Plan (NPS 2005), impacts to health and safety would be limited, they would be ***direct, adverse, short-term, and negligible to minor.***

Cumulative Impacts
Cumulatively, effects of Alternative II, when combined with other past, present, and reasonably foreseeable actions, would be similar to those described for Alternative I. Except that Alternative II would be more effective in controlling invasive species. Cumulatively, effects of Alternative I, when combined with other past, present, and reasonably foreseeable actions, would result in ***direct and indirect, adverse, long-term, minor effects***. Alternative I would have a negligible contribution to this cumulative adverse effect

Conclusion of Impacts
Toxicological problems are not expected as they relate to the application of herbicides in any of the alternatives, but especially in Alternative II. Recommended application rates are, at both the minimum and maximum levels, generally considerably below the maximum rate recommended on the label. The individuals most likely to be exposed for any duration are the applicators of the herbicide themselves. Use of personal protective gear and BMPs will reduce the probability of ever exceeding safe levels. The general public, even though they may have traveled through a recently treated zone, would not have the exposure time or levels to create potential problems related to human health. Signing and other mitigation practices would reduce this probability even lower since the general public can avoid the treatment area altogether and avoid exposure to the products.

A USDA Forest Service (2003a) publication noted that the herbicides prescribed have either no or, at the most, a slight influence on mutagenic or reproductive potentials. Of the 11 considered, only metsulfuron methyl and triclopyr are considered within the category of none to slight with respect to mutagenic and reproductive properties. Dicamba and 2,4-D have been classed as "evidence of noncarcinogenicity." The general public will be exposed to little, if any, herbicides as treatments are undertaken if either Alternatives I or II are implemented. If there is exposure, the duration will probably be on the order of minutes, and it is expected that this and the low application rates are not predicted to approach the EPA Reference Dose (RfD). It is possible that applicators may have the potential to exceed the RfD, and that would only take place if a spill of concentrated herbicide occurred during mixing. This is a low probability if they are trained, use required protective clothing and equipment, and follow steps outlined in the safety and spill plan.

In summary, the authorization of herbicides in Alternatives I and II will not have any adverse impacts on human health as it relates to carcinogenicity, developmental problems, reproduction, or mutagenicity. This statement assumes that: (1) the label instructions are being followed and the appropriate herbicide is being used; (2) the applicators are using the proper personal protective gear; (3) mitigation measures are being applied; and (4) the application rate does not exceed the routine extreme, and typically it will approximate the routine level or lower. At these levels, it is unlikely the Reference Dose would be exceeded.

Under Alternative II effects to public health and safety from use of hand tools, mechanized equipment, chemicals, and fire would be ***direct and indirect, adverse, localized, short- to long-term, and minor to moderate.*** Cumulative impacts would be beneficial long-term minor. No unacceptable impacts to public health and safety would result.

Impacts of Alternative III

Alternative III: *Limited use of IPM techniques (mechanical and cultural) to manage invasive plants. No use of chemical or biological treatments.*

Impact Analysis

Manual/Mechanical Treatments
Same as Alternative I. Impacts to public health and safety would be ***direct, adverse, short-term, and negligible to minor.***

Chemical Treatments
Will not be allowed.

Biological Treatments
Will not be allowed.

Prescribed Fire Treatments
Same as Alternative I. Impacts to health and safety would be limited, they would be ***direct, adverse, short-term, and negligible to minor.***

Cumulative Impacts

Same as Alternative I. Cumulative effects of Alternative III, when combined with other past, present, and reasonably foreseeable actions, would result in ***direct and indirect, adverse, long-term, negligible to minor effects***.

Conclusion

Similar as Alternative I. Under Alternative III, effects to public health and safety from use of hand tools and mechanized tools would be ***direct or indirect, adverse, localized, short- to long-term, and negligible to minor***. There would be no impacts from chemical treatments because they would not be allowed.

4.0 CONSULTATION AND COORDINATION

4.1 External Scoping

External (public) scoping was conducted to inform various agencies and the public about the proposal to implement invasive plant management and restoration at FLAG, and to generate input on the preparation of this Environmental Assessment.

External scoping was initiated with the distribution of a scoping letter to inform the public of the proposal to implement invasive plant management and restoration, and to generate input on the preparation of this Environmental Assessment. The scoping letter dated February 15, 2009 was mailed to 25 addressees including landowners adjacent to the Monuments, various federal and state agencies, affiliated Native American tribes, local governments, and local news agencies. Information on the environmental assessment was also posted on the NPS Planning, Environment, and Public Comment website (PEPC) at http://parkplanning.nps.gov/. The public was given 30 days to comment on the project beginning February 26, 2009. One comment asked that no herbicides be used in the treatment of invasive species and this concern is addressed in Alternative III.

Addressees included local landowners, state and local government officials and:

Federal Agencies
U.S. Forest Service
U.S. Fish and Wildlife Service
Advisory Council on Historic Preservation
US Geological Survey, Southwest Biological Science Center

State Agencies
Arizona State Parks
Arizona Department of Game and Fish
Arizona Dept. of Water Resources
Arizona Dept. of Environmental Quality
Arizona Dept. of TransportationArizona State Land Department, Forestry Division
Arizona State Historic Preservation Office
Arizona Public Service

Affiliated Native American Groups
Navajo Nation
Hopi Tribe
Hualapai Tribe
Havasupai Tribe
White Mountain Apache Tribe
Yavapai Prescott Indian Tribe
Yavapai-Apache Nation
Zuni Heritage and Historic Preservation Office
Tonto Apache Tribe
San Juan Southern Paiute Tribe
Kaibab Paiute Tribe

4.2 Internal Scoping

Internal scoping was conducted by an interdisciplinary team of professionals from the Flagstaff Area Group. Interdisciplinary team members met on February 15 and March 15, 2009 to discuss the purpose and need for the project; various alternatives; potential environmental impacts; past, present, and reasonably foreseeable projects that may have cumulative effects; and possible mitigation measures. The team also gathered background information and discussed public outreach for the project. Over the course of the project, team members have conducted individual site visits to view and evaluate the proposed project sites, and discussed the impact analyses associated with this assessment. The results of multiple meetings are documented in this Environmental Assessment.

Internal meetings involving the environmental assessment of the invasive plant management program include the following:

4.3 Environmental Assessment Review and List of Recipients

The Environmental Assessment will be released for public review on July 15, 2009. To inform the public of the availability of the Environmental Assessment, the NPS will publish and distribute a letter or press release to various agencies, tribes, and members of the public on the National Park's mailing list, as well as place an ad in the local newspaper. Copies of the Environmental Assessment will be provided to interested individuals upon request. Copies of the document will also be available for review at the FLAG Headquarters, at the visitor centers at each monument, and on the internet at www.nps.gov/waca, or www.nps.gov/sucr or www.nps.gov/wupa.

The Environmental Assessment is subject to a 30-day public comment period ending August 1, 2009. During this time the public is encouraged to post comments online at http://parkplanning.nps.gov/ or mail comments to Superintendent; Flagstaff Area Monuments; 6400 N. Highway 89, Flagstaff, Arizona 86001. Following the close of the comment period, all public comments will be reviewed and analyzed prior to the release of a decision document. NPS will issue responses to substantive comments received during the public comment period, and will make appropriate changes to the Environmental Assessment as needed.

4.4 List of Preparers

Preparers (developed EA content):

- Charles Schelz, Ecologist, NPS, Flagstaff Area National Monuments, Flagstaff, AZ
- Lisa Leap, Chief of Cultural Resources, Flagstaff Area National Monuments, Flagstaff, AZ
- Sharon Kim, Acting Chief of Natural Resources, Flagstaff Area National Monuments, Flagstaff, AZ

5.0 REFERENCES

Executive Orders

Executive Order 11988 (Floodplain Management)

Executive Order 11990 (Protection of Wetlands)

Executive Order 12898 (Floodplain Management)

Executive Order 13045 (Protection of Children from Environmental Health Risks and Safety Risks)

Executive Order 13112 (Invasive Species)

NPS Director's Orders

DO-12 Conservation Planning, Environmental Impact Analysis and Decision Making

DO-13B Solid and Hazardous Waste Management (in prep)

DO-28 Cultural Resource Management

DO-47 Sound Preservation and Noise Management

DO-77 Natural Resources Management Guideline (NPS-77)

DO-77-1 Wetland Protection

DO-77-7 Integrated Pest Management (in prep)

Federal and State Government

36 CFR Parks, Forests, and Public Property

40 CFR Protection of Environment

50 CFR Wildlife and Fisheries

1916 Organic Act

1963 Clean Air Act, as amended

1964 Wilderness Act

1966 National Historic Preservation Act

1969 National Environmental Policy Act

1970 General Authorities Act

1972 Clean Water Act

1972 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

1973 Endangered Species Act

1978 Redwoods Act Amendment

1979 Archeological Resources Protection Act

1981 Farmland Protection Policy Act

1993 Government Performance Results Act

Secretarial Order No. 3175 – Departmental Responsibilities for Indian Trust Resources

6.0 LITERATURE CITED

ADEQ. Draft 2007. Arizona's 2006 Integrated 305(b) Assessment and 303(d) Listing Report. February. Publication Number: EQR 07-02. Arizona Department of Environmental Quality, Phoenix.

Allen, E.B. 1995. Restoration Ecology: Limits and Possibilities in Arid and Semiarid Lands. *In*: Proceedings: Wildland Shrub and Arid Land Restoration Symposium. Complied by: B.A. Roundy, E.D. McArthur, J.S. Haley, and D.K. Mann. INT-GTR-315. USDA Forest Service, Intermountain Research Station, Ogden UT.

Amos, R.C. 1986. Sunset Crater, Arizona: Evidence for a Large Magnitude Strombolian Eruption. Unpublished master's thesis, Arizona State University, Phoenix.

Andrascik, R., T. Cacek, R. Doren, L. Fox, R. Hiebert, G. Johnston. 1996. Preserving Our Natural Heritage: A Strategic Plan for Managing Invasive Nonnative Plants on National Park System Lands. USDI National Park Service.

APRS Implementation Team. 2001. Alien plants ranking system version 5.1. Jamestown, ND:

Arizona Department of Agriculture. 2003. Prohibited, regulated and Restricted Noxious Invasive plants. Online: http://agriculture.state.az.us/PSD/quarantine5.htm.

Arizona Department of Water Resources. 1999. Third management plan for the Phoenix Active Management Area, 2000-2010. Phoenix, AZ.

Arizona Game and Fish Department. 1993. *Psorothamnus thompsoniae* var. *whitingii.* Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ.

Arizona Game and Fish Department. 1997. PHACELIA SERRATA. Unpublished plant abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix.

Arizona Game and Fish Department. 1997. *Cimicifuga arizonica*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ.

Arizona Game and Fish Department. 1998. Cymopterus megacephalus. Status Designations, Biological Elements of Arizona. Unpublished notebook, Heritage Data Management System, Phoenix, AZ.

Arizona Game and Fish Department. 2003. PENSTEMON CLUTEI. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix.

Arizona Game and Fish Department. 2004. PHACELIA WELSHII. Unpublished plant abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix.

Arizona Game And Fish Department. 2006. Arizona Heritage Data Management System, Arizona Game and Fish Department, Phoenix.

Arnberger, L. 1947. Flowering Plants and Ferns of Walnut Canyon. Plateau Vol. 20, pp. 29-36.

Author unknown. 1981. Maps Showing Ground-water Conditions in the San Francisco Peaks Area, Coconino County, Arizona-1979. Appel, Cynthia L. and Bills, Donald J., cartographers. Open-File Report (81-914). USGS. Tucson, AZ.

Author unknown. Plate IV, Summary of Hydrogeologic Conditions in the Sunset Crater and Wupatki National Monuments Area, Coconino County, Arizona.

Bateman, Gary C. 1976. Natural Resource Survey and Analysis of Sunset Crater Volcano and Wupatki National Monuments. Report prepared by Northern Arizona University, Contract No. 950134. Ms. on file, Wupatki National Monument, Flagstaff, Arizona.

Bateman, Gary C. 1979. Natural Resource Survey and Analysis of Sunset Crater Volcano and Wupatki National Monuments, Preliminary Report (Phase III). Prepared for the Office of Natural Resource Management, Southwest Region, National Park Service. Ms on file, Wupatki National Monument, Flagstaff, Arizona.

Bateman, Gary C. 1980. Natural Resources Survey and Analysis of Sunset Crater and Wupatki National Monuments, Final Report (Phase III). Prepared for the Office of Natural Resources Management, Southwest Region, National Park Service. Ms. on file, Wupatki National Monument, Flagstaff, Arizona.

Batterson, T. R. and D. W. Hall. 1984. Common reed - Phragmites australis (Cav.) Trin. ex Steudel. Aquatics 6(2): 16-17, 20.

Behl, Mark, Cindy Parker, and Paul Whitefield. 2008. Non-Native Invasive plant Survey and Recommendations 2003-2005, Wupatki National Monument. National Park Service Technical Report, Flagstaff Area Monuments, Flagstaff, AZ.

Benfer, J. A. 1971. The Petrology of the Eastern Phase of the Toroweap Formation, Walnut Canyon, Arizona." Unpublished Master's Thesis. Northern Arizona University, Flagstaff, AZ.

Benson, L. 1962. A revision and amplication [sic] of Pediocactus IV. Cactus and Succulent Journal of the Cactus and Succulent Society of America 34: 163-168.

Bills, Donald J.; Truini, Margot; Flynn, Marilyn E.; Pierce, Herbert A.; Catchings, Rufus D., and Rymer, Michael J. 2000. Hydrogeology of the regional aquifer near Flagstaff, Arizona, 1994-97. US Geological Survey Water-resources Investigations Report 00-4122. USGS. Tucson, AZ.

Blinn D., and G.E. Oberlin. 1996. Aquatic biota: invertebrates and algae. US Geological Survey, Colorado Plateau Research Station, Flagstaff, AZ.

Blyth, C. P. 1995. The Cenozoic evolution of Wupatki National Monument. Master's Thesis, Northern Arizona University, Flagstaff, Arizona.

Brady, N. and R. Weil. 1999. The Nature of Soils. 12th Edition. Prentice Hall. Upper Saddle River, NJ.

Brehl, Mark, Cindy Parker, and Paul Whitefield (Editor). 2008. Non-Native Invasive Plant Survey and Recommendations, 2003-2005. Wupatki National Monument. Natural Resource Program, Flagstaff Area National Monuments, Flagstaff, AZ. 19 pp. plus maps

Brian, N. J. 1992. Historical Review of Water Flow and Riparian Vegetation at Walnut Canyon National Monument, Arizona. Technical Report/Cooperative National Park Resources Studies Unit. Number 44. National Park Service, Flagstaff, Arizona.

Bureau of Land Management. 1998. Endangered, Threatened, and Sensitive Plant Field Guide - Albuquerque District. Bureau of Land Management, Albuquerque District Office, New Mexico.

Center for Plant Conservation. No date. National Collection Plant Profile: Penstemon clutei. Online. Available: http://ridgwaydb.mobot.org/cpcweb/CPC_ViewProfile.asp?CPCNum=3221. Accessed 2009, February 10.

Chronic, Halka. 1988. Pages of Stone -- Geology of Western National Parks and Monuments: Vol. 4, Grand Canyon & The Plateau Country. The Mountaineers Books.

Cinnamon, S. K. 1983. Camelthorn Census Pre-Control Camelthorn Plots. Unpublished report on file, Flagstaff Area National Monuments, Flagstaff, Arizona.

Cinnamon, S. K. 1987. Wupatki National Monument Tamarisk and Camelthorn Eradication Program 1983-88. In: Tamarisk Control in the United States, Proceedings of Tamarisk Conference, University of Arizona, Tucson.

Colorado Natural Areas Program (CNAP). 2000. Creating an Integrated Invasive plant Management Plan: A Handbook for Owners and Land Mangers of Lands with Natural Values. Colorado State Parks. http://parks.state.co.us/cnap/IWM_handbook/IWM_index.htm. 4/04

Cowardin, L. W., V. Carter, F.C. Golet, and E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. Biological Service Program, U.S. Fish and Wildlife Service, FWS/OBS 79/31. Office of Biological Services, Fish and Wildlife Service, U.S. Department of Interior, Washington, D.C., USA.

Cronk, Q. C. B., and J. L. Fuller. 1995. Plant Invaders. Chapman and Hall, New York.

Cronquist, Arthur, N.H. Homgren, and P.K. Holmgren. 1997. Intermountain Flora: Vascular plants of the Intermountain West, U.S.A. Vol 3, Part A, Subclass Rosidae. The New York Botanical Garden, Bronx, NY.

Darton,, N. H. 1910. Geology of the Walnut Canyon Region. U.S. Geological Survey, Washington, D.C. Bulletin #435.

Derscheid, L. A., K. E. Wallace, and R. L. Nash. 1961. Russian Knapweed Control with Cultivation, Cropping and Chemicals. Invasive plants 8:(268-278).

Despain, D. W., and J. C. Mosley. 1990. Fire History and Stand Structure of a Pinyon- Juniper Woodland." At Walnut Canyon National Monument, Arizona. Report presented to Southern Arizona Group, National Park Service, Phoenix, Arizona. Ms on file Walnut Canyon National Monument.

DiTomaso, J.M., G.B. Kyser, S.B. Orloff, and S.F. Enloe. 2000. Integrated strategies offer site-specific control of yellow starthistle. California Agriculture Volume 54, Number 6.

Drost, Charles. 2008. Inventory of Mammals at Walnut Canyon and Wupatki National Monuments. United States Geological Survey, Southwest Biological Science Center, Colorado Plateau Research Station.

Eggler, W. A. 1966. “Plant Succession on the Recent Volcano, Sunset Crater.” Plateau 38, No. 4:81-96.

Epple, A.O. 1995. A Field Guide to the Plants of Arizona, first edition. Falcon Publishing Inc. Helena, Montana.

Extension Toxicology Network. 1996. Pesticide Information Profiles – Glyphosate. Michigan State University, Lansing, MI.

Greco, D., P. Benjamin, M. Ziegenbein. 2001. Wupatki National Monument Disturbed Land Inventory and Recommendations. National Park Service Natural Resource Program Center, Geologic Resources Division. Denver, CO

Hansen, M. J. Coles, K.A. Thomas, D. Cogan, M. Reid, J. Von Loh, and K. Shulz. 2004a. USGS-NPS National Vegetation Mapping Program: Walnut Canyon National Monument, Arizona, Vegetation Classification and Distribution. Final Report, U.S. Geological Survey, Southwest Biological Center, Flagstaff, Arizona.

Hansen, M. J. Coles, K.A. Thomas, D. Cogan, M. Reid, J. Von Loh, and K. Shulz. 2004b. USGS-NPS National Vegetation Mapping Program: Wupatki National Monument, Arizona, Vegetation Classification and Distribution. Final Report, U.S. Geological Survey, Southwest Biological Center, Flagstaff, Arizona.

Hansen, M. J. Coles, K.A. Thomas, D. Cogan, M. Reid, J. Von Loh, and K. Shulz. 2004c. USGS-NPS National Vegetation Mapping Program: Sunset Crater Volcano National Monument, Arizona, Vegetation Classification and Distribution Final Report. U.S. Geological Survey, Southwest Biological Center, Flagstaff, Arizona.

Hart, R.J., J.J. Ward, D.J. Bills, and M.E. Flynn. 2002. Generalized hydrogeology and ground-water budget for the C aquifer, Little Colorado River Basin and parts of Verde and Salt River basins Arizona and New Mexico. USGS. Water-Resources Investigations Report 02-4026. USGS. Flagstaff, AZ.

Heibert, R. D., J. Stubbendieck. 1993. Handbook for Ranking Exotic Plants for Management and Control. USDI Natural Resources Report NPS/NRMWRO/NRR-93/08. Denver, CO

Howery, L.D., G. Ramos, Editors. 2001. Arizona's Invasive Weeds. Arizona Cooperative Extension. University of Arizona, Tucson.

Huisinga, K., P. Hogan, K. Wright, H. Hamilton, and S. Crow. 2000. Special Status Plants of the Flagstaff Area National Monuments: Final Report. Submitted to National Resource Coordinator, Flagstaff Area National Parks and Monuments Office, Flagstaff, Arizona.

Jacobs, J. S., M. F. Carpinelli, and R. L. Sheley. 1998. Revegetating Invasive plant-Infested Rangeland: What We've Learned. Rangelands 20:(6)10-15.

Jenkins, P., F. Reichenbacher, K. Johnson, and A. Gondor. 1991. Vegetation Inventory, Classification, and Monitoring at Walnut Canyon National Monument." Study Report to the National Park Service.

Joyce. J. F. 1974. A Taxonomic and Ecological Analysis of the Flora of Walnut Canyon, Arizona." Unpublished master's thesis. Northern Arizona University, Flagstaff.

Kearney, T.H., R.H. Peebles, and collaborators. 1951. Arizona Flora. 2nd edition with supplement (1960) by J.T. Howell, E. McClintock, and collaborators. University of California Press, Berkeley, 1085 pp.

Kearney, T.H., and R. H. Peebles. 1960. Arizona Flora. Revised 2nd Edition with Supplement by J.T. Howell and E. McClintock. University of California Press, Berkeley, p. 917.

Maschinski, Joyce; Holter, Louella, editors. 2000. Southwestern rare and endangered plants: proceedings of the third conference; September 25-28 in Flagstaff, AZ. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins, CO (Proceedings RMRS-P-23).

Mau-Crimmins, T.M., S.E. Studd, and M.S. Mauzy. July 2005. Exotic Plant Management Plant for Montezuma Castle and Tuzigoot National Monuments. Technical Report NPS/IMR/SODN-001. National Park Service, Denver, CO.

McCormack, D. C. 1989. The geology of Wupatki National Monument, Northern Arizona. Master's Thesis, Northern Arizona University, Flagstaff, Arizona.

McDougall, W.B. 1973. Seed Plants of Northern Arizona. The Museum of Northern Arizona, Flagstaff, AZ.

Menzel, J. P. 1996. Historical Changes in Forest Structure in the Ponderosa Pine Type, Walnut Canyon Area, Northern Arizona." Unpublished Master's Thesis, Northern Arizona University, Flagstaff.

Meunscher, W. C. 1980. Invasive plants. Cornell University Press, Ithaca, NY.

Munson, K. 2004. Human Health Effects of Weed Treatment Methods. 5 pages.

Murdock, L. 1994. Analysis of Woodrat (Neotoma) Middens Found in Walnut Canyon, Coconino County, Arizona." Unpublished master's thesis, Northern Arizona University, Flagstaff.

National Park Service. 2009. NPS website description of Invasive Species Management Program. http://www.nature.nps.gov/ biology/invasivespecies/

National Park Service. 2008. NPS website description of Flagstaff Area National Monuments. www.nps.gov.

National Park Service. 2007. General Management Plan and Final Environmental Impact Statement, Walnut Canyon National Monument.

National Park Service. 2007. Cultural Landscapes Inventory at Sunset Crater Volcano National Monument. US Department of the Interior, National Park Service. Flagstaff, AZ.

National Park Service. 2007. Cultural Landscapes Inventory at Wupatki National Monument. US Department of the Interior, National Park Service. Flagstaff, AZ.

National Park Service. 2006. Management Policies 2006. US Department of the Interior, National Park Service. Washington, DC.

National Park Service. 2005. Fire Management Plan Environmental Assessment/Assessment of Effect. Flagstaff Area National Parks and Monuments Office, Flagstaff, Arizona.

National Park Service. 2005. Dinosaur National Monument Invasive Plant Management Plan and Environmental Assessment. October 2005. Dinosaur National Monument, Dinosaur, CO.

National Park Service. 2002. General Management Plan and Final Environmental Impact Statement, Sunset Crater Volcano National Monument.

National Park Service. 2002. General Management Plan and Final Environmental Impact Statement, Wupatki National Monument.

National Park Service. 2001. Draft NPS Species Flora and Fauna Database for Walnut Canyon National Monument, National Park Service Natural Resource Inventory and Monitoring Program, Colorado Plateau Cooperative Ecological Studies Unit, Northern Arizona University, Flagstaff.

National Park Service. 2001. Management Policies. National Park Service. Washington, D.C.

National Park Service. 2001 Sunset Crater Volcano National Monument General Management Plan. National Park Service.

National Park Service. 2000. Biological Inventory of National Park Areas on the Southern Colorado Plateau. September Colorado Plateau Cooperative Ecosystem Studies Unit and USGS / Colorado Plateau Field Station. Flagstaff, AZ

National Park Service. 1996. Water quality data inventory and analysis Sunset Crater National Monument. NPS/NRWRD/NRTR-96/90. Fort Collins, CO.

National Park Service. 1996. Baseline water quality data inventory and analysis Wupatki National Monument. National Park Service. Fort Collins, CO.

National Park Service. 1991. NPS – 77: Natural Resource Management Guideline. Washington D.C.

National Park Service. 1981. Hydrochemical Map. National Park Service.

NatureServe, 2002. Species Description: Sunset Crater beardtongue (Penstemon clutei). http://www.natureserve.org/

NatureServe, 2002. Species Description: Saw Phacelia (Phacelia serrata). http://www.natureserve.org/

Nelson, A. 1927. A new Penstemon from Arizona. American Botanist 33:109-110.

NOAA [National Oceanic Atmospheric Administration]. 2004. Internet Site: National Climatic Data Center weather data. http://www.ncdc.noaa.gov/ol/climate/online/coop-precip.html. Accessed 1997-2004.

Olson B.E. 1999. Manipulating Diet Selection to Control Weeds. In K.L. Launchbaugh, K.D. Sanders, and J.C. Mosley,eds. *Grazing Behavior of Livestock and Wildlife*. Idaho Forest, Wildlife & Range Exp. Sta. Bull. #70 Univ. of Idaho, Moscow, ID.

Ort, M.H., M.D. Elson, and D.E. Champion. 2002. A Paleomagnetic Dating Studyof Sunset Crater Volcano. Technical Report No. 2002-16. Desert Archeology, Inc. Tucson, Arizona.

Phillips, Barbara G., R. Popowski, C. Franz, and P. Warren. 1996. Conservation Assessment and Strategy for Cimicifuga arizonica Watson (Arizona Bugbane) on the Coconino and Kaibab National Forests. Pp. 213-218. In Maschinski, Joyce, H.D. Hammond, L. Holter. Southwestern Rare and Endangered Plants: Proceedings of the Second Conference. September 11-14, 1995, Flagstaff, Arizona.

Phillips, A. M., III, M. Murov and R. van Ommeren. 1992. Unpublished final report, distribution and ecology of Sunset Crater Beardtongue (*Penstemon clutei*) in the Cinder Hills area, Coconino National Forest, Flagstaff, AZ, for Coconino National Forest.

Phillips, A. M., III, B. G. Phillips, L. T. Green, III, J. Mazzoni, and N. Brian. 1982b. Status report: Pediocactus peeblesianus var. fickeiseniae L. Benson. Submitted to U.S. Fish and Wildlife Service, Albuquerque, NM. 13 pages.

Phillips, B. G. 1990. Riparian Inventory of Walnut Canyon National Monument: Vegetation Map, Sampling Plots, Annotated Checklist. Tucson, Arizona: Southwest Parks and Monuments Association.

Plate II, Hydrochemical Map of the Coconino Aquifer in the Sunset Crater and Wupatki National Monuments Area, Coconino County, Arizona. Christensen, P., cartographer. [August 1981]. No date included in original record.

Priest, S.S., W.A. Duffield, K. Malis-Clark, J.W. Hendley II, and P.H. Stauffer. 2001. The San Francisco Volcanic Field, Arizona. U.S. Geological Survey Fact Sheet 017-01. Internet Site: http://geopubs.wr.usgs.gov/fact-sheet/fs017-01/.

Renz, M. J., and J. M. DiTomaso. 1998. The Effectiveness of Mowing and Herbicides to Control Perennial Pepperweed in Rangeland and Roadside Habitats. Proceedings of the Western Society of Invasive plant Scientists. 129.

Reichenbacher, F.W. 1986. Unpublished status report on *Amsonia peeblesii* for US Forest Service. Comprehensive report on taxon history, description, biology, geographic distribution, habitat, management. United States Fish and Wildlife Service, line drawings of plant in flower and seed.

Roth, Daniella. 1999. Unpublished abstract on Psorothamnus thompsoniae var. whitingii. Navajo Nation Botanist report.

Roundy, B. A. 1996. Revegetation of Rangeland for Wildlife. Pages 355-368 in P. R. Krausman, editor. Rangeland Wildlife. Society for Range Management, Denver, CO.

Schelz, Charles, John Cannella, and Kristin Straka. 2008. Floristic Survey and Exotic and Non-native Vegetation Mapping of Walnut Canyon National Monument, 2008. U.S. Department of Interior, National Park Service, Technical Report # FLAG-2008-02, Flagstaff Area National Monuments, Resource Management Division. Flagstaff, AZ. 83 pp.

Schelz, Charles. 2008. Personal Communication. Schelz, NPS ecologist at FLAG, documented two active burrowing owl nests within 300 meters north of the north boundary of WUPA in June, 2008. Flagstaff Area Monuments, Wupatki National Monument, Flagstaff, AZ.

Schelz, Charles. 2008. Monitoring Plan for the Golden Eagle and Other Raptors in the Flagstaff Group units. National Park Service General Technical Report #FLAG-001-2008, Resource Management Division, Flagstaff Group. 97 pp.

Schon, K. 2000. Saguaro National Park and Walnut Canyon National Monument 2000 Fire Effects Report. Fire Effects Monitoring Program, Saguaro National Park.

SER. 2002. The SER Primer on Ecological Restoration. Society for Ecological Restoration Science &Policy Working Group. www.ser.org/. 5/03.

Sheley, R. L., T. J. Svejcar, and B. D. Maxwell. 1996. A Theoretical Framework for Developing Successional Invasive plant Management Strategies on Rangeland. Invasive plant Technology 10:766-773.

Sheley, R.L., M. Manoukian, and G. Marks. 1999. Preventing noxious invasive plant invasion. In: Sheley, R.L. and J.K. Petroff, eds. Biology and management of noxious rangeland invasive plants. Corvallis, OR: Oregon State University Press: 69-72.

Southwest Exotic Plant Information Clearinghouse (SWEPIC) 2008. The URL of this page is http://sbsc.wr.usgs.gov/research/projects/swepic/swepic.asp

Spangle, P.F. 1953. A Revised Checklist of the Flora of Walnut Canyon National Monument." Plateau Vol. 26, pp. 86- 88.

Tu, M., Hurd, C., & J.M. Randall, 2001. Weed Control Methods Handbook, The Nature Conservancy, http://tncinvasives.ucdavis.edu, Version: April 2001.

Thomas, L.P., M.N. Hendrie (editor), C.L. Lauver, S.A. Monroe, N.J. Tancreto, S.L. Garman, and M.E. Miller. 2006. Vital Signs Monitoring Plan for the Southern Colorado Plateau Network. Natural Resource Report NPS/SCPN/NRR-2006/002. National Park Service, Fort Collins, Colorado.

Thomas, B.E. 2003. Water-Quality data for Walnut Canyon and Wupatki National Monuments, Arizona – 2001-02. Open-File Report 03-286. US Geological Survey. Flagstaff, AZ.

U.S. Department of Agriculture, Forest Service (Forest Service). 2004. Pesticide Fact Sheets [Web page]. Located at http://infoventures.com/e-hlth/pestcide/pest-fac.html. Links to: 2,4-D, Chlorsulfuron, Clopyralid methyl, Glyphosate, Metsulfuron methyl, Picloram, and Triclopyr.

USDA Forest Service. 2003a. Environmental Assessment for Management of Noxious Weeds and Hazardous Vegetation on Public Roads on National Forest System Lands in Arizona. Accessed at http://www.fs.fed.us/r3/projects/index.shtml.

USDA Forest Service. 2003b. Chlorsulfuron – Pesticide Fact Sheet. USDA Forest Service, Washington Office, Washington, DC.

USDA Forest Service. 2003c. Dicamba – Pesticide Fact Sheet. USDA Forest Service, Washington Office, Washington, DC.

USDA Forest Service. 2003d. Imazapyr. Pesticide Fact Sheet. USDA Forest Service, Washington Office, Washington, DC.

USDA Forest Service. 2003e. Metsulfuron Methyl. Pesticide Fact Sheet. USDA Forest Service, Washington Office, Washington, DC.

USDA Forest Service. 2003f. Picloram. Pesticide Fact Sheet. USDA Forest Service, Washington Office, Washington, DC.

USDA Forest Service. 2003g. Sulfometuron-methyl Pesticide Fact Sheet. USDA Forest Service, Washington Office, Washington, DC.

USDA Forest Service. 2003h. Triclopyr. Pesticide Fact Sheet. USDA Forest Service, Washington Office, Washington, DC

United States Fish and Wildlife Service & United States Department of the Interior. 2007. Recommended protection measures for pesticide applications in Region 2 of the U.S. Fish and Wildlife Service, Austin, TX.

United States Geologic Service. 2002. Investigation of the geology and hydrology of the Coconino Plateau of Northern Arizona: A project of the Arizona Rural Watershed Initiative. USGS Fact Sheet 113-02. USGS. Flagstaff, AZ.

Vandiver, V. W. 1936. Geological Report on Walnut Canyon, Arizona. Western Archaeological and Conservation Center Archives, National Park Service, Tucson, Arizona.

Various authors. Various Dates. File folder: N3027 Vulcanology, New Theory on [the] Volcanics of Sunset Crater.

Voss, J.W. 1937. "A Revision of the Phacelia crenulata Group for North America." Bulletin of the Torrey Club, 64: 81-144.

Walker, J.W., S.L. Kronberg, S.L. Al-Rowaily, and N.E. West. 1994. Comparison of sheet and goat preferences for leafy spurge. Journal of Range Management. 47:429-434.

Washingto State Department of Transportation. 2006. Clopyralid: Roadside Vegetation Management Herbicide Fact Sheet.

Washingto State Department of Transportation. 2006. Imazapic: Roadside Vegetation Management Herbicide Fact Sheet.

Whitson, T. D. et al 2001. Weeds of the West. 9th ed. University of Wyoming

Wilson, F. and C.B. Huffaker. 1976. The philosophy, scope and importance of biological control. In: Huffaker, C.B. and P.S. Messenger (eds.), Theory and Practice of Biological Control. Academic Press, New York, 3-15.

Williams, S. and T. Prather. 2006. Goats: A tool for controlling spotted knapweed. Journal of Extension. Volume 44, Number 5, Article Number 5RIB6.

Zion Natural History Association. 1985. Geologic Cross Section of the Grand Canyon - San Francisco Peaks - Verde Valley Region. ISBN 0-915630-02-8. NPS-Zion National Park. Springdale, UT.

APPENDIX A:

Flagstaff Area National Monuments Invasive Plant Management Plan Decision-making Tool

Listed below are 7 essential steps or sections that must be reviewed and completed during the planning stages for all invasive plant treatment projects that are considered by the Flagstaff Area Monuments. Each section has a procedure that is outlined in detail in the following pages.

Section 1: Identify Exotic/Invasive Plants that Meet Action Thresholds

- Establish management objectives.
- Identify invasive plants present within monument.
- Identify those invasive plants whose management meets action thresholds.
- Complete all the procedures for Section 1 below.

Section 2: Guidance for Setting Management Priorities

- Use guidance to set invasive plant management priorities based on their potential impact on monument resources and potential for control.
- Complete all the procedures for Section 2 below.

Section 3: Confirm Compliance of Treatment Method with an Existing NEPA Document

- Prior to implementing the selected treatment, confirm that the selected treatment method has the necessary compliance with NEPA.
- Complete all the procedures for Section 3 below.

Section 4: Optimum Tool Analysis for Treatment Options

- Identify proposed treatment options for each priority invasive plant.
- For each proposed treatment option, evaluate whether alternative treatment options with fewer potential impacts could be used.
- Complete all the procedures for Section 4 below.

Section 5: Confirm Compliance of Chemical and Biological Control Treatments with Applicable Regulations

- If chemical or biological treatments are selected, confirm that their use is compliant with applicable regulations and policies.
- Complete all the procedures for Section 4 below

Section 6: Ensure that all Mitigation, Best Management Practices, and Job Hazard Analyses have been Reviewed and Completed

- If herbicide use is planned complete "Herbicide Application Mitigation Check List" in Appendix B.
- Mitigation Considerations Common to all Projects (**Appendix D**) must be reviewed and completed.
- Required Protection Measures for Invasive Plant Treatments in Identified Special Species Habitats (**Appendix C**) must be reviewed and completed.

Section 7: Ensure that all 10 Steps of Integrated Pest Management are followed.

- Review Chapter 2, section 2.2 of this document (FLAG IPMP/EA).
- Incorporate all 10 steps into each project.

Section 1. Identify Invasive Plants that Meet Action Thresholds

This procedure must be followed sequentially.

1 Establish short- and long- term invasive plant management objectives for FLAG monument unit.

2. Review plant species list for the monument. Identify all plants that are of control interest. **From here go to Step 3 for each invasive plant species of concern for the project.**

3. Does this plant occur within a FLAG monument as the result of direct or indirect, deliberate or accidental actions by humans (National Park Service. 2001. Management Policies. Section 4.4.1.3.)

3.1 **No** **Species is not an exotic/invasive plant, and therefore will not be managed under this plan**.

3.1 **Yes** Go to **Step 4**.

4. Species is an invasive plant. Does it meet, or is it managed for, an identified park purpose (for example, is this plant managed as part of the cultural landscape) (National Park Service Management Policies. 2001. Section 4.4.4.2)? If No, go to Step 4.1. If Yes, go to Step 4.2.

4.1 **No** Is management of this invasive plant prudent and feasible? If No, go to Step 4.1.1 If Yes, goto Step 4.1.2

4.1.1 **No** Management of invasive plant is not justified.

4.1.2 **Yes** Does this exotic plant meet any of the following action thresholds?

- Interferes with natural processes and the perpetuation of natural features, native species, or natural habitats; or
- Disrupts the genetic integrity of native species; or
- Disrupts the accurate presentation of a cultural landscape; or
- Damages cultural resources; or
- Significantly hampers the management of park or adjacent lands; or
- Poses a public health hazard as advised by the U.S. Public Health Service; or
- Creates a hazard to public safety.

If Yes, go to Step 4.1.2.1. If No, go to 4.1.2.2.

4.1.2.1 **Yes** Management of invasive plant meets at least one action threshold. **Proceed to Section 2 "Guidance for Setting Management Priorities".**

4.1.2.2 **No** Management of exotic/invasive plant is not justified.

4.2 **Yes** Does this invasive plant pose a significant risk or nuisance to surrounding natural areas? If No, go to 4.2.1. If Yes, go to 4.2.2.

4.2.1 **No** Exotic/Invasive plants that do not pose a significant threat or nuisance to natural areas are exempt from control efforts within the boundaries of developments and cultural landscapes. This plant may be managed in accordance with park resource management objectives.

4.2.2 **Yes** Go back to 4.1 and proceed from there.

Section 2. Guidance for Setting Management Priorities

This procedure must be followed sequentially.

1. Is the exotic/invasive plant included on a federal, state, or county noxious weed list?
   - 1.1 **No** Determine relative management priorities. Are there available data and resources to use a quantitative ranking system?
     - 1.1.1 **Yes** Use Alien Plant Ranking System or other suitable system to quantitatively determine relative exotic/invasive plant management priorities. **Go to Step 5**
     - 1.1.2 **No** Qualitatively determine relative exotic plant management priorities using the **four decision trees** provided. Go through each of 4 decision trees below.
   - 1.2 **Yes** Exotic/Invasive plants on a federal, state, or county noxious weed list are a management priority. **Go to Step 1.1.**

2. Decision Tree 2, Part 2 includes characteristics of a disruptive exotic/invasive plant. **Highest priority** is to manage disruptive exotic plants that have, or potentially have, a substantial impact on park resources, and can reasonably be expected to be controlled (NPS Management Policies 2001. Section 4.4.4.2).

   Lower priority will be given to less innocuous exotic/invasive plants that have almost no impact on park resources or likely cannot be successfully controlled (NPS Management Policies 2001. Section 4.4.4.2). **Go to Step 2.1**

   - 2.1 **Proceed to Optimum Tool Analysis for Treatment Options (Section 3).**

Decision Tree 1

DT 1.1 Through cooperative relationships, are there known exotic/invasive plants present near the monument, but not within the monument?
If Yes, go to DT 1.1.1. If No, go to DT 1.1.2.

- DT 1.1.1 **Yes** Cooperate with local landowners, county extension agents, and state agencies to prevent introduction into park. **Go to DT 1.2**
- DT 1.1.2 **No** Determine priorities based on current extent (distribution) of exotic plant populations within the monument. **Go to DT 1.2**.

DT 1.2 Is exotic/invasive plant present as a small or new population or outlier of larger infestations? If Yes, go to DT 1.2.1. If No, go to 1.2.2.

- DT 1.2.1 **Yes** ***First priority – eliminate all small infestations. Go to Step 5.***
- DT 1.2.2 **No** Is exotic plant present in a large infestation(s) that continues to

expand? If Yes, go to DT 1.2.2.1. If No, go to DT 1.2.2.2

DT 1.2.2.1 **Yes** ***Second priority – prevent large infestation from expanding. Go to Step 2 above.***

DT 1.2.2.2 **No** Is exotic plant present in large infestation(s) that is not expanding? If Yes, go to DT 1.2.2.2.1

DT 1.2.2.2.1 **Yes** ***Third priority – contain, reduce, or eliminate large populations. Go to Step 2 above.***

Decision Tree 2

DT 2.1 Determine priorities based on current and potential impacts of the exotic plant.

DT 2.2 Prioritize according to the following criteria:

DT 2.2.1 Alters ecosystem processes.
DT 2.2.2 Out competes native species.
DT 2.2.3 Does not out compete natives, but:
- Prevents recruitment/regeneration
- Reduces/eliminates resources.
- Provides resources to non-native animals.

DT 2.2.4 May overtake or exclude natives following disturbance.

Go to Step 2 above.

Decision Tree 3

DT 3.1 Determine priorities based on difficulty to control the exotic/invasive plant.

DT 3.2 Prioritize according to the following criteria:

a. Likely to be controlled and replaced with native species.
b. Likely to be controlled, but not replaced with native species.
c. Difficult to control and potential impact from control on park resources.
d. Unlikely to be controlled.

Go to Step 2 above.

Decision Tree 4

DT 4.1 Determine priorities based on value of habitats and areas of infestations.

DT 4.2 Prioritize according to the following criteria:

a. Infestation occurs in high quality/high value habitat or resource areas.
b. Infestation occurs in less valued areas.

Go to Step 2 above.

Section 3: Confirm Compliance of Treatment Method with an Existing NEPA Document

1. Use FLAG Monuments Environmental Screening Form to answer the following questions:

   1.1 Is the selected treatment included in the FLAG EPMP/EA or another approved plan and accompanying NEPA document? If Yes, go to 1.1.1. If No, go to 1.1.2.

      1.1.1 **Yes** Are the potential selected treatment impacts **consistent** with the FLAG EPMP/EA or the other NEPA document?
      If Yes, go to Step 1.3. If No, go to 1.1.2.

      1.1.2 **No** Does this exotic plant pose an imminent danger to visitors or an immediate threat to park resources? If Yes, go to 1.2. If No, go to 1.3

   1.2 **Yes** Does the proposed treatment qualify as a Categorical Exclusion using an Environmental Screening Form? If Yes, go to 1.2.1. If No, go to 1.2.2.

      1.2.1 **Yes** Complete the Categorical Exclusion Form. Document that the proposed treatment method will be covered under a Categorical Exclusion. **Return to Section 4 "Optimum Tool Analysis for Treatment Options".**

      1.2.2 **No** Prepare an Environmental Assessment or Environmental Impact Statement. Document that the proposed treatment method will be covered under an EA or EIS. **Return to Section 4 "Optimum Tool Analysis for Treatment Options".**

   1.3 Is the FLAG EPMP/EA or other NEPA document accurate and up- to- date?
   If Yes, go to 1.3.1. If No, go to 1.1.2.

      1.3.1 **Yes** Document in a Memo to File that the selected treatment complies with the FLAG EPMP/EA or other NEPA document. **Return to Section 4 "Optimum Tool Analysis for Treatment Options".**

Section 4: Optimum Tool Analysis for Treatment Options

This procedure must be followed sequentially. If there are different answers to questions follow the directions included with that answer only.

1. Identify proposed treatment option for exotic plant that meets management objectives and is feasible given potential costs, available resources, potential impacts and effectiveness, and applicable regulations and policies. **Go to 2.**

2. Is there an alternative treatment, agent, or application method that would have less impact?
   If Yes/Maybe, go to 2.1, If No, go to 2.2.

   2.1 **Yes/Maybe** Is this alternative option feasible given potential costs, available resources, impacts, and effectiveness?
   If Yes, go to 2.1.1. If No, go to 2.1.2

   2.1.1 **Yes** Select alternative treatment option. **Go to 3.**
   2.1.2 **No** Select proposed treatment option. **Go to 3.**

   2.2 **No** Select proposed treatment option. **Go to 3.**

3. Does the selected treatment include the use of chemicals or biological control agents?
   If Yes, go to 3.1. If No, go to 3.2.

   3.1 **Yes** Proceed to Section 5 "Confirm Compliance for Chemical and Biological Treatments". **Go to 3.2**
   3.2 **No** Proceed to Section 3 "Confirm Compliance of Treatment Method with an Existing NEPA Document". **Go to 4.**

4. Are there sensitive resources that may be affected by proposed treatment?
   If Yes, go to 4.1. If No, go to 4.2.

   4.1 **Yes** Delineate buffer areas for sensitive resource and avoid treating those areas. Consider alternative treatment for sensitive areas. **Go to 4.2.**
   4.2 **No** Implement selected treatment with best management practices to mitigate potential impacts. **Go to 5.**

5. Complete pesticide and/or biological control agent use forms. Submit annual reports. **Go to 6.**

6. Monitor areas treated. Were management objectives met?
   If Yes, go to 6.1. If No, go to 6.2

   6.1 **Yes** Document monitoring results. **Go to 2.**
   6.2 **No** Modify treatment or consider alternative treatment methods through adaptive management. **Go to 7.**

7. Notify public of any proposed changes that result from adaptive management. **Go to 1.**

Section 5. Confirm Compliance of Chemical and Biological Control Treatments with Applicable Regulations

1. Does the selected treatment include the use of chemicals or biological control agents?
If No, go to 1.1. If Yes, go to 1.2.

1.1 **No** This decision tree is only applicable to chemical or biological control agents.
Return to Section 4 "Optimum Tool Analysis for Treatment Options".

1.2 **Yes** Has the use of chemicals or biological control agents been determined necessary by a designated NPS IPM specialist?
If No, go to 1.2.1. If Yes, go to 1.2.2.

1.2.1 **No** Use of chemicals or biological control agents is **not** justified. Consider alternative treatments using **Section 4 "Optimum Tool Analysis for Treatment Options".**

1.2.2 **Yes** Are all other available treatment options either not acceptable or not feasible? If No, go to 1.2.1. If Yes, go to 1.2.2.1.

1.2.2.1 **Yes** Use of chemicals or biological control agents is justified.
Go to Step 2 for "Chemical Treatments", or Step 3 for "Biological Control Treatments".

2. Chemical Treatments

2.1 Is this chemical registered for use by the U.S. EPA?
If Yes, go to 2.1.1. If No, go to 2.1.2.

2.1.1 **Yes** According to the product label, are there any existing conditions at the proposed application site that would prohibit its use?
If Yes, Go to 2.2. If No, go to 2.3

2.1.2 **No** Do not use chemical. Only registered chemicals may be used under this plan. Consider alternative treatment using **Section 4 "Optimum Tool Analysis for Treatment Options".**

2.2 **Yes** Do not use if chemical is not approved for existing conditions at application site. Consider alternative treatment using **Section 4 "Optimum Tool Analysis for Treatment Options".**

2.3 **No** Submit pesticide use proposal and obtain approval from the Regional/ National IPM Coordinator. Approval must be received from the Regional / National IPM Coordinator. Only purchase chemicals that are authorized and are expected to be used within one year from date of purchase. **Return to Section 4 "Optimum Tool Analysis for Treatment Options".**

3. Biological Control Treatments

3.1 Is this biological control agent approved by USDA APHIS for release?
If Yes, go to 3.1.1. If No, go to 3.1.2

3.1.1 **Yes** Submit request to use biological control agent to Regional / National IPM Coordinator. Receive approval from Regional / National IPM Coordinator. **Go to Step 3.2**

3.1.2 **No** Do not use biological control agent. Only agents approved by APHIS will be used under this plan. **Consider alternative treatment using Section 4 "Optimum Tool Analysis for Treatment Options".**

3.2 Will the biological control agent be obtained from another state?
If Yes, go to 3.2.1. If No, go to 3.2.2.

3.2.1 **Yes** Obtain permit to transport biological control agent across state lines if source is another state. Transport agent according to permit conditions.

3.2.2 **No** Return to **Section 4 "Optimum Tool Analysis for Treatment Options".**

Appendix B: Herbicide Application Mitigation Check List

HERBICIDE APPLICATION METHODS: Herbicide application methods are designed to use the least, most effective amount of herbicide with the most effective method of application. Methods selected will reduce impacts to non-target plant and animal species, T&E species, water quality, and air quality.
☐ Label directions are strictly followed.
☐ Appropriate adjuvants are used if necessary.
☐ Approval has been received through the PUPS system.
☐ The most appropriate application technique is used: painting, wicking, squirting, and/or spraying.
☐ The most appropriate form of herbicide is used: liquid or granular.
☐ The most effective, least impacting application tools are used: backpack, ATV. No aerial application will be used.
☐ Application methods must be selected to minimize impacts to non-target plant and wildlife species.
☐ Herbicides must have low volatility and be applied under the appropriate weather conditions and wind speeds.
SOILS: Treatment methods minimize soil compaction, disturbance and erosion
☐ Soils are not wet and susceptible to compaction during treatments.
☐ Equipment and crews follow designated routes and trails as much as possible.
☐ The smallest and lightest possible effective equipment is used.
☐ Surface treatments are used on erosive soils when appropriate.
☐ Erosion controls such as: erosion fabric, re-contouring, mulch, silt fencing, and revegetation are used when necessary to reduce erosion.
VEGETATION: Treatment methods minimize seed dispersal and impacts to non-target species
☐ Invasive plant material is removed from the site if it poses a fire hazard or provides a seed source.
☐ Treatments are timed to avoid seed spread and germination.
☐ Sites requiring revegetation are restored as quickly as possible.
☐ Off-site seed is certified weed free.
WILDLIFE: Treatments and application methods will be selected to minimize impacts to wildlife species.
☐ Herbicides must have a low toxicity rating for wildlife.
☐ Treatments will be applied outside 'critical times' such as nesting and migration, whenever possible.
☐ Bio-control will only be considered when the risks to wildlife are low and their application has been approved by APHIS and USFWS.
☐ All treatments will be applied in accordance with USFWS stipulations for special status species.
WATER QUALITY: Treatments minimize overspray, drift and spills near surface waters.
☐ Herbicide treatments within 50 feet of water must be applied by hand.
☐ No open containers of herbicides are allowed in riparian areas or near open water. All refilling and repairs will take place at a designated staging area.
☐ Treatments must be timed to avoid high stream flows.
CULTURAL RESOURCES: Treatments and application methods will be selected to minimize impacts to cultural resources and conducted with the approval of the park archeologist.
☐ Consult with park archeologist before implementing any treatments.
☐ All ground disturbing and chemical treatments in the vicinity of archeological resources must be approved and monitored by the park archeologist.
☐ If previously unknown archeological resources are encountered during treatments all work must stop and the park archeologist will be notified.
☐ Any trimming or cutting of trees in the vicinity of standing historic or prehistoric architecture will be monitored by the park archeologist or other cultural resource specialist.

Appendix C: Required Protection Measures for Invasive Plant Treatments in Identified Special Species Habitats

There are a number of special status species known or suspected to occur within FLAG National Monuments. A complete list is found in **Appendices F and G**. FLAG staff conducted formal consultation with the US Fish and Wildlife Service to ensure protection of these species (USFWS April, 2009).

The following mitigation measures would be incorporated into all action alternatives:

1. The proposed project would include provisions for the discovery of previously unknown or undiscovered threatened, endangered, or special status species. These provisions require the complete stop of project activities until FLAG staff evaluates the project impact on the discovered species and conducts additional Section 7 consultation with the U.S. Fish and Wildlife Service, if necessary.
2. All project participants would be informed about special status species and what actions should occur if any special status species is encountered.
3. Work involving string trimmers or chainsaws will not occur within sensitive habitat during breeding and dispersal periods for threatened, endangered, or special status species.
4. Mexican Spotted Owl: See mitigation measures listed below.
5. Southwestern willow flycatcher: See mitigation measures listed below. Formal consultation with USFWS allows for treatment of invasive plant species at any time of year, if necessary to make use of seasonal work crews. Treatment during times of flycatcher migration will be avoided.
6. Yellow-billed cuckoo: See mitigation measures listed below. This is a migratory species; therefore work in riparian gallery forests will be conducted in the fall/winter to avoid disturbing yellow-billed cuckoos.

Species Conservation Measures (Project Design Features)

RPMPA refers to the Recommended Protection Measures for Pesticide Applications in Region 2 of the U.S. Fish and Wildlife Service (summarized in Tables 26 and 27) authored by J. Allen White, 2007.

1. Personnel would be trained to identify and avoid special status species. If any species are identified in the field, treatments would be halted until buffer areas are established. Livestock, such as horses, and ATVs and off-road vehicle traffic would not be allowed in areas where special status plants are known to occur or have the potential to occur.
2. Restoration activities, such as reseeding, re-vegetation, and irrigation, would only be used where necessary to promote the reestablishment of native plant communities. To avoid take, activities near special status species habitat would be avoided during sensitive periods. Any manual or mechanical methods would be highly selective for individual exotic plants to minimize the potential for impacting special status plants. Personnel would be trained to identify and avoid special status species if encountered. Tilling would not be used in areas where special status plants are known to occur or have the potential to occur, and any ground disturbance will be kept to an absolute minimum.

3. Cultural treatments would not likely have any measurable impacts on native fish or aquatic wildlife species, their habitats, or natural processes sustaining them. Impacts would be site-specific and short-term.
4. Chemicals would only be used when determined necessary, or if there are no other acceptable or feasible treatment options. Species-specific BMPs have been developed, in addition to general BMPs, to minimize the potential exposure of special status species to pesticides. These can be found in **Appendix C**. Application of pesticides near special status species' habitat would be avoided during sensitive periods. In most situations hand applications will be required to apply pesticides, a 40-foot radius no-spray zone shall be established around special status plants. Hand spraying allows for treatment of individual plants and minimizes overspray and drift. The spray can be directed within an inch of the target plant. If boom treatments are used (ATVs or aircraft) to apply pesticides, a 100-foot no-spray zone would be established around these plants.
5. Any biological control agents released in a park must be approved by APHIS and have no demonstrated affinity for special status plant species or close relatives.
6. Project-specific prescribed fire plans would be developed for each prescribed fire to limit the potential for high-intensity fires. Prescribed fires would not be conducted in special status species' habitat during active breeding periods. Project specific prescribed fire plans would be designed to prioritize the protection of habitat for special status species.
7. In addition, species-specific BMPs shall be implemented for each special status species. These can be found in **Appendix C**.
8. Implement integrated weed best management practices.
9. Survey T&E species' habitats to determine and prioritize the occupied and potential habitats that would be most vulnerable to encroachment of invasive and noxious weeds.
10. Use native species for seeding and planting during re-vegetation. An exception is the use of sterile hybrid grasses after careful analysis to provide immediate ground cover after wildfires.
11. NPS will review "weed-free" certifications for seed and mulch to ensure they are "free" of the weed species to be controlled in the action area.
12. Treatments that are not within these design features would require additional analysis and may require additional coordination with the USFWS (U.S. Fish and Wildlife Service).
13. Work cooperatively with adjacent landowners to manage noxious or invasive weeds to prevent their spread into NPS lands.

All Species

1. Where specified, species breeding season timing restrictions and buffers are applicable to all treatment methods that are not commensurate with the designated uses.
2. Where two or more species' habitats occur, the more restrictive measures will take priority.
3. Noxious or invasive weed treatment methods during the breeding seasons for birds would be commensurate with designated uses (non-motorized, proposed wilderness, etc.) in the treatment areas.

4. Adjuvants including surfactants and cleaners would be used or applied according to the adjuvant **Table 10** below.

5. Forest Service would submit to the USFWS an annual report of herbicide treatments occurring within T&E species' habitat.

Treatments within Small Riparian Habitats

1. After a survey has been conducted, no restrictions on pesticide applications if USFWS concur that habitat is unoccupied by TES species.

2. When streamflows are 100 cfs or greater, herbicides would be applied per guidelines for large aquatic habitats listed below (see page 74 in RPMPA).

3. When streamflows are less than 100 cfs, herbicides would be applied per guidelines in RPMPA with the following modifications:

    - Approved herbicides (aquatic formulations only): Glyphosate, Imazapic, and Imazapyr may be used within the riparian zone adjacent to but not in the aquatic habitat.

    - Spot applications to individual plants are permitted within the buffer zone.

    - For pool habitats, no pesticide applications may occur near pools when there is no surface flow of water in and out of the pool(s). Per the RPMPA, a 30-foot buffer would apply when there is no surface flow of water.

    - When streamflows exceed 100 cfs (cubic feet per second), may apply guidelines for large riparian habitats (see Table 26 in RPMPA).

Treatments within Large Riparian Habitats

1. After a survey has been conducted, no restrictions on pesticide applications if USFWS concur that habitat is unoccupied by the species.

2. When streamflows are 100 cfs or greater, herbicides would be applied per guidelines for large aquatic habitats in RPMPA, pg. 76 (see Table 26 in RPMPA).

3. When streamflows are less than 100 cfs, herbicides would be applied per guidelines in RPMPA, pg. 73 with the following modifications (see Table 26 in RPMPA):

    - Spot applications to individual plants are permitted within the buffer zone.
    - Approved herbicides (aquatic formulations only): Glyphosate, Imazapic, and Imazapyr may be used within the riparian zone adjacent to but not in the aquatic habitat.
    - For pool habitats, no pesticide applications may occur near pools when there is no surface flow of water in and out of the pool(s). Per the RPMPA, a 30-foot buffer would apply when there is no surface flow of water.

Southwestern willow flycatcher

1. No biological control of tamarisk anywhere on the three FLAG Monuments ("SWWF Recovery Plan," pg. 121) unless NEPA analysis and ESA Section 7 compliance is documented.

2. Treatment within patches will comply with the southwestern willow flycatcher recovery plan.

3. NPS Ecologist will determine patch size for nesting areas per the "SWWF Recovery Plan" and identify sites on the ground prior to treatments.

4. NPS Ecologist would confirm occupancy status during the breeding season (April through August, "SWWF Recovery Plan," pg. 21).

5. For occupied breeding patches, treatments adjacent to breeding patches would occur 100 meters from the edge of the patch ("SWWF Recovery Plan," pg. H-21).

6. Herbicides would be applied per guidelines in RPMPA, pg. 64 (see Table 26 in RPMPA).

Yellow-billed cuckoo

1. Herbicides would be applied per guidelines in RPMPA, pg. 64 (see Table 26 in RPMPA).

2. FS biologist would determine patch size for nesting areas and identify sites on the ground prior to treatments.

3. FS biologist would confirm occupancy during the breeding season (May through August).

4. In occupied breeding areas, treatments adjacent to breeding areas would occur outside the time of occupancy.

Golden and Bald Eagle

1. Breeding season is December 1 through June 30.

2. Nest occupancy confirmed by NPS biologist.

3. No treatments may occur within one-half mile of occupied eagle nests (FWS per consultation) from the beginning of breeding season through occupancy for each occupied territory confirmed by NPS Ecologist.

4. Specified herbicides may be applied along road rights-of-way within breeding areas during the breeding season (see Table 26 in RPMPA).

5. No treatments within 100 meters of occupied winter roosts (roosting season October 1 through March 30).

Mexican spotted owl

1. Pesticide users should contact the Flagstaff USFWS field office for information on the Mexican spotted owl before application of pesticide with mixed conifer forest that has (1) at least 70 percent canopy cover, (2) downed woody material, and (3) 40 percent slopes or greater. If surveys for the species are necessary, survey protocols and a

scientific permit should be obtained from the Service. A Service-approved survey will be accepted for up to one year if the survey does not detect the presence of Mexican spotted owls in areas targeted for pesticide application. Further restrictions on pesticide application are unnecessary if the Service concurs that the habitat is unoccupied by the species. For occupied habitat or habitat that has not been surveyed, the Service should be consulted prior to pesticide treatment for appropriate protection measures and for any necessary incidental take authorization or permit.

2. Breeding season is March 1 through August 30.

3. Pesticides should ordinarily not be applied inside or adjacent to protected activity centers of Mexican spotted owls. A protected activity center is an area of approximately 600 acres established around an owl activity center for conservation purposes. An "activity center" is defined as (1) the nest site, (2) the roost grove commonly used during the breeding season in absence of a verified nest site, or (3) the best roosting/nesting habitat if nesting and roosting information are lacking. For control of pest or invasive plant species along existing rights-of-way (paved or gravel-base roadways only) inside protected activity centers of the Mexican spotted owl, a non-persistent herbicide with a vegetable oil carrier may be used if the herbicide does not exceed Class 0 or Class 1 in the Predatory Avian toxicity group. Applicators should make sure that pesticide spray drift does not occur beyond the right-of-way by using pesticide sprays with (1) coarse droplet sizes or (2) nontoxic drift retardants. Applicators may conduct spot applications with Class 0 or Class 1 herbicides in protected activity centers away from existing rights-of-way if (1) treatment is approved by the Service, (2) a backpack sprayer or other hand-operated equipment is used for the application, and (3) the pesticide is applied outside the general breeding season of March 1 through August 31.

4. No treatments may occur within occupied "No Activity Centers." "No Activity Center" is the nest area from the MSO Recovery Plan, page 86. NPS biologist to determine occupancy. If no surveys are done, all MSO territories and/or PACs (Protected Activity Centers) are assumed occupied until surveys are completed to determine otherwise.

5. Specified herbicides may be applied along road rights-of-way in MSO PACs during the breeding season (see Table 26 in RPMPA).

6. Only specified herbicides may be applied within MSO PACs (see Table 26 in RPMPA).

7. Specified herbicides may be applied from FS system trails during the breeding season commensurate with the designated trail use (non-motorized, motorized, livestock). Crews of two people may enter the PAC up to six times per breeding season for treatment purposes.

8. Specified herbicides may be applied during the breeding season to the remainder of the MSO PAC outside of the "No Activity Center" by non-motorized methods.

9. The following predator/rodent control agents or any pesticide that can cause secondary poisoning (Class 1sp, Class 2sp, or Class 3sp) in the Predatory Avian toxicity group should not be used within 1 mile of (1) currently occupied protected activity centers as determined by a Service-approved survey or (2) species habitat that has not been surveyed.

    a) brodifacoum
    b) diphacinone *

c) sodium fluoroacetate
d) zinc phosphide
e) chlorophacinone *
f) sodium cyanide strychnine

* Chlorophacinone or diphacinone may be applied below ground for control of rodents inside occupied protected activity centers if (1) treatment is approved by the Service, (2) the pesticide is applied on bait sticks inside heavily used burrows of the rodent colony, and (3) all tunnel entrances of the colony are covered up.

10. For applications of pesticides other than predator/rodent control agents or any pesticide that can cause secondary poisoning as indicated above, measures to protect the species are:

Pesticides (except predator/rodent control agents or any pesticide that can cause secondary poisoning) that rate as Class 0 or Class 1 in the Predatory Avian toxicity group should have the following buffer zones when applied outside (1) the perimeter of a protected activity center as determined by a Service-approved survey or (2) species habitat that has not been surveyed.[1] Aerial pesticide applications should be made in swaths parallel to a protected activity center and its aerial buffer zone.

Buffer Zones 1	**Spot applications** 2	**Mechanized ground applications**	**Low aerial applications**	**High aerial applications**
All formulations	80 feet *	300 feet *	300 feet	300 feet

Alternative Buffer Zone

* A buffer zone is unnecessary for application of these pesticides in existing rights-of-way (paved or gravel-base roadways only) through owl habitat. Applicators should make sure that pesticide spray drift does not occur beyond the right-of-way by using pesticide sprays with (1) coarse droplet sizes or (2) nontoxic drift retardants.

Notes:

1 A buffer zone is the distance between the boundary of the area requiring protection and the closest point of the last spot application or application swath. Border areas (roadways, fence lines, canal dikes, etc.) may be used as part of a buffer zone if the border area itself does not involve species habitat or a sensitive area. Standard weather conditions for pesticide application (i.e., no temperature inversions, wind speeds between 3 to 10 miles per hour, and no rainfall for 48 hours) should be followed when implementing recommended buffer zones.

2 Spot applications include pesticide applications by hand-operated equipment only.

3 Low and high aerial applications (respectively, aerial applications either less than 10 feet or greater than 10 feet) are relative to the height of the nozzles or spreaders above (1) the canopy of the field crop or native plant community or (2) a bare ground surface. In grassland or semi-open plant communities (shrubland, woodland, etc.) with more than 40 percent grass cover, the top of the grass canopy should be used to determine whether an aerial application is low or high. For forested lands or dense shrubland with less than 40 percent grass cover, the tops of trees or shrubs should be used in determining whether applications are low or high.

10) Pesticides (except predator/rodent control agents or any pesticide that can cause secondary poisoning) that rate as Class 2 or Class 3 in the Predatory Avian toxicity group should have the following buffer zones when applied outside (1) the perimeter of a protected activity center as determined by a Service-approved survey or (2) species

habitat that has not been surveyed.[2] Aerial pesticide applications should be made in swaths parallel to a protected activity center and its aerial buffer zone.

1 Recommended buffer zones for protection of protected activity centers of the Mexican spotted owl against Class 0 or Class 1 pesticides are based on disturbance factors.

2 Recommended buffer zones for protection of protected activity centers of the Mexican spotted owl against Class 2 or Class 3 pesticides are based on disturbance factors and/or pesticide drift.

Buffer Zones 1	**Spot applications** 2	**Mechanized ground applications**	**Low aerial applications** 3	**High aerial applications** 3
All formulations other than ULV or dust formulations	300 feet	1/4 mile	1/4 mile	1/4 mile
ULV or dust formulations 4	300 feet	1/4 mile	1/4 mile	1/2 mile

Notes:

1 A buffer zone is the distance between the boundary of the area requiring protection and the closest point of the last spot application or application swath. Border areas (roadways, fence lines, canal dikes, etc.) may be used as part of a buffer zone if the border area itself does not involve species habitat or a sensitive area. Standard weather conditions for pesticide application (i.e., no temperature inversions, wind speeds between 3 to 10 miles per hour, and no rainfall for 48 hours) should be followed when implementing recommended buffer zones.

2 Spot applications include pesticide applications by (1) hand-operated equipment or (2) a spray gun that discharges pesticide in liquid streams from a spray tank.

3 Low and high aerial applications (respectively, aerial applications either less than 10 feet or greater than 10 feet) are relative to the height of the nozzles or spreaders above (1) the canopy of the field crop or native plant community or (2) a bare ground surface. In grassland or semi-open plant communities (shrubland, woodland, etc.) with more than 40 percent grass cover, the top of the grass canopy should be used to determine whether an aerial application is low or high. For forested lands or dense shrubland with less than 40 percent grass cover, the tops of trees or shrubs should be used in determining whether applications are

4 ULV (ultra low volume) refers to liquid formulations applied at a rate of 1/2 gallon or less per acre.

low or high.

Black-footed ferret

1) Manual control will be the preferred treatment within the boundaries of prairie dog towns within the FLAG Area Monuments.

2) If chemical treatments are necessary, only the least toxic herbicides will be used in the vicinity of prairie dog towns within the Flagstaff Area Monuments.

3) As per the USFWS Recommended Protection Measures (White 2007) there are no specific herbicide restrictions in black-footed ferret habitat. The following mitigation measures must be followed if rodenticide treatments are considered.

   a. Populations (experimental or unknown) of the black-footed ferret should be located before using rodent control agents in prairie dog colonies:

   ♦ Applicators or relevant agencies should contact the Arizona field office of the Service at 602-242-0210 to determine the current location of experimental ferret populations in Yavapai County, Arizona.

   ♦ A ferret survey is recommended for prairie dog colonies in locations other than Yavapai County, Arizona. Colonies to be surveyed should be sufficiently large to support a small population of black-footed ferrets (i.e., black-tailed prairie dog colonies greater than 80 acres; white-tailed prairie dog colonies greater than 200 acres). A copy of survey guidelines for black-footed ferrets may be obtained from the regional pesticide coordinator in Austin at 512-490-0057. A scientific permit should be obtained from the Service before conducting a ferret survey. If a prairie dog colony is occupied by black-footed ferrets, the Service should be contacted.

   ♦ The Service should be notified before treatment of prairie dog complexes larger than 1,000 acres. Control agents for prairie dogs should not be used in such a complex until the complex has been (1) systematically surveyed for black-footed ferrets and (2) evaluated by appropriate state and Federal agencies for its potential as a ferret recovery site. Additional surveys for the complex are recommended after an extended period of time.

   b. Applicators should not use the following rodent control agents in a prairie dog colony or any pesticide that can cause either secondary poisoning (Class 1sp or Class 2sp) or burrow fumigation (Class 2 b) in the Predatory Mammal toxicity group when black-footed ferrets are present: 1)acrolein, 2) aluminum phosphide, 3) chlorophacinone, 4) diphacinone, 5) mag-nesium phosphide, 6) potassium nitrate, 7) sodium nitrate, and 8) zinc phosphide

Northern goshawk

1. Breeding season is March 1 through September 30.

2. No treatments may occur within occupied “nest stands”. NPS biologist to determine extent of nest stand area.

3. Specified herbicides may be applied along road rights-of-way in goshawk PFAs during the breeding season (same as MSO).

4. Only specified herbicides may be applied within goshawk PFAs (same as MSO).
5. Specified herbicides may be applied from NPS system trails during the breeding season commensurate with the designated trail use (non-motorized, etc.).
6. Specified herbicides may be applied during the breeding season to the remainder of the goshawk PFA outside of the "nest stand" by non-motorized methods.

Migratory Birds Including Sensitive, MIS, and PIF Species

1. Class 0 or 1 avian toxicity herbicides may be applied during nesting season (March through August).
2. Treatment and application methods would be commensurate with the designated uses within the treatment area.
3. Avoid using avian toxicity Class 2 or 3 (Dicamba) during the breeding season. For all habitats, these herbicides may be used September through February.

Table 9. Required protection measures for pesticide applications in identified species habitats.

Federal Species	Herbicides					
	2,4-D (acid formulations)	2,4-D (aquatic amine salt formulations)	2,4-D (nonaquatic amine salt formulations)	2,4-D (aquatic ester formulations)	2,4-D (nonaquatic ester formulations)	Chlorsulfuron
Bald eagle and Golden Eagle	A half-mile buffer from currently occupied nests. May be applied along existing road ROW (paved or gravel-base roadways only) during breeding season.			Buffer applies for 1 mile up and downstream from nest's location when applied at edge of water of occupied nest. Spot - 10 ft. from water edge. Mechanized - 80 ft. from water edge. A ½-buffer from currently occupied nests.	Buffer applies for 1 mile up and downstream from nest's location when applied at edge of water of occupied nest. Spot - 10 ft. from water edge. Mechanized - 80 ft. from water edge. A ½-buffer from currently occupied nests.	A ½-mile buffer from currently occupied nests. May be applied along existing road ROW (paved or gravel-base roadways only) during breeding season.
Mexican gray wolf, Black-footed ferret	No limitations					
Mexican spotted owl	May be sprayed along road ROW during breeding season. May be applied in rest of PAC outside the breeding season.			May be sprayed within the PAC outside of No Activity center during the breeding season.		May be sprayed along road ROW during BS. May be applied in rest of PAC outside The BS.
Migratory birds including sensitive & PIF species	May be applied during the breeding season.					

Abbreviation Key: BS - Breeding Season; ROW - Right of way; PAC - Protected Activity Center; PFA – Post-fledging family area; MSO - Mexican spotted owl; TR - Timing restriction. Additional notes listed after Table 28.

Table 9 (cont.). Required protection measures for pesticide applications in identified species habitats.

Federal Species	Herbicides					
	2,4-D (acid formulations)	2,4-D (aquatic amine salt formulations)	2,4-D (nonaquatic amine salt formulations)	2,4-D (aquatic ester formulations)	2,4-D (nonaquatic ester formulations)	Chlorsulfuron
Northern goshawk	May be sprayed along road ROW during the breeding season. May be applied in rest of PFA outside the breeding season.			May be sprayed within PFA outside of nest stand during the breeding season.		May be sprayed along road ROW during the BS. May be applied in rest of PFA outside the BS.
South-western willow flycatcher	Spot – no buffer Mechanized – 30-foot buffer Breeding season timing restriction – April through August			No buffer. Breeding season timing restriction – April through August		Spot – no buffer Mechanized – 30-foot buffer BS TR – April-August
Yellow-billed cuckoo	Spot – no buffer Mechanized – 30-foot buffer Breeding season timing restriction – May through August			No buffer Breeding season timing restriction – May through August		Spot – no buffer Mechanized – 30-foot buffer BS TR – May-August

Abbreviation Key: BS - Breeding Season; ROW - Right of way; PAC - Protected Activity Center; PFA – Post-fledging family area; MSO - Mexican spotted owl; TR - Timing restriction. Additional notes listed after Table 28.

Table 9 (cont.) Required protection measures for additional pesticide applications in identified species habitats.

	Herbicides						
Federal Species	**Clopyralid**	**Dicamba**	**Glyphosate (aquatic)**	**Glyphosate (nonaquatic)**	**Imazapic**	**Imazapyr (technical formulation)**	**Imazapyr (aquatic)**
Mexican spotted owl	May be sprayed along road ROW during BS. May be applied in rest of PAC outside the BS.	May not be sprayed in MSO PACS Spot-300 ft outside PACs & unsurveyed habitat Mechanized-¼ mile outside PACs & unsurveyed habitat.	May be sprayed within PAC outside of No Activity center during the BS.	May be sprayed along road ROW during BS. May be applied in rest of PAC outside BS.	May be sprayed within PAC outside of No Activity center during the BS.	May be sprayed along road ROW during BS. May be applied in rest of PAC outside BS.	May be sprayed within PAC outside of No Activity center during the BS.
Bald eagle and Golden eagle	A ½-mile buffer from currently occupied nests. May be applied along existing road ROW (paved or gravel-base roadways only) during breeding season	Buffer applies for 1 mile up & down stream from nest's location when applied at edge of water of occupied nest. Spot-10 feet from water edge Mechanized-80 feet from water edge. Half-mile buffer from currently occupied nests.	A ½-mile buffer from currently occupied nests. May be applied along existing road ROW (paved or gravel-base roadways only) during breeding season.				

Abbreviation Key: BS - Breeding Season; ROW - Right of way; PAC - Protected Activity Center; PFA – Post-fledging family area; MSO - Mexican spotted owl; TR - Timing restriction. Additional notes listed after Table 28.

Table 9 (cont.). Required protection measures for additional pesticide applications in identified species habitats.

	Herbicides						
Federal Species	**Clopyralid**	**Dicamba**	**Glyphosate (aquatic)**	**Glyphosate (nonaquatic)**	**Imazapic**	**Imazapyr (technical formulation)**	**Imazapyr (aquatic)**
Migratory birds including sensitive & PIF species	May be applied during the BS.	May be applied Sept.-February	May be applied during the breeding season.				
Northern goshawk	May be sprayed along road ROW during BS. May be applied in rest of PFA outside BS.	May be sprayed within PFA outside of nest stand during the BS.		May be sprayed along road ROW during BS. May be applied in rest of PFA outside BS.	May be sprayed within PFA outside of nest stand during the BS.	May be sprayed along road ROW during BS. May be applied in rest of PFA outside BS.	May be sprayed within PFA outside of nest stand during the BS.
Southwestern willow flycatcher	Spot - no buffer Mechanized - 30 ft BS TR - April-August	Spot - 10 ft Mechanized - 60 ft BS TR - April-August	No buffer. BS TR - April-August	Spot - no buffer Mechanized - 30 ft BS TR - April-August	No buffer. BS TR - April-August	Spot - no buffer Mechanized - 30 ft BS TR - April-August	No buffer. BS TR - April-August
Yellow-billed cuckoo	Spot - no buffer Mechanized - 30 ft BS TR – May - August	Spot - 10 ft Mechanized - 60 ft BS TR - May - August	No buffer. BS TR - May-August	Spot - no buffer Mechanized - 30 ft. BS TR - May-August	No buffer. BS TR - May-August	Spot - no buffer Mechanized - 30 ft buffer BS TR - May-August	No buffer. BS TR - May-August
Mexican gray wolf and Black-footed ferret	No limitations						

Abbreviation Key: BS - Breeding Season; ROW - Right of way; PAC - Protected Activity Center; PFA – Post-fledging family area; MSO - Mexican spotted owl; TR - Timing restriction. Additional notes listed after Table 28.

Table 9 (cont.). Required protection measures for additional pesticide applications in identified species habitats.

Federal Species	Herbicides					
	Imazapyr (nonaquatic)	Metsulfuron--Methyl (see note below)	Picloram (see note below)	Sulfometuron--Methyl	Triclopyr (amine salt formulations)	(ester formulations)
Bald eagle and Golden Eagle	A ½-mile buffer from currently occupied nests. May be applied along existing road ROW (paved or gravel-base roadways only) during the breeding season.					Buffer applies for 1 mile up & downstream from nest's location when applied at edge of water of occupied nest. Spot - 10 ft. from water edge Mechanized-80 ft. from water edge ½ mile buffer from currently occupied nests.
Black-footed ferret	No limitations					
Mexican spotted owl	May be sprayed within PAC outside of No Activity center during the BS.	May be sprayed along road ROW during breeding season. May be applied in rest of PAC outside the breeding season.		May be sprayed within PAC outside of No Activity center during the BS.	May be sprayed along road ROW during BS. May be applied in rest of PAC outside BS.	May be sprayed within PAC outside of No Activity center during the BS.
Migratory birds including sensitive & PIF species	May be applied during the breeding season.					

Abbreviation Key: BS - Breeding Season; ROW - Right of way; PAC - Protected Activity Center; PFA – Post-fledging family area; MSO - Mexican spotted owl; TR - Timing restriction. Additional notes listed after Table 28.

Table 9 (cont.). Required protection measures for additional pesticide applications in identified species habitats.

Federal Species	Herbicides					
	Imazapyr (nonaquatic)	Metsulfuron--Methyl (see note below)	Picloram (see note below)	Sulfometuron--Methyl	Triclopyr (amine salt formulations)	(ester formulations)
Northern goshawk	May be sprayed within PFA outside of nest stand during the BS.	May be sprayed along road ROW during the breeding season. May be applied in rest of PFA outside the breeding season.		May be sprayed within PFA outside of nest stand during the BS.	May be sprayed along road ROW during BS. May be applied in rest of PFA outside BS.	May be sprayed within PFA outside of nest stand during the breeding season.
Southwestern willow flycatcher	No buffer - BS TR - April-August	Spot - no buffer. Mechanized - 30 ft. BS TR - April-August	No buffer. BS TR - April-August	No buffer. BS TR - April-August	Spot - no buffer. Mechanized - 30 ft. BS TR - April-August	No buffer. BS TR - April-August
Yellow-billed cuckoo	No buffer - BS TR - May-August	Spot - no buffer. Mechanized - 30 ft. BS TR - May-August	No buffer. BS TR - May-August	No buffer. BS TR - May-August	Spot - no buffer. Mechanized - 30 ft. BS TR - May-August	No buffer. BS TR - May-August

Abbreviation Key: BS - Breeding Season; ROW - Right of way; PAC - Protected Activity Center; PFA – Post-fledging family area; MSO - Mexican spotted owl; TR - Timing restriction.

Additional Notes for Table 9:

RPMPA - Resource Protection Measures for Pesticide Applications in Region 2 of the U.S. Fish and Wildlife Service. J. Allen White, U.S. Fish and Wildlife Service, 10711 Burnett Road, Suite No. 200, Austin, Texas 78758, April 2007.

These RPMP are to be implemented in concert with the required protection measures detailed in Appendix B of the FEIS for the tri-forest noxious or invasive weed treatments.

Metsulfuron = metsulfuron is rated as Class 1 in toxicity groups for fish and amphibians due to reported mortality incidents not indicated by toxicity data.

Picloram = picloram is used mostly for broad-leaved plants but can harm some grasses and other monocots.

A **buffer zone** is the distance between the boundary of the area requiring protection and the closest point of the last spot application or application swath. Standard weather conditions for pesticide application (i.e., no temperature inversions, wind speeds between 3 and 10 miles per hour, and no rainfall for 24 hours) should be followed in implementing recommended buffer zones.

Spot applications include pesticide applications by hand-operated equipment or a spray gun that discharges pesticide in liquid streams from a spray tank.

Low aerial applications (nozzle or spreader height less than 12 feet) and high aerial applications (nozzle or spreader height greater than 12 feet) are relative to the plant canopy or a bare ground surface. In grassland or semi-open plant communities (shrubland, woodland, etc.) with more than 40 percent grass cover, the top of the grass canopy should be used to determine whether an aerial application is low or high. For forested lands or dense shrubland with less than 40 percent grass cover, the tops of trees or shrubs should be used in determining whether applications are low or high.

Solid formulations include baits, granules, pellets, and treated seed but do not include dusts.

Liquid formulations include any type of liquid-based formulation other than ULV formulations.

ULV (ultra low volume) refers to liquid formulations applied at a rate of 1/2 gallon or less per acre.

Table 10. Adjuvant Summary Table and Required Protection Measures

Species	- ACTIVATOR 90 - SILWET L-77 - CHOICE - LI 700 - ACIDI pHACTANT - ALL CLEAR, - Tank and Equipment Cleaner - Mineral oil**	- Methylated Seed Oil** - AMIGO** - Marker dye WSP - CHEM-TROL - NU FILM P - FIGHTER F - FOAM FIGHTER
Southwestern willow flycatcher, Yellow-billed cuckoo, Bald eagle, Golden eagle, Rriparian migratory birds	Shall not be used in riparian habitat*.	Approved for use in riparian habitat.
Mexican spotted owl, Black-footed ferret, Mexican gray wolf, Northern goshawk, Terrestrial migratory birds	Approved for use in habitat.	Approved for use in habitat.

***Riparian habitat –** Overstory trees include alders, conifers, cottonwood, maple, sycamore, and willows. Understory species include hackberry, New Mexico locust, and soapberry. Herbaceous plants include sedges, spikerush, bull rush, little bluestem, blue grama, Canadian wildrye, sand bluestem, squirreltail, smartweed, and curlydock (EIS vegetation affected environment).

****Carriers –** Three types of oils used to ensure even distribution of small amounts of herbicides during application.

Appendix D: Mitigation Considerations Common to all Projects

The following are mitigation practices that must be considered during the planning stage of every invasive plant control project.

Mitigation measures are related to a number of resource areas. A mitigation checklist has been prepared and must be reviewed prior to any treatments (see **Appendix A**).

- **Prevention**

Preventing establishment is an economical way to manage exotic plants. Under the preferred alternative, the following prevention actions would be implemented:

1. Any feed, forage, mulch, fill, gravel, and other like materials brought into a park should be certified free of exotic plant seed ("certified weed-free"). Certified weed-free hay is often smooth brome, crested wheat grass, and alfalfa, which are not native to this country. While certified weed-free hay may include exotics, it may be the best option available. However, parks will encourage the use of hay composed only of native forage. Weed-free hay that does not include exotic plants is readily available in the NGP.
2. Sources of "clean fill" (weed-free) will be used, where available, if construction fill will be obtained from within parks. If not feasible, fill not designated as "clean fill" may be used but should be closely monitored for exotic plant growth. Construction equipment will otherwise avoid exotic plant infestations, to the extent feasible.
3. Brush horses and pack animals thoroughly and have their hooves cleaned before entering a park.
4. Feed horses and pack animals only food that is "certified weed free" starting 96 hours before entering a park.
5. Any seed or plant materials used for restoration efforts within a park should be "certified weed free."
6. Require inspections and cleaning of contractors' and fire fighters' equipment, vehicles, and materials to prevent importation of nonnative plant seed or materials into a park.
7. Require commercial users that disturb established vegetation to provide bonds that are
8. retained until sites are returned to a specified condition.
9. Develop BMPs to limit the amount and impact of ground-disturbing activities.
10. Train park staff and volunteers on how to identify priority exotic plants. Park employees and volunteers should report any observations of exotic plants to the resource manager immediately. A phone number for the point of contact would be provided to staff and volunteers.
11. Develop information for the public and park staff on exotic plants. This information may include signs, interpretive displays, brochures, and programs.

- **Cultural Resources**

Mechanical treatments in close proximity to historic and prehistoric cultural resource sites will only be implemented under the supervision of a cultural resource specialist to avoid the possibility of disturbing subsurface archeological material or undermining remaining standing architecture. Prescribed burns will only be implemented after the approval of a burn plan, and only used in areas away from cultural resource sites. Should any treatment be determined to potentially affect cultural resources, site specific compliance with Section 106

of the National Historic Preservation Act will be initiated with the park's affiliated tribes as well as the state historic preservation office.

FLAG archeologists will work closely with the biologist and invasive species treatment crews in the location and identification of historic and prehistoric structures. FLAG staff and EPMT crews conducting invasive plant management work will be trained yearly in cultural site awareness to learn how to identify and avoid archeological and historical resources on the ground. This training has been very successful in other parks to assure the protection of park cultural resources (Wells 2004). Should presently unidentified archeological resources be discovered during project implementation, work in that location would stop until the resources are properly recorded by an NPS archeologist and evaluated under National Register of Historic Places eligibility criteria in consultation with the Arizona State Historic Preservation Officer (AZ SHPO) and affiliated tribes as appropriate. If the resources are determined eligible, appropriate measures would be implemented either to avoid resource impacts or to mitigate disturbance. In compliance with the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), the NPS would also notify and consult affiliated tribal representatives for proper treatment of human remains, funerary, and sacred objects, should these be discovered. All workers would be informed of penalties for illegally collecting artifacts or intentionally damaging any archeological or historic property in the vicinity. Should any unusual treatment conditions or locations arise related to cultural resources, park staff would contact the park archeologist to determine how to proceed.

To minimize impacts on cultural resources, the following mitigation measures would be incorporated into the action alternative:

1. If previously unknown cultural resources are discovered during the project, a Cultural Resources specialist would be contacted immediately. All work in the immediate vicinity of the discovery would be halted until resources could be identified and documented and an appropriate mitigation strategy developed, if necessary, in accordance with stipulations of the Programmatic Agreement among the National Park Service, Arizona State Historic Preservation Officer, and Advisory Council on Historic Preservation.
2. All workers would be informed of penalties of illegally collecting artifacts or intentionally damaging any cultural property. Workers would also be informed of correct procedures if previously unknown resources were uncovered during construction activities.
3. Areas selected for equipment and materials staging in developed areas are expected to be in existing disturbed areas or existing paved overlooks where there is no potential for disturbance to cultural resources. If sites selected for these activities change during later design phases for implementation of any of the alternatives, additional surveys would be conducted.
4. Vegetation Program Crew Leaders would attend one-day training in recognition of archaeological sites and associated sensitivities in field work conditions. This training will be provided by Flagstaff Area Monuments Cultural Resources staff and will include methods for planning ahead and preparing field crews for work around archaeological sites, identification of historic and prehistoric artifacts and features, and avoiding site disturbances.
5. Annual work plans would be reviewed by FLAG Cultural Resources staff to evaluate project areas, crew size, and invasive vegetation treatment types and associated ground

disturbing activities.

6. FLAG Cultural Resources staff would provide maps to Vegetation Program Crew Leaders showing location of archaeological sites in relation to vegetation treatment areas in the monuments. Maps showing location of archaeological sites would be returned at the end of the project.
7. In areas proposed for invasive plant treatment where archaeological inventory survey has not been completed, an archeologist or other specialist would need to review mechanical subsurface treatment of plants prior to implementation. Mechanical subsurface treatment includes any ground disturbance greater than 6 inches deep and 12 inches in diameter.
8. An archeologist would review mechanical subsurface treatment (digging) in sensitive areas of known archaeological sites (constructed features, middens, artifact concentrations) prior to implementation. All such activities would be documented and filed with site records. Loosening soil with hand tools while hand-pulling herbaceous plants and shrubs is allowable, provided the ground disturbance would not exceed 6 inches deep and 12 inches in diameter, and soil would not be removed from the area of treatment
9. Accessing work / treatment areas should be planned to avoid walking through archaeological sites whenever possible.
10. Work crews would be split into small teams of two to four people when working around archaeological sites.
11. Work crews would not walk across archaeological features such as constructed features, middens, or artifact concentrations.
12. Work crews would avoid creating paths and trails in loose soils and sand.
13. Work crews would avoid walking on bedrock surfaces that contain artifact concentrations to avoid crushing artifacts.
14. Work crews would report all previously unrecorded archaeological sites.
15. All inadvertent damage to archaeological sites would be documented by recording GPS coordinates, map location, photographs and description of damage.
16. If vegetation removal or herbicide use were anticipated at historic wall foundations or mortar joints, the FLAG Chief of Cultural Resources would be consulted prior to treatment to avoid any adverse impacts to these resources

- **Mapping of Invasive Plant Species**

  Newly discovered invasive plant species and infestations will be mapped with a GPS unit, and the FLAG resource staff will be notified. All workers' clothing and footwear and all tools and equipment shall be cleaned at the treatment sites to ensure that seeds or propagules (any plant part that can give rise to new individuals) from invasive plant plants are not transported to new locations. FLAG staff will continue to work with SCPN on their invasive species vital sign monitoring and to store GIS data.

- **Job and Tool Use Safety**

  A job hazard analysis (JHA) that outlines job hazards and safety precautions will be developed for each project, and all project participants will receive tool safety training and will be required to use the appropriate Personal Protective Equipment (PPE) for each associated task. The tools would be kept in appropriate and assigned storage locations at all times. The use of tools would follow procedures outlined in the JHA.

- **Visitor Experience**
  NPS staff will be available to provide educational and informational messages to any groups encountered during project implementation. Infestations located near heavily used areas will be mechanically controlled, if feasible, and the work will be completed when visitors will be least impacted.

  1. Unless otherwise approved by the park, operation of mechanized equipment would be restricted to dawn to dusk, year-round

  2. As time and funding allow, information regarding project implementation and other foreseeable future projects would be shared with the public through park publications and other appropriate means during construction periods. This may include an informational brochure or flyer distributed at the Visitor Centers sent to those with reservations at monument facilities, postings on the monument's website, press releases and/or other methods. The purpose would be to minimize potential for negative impacts to visitor use experience during project implementation and other planned projects during the same construction season

- **Biological Control**

Release of biological control agents adhere to the following BMPs:

1. Biological control agents must be approved by APHIS and the USFWS. They should be released in each climatic zone that is occupied by the host so that the natural enemy has a chance to develop in all areas where the host occurs.
2. The number of biological control agents released should account for the size and density of the treatment area and the number of agents required to maintain a viable biological control agent population.
3. More than one release in an area may be necessary for successful establishment.
4. Releases should be synchronized with the time period when the host is present.
5. Biological control agents should be released at times of the day when they will not disperse from the treatment area.
6. Surveys for biological control agents should be completed several times during the season to monitor biological control agents.

- **Chemical Control**

BMPs would be followed to ensure that the overall effectiveness of pesticides is maximized and the potential for impacts is minimized. These general BMPs include the following:

1. Pesticides would be selected and BMPs would be implemented to maximize the effectiveness of the treatment on the target exotic plant and to minimize the potential effects on non-target plants.
2. Reduced application rates of pesticides would be used wherever possible. Reduced application rates are often more effective than higher application rates because translocation is enhanced prior to loss of physiologic function. Higher rates may burn off leaves and reduce translocation.
3. Pesticides would be applied as near to the target plant as possible.
4. Pesticide application would account for meteorological factors such as wind speed, wind direction, inversions, humidity, and precipitation in relation to the presence of sensitive

resources near the treatment area and direction provided on labels. Pesticides would only be applied when meteorological conditions at the treatment site allow for complete and even coverage and would prevent drifting of spray onto non-target sensitive resources or areas used by humans.

5. Pesticides would be applied only during periods of suitable meteorological conditions. Loss of spray from a treated area increases during high winds or low humidity. Pesticides should also not be applied during periods of dead calm (this could indicate an inversion) or when wind velocity and direction pose a risk of spray drift.
6. Pesticides would be applied using coarse sprays to minimize the potential for drift. Avoid combinations of pressure and nozzle type that would result in fine particles (mist). Add thickeners if the product label permits.
7. Pesticides would be applied at the appropriate time based on the pesticide's mode of action. Poor timing of application can reduce the effectiveness of pesticides and can increase the impact on non-target plants.
8. Pesticides would be applied according to application rates specified on the product label.
9. In areas where there is the potential to affect surface water or ground water resources, pesticide pH and soil pH would be considered to select the pesticide with the lowest leaching potential.
10. Highly water-soluble pesticides would not be used in areas where there is potential to affect surface water or ground water resources.
11. Pesticides with high volatility would not be used to treat areas located adjacent to sensitive areas because of the potential for unwanted movement of pesticides to these areas.
12. Pesticides with high soil retention would be used in areas where there is potential to affect surface water or ground water resources.
13. Pesticides with longer persistence would be applied at lower concentrations and with less frequency to limit the potential for accumulation of pesticides in soils.
14. As needed to protect the efficacy of the pesticide, water would be buffered, depending on hardness, pH, and other factors.
15. Safety protocols for storing, mixing, transporting, handling spills, and disposing of unused pesticides and containers are included in Appendix E and would be followed at all times. Plans for emergency spills are included in Appendix E.
16. All federal, state, and local regulations regarding pesticide use would be followed at all times.
17. All product labels would be read and followed by pesticide applicators. It is a violation of federal law to use a pesticide in a manner that is inconsistent with its label.
18. Pesticide applicators would obtain any certifications or licenses required by the state and/or county.
19. NPS policy requires that only pesticides that are expected to be used in a 1-year period can be purchased at one time. Therefore, pesticides would not be stored for periods greater than on year. Pesticide efficacy is lost over time. This practice of purchasing no more than a one-year supply would maintain pesticide efficacy that would otherwise be reduced by longer storage.
20. Equipment would be maintained and calibrated prior to each application of pesticides. During all applications, droplet size would be controlled to decrease the risk of pesticide drift to non-target species outside the immediate treatment area. Droplet size is controlled by nozzle settings.

21. All concessioners would comply with the EPMP/EA and NPS policy when applying pesticides. Concessioners would comply with guidance document, Understanding the National Park Service's Integrated Pest Management Program (NPS 2003i).
22. Any motorized water crossings to access treatment areas should be done at right angles to drainages to minimize potential disturbance.

- **Chemical Treatments near Surface Water and Ground Water Sources**

Only pesticides that are registered for use in or near water would be used in those areas.

1. Only those pesticides that have a low potential toxicity, such as glyphosate (Roundup Pro and Rodeo) would be used within areas near surface waters or in areas with a high leaching potential. Glyphosate is strongly adsorbed into soil, with little potential for leaching to ground water. Microbes in the soil readily and completely degrade it even in low temperatures. It tends to adhere to sediments when released to water and does not accumulate in aquatic life (Forest Service 2004).
2. Applications of pesticides would be avoided during periods and in areas where seasonal precipitation or excess irrigation water is likely to wash residual pesticides into waterways.
3. Applications of pesticides within 50 feet of surface water bodies (including streams, rivers, lakes, and waterways) would be done by hand or with vehicle mounted ground equipment to minimize the potential impacts to surface waters.
4. If aerial applications are used, flights would be designed and scheduled for wind conditions that minimize potential impacts to surface waters.
5. Each monument currently monitors potable drinking water quality. This monitoring would continue to confirm that potable water meets drinking water standards as outlined by the Safe Drinking Water Act (SDWA).
6. FLAG would implement surface water and ground water monitoring programs as appropriate to protect natural resources. Rigorous testing of pesticides is required prior to release as a registered product.
7. The RAVE system would be used, as necessary and appropriate, to evaluate potential risks to ground water from chemical treatments.
8. When available from the Regional IPM Coordinator, vertical buffer zones to ground water would be used.

- **Native Plant Restoration**

Active native species restoration must be used in all project areas. All restoration efforts will use native species. Restoration will seek to restore the natural conditions prior to invasive plant species arrival or to prevent re-invasion after removal. Active restoration will include the collection of seed and/or cuttings from native plants in the project area. Any seed spreading or planting of cuttings would seek to replicate the composition and structure of the untrammeled native plant communities. Effective monitoring and maintenance must be conducted in these areas to ensure project success.

- **Soil Compaction and Biotic Community Disturbance**

To minimize soil compaction, the following mitigation measures will be incorporated into all action alternatives:

1. The project leader will determine the access route that would cause the least disturbance to sensitive soils and vegetation. Access to areas should include

existing wildlife or hiking trails wherever possible. If no trails exist, the project leader will determine whether single or multiple paths can be used depending on which would cause the least impact.

2. The least amount of people and the minimum number of trips will be conducted into sensitive areas for follow-up treatments and/or monitoring.

3. If equipment such as an Off-Road Vehicle (ORV), utility vehicle (UV), or tractor is used for invasive plant treatments or restoration, the lightest/smallest equipment shall be used. No such equipment will be used on wet soils or cryptobiotic soil crusts that could be subject to long-term compaction impacts. Equipment will be cleaned on-site to prevent the transport of invasive species into new areas.

- **Special Status Species**
  See **Appendix C** for a thorough listing of required mitigation for any project that involves or may involve special status species.

- **Construction and Ground Disturbing Projects**
  The following mitigation measures will be used in all FLAG construction projects:

1. Inventories for existing populations of nonnative species will occur in all project and staging areas and will be treated before construction, as deemed necessary by the FLAG vegetation program manager. As design plans develop, they will be cross-referenced with existing vegetation survey information to ensure that no new survey is necessary before work starts.

2. All vehicles and construction equipment that will leave the road will be pressure-washed before entering the park. The location selected for vehicle washing will be approved by a FLAG supervisory biologist.

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

4. Staging area locations for construction equipment will be management approved, and the need to treat for nonnative vegetation will be mandatory.

5. Vehicle parking will be limited to existing roads or designated staging areas.

6. Any imported fill, rock, topsoil, mulch, straw, or other imported material will be obtained from a park-approved weed-free source. Topsoil from the project area will be retained whenever feasible and stockpiled in a segregated location for later re-use.

7. A restoration plan will be developed by the FLAG vegetation program manager in consultation with a landscape architect, if necessary. Any revegetation efforts will use site-adapted native species and/or site-adapted native seed. Park policies regarding revegetation and site restoration will be incorporated. Incorporated within the plan will be, among other things, the use of native species, plant salvage potential, nonnative vegetation management, and pedestrian barriers. Policies related to revegetation will be referenced from NPS *Management Policies 2006*.

8. All areas disturbed by construction will be revegetated using site-adapted native seed and/or plants. Disturbed areas will be mulched and seeded with native plant seed to minimize potential for nonnative annual plant invasion and infestation.

9. Revegetation efforts will be initiated as soon as possible following construction to minimize the competition of native species with nonnative species.

10. Nonnative species encroachment and distribution will be monitored for a minimum of two to three years after construction around each project site.

11. The NPS will provide visitors with educational and advisory materials about driving vehicles from areas that have nonnative species infestations outside the parks and bringing these species into contact with areas that have little to no current nonnative species infestations inside the parks.

Appendix E:
Herbicide Risk Assessment

The herbicides proposed for use include chlorsulfuron, clopyralid, 2,4-D, dicamba, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sufometuron methyl, and triclopyr. These herbicides are marketed under a variety of trade names. The U.S. Environmental Protection Agency (EPA) has registered all of these herbicides and the various product labels include requirements and restrictions.

None of the herbicides proposed for use bioaccumulate and, therefore, none pose a risk to upper food chain consumers. Animals and plants have different metabolic pathways so a compound that is toxic to plants can be relatively non-toxic to animals. The EPA classifies all of the herbicides proposed for use, except for 2,4-D, as slightly toxic (Category III) to almost non-toxic (Category IV) to humans. The rating for 2,4-D is moderately toxic (Category II).

The risk assessment is a common method for analyzing potential effects of various chemicals on humans and non-target species. It uses generally accepted standards of safety to quantify the long-term risks from an action. The USDA Forest Service, Southwestern Region has analyzed the risk of the use of 21 herbicides and 4 carriers (USDA Forest Service 1992). In addition, specific risk assessments are available for all of the herbicides being considered (http://www.fs.fed.us/foresthealth/pesticide/risk_assessments). A comparison of the 1992 risk assessment and the updated risk assessments indicate the conclusions remain the same. The risk assessment for the Southwestern Region (USDA Forest Service 1992) displays estimated risks to non-target species of mammals, fish, birds, reptiles, amphibians, and invertebrates. These estimates are based on a comparison of laboratory toxicity studies with estimated exposures of representative species. The assessments display risks from "routine typical" and "routine extreme" cases. Routine typical cases represent risks to workers, the public, and other organisms that may occur as a result of routine operations. The routine extreme approach is used to estimate doses that would occur under conditions of maximum use and maximum exposure (Appendix A, USDA Forest Service 2003).

The herbicides proposed for use all have low aquatic toxicity under typical case water concentrations (Table III-H-6. page III-H-13. 1992 risk assessment). The only exception is triclopyr not labeled for aquatic application, which may present a high risk for trout in streams and a moderate risk for trout in lakes. All herbicides would be used in accordance with label directions so triclopyr would not be used where it might enter water. Picloram, dicamba, and 2,4-D not labeled for aquatic applications may present a moderate risk under extreme water concentration, but this case seems highly unlikely under the conditions of proposed application. Nevertheless, these herbicides would not be used where they might enter water. Clopyralid, dicamba, and glyphosate are roughly 1/5 to 1/50 as toxic to various aquatic organisms, so under conditions of proposed application they are highly unlikely to pose a risk to aquatic organisms (Appendix A, USDA Forest Service 2003).

For threatened, endangered, or sensitive aquatic organisms, triclopyr products not labeled for aquatic use may present an unacceptable risk to cold-water fish under the typical case scenario. Likewise, 2,4-D not labeled for aquatic use may present an unacceptable risk to aquatic invertebrates. However, in accordance with label directions, these products would not be used in aquatic applications. It must be noted that the assessment was made using aerial application as

the treatment approach realizing that aerial application poses the potential risk of inadvertent application to water. The herbicide applications near water would be hand backpack applications by spot application to single plant or plant clusters using hand-operated equipment and a back pack tank, and this would result in minimal risk of contamination to surface water. Leaching of herbicides through soil is not a significant process.

Herbicides do have the potential for overland flow during heavy rainstorms, but the likelihood of such movement on infiltration-dominated sites makes water contamination unlikely. Mitigation measures and BMPs would reduce the potential for possible adverse effects to aquatic organisms.

Appendix F: Weed Control Pesticide Safety and Spill Plan

Information and Equipment

The Flagstaff Area Monuments coordinator for Walnut Canyon, Wupatki, and Sunset Crater National Monuments will fulfill the role as the certified pesticide applicator for the project. The coordinator for FLAG will be the Vegetation Ecologist who is based at the Headquarters Building in Flagstaff. The regional pesticide coordinator will serve as the fall-back technical staff and advisor if NPS personnel are not trained and certified.

All participants must be pesticide spray applicator certified by the State of Arizona prior to any spraying. A copy of the labels and material safety data sheets (MSDS) for all herbicides will be available at all times during project operations. Employees will be completely familiar with the information in these documents in case it is needed in the event of a spill or incident. Required personal protective equipment (PPE) shall be worn at all times when herbicides are being mixed and applied. Label requirements for specific herbicides must be followed. Applicators and handlers must wear long-sleeved shirt and long pants, waterproof and chemical-resistant gloves, and boots and socks.

An emergency spill kit, with directions for use, must be present when herbicides are being mixed, transported, and applied. Employees shall be trained in the use of the spill kit prior to initiation of operations.

The spill kit shall contain the following equipment:

Shovel
Broom
Ten pounds of absorbent material
Box of large plastic bags
Nitrile gloves

Mitigations for Herbicide Use

1. Application personnel shall be State of Arizona certified pesticide applicators . All applicators must wear protective clothing as described on the label.
2. All herbicide applications will follow EPA label requirements, USDA policy, and National Park Service direction.
3. Only herbicides labeled for use adjacent to water will be used within riparian zones and areas with shallow ground water.
4. Suspension of broadcast herbicidal applications will occur when the following conditions exist. During these weather patterns, herbicide application methods shall be limited to hand-held spot spraying or wick application:
    a. Wind velocity exceeds 6 miles per hour for liquids or 15 miles per hour for granular herbicides, unless a lower maximum wind speed is specified on the label.
    b. Snow or ice covers the target plant.
    c. Precipitation is occurring or is imminent.
    d. Fog significantly reduces visibility.
    e. Air turbulence, such as thermal updrafts, is sufficient to affect the normal herbicide distribution pattern.

5. Herbicides shall be transported daily to the project site under the following conditions:
    a. transport only the quantity needed for that day's work, and
    b. transport concentrate only in containers in a manner that will prevent tipping or spilling, and in a compartment that is isolated from food, clothing, and safety equipment.
6. Mixing, loading, and equipment cleaning must be done onsite and at least 300 feet from the edge of a "Limited Spray Zone" or from private land (unless the owner is cooperating in the project), open water, known wellheads, or sensitive areas. Mixing and cleaning water must be transported to the site in labeled containers that are separate from water used for other purposes.
7. Non-herbicidal methods will be the preferred choice for 35 meters around wellheads or water tanks. If herbicides must be used, treatments will be timed with the driest periods to prevent leaching of any herbicides directly into the wellhead and still have effective control.
8. Safety and spill plans shall be written for each project.
9. All herbicide containers will be disposed of in accordance with label, State, and Federal requirements.
10. Broadcast spray sites will be posted at all access points 2 weeks before, during, and 2 weeks following herbicide application.

Procedures for Herbicide Spill Containment

Notify the superintendent and relevant monument visitor center of an incident or spill. Identify the nature of the incident and extent of the spill.

Include the following information (examples are supplied):

Product Name:	Tordon 22K	Reclaim
Chemical Name:	Picloram	Clopyralid
EPA Registration Number:	62719-6	62719-83

Remove any injured or contaminated person to a safe area. Remove contaminated clothing and follow instructions on the MSDSs. Do not leave an injured person alone. Obtain medical help for any injured employee.

Contain the spilled herbicide as much as possible on the site. Prevent the herbicide from entering ditches, gullies, wells, or water systems.

Small Spills

A "small spill" is defined as less than 1 gallon of herbicide formulation or less than 10 gallons of herbicide mixture.

1. Qualified employees must be present to confine a spill.
2. Follow MSDS guidelines for emergency first aid procedures in the event of an accidental exposure.
3. Restrict entry to the spill area by roping off and flagging.
4. Contain spread of spill with earthen dikes.
5. Cover spill with absorbent material.
6. Place contaminated materials into leak-proof containers and label them with time, date, and contents.

7. Dispose of contaminated materials according to label instructions and State requirements.

Large Spills

A "large spill" is more than 1 gallon of herbicide formulations or more than 10 gallons of herbicide mixture.

1. Keep people away from the spill.
2. Flag and rope off the spill area.
3. Follow MSDS guidelines for emergency first aid procedures in the event of an accidental exposure.
4. Contact Dow AgroSciences at 1-800-992-5994.
5. Call Chemical Transportation Emergency Center (Chemtrec) at 1-800-424-9300 if DowAgroSciences cannot be reached.
6. Notify the highway patrol or sheriff if the spill occurs on a highway.
7. Contain spread of the spill with earthen dikes.
8. Cover the spill with absorbent material.
9. Spread the absorbent material around the perimeter of the spill and sweep toward the center.
10. Call the direct supervisor or safety coordinator and the NPS hazardous material coordinator for further instruction or action.

Notification List of Key Personnel

(To be updated for individual monuments/projects)

FLAG Superintendent:_____928.526.1157 x227_____
Monument VC (numbers):_____

Regional Pesticide Coordinator: __Craig Hauke at (435) 719-2132_____

FLAG Safety Officer: Name & number_____

Local hospital and number_____

Chemtrec: 1-800-424-9300

Appendix G: Annual Work Plan Outline

I. Introduction

1) Review of Park Management Areas (see Chapter 1)
2) Goals and Objectives of the Invasive Plant Work Plan (see Chapter 1)
3) Description of How Plant Species Can Interfere with Management Goals

II. Overview of Invasive Plant Work Plan

A. General Management Philosophy and Setting Priorities

1) Prevent Invasion
2) Public Awareness, Outreach, Education, and Collaboration
3) Inventory and Monitoring
4) Research and Priority Setting
5) Record Keeping and Evaluation
6) Manage Invasive Nonnative Plants

B. Summary of Specific Actions Planned

1) Survey and Treatment Areas (specific areas scheduled for the year)

C. Tables and Appendices

Table 1 Prioritized list of Invasive Plant Species including location and removal recommendations
Table 2 List of Prioritized Areas for Species Surveys and Treatment
Table 3 Invasive Species Survey and Treatment Implementation Schedule

Appendix 1 Forms used in collecting monitoring data
Appendix 2 Herbicide use protocols
- **1)** Herbicide Training Log
- **2)** Job Hazard Analyses
- **3)** Pesticide Use Proposal Forms
- **4)** Herbicide Use Log

Appendix 3 Herbicide Labels
Appendix 4 GRCA Vegetation Program Safety Plan
Appendix 5 Additional Species Information

Appendix H:

Federally-listed species, other agency "sensitive species", or "species of concern" known to occur or potentially occur within Wupatki, Sunset Crater Volcano, and Walnut Canyon National Monuments.

Wildlife Species

COMMON NAME	SCIENTIFIC NAME	STATUS	LOCATION
1) Mexican Spotted Owl	*Strix occidentalis* ssp. *lucida*	ESA Threatened	WACA (confirmed)
2) Bald Eagle	*Haliaeetus leucocephalus*	USFWS Recovered	WACA (No nests) SUCR (No Nests) WUPA (No nests)
3) Peregrine Falcon	*Falco peregrinus* ssp. *anatum*	USFWS Recovered	WACA (confirmed)
4) Northern Goshawk	*Accipiter gentilis*	USFWS SC	WACA (confirmed)
5) Golden Eagle	*Aquila chrysaetos*	NPS SC	WUPA (confirmed)
6) Western Burrowing Owl	*Athene cunicularia* ssp. *hypugaea*	USFWS SC	WUPA (confirmed)
7) Ferruginous Hawk	*Buteo regalis*	USFWS SC	WUPA (potential)
8) Wupatki pocket mouse	*Perognathus amplus* ssp. *cinerus*	USFWS SC	WUPA (confirmed)
9) Gunnison's prairie dog	*Cynomys gunnisoni*	AZ WSC	WUPA (confirmed) SUCR (obs.) WACA (adjacent)
10) American pronghorn	*Antilocapra americana*	NPS SC	WUPA (confirmed) SUCR (confirmed) WACA (obs.)
11) Townsend's big-eared bat	*Corynorhinus townsendii* spp. *pallescens*	USFWS SC	WUPA (confirmed) SUCR (potential) WACA (potential)
12) spotted bat	*Euderma maculatum*	USFWS SC	WUPA (confirmed) WACA (potential)
13) Allen's big eared bat	*Idionycteris phyllotus*	USFWS SC	SUCR (potential) WACA (confirmed)
14) western small-footed myotis bat	*Myotis ciliolabrum*	USFWS SC	WUPA (confirmed) SUCR (confirmed) WACA (confirmed)
15) long-eared myotis bat	*Myotis evotis*	USFWS SC	SUCR (confirmed) WACA (confirmed)
16) Arizona myotis bat	*Myotis occultus*	USFWS SC	SUCR (potential) WACA (confirmed)
17) fringed myotis bat	*Myotis thysanodes*	USFWS SC	WUPA (confirmed) SUCR (confirmed) WACA (confirmed)
18) long-legged myotis bat	*Myotis volans*	USFWS SC	SUCR (confirmed) WACA (potential)
19) big free-tailed bat	*Nyctinamops macrotis*	USFWS SC	WUPA (confirmed) SUCR (potential) WACA (confirmed)
20) endemic pseudoscorpion Wupatki Earthcrack System	*Archeolarca welbourni*	NPS SC	WUPA (confirmed)
21) endemic pseudoscorpion Wupatki Earthcrack System	*Pseudogarypus hypogeus*	NPS SC	WUPA (confirmed)

Mammals (American pronghorn antelope, Allen's lappet-browed bat, greater western mastiff bat, long-legged myotis bat, Mexican long-tongued bat, pale Townsend's big-eared bat, pocketed free-tailed bat, southwestern myotis bat, spotted bat, western red bat)

Plant Species

COMMON NAME	SCIENTIFIC NAME	STATUS	LOCATION
1) Peeble's bluestar	*Amsonia peeblesii*	NPS SC	WUPA (confirmed)
2) Beath milkvetch	*Astragalus beathii*	BLM Sensitive	WUPA (potential)
3) Marble Canyon milkvetch	*Astagalus cremnophylax* var. *hevronii*	USFS Sensitive	WUPA (potential)
4) Mogollon columbine	*Aquilegia desertorum*	AZ SR	WACA (confirmed)
5) Arizona bugbane	*Cimicifuga arizonica*	USFWS SC	WACA (potential)
6) Cameron water parsley	*Cymopterus megacephalus*	USFWS SC	WUPA (confirmed)
7) Clustered barrel cactus	*Echinocactus polycephalus*	AZ SR, NPS SC	WUPA (confirmed)
8) Rock fleabane	*Erigeron saxatalis*	USFS Sensitive	WACA (confirmed)
9) Roundleaf errazurizia	*Errazurizia rotundata*	BLM Sensitive	WUPA (confirmed)
10) Flagstaff pennyroyal	*Hedeoma diffusum*	USFS Sensitive	WACA (potential)
11) Arizona walnut	*Juglans major*	NPS SC	WACA (confirmed) WUPA (confirmed)
12) Fickeisen pincushion cactus	*Pediocactus peeblesianus* var. *fickeiseniae*	ESA Candidate	WUPA (potential)
13) Simpson plains cactus	*Pediocactus simpsonii*	AZ SR	WUPA (confirmed)
14) Sunset Crater penstemon	*Penstemon clutei*	USFWS SC	SUCR (confirmed)
15) Cinder phacelia	*Phacelia serrata*	USFWS SC	SUCR (confirmed) WUPA (confirmed)
16) Welsh's phacelia	*Phacelia welshii*	USFWS SC	WUPA (confirmed)
17) Common reed	*Phragmites australis*	NPS SC	WUPA (confirmed)
18) Whiting's indigo bush	*Psorothamnus thompsoniae* var. *whitingii*	USFWS SC	WUPA (confirmed)

(1) Status Acronyms

ESA Threatened – Federally listed as "Threatened" under the Endangered Species Act
ESA Candidate – Candidate species for listing as "Threatened" under the Endangered Species Act
USFWS Recovered – Recently removed from the Endangered Species List and currently in the post-listing monitoring period
USFWS SC – Identified by the U.S. Fish & Wildlife Service as a "species of concern"
AZ WSC – "Wildlife species of concern" identified by the Arizona Game & Fish Dept.
AZ SR – Listed under the Arizona Native Plant Law as "Salvage restricted"
BLM Sensitive – Identified in Bureau of Land Management planning documents as a "sensitive species"
USFS Sensitive – Identified in USDA Forest Service planning documents as a "sensitive species"
NPS SC – Identified in the recent General Management Plans for WUPA, SUCR, and WACA as a "species of special management concern"

(2) Location Acronyms

WUPA = Wupatki National Monument
WACA = Walnut Canyon National Monument
SUCR = Sunset Crater Volcano National Monument

(3) Occurrence Record

Confirmed = museum voucher, published account, or NPS written record on file
Potential = suitable habitat but no occurrence record
Observation = reliable observation communicated to NPS by other Federal agency or AZG&F Dept. biologist
Adjacent = confirmed observation on adjacent lands close to the boundary

References

Arizona Game & Fish Department. 2004. List of protected and sensitive species for Coconino County, Arizona. Heritage Data Management System, via the internet at www.azgf.com.

2002b General Management Plan/Final Environmental Impact Statement. Wupatki National Monument. November 2002.

2002b General Management Plan and Final Environmental Impact Statement, Sunset Crater Volcano National Monument. November 2002.

2001c Draft General Management Plan/Environmental Impact Statement for Walnut Canyon National Monument. September 2001.

Appendix I:
Flagstaff Area Monuments Special Status Species, Status, Distribution and Habitat Information

Special Status Species at Sunset Crater Volcano National Monument

COMMON NAME	SCIENTIFIC NAME	STATUS [1]	DISTRIBUTION/ HABITAT INFORMATION [2]
BIRDS:			
Bald Eagle	*Haliaeetus leucocephalus*	ESA Threatened	Routinely observed in flight over Sunset Crater area during winter months; Likely to perch in snags along roadways and feed on carrion on roads; May perch or rarely roost in large ponderosa and Douglas fir snags in other areas.
Northern Goshawk	*Accipiter gentilis*	USFWS SC	No known nesting areas within/near SUCR; May hunt in SUCR; Nests within ponderosa pine stands with large diameter trees and moderate-high canopy closure.
MAMMALS:			
American pronghorn	*Antilocapra americana*	NPS SC	💻 Bonito Park adjacent to SUCR; Infrequent in open cinder terrain around SUCR boundary.
Spotted bat	*Euderma maculatum*	USFWS SC	Habitat use/habitat attributes unknown.
Towndsend's big-eared bat	*Plecotus townsendii* spp. *pallescens*	USFWS SC	Habitat use/habitat attributes unknown.
Greater western mastiff bat	*Eumops perotis* ssp. *Californicus*	USFWS SC	Habitat use/habitat attributes unknown.
Allen's big eared bat	*Idionycteris phyllotus*	USFWS SC	Habitat use/habitat attributes unknown.
Long-eared myotis bat	*Myotis evotis*	USFWS SC	Habitat use/habitat attributes unknown.
Occult little brown bat	*Myotis lucifugus* ssp. *occultus*	USFWS SC	Habitat use/habitat attributes unknown.
Fringed myotis bat	*Myotis thysanodes*	USFWS SC	Habitat use/habitat attributes unknown.
Long-legged myotis	*Myotis volans*	USFWS SC	Habitat use/habitat attributes unknown.
Big free-tailed bat	*Nyctinamops macrotis*	USFWS SC	Habitat use/habitat attributes unknown.
Cave myotis	*Myotis velifer*	USFWS SC	Habitat use/habitat attributes unknown.
Western small-footed myotis	*Myotis ciliolabrum*	USFWS SC	Habitat use/habitat attributes unknown.
Western red bat	*Lasiurus blossevilli*	AZ WSC	Habitat use/habitat attributes unknown.
PLANTS:			
Cinder phacelia	*Phacelia serrata*	USFWS SC	💻 Ephemeral annual on sparsely vegetated and volcanic cinder terrain; Numerous locations known.
Sunset Crater penstemon	*Penstemon clutei*	USFWS SC	💻 Sparsely vegetated volcanic cinder terrain; Several locations known.

Special Status Species at Walnut Canyon National Monument

COMMON NAME	SCIENTIFIC NAME	STATUS [1]	DISTRIBUTION/ HABITAT INFORMATION [2]
BIRDS:			
Mexican Spotted Owl	*Strix occidentalis* ssp. *lucida*	ESA Threatened	Nests within canyon & riparian corridor environments: Douglas fir-Gambel oak on steep slopes; pinyon-juniper-succulent-shrub on steep slopes; ponderosa pine on steep slopes. Hunts in ponderosa pine-Gambel oak on level terrain.
Bald Eagle	*Haliaeetus leucocephalus*	ESA Threatened	Nests at perennial lakes near Walnut Canyon; Winter residents routinely observed in-flight over Walnut Canyon Oct-April; Few observations in snags adjacent to entrance road, feeding on elk carrion on roads and in backcountry; May perch or rarely roost in large ponderosa and Douglas fir snags in other areas.
Peregrine Falcon	*Falco peregrinus* ssp. *anatum*	USFWS Recovered	Nests on cliffs & steep slopes of Walnut Canyon
Northern Goshawk	*Accipiter gentilis*	USFWS SC	Two known nesting areas within/near WACA; Nests/hunts in ponderosa pine stands with large diameter trees and moderate-high canopy closure.
Golden Eagle	*Aquila chrysaetos*	NPS SC	Historic nest in E canyon area; Rare observations perching on canyon ledges.
MAMMALS:			
American pronghorn	*Antilocapra americana*	NPS SC	Adj. Coconino NF on Cosnino Grazing Allotment, Youngs Canyon Grazing Allotment, & Campbell Mesa; Possibly east canyon rims within WACA.
Spotted bat	*Euderma maculatum*	USFWS SC	Anabat detection record at WACA sewage lagoon; Specific habitat use/habitat attributes unknown.
Townsend's big-eared bat	*Plecotus townsendii* spp. *pallescens*	USFWS SC	Anabat detection record at WACA sewage lagoon; Specific habitat use/habitat attributes unknown.
Greater western mastiff bat	*Eumops perotis* ssp. *Californicus*	USFWS SC	Anabat detection record at WACA sewage lagoon; Specific habitat use/habitat attributes unknown.
Allen's big eared bat	*Idionycteris phyllotus*	USFWS SC	Anabat detection record at WACA sewage lagoon; Specific habitat use/habitat attributes unknown.
Long-eared myotis bat	*Myotis evotis*	USFWS SC	Anabat detection record at WACA sewage lagoon; Specific habitat use/habitat attributes unknown.
Occult little brown bat	*Myotis lucifugus* ssp. *occultus*	USFWS SC	Anabat detection record at WACA sewage lagoon; Specific habitat use/habitat attributes unknown.
Fringed myotis bat	*Myotis thysanodes*	USFWS SC	Anabat detection record at WACA sewage lagoon; Specific habitat use/habitat attributes unknown.
Long-legged myotis	*Myotis volans*	USFWS SC	Anabat detection record at WACA sewage lagoon; Specific habitat use/habitat attributes unknown.
Big free-tailed bat	*Nyctinamops macrotis*	USFWS SC	Habitat use/habitat attributes unknown.
Cave myotis	*Myotis velifer*	USFWS SC	Habitat use/habitat attributes unknown.
Western small-footed myotis	*Myotis ciliolabrum*	USFWS SC	Habitat use/habitat attributes unknown.
Western red bat	*Lasiurus blossevilli*	AZ WSC	Habitat use/habitat attributes unknown.
PLANTS:			
Flagstaff pennyroyal	*Hedeoma diffusum*	USFS Sensitive	Shallow soil of exposed limestone pavement, cliffs, and outcrops in ponderosa pine-dominated vegetation; populations known near monument boundary.
Mogollon columbine	*Aquilegia desertorum*	AZ SR	Limestone slopes, benches, outcrops throughout the monument
Rock fleabane	*Erigeron saxatalis*	USFS Sensitive	Several populations on sandstone slickrock crevices and ledges in the canyon bottom.
Arizona bugbane	*Cimicifuga arizonica*	USFWS SC	Marginal potential to occur in seasonally moist, shaded, deep soil terraces along canyon bottom. Not found during field surveys.

Special Status Species at Wupatki National Monument

COMMON NAME	SCIENTIFIC NAME	STATUS [1]	DISTRIBUTION/ HABITAT INFORMATION [2]
BIRDS:			
Golden Eagle	*Aquila chrysaetos*	NPS SC	Nests in canyons along Doney Monocline; possibly other nests on mesa bluffs; hunts and frequently perches on bluffs across WUPA.
Burrowing Owl	*Athene canucularia* ssp. *hypugaea*	USFWS SC	Gunnison's prairie dog towns in grasslands & mixed grass-shrublands
Ferruginous Hawk	*Buteo regalis*	USFWS SC	Observed in juniper savanna in close proximity to S WUPA boundary.
MAMMALS:			
Wupatki pocket mouse	*Perognathus amplus* ssp. *cinerus*	USFWS SC	Desert shrub vegetation; Moenkopi Formation terrain within Little Colorado River Basin; rare occurrence records west of Doney Monocline
American pronghorn	*Antilocapra americana*	NPS SC	All of WUPA; Bonito Park adjacent to SUCR; rare in open cinder terrain around SUCR boundary; Cosnino & Youngs Canyon Range Allotments adjacent to WACA.
Spotted bat	*Euderma maculatum*	USFWS SC	Anabat detection records for WUPA; specific habitat attributes unknown.
Townsend's big-eared bat	*Plecotus townsendii* spp. *pallescens*	USFWS SC	Winter and breeding use in limestone fracture system at WUPA; specific habitat use/habitat attributes unknown.
Greater western mastiff bat	*Eumops perotis* ssp. *Californicus*	USFWS SC	Habitat use/habitat attributes unknown.
Allen's big eared bat	*Idionycteris phyllotus*	USFWS SC	Habitat use/habitat attributes unknown.
Long-eared myotis bat	*Myotis evotis*	USFWS SC	Habitat use/habitat attributes unknown.
Occult little brown bat	*Myotis lucifugus* ssp. *occultus*	USFWS SC	Habitat use/habitat attributes unknown.
Fringed myotis bat	*Myotis thysanodes*	USFWS SC	Habitat use/habitat attributes unknown.
Long-legged myotis	*Myotis volans*	USFWS SC	Habitat use/habitat attributes unknown.
Big free-tailed bat	*Nyctinamops macrotis*	USFWS SC	Habitat use/habitat attributes unknown.
Cave myotis	*Myotis velifer*	USFWS SC	Habitat use/habitat attributes unknown.
Western small-footed myotis	*Myotis ciliolabrum*	USFWS SC	Habitat use/habitat attributes unknown.
Western red bat	*Lasiurus blossevilli*	AZ WSC	Habitat use/habitat attributes unknown.
PLANTS:			
Fickeisen cactus	*Pediocactus peeblesianus var. fickeiseniae*	ESA Candidate	Considerable area of good habitat occurs - shallow limestone gravels over limestone bedrock; Doney Monocline and limestone ridges/flats in western grasslands.
Simpson plains cactus	*Pediocactus simpsonii*	AZ SR	Historic occurrence records at WUPA; on limestone terraces and cinder-covered grassland.

Peeble's bluestar	*Amsonia peeblesii*	NPS SC	Documented in shrubland and grassland habitats in a wide variety of substrates.
Welsh's ladies tresses	*Phacelia welshii*	USFWS SC	Ephemeral annual on sparsely vegetated shale outcrops and volcanic cinder terrain.
Cameron water parsley	*Cymopterus megacephalus*	USFWS SC	Historic occurrence record at WUPA on shale outcrops in the Wupatki Basin.
Roundleaf errazurizia	*Errazurizia rotundata*	BLM Sensitive	Historic occurrence record along ephemeral drywash in the Wupatki Basin.
Common reed	*Phragmites australis*	NPS SC	Growing in saturated soil near seeps; one location known.
Whiting's indigo bush	*Psorothamnus thompsoniae var. whitingii*	USFWS SC	Sandy and gravelly slopes and ephemeral drywashes in the Wupatki Basin.
Beath milkvetch	*Astragalus beathii*	BLM Sensitive	Potentially occurs at WUPA on shale soils in the Wupatki Basin.
Marble Canyon milkvetch	*Astagalus cremnophylax var. hevronii*	USFS Sensitive	Potentially occurs at WUPA on limestone terraces along Doney Monocline.
Cinder phacelia	*Phacelia serrata*	USFWS SC	Ephemeral annual on sparsely vegetated and volcanic cinder terrain; numerous locations known.

(1) STATUS CODES:
ESA Threatened – listed as "Threatened" under the Endangered Species Act
ESA Candidate – candidate species for listing as "Threatened" under the Endangered Species Act
USFWS Recovered – removed from the Endangered Species List; currently in delisting monitoring period
USFWS SC – U.S. Fish & Wildlife Service as a "species of concern"
AZ WSC – Arizona Game & Fish Department "wildlife species of concern"
AZ SR – Listed as "salvage restricted" under the Arizona Native Plant Law
Arizona BLM Sensitive –Bureau of Land Management "sensitive species"
USFS Sensitive – USDA Forest Service "sensitive species"
NPS SC – identified in NPS planning documents as a "species of special management concern" for WUPA, SUCR, or WACA

(2) 💻 Indicates full or partial survey and occurrence information is available for this species in the FLAG GIS.

APPENDIX J:

Prior ESA Section 7 Consultation Record at the Flagstaff Area National Monuments

October 1998 Informal Consultation: Meadow and Pictograph Prescribed Fires, Walnut Canyon National Monument. The NPS submitted a Biological Assessment for two prescribed fires along the Walnut Canyon rim terraces (see Figure 3 in the FMP), affecting approximately 200 acres of mostly unrestricted habitat, with some restricted ponderosa pine-Gambel oak habitat. The USFWS concurred with NPS determinations of "may affect, not likely to adversely affect MSO", "no effect for Bald Eagle", and "no effect for Chiricahua dock". Both burns were implemented in 1999.

Nov. 1999 Emergency Consultation: Pictograph Fire, Walnut Canyon National Monument. The NPS initiated emergency consultation because of escaped spot fires. The USFWS concurred with NPS determination of "may affect, not likely to adversely affect MSO".

June 2002 Informal Consultation: Repairs and Reconstruction, Island Trail, Walnut Canyon National Monument. NPS submitted a biological assessment, with a determination of "no effect" for MSO. The USFWS concurred with NPS determination. Potential effects to Bald Eagle were not considered, because the NPS biologist was not aware of nearby perching and feeding activity by over-wintering Bald Eagles. Project implemented July through November 2002 and April through November 2003.

July 2002 Informal Consultation: Survey of 1996 Boundary Expansion Area, Walnut Canyon National Monument. NPS submitted a biological assessment, with a determination of "No effect" for MSO, with courtesy copy and cover memorandum provided to USFWS. Potential effects to Bald Eagle were not considered, because the NPS biologist was not aware of nearby perching and feeding activity by over-wintering Bald Eagles. The boundary surveys were completed between July 2002 and July 2004.

July 2003 Informal Consultation: Fence construction around 1996 boundary expansion area, Walnut Canyon National Monument. NPS submitted a biological assessment, with a determination of "may affect, not likely to adversely affect" MSO; "no effect" on designated MSO critical habitat; and "no effect" on Bald Eagle. The USFWS concurred with NPS determination. NPS finished constructing the new lands boundary fence in November 2005.

Sept. 2003 Informal Consultation: Removal of fire-scarred material from living and dead trees within the four MSO PAC's for a fire history study, conducted by Shawn Knox and William Romme, Colorado State University. NPS submitted a biological assessment, with a determination of "may affect, not likely to adversely affect" MSO; "not likely to adversely modify or result in the destruction" of

designated MSO critical habitat; and "no effect" on Bald Eagle. The USFWS concurred with NPS determination. Field work implemented November 2003.

June 2004 Formal Consultation: Draft Environmental Impact Statement and General Management Plan (NPS 2001), Walnut Canyon National Monument. The GMP establishes long-term planning zones across the entire monument, broadly designating primary facility and visitor activity areas, and resource preservation areas. NPS submitted a biological assessment, determining that proposed management zones, NPS operations, administrative facilities, and visitor use under the Preferred Alternative "may affect, not likely to adversely affect Bald Eagle", and that newly proposed visitor activities in areas near PAC's that had formerly been closed to all public use "may adversely affect MSO" and "may adversely affect MSO Critical Habitat." U.S. Fish & Wildlife Service issued Biological Opinion #AESO/SE, 02-21-02-F-0037 in June 2005. The NPS issued the Final Environmental Impact Statement and General Management Plan, along with the NEPA Record of Decision selecting the Preferred Alternative, in January, 2007.

June 2005 Informal Consultation. USGS airborne imaging, Walnut Canyon National Monument. The NPS consulted via telephone and e-mail over a low level helicopter overflight of Walnut Canyon to acquire high resolution digital imagery for GIS mapping of vegetation fire hazard conditions. NPS submitted a biological assessment with a determination of "may affect, not likely to adversely affect MSO." Concurrence expedited by USFWS.

March 2006 Informal Consultation: Wastewater/sewage Lagoon Expansion, Walnut Canyon National Monument. MNA Environmental Solutions, Flagstaff, Arizona. NPS prepared a biological assessment with a determination of "No effect" for MSO, with courtesy copy and cover memorandum provided to USFWS. Project implemented June through October 2007.

June 2006 Informal Consultation: Hazard Tree Removal, Island Trail, Walnut Canyon National Monument. NPS submitted a biological assessment with a determination of "May affect, not likely to adversely effect" MSO, and "No effect" on Bald Eagle. Concurrence letter expedited by USFWS. Project implemented June 2006.

July 2006 Emergency Consultation: "Oak Fire", Walnut Canyon National Monument. NPS submitted emergency documentation, with a determination of "May affect, not likely to adversely effect" MSO, and "No effect" on Bald Eagle. The primary concern was the use of helicopters and water bucket drops in close proximity to the core nest buffer for the Lucida PAC.

July 2007 Emergency Consultation: "Abert Fire", Walnut Canyon National Monument. The NPS consulted via telephone and provided emergency documentation via e-mail regarding a lightning ignited snag near the Lucida and Breezy PACs.

October 2007 Formal Consultation: Wildland Fire & Fuels Management Plan (FMP), Flagstaff Area National Monuments. The FMP establishes Fire Management Units across Wupatki, Sunset Crater, and Walnut Canyon National Monuments; identifies wildfire suppression strategies; identifies pro-active strategies and a 10-year program of work projects for restoring fire as a natural ecological process within fire-adapted vegetation; and incorporates guidelines to minimize impacts to sensitive cultural and natural resources from fire management activities. The NPS submitted a biological evaluation, determining that implementing the FMP: (1) "may affect, is not likely to adversely affect black-footed ferret" at Wupatki National Monument; (2) "may affect, is not likely to adversely affect bald eagle" at Sunset Crater Volcano and Walnut Canyon National Monuments; (3) "may adversely affect MSO" and "may adversely affect MSO Critical Habitat" at Walnut Canyon National Monument. The USFWS concurred with the NPS determination for the black-footed ferret. The bald eagle was removed from the Endangered Species list in August 2007, so potential effects were not considered by the USFWS under the Endangered Species Act. The USFWS issued a Biological Opinion in March 2008 (Consultation Record #AESO/SE 22410-2001-F-0352), concluding that MSO and critical habitat will likely be adversely affected. An "Incidental Take Statement" was issued for two MSO (one breeding pair) and/or eggs, nestlings, or juveniles associated with the Breezy, Cherry, Lucida, or Walnut #33 PACs while implementing the FMP. The NEPA Decision Record is currently being drafted for publication.

April 2008 Formal Consultation: Island Trail Rockfall Removal and Repairs, Walnut Canyon National Monument. NPS submitted a biological assessment, with a determination of "May affect – likely to adversely affect MSO", and "May affect – not likely to adversely affect designated critical habitat for MSO." The USFWS issued a Biological Opinion in May 2008 (Consultation Record #AESO/SE 22410-2008-F-0118), concurring with the NPS determination for MSO Critical Habitat, and concluding that breeding MSO might be adversely affected by noise caused by the action, and issuing an Incidental Take Statement. The NPS later changed the agency action so that noise levels would be much lower than initially proposed, as documented in a follow-up memo to USFWS, dated August 4, 2008.

June 2009 Formal Consultation: Flagstaff Area Monuments Invasive Plant Management Plan. NPS submitted a biological assessment, with a determination of "May affect – likely to adversely affect MSO", and "May affect – not likely to adversely affect designated critical habitat for MSO."

Appendix K: Minimum Requirement Analysis

INTRODUCTION
No portion of the Flagstaff Area National Monuments has been designated as wilderness, yet parts of WUPA have been designated by the NPS to be managed as "proposed wilderness". *NPS Management Policies* 2006 state, "For the purposes of these policies, the term 'wilderness' will include the categories of suitable, study, **proposed**, recommended, and designated wilderness. Potential wilderness may be a subset of any of these five categories. The policies apply regardless of category (National Park Service, 2006)".

Management Policies clearly state: "The National Park Service will take no action that would diminish the wilderness suitability of an area possessing wilderness characteristics until the legislative process of wilderness designation has been completed. Until that time, management decisions pertaining to lands qualifying as wilderness will be made in expectation of eventual wilderness designation. This policy also applies to potential wilderness, requiring it to be managed as wilderness to the extent that non-conforming conditions allow (National Park Service, 2006)."

In accordance with *NPS Management Policies* 2006:
All management decisions affecting wilderness must be consistent with the minimum requirement concept. This concept is a documented process used to determine whether administrative activities affecting wilderness resources or the visitor experience are necessary, and how to minimize impacts. The minimum requirement concept will be applied as a two-step process that determines:

- Whether the proposed management action is appropriate or necessary for the administration of the area as wilderness and does not pose a significant impact to wilderness resources and character; and

- The techniques and types of equipment needed to ensure that impact to wilderness resources and character is minimized

In accordance with this policy, superintendents will apply the minimum requirement concept to the context of wilderness management planning, as well as to all other administrative practices, proposed special uses, scientific activities, and equipment use in wilderness (National Park Service, 2006).

NPS Management Policies also require the NPS to apply the minimum requirement concept to authorized commercial activities in wilderness areas.

This appendix includes the Minimum Requirement Analysis (MRA) for invasive plant management throughout the Flagstaff Area National Monuments. If mechanized equipment is proposed in or adjacent to proposed wilderness areas during the life of this plan, an additional MRA would need to be completed.

FLAG MINIMUM REQUIREMENT ANALYSIS (MRA)

Invasive Plant Management in Flagstaff Area National Monuments

For areas in Wupatki National Monument that are to be managed as Wilderness

PART A: Is this action necessary to manage the area as wilderness?

DESCRIPTION OF PROPOSED ACTION:
Treat invasive plants using integrated pest management techniques (IPM) including survey, coordination with FLAG staff and adjacent land owners, education of FLAG staff and visitors, manual, cultural, and chemical treatment of invasive plants throughout the FLAG monuments, and mechanical treatment of plants in developed areas.

1. Describe Special Provisions of Wilderness Legislation: Is there a special provision in wilderness legislation (The Wilderness Act or others) that allows consideration of actions involving Section 4(c) uses?

Cite law and section:
No portion of the Flagstaff Area National Monuments has been designated as wilderness; therefore, no special wilderness legislative provisions apply.

Section 4 of the Wilderness Act generally describes authorized uses of wilderness areas. Subsection 4 (c) of the Act states: "…except as necessary to meet minimum requirement for the administration of the area for the purpose of the Act…there shall be no use of motorized vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

2. Describe Requirements of Other Legislation, Policy, and Guidance: Does taking action conform to and implement relevant standards and guidelines and direction contained in other legislation, policy, management plans, species recovery plans, tribal government agreements, and/or other interagency agreements?

Explain and cite law, policy, etc.:
Refer to Appendix M of the FLAG IPMP/EA for applicable laws and policy.

3. Describe Options Outside of proposed wilderness: Can this action be accomplished outside FLAG wilderness?

Yes ☐ No ☒

Explain:

Invasive plant surveys and treatments are necessary throughout the entire monuments within the Flagstaff Area; therefore, the proposed action cannot be completed outside FLAG's proposed wilderness boundaries.

4. Describe how the action would contribute to the preservation of wilderness character: How would the action contribute to the preservation of wilderness character as described by the components below?

Untrammeled Wilderness is ideally unhindered and free from modern human control or manipulation: Action would maintain natural vegetation associations and processes, thus preserving an untrammeled wilderness setting.

Undeveloped Wilderness has minimal evidence of modern human occupation or modification: Action would not cause any new development in WUPA proposed wilderness. Action would restore areas of infestation to natural undeveloped condition.

Natural Wilderness is where ecological systems are substantially free from the effects of human use, e.g. visitation and/or management activities: Action would control exotic/invasive species and thus augment and encourage the establishment of natural ecological conditions.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation Wilderness provides opportunities for people to experience natural sights and sounds, solitude, risk, adventure and other attributes: Action would return the area to natural conditions and provide the highest quality opportunity for solitude of a primitive and unconfined type of recreation.

Explain:

The proposed action contributes to the untrammeled, undeveloped and natural character of proposed wilderness within the Flagstaff Area National Monuments because it is a vital component in the successful restoration of natural plant communities and native habitat. The restoration and preservation of the wilderness character of the FLAG monuments as a result of IPM activities will greatly enhance the outstanding opportunities for solitude.

5. Describe the effects to the public purposes of wilderness: How would this action support the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation and historical use?

Explain:

The proposed action would enhance wilderness values and the recreation, scenic, scientific, education, conservation, or historical use of proposed wilderness in the Flagstaff Area National Monuments. Invasive plant management in itself is a form of conservation of native plant species and habitats, and supports native ecosystems. As such, the proposed action would

enhance and support public purposes through the removal of nonnative invasive species. Additionally, the plan identifies numerous and varied opportunities for education.

PART A DECISION: Is it necessary to take this action?

Yes ☒ No ☐

Explain:

The Purpose and Need section of Chapter 2 of this EA determines that invasive plant management is an appropriate use in the Flagstaff Area National Monuments. Additionally, NPS policies and laws support the action to manage invasive plant species in the Flagstaff Area National Monuments. Removal of nonnative invasive species and restoration of native species are necessary to the effective management of recommended wilderness values within the Flagstaff Area National Monuments.

Appendix L:

Prohibited, Regulated and Restricted Noxious Weeds of Arizona

PROHIBITED:

The following noxious weeds (includes, plants, stolons, rhizomes, cuttings and seed) are prohibited from entry into the state. Highlighted plants are found in the Flagstaff Area Monuments.

Acroptilon repens (L.) DC. -- Russian knapweed,
Aegilops cylindrica Host. -- Jointed goatgrass,
Alhagi pseudalhagi (Bieb.) Desv. -- Camelthorn,
Alternanthera philoxeroides (Mart.) Griseb. -- Alligator weed,
Cardaria pubescens (C.A. Mey) Jarmolenko -- Hairy whitetop,
Cardaria chalepensis (L.) Hand-Muzz -- Lens podded hoary cress,
Cardaria draba (L.) Desv. -- Globed-podded hoary cress (Whitetop),
Carduus acanthoides L. -- Plumeless thistle,
Cenchrus echinatus L. -- Southern sandbur,
Cenchrus incertus M.A. Curtis -- Field sandbur,
Centaurea calcitrapa L. -- Purple starthistle,
Centaurea iberica Trev. ex Spreng. -- Iberian starthistle,
Centaurea squarrosa Willd. -- Squarrose knapweed,
Centaurea sulphurea L. -- Sicilian starthistle,
Centaurea solstitialis L. -- Yellow starthistle (St. Barnaby's thistle),
Centaurea diffusa L. -- Diffuse knapweed,
Centaurea maculosa L. -- Spotted knapweed,
Chondrilla juncea L. -- Rush skeletonweed,
Cirsium arvense L. Scop. -- Canada thistle,
Convolvulus arvensis L. -- Field bindweed,
Coronopus squamatus (Forskal) Ascherson -- Creeping wartcress (Coronopus),
Cucumis melo L. var. Dudaim Naudin -- Dudaim melon (Queen Anne's melon),
Cuscuta spp. -- Dodder,
Drymaria arenarioides H.B.K. -- Alfombrilla (Lightningweed),
Eichhornia crassipes (Mart.) Solms – Floating water hyacinth,
Eichhornia azurea (SW) Kunth. -- Anchored water hyacinth,
Elytrigia repens (L.) Nevski -- Quackgrass,
Euphorbia esula L. -- Leafy spurge,
Halogeton glomeratus (M. Bieb.) C.A. Mey -- Halogeton,
Helianthus ciliaris DC. -- Texas blueweed,
Hydrilla verticillata Royale -- Hydrilla (Florida-elodea),
Ipomoea spp. -- Morning glory. All species except Ipomoea carnea, Mexican bush morning glory; Ipomoea triloba, three-lobed morning glory (which is considered a restricted pest); and Ipomoea aborescens, morning glory tree,
Ipomoea triloba L. – Three-lobed morning glory,
Isatis tinctoria L. – Dyers woad,
Linaria genistifolia var. dalmatica – Dalmation toadflax,
Lythrum salicaria L. – Purple loosestrife,
Medicago polymorpha L. -- Burclover,
Nassella trichotoma(Nees.) Hack. -- Serrated tussock,
Onopordum acanthium L. -- Scotch thistle,
Orobanche ramosa L. -- Branched broomrape,
Panicum repens L. -- Torpedo grass,
Peganum harmala L. -- African rue (Syrian rue),
Pennisetum ciliare (L.) Link – buffelgrass,
Portulaca oleracea L. -- Common purslane,
Rorippa austriaca (Crantz.) Bess. -- Austrian fieldcress,
Salvinia molesta – Giant salvina
Senecio jacobaea L. -- Tansy ragwort,

Solanum carolinense L. -- Carolina horsenettle,
Sonchus arvensis L. -- Perennial sowthistle,
Solanum viarum Dunal -- Tropical Soda Apple,
Stipa brachychaeta Godr. -- Puna grass,
Striga spp. -- Witchweed,
Trapa natans L. -- Water-chestnut,
Tribulus terrestris L. -- Puncturevine.

REGULATED:

The following noxious weeds are regulated (includes plants, stolons, rhizomes, cuttings and seed) and if found within the state may be controlled or quarantined to prevent further infestation or contamination. Highlighted plants are found in the Flagstaff Area Monuments.

Cenchrus echinatus L. -- Southern sandbur,
Cenchrus incertus M.A. Curtis -- Field sandbur,
Convolvulus arvensis L. -- Field bindweed,
Eichhornia crassipes (Mart.) Solms -- Floating water hyacinth,
Medicago polymorpha L. -- Burclover,
Pennisetum ciliare (L.) Link – buffelgrass,
Portulaca oleracea L. -- Common purslane,
Salvinia molesta– Giant Salvinia *
Tribulus terrestris L. -- Puncturevine.

RESTRICTED:

The following noxious weeds are restricted (includes plants, stolons, rhizomes, cuttings and seed) and if found within the state shall be quarantined to prevent further infestation or contamination. Highlighted plants are found in the Flagstaff Area Monuments.

Acroptilon repens (L.) DC. -- Russian knapweed,
Aegilops cylindrica Host. -- Jointed goatgrass,
Alhagi pseudalhagi Bieb.) Desv. -- Camelthorn,
Cardaria draba (L.) Desv. -- Globed-podded hoary cress (Whitetop),
Centaurea diffusa L. -- Diffuse knapweed,
Centaurea maculosa L. -- Spotted knapweed,
Centaurea solstitialis L. -- Yellow starthistle (St. Barnaby's thistle),
Cuscuta spp. -- Dodder,
Eichhornia crassipes (Mart.) Solms – Floating water hyacinth
Elytrigia repens (L.) Nevski -- Quackgrass,
Euryops sunbcarnosus subsp. vulgaris – Sweet resinbush,
Halogeton glomeratus (M. Bieb.) C.A. Mey -- Halogeton,
Helianthus ciliaris DC. -- Texas blueweed,
Ipomoea triloba L. -- Three-lobed morning glory,
Linaria genistifolia var. dalmatica -- Dalmation toadflax,
Onopordum acanthium L. -- Scotch thistle.

Additional weed species are regulated by the federal government and may not be transported without specific permit. The federal noxious weed list may be obtained at the following web site
http://www.aphis.usda.gov/ppq/weeds/

Appendix M:

Regulatory Measures

FEDERAL REGULATORY MEASURES
The following Federal regulatory measures are applicable to all alternatives:

- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- Occupational Health and Safety Administration (OSHA) Hazard Communication Standard
- EO 13112 on Invasive Species
- Government Performance Results Act of 1993 (GPRA)

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
FIFRA and regulations established by the United States Environmental Protection Agency (EPA) act as primary guidance governing pesticide registration, pesticide usage, training and certify-cation of pesticide applicators, and criminal and civil penalties associated with misuse of pesticides. FIFRA defines the term pesticide as:

(1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pests,
(2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant, and
(3) any nitrogen stabilizer, except that term "pesticide" shall not include any article that is a "new animal drug" within the definition of the Federal Food, Drug, and Cosmetic Act.

Both FIFRA and NPS policy use this definition of "pesticide" in their guidance. However, herbicides are the class of pesticides used to chemically treat exotic plant species and is the term primarily used in this document when referring to specific actions and alternatives.

EPA is the agency responsible for registration of all pesticides. The process includes examination of ingredients; site or crop on which it is to be used; amount, frequency and timing of use; and storage and disposal practices. EPA evaluates the pesticide to ensure it will not have unreasonable adverse effects on humans, the environment, and non-target species.

Once registered, a label is developed for each pesticide. Pesticide labels include directions for protection of workers who apply the pesticide, directions for reducing exposure to non-applicators, and reducing potential impacts to the environment. Violations of pesticide label directions constitute a violation of FIFRA. Storage and disposal of most pesticides are also regulated under FIFRA, with specific direction provided on pesticide labels. Under FIFRA, enforcement of the act is delegated to individual states. Because labels contain important application, safety, and storage and disposal information, labels must be kept with the product.

Occupational Health and Safety (OSHA) Hazard Communication Standard
Under the OSHA Hazard Communication Standard (Section 1910.1200), employers must provide workers with training, protective equipment, and information about hazardous

substances. The employer is also required to maintain Material Safety Data Sheets (MSDS's) about these substances and provide employees with a copy of the sheets if requested. MSDS's for common chemicals can be obtained at the following websites:

- Greenbook - http://www.greenbook.net/
- Seed Search - http://www.cdms.net/manuf/acProducts.asp .

Park resource managers must maintain a current set of MSDS's for pesticides used.

Executive Order 13112
Section 2 of EO 13112 on Invasive Species, signed February 1999, directs Federal agencies identify actions that may affect invasive species status and take action to:

- Prevent introduction of invasive species
- Detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner
- Monitor invasive species populations accurately and reliably
- Provide for restoration of native species and habitat conditions in ecosystems that have been invaded
- Conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species, and
- Promote public education on invasive species and the means to address them

EO 13112 also established the Invasive Species Council and authorized the Council to develop and implement a National Management Plan (NMP) for Invasive Species. This first edition of this plan was finalized on January 18, 2001. The plan is updated every two years and serves as a blueprint for all Federal action on invasive species.

Government Performance Results Act of 1993 (GPRA)
The purpose of GPRA is to improve the confidence of the American people in the capability of the Federal Government by systematically holding Federal agencies accountable for achieving program results.

To meet GPRA requirements, NPS developed strategic performance goals, most recently updated for FY 2008 - 2012, that reflect and expand larger Department of the Interior Strategic Plan goals. These goals serve as indicators to show the National Park Service's success in fulfilling its mission. Each park unit is required to select those goals that represent what can be measured as accomplished and reported quarterly. The following is a description of the servicewide GPRA goals (excerpted from Technical Guidance [Manual] for National Park Service Strategic Goals 2004b) that GRCA expects this plan to address:

> **Goal Category 1: Preserve Park Resources**
> The mission and long-term goals in Goal Category I are inclusive of the mandate regarding parks in the NPS Organic Act "...to conserve the scenery and the natural and historic objects and the wild life therein..."

Mission Goal 1a

Natural and cultural resources and associated values are protected, restored, and maintained in good condition and managed within their broader ecosystem and cultural context.

Servicewide (NPS) Goals Relevant to This Planning Effort:

Ia1A – Disturbed Lands: calls for restoration of targeted park lands that are disturbed by development or agriculture.

Ia1B – Invasive (nonnative) Plants: calls for effective control of park lands that have invasive (nonnative) plant invasions.

Ia1D – Land Health: Riparian and Stream Areas: requires stream/riparian areas achieve desired conditions where conditions are known and where desired conditions are specified in management plans consistent with applicable substantive and procedural requirements of State and Federal water law.

Ia1H – Land Health: Parklands in Desired Condition: addresses the status (maintenance) and improvement of the health of watersheds, landscapes, and marine resources areas that are managed by the NPS.

Ia2A – Federally Listed T&E Species: requires progress toward recovery of Federally listed species that occur or have occurred in parks.

Ia2B – Species of Management Concern: requires populations of native plant and animal Species of Management Concern are managed to self-sustaining levels in cooperation with affected States and others, as defined in approved management documents.

Mission Goal 1b

The NPS contributes to knowledge about natural and cultural resources and associated values; management decisions about resources and visitors are based on adequate scholarly and scientific information.

STATE REGULATORY MEASURES

Implementation of the Exotic Plant Species Management Plan will conform to applicable state laws. It is NPS general policy to comply with more stringent state requirements, where applicable. For example, some states have established legislation and regulations that further define pesticide registration, pesticide usage, training and certification of pesticide applicators, and criminal enforcement and civil penalties associated with misuse of pesticides. All herbicide application will be conducted by or under supervision of a certified pesticide applicator in accordance with Arizona laws. All NPS employees that have herbicide application as a significant element of their job descriptions will obtain state certification for pesticide application.

Exotic/Invasive plant species found in FLAG Monuments and on the Arizona Noxious Plant List			
Camelthorn	*Alhagi maurorum*	**Puncturevine**	*Tribulus terrestris*
Canada thistle	*Cirsium arvense*	**Scotch thistle**	*Onopordum acanthium*
Dalmatian toadflax	*Linaria dalmatica*		
Diffuse knapweed	*Centaurea diffusa*		
Field bindweed	*Convolvulus arvensis*		
Little hogweed	*Portulaca oleracea*		

Spread of exotic plant species throughout Arizona, the American West, and the United States poses a serious environmental and economic threat to public land, ranchland, farmland, and private property. In 2005, Governor Janet Napolitano established the Arizona Invasive Species Advisory Council (AISAC) by Executive Order 2005-09. AISAC has been developing a coordinated, multi-stakeholder approach to invasive species management in the State (Arizona Invasive Species Advisory Council 2006).

Arizona has legislation that identifies noxious weeds. A noxious weed is specified by law as being especially undesirable, troublesome, and difficult to control. Of the 78 priority exotic plant species in GRCA, 17 are listed on Arizona's noxious plant list (see Table above) and the FLAG Monuments are mandated through Arizona's administrative code to control these species.

NATIONAL PARK SERVICE POLICIES AND GUIDELINES

The NPS has a strong and clear policy on managing exotic plants in parks. Parks are guided by three primary internal documents to manage exotic plants:

- NPS Management Policies
- Natural Resources Management Guidelines (DO-77)
- Individual Park's Natural Resource Management Plans and Exotic or Invasive Plant Management Plans

NPS Management Policies

General policies for management of exotic plants are provided in the NPS Management Policies (National Park Service, 2006). The most relevant sections are summarized below.

Definition of Native and Exotic Species

NPS Management Policies page 43, section 4.4.1.3 includes definitions of native species and exotic species adopted for the EPMP (EA/AEF) (Chapter 1, Section 1.1).

Management of Exotic Species

NPS Management Policies page 47, section 4.4.4 requires parks to manage exotic species to prevent displacement of native species, stating, "Exotic species will not be allowed to displace native species if displacement can be prevented."

Removal of Exotic Species Already Present

NPS Management Policies page 48, section 4.4.4.2 allows parks to remove exotic species already present in parks. NPS Management Policies list specific criteria that must be met before an exotic species may be managed. These criteria include:

"All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed - up to and including eradication - if (1) control is prudent and feasible, and (2) the exotic species:

- interferes with natural processes and the perpetuation of natural features, native species or natural habitats; or
- disrupts the genetic integrity of native species; or
- disrupts the accurate presentation of a cultural landscape; or
- damages cultural resources; or
- significantly hampers the management of park or adjacent lands; or

- poses a public health hazard as advised by the United States Public Health Service (which includes the Centers for Disease Control and the NPS Public Health Program); or
- creates a hazard to public safety"

For a species determined to be exotic, and where management appears to be feasible and effective, superintendents should: (1) evaluate the species' current or potential impact on park resources, (2) develop and implement exotic species management plans according to established planning procedures, (3) consult, as appropriate, with Federal and state agencies, and (4) invite public review and comment, where appropriate. Programs to manage exotic species will be designed to avoid causing significant damage to native species, natural ecological communities, natural ecological processes, cultural resources, and human health and safety.

NPS Management Policies page 48, section 4.4.4.2 also provides guidance to parks on how to determine exotic plant management priorities:

> "High priority will be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controlled. Lower priority will be given to exotic species that have almost no impact on park resources or that probably cannot be successfully controlled. The decision to initiate management should be based on a determination that the species is exotic."

Pest Management
NPS Management Policies page 48, section 4.4.5 provides guidance on general pest management. Pests are living organisms that interfere with purposes or management objectives of a specific site in a park, or jeopardize human health or safety. Exotic pests will be managed according to exotic species policies provided on page 48, section 4.4.4.2. All park employees, concessionaires, contractors, permittees, licensees, and visitors on all lands managed or regulated by the NPS will comply with NPS pest management policies.

Integrated Pest Management Program

Pesticide Use
NPS Management Policies page 49, sections 4.4.5.3 and 4.4.5.4 address use of chemicals and biological control agents. A pesticide, as defined by the FIFRA, is any substance or mixture used in any manner to destroy, repel, or control growth of any viral, microbial, plant, or animal pest. A park resource management specialist must first determine use of pesticides is necessary, and that all other available options are either not acceptable or not feasible.

Once a resource management specialist determines use of a chemical or biological control agent is necessary, its use must then be approved. Apart from few exceptions (see discussion of NPS 77 below), all prospective users of pesticides in parks must submit a pesticide use proposal, which is reviewed on a case-by-case basis by the Regional and possibly National IPM Coordinator, as required. These proposals take into account environmental effects, cost and staffing, and other relevant considerations. Application or release of any biological control agent must also be approved by a National IPM Coordinator in accordance with DO 77-7, and must conform to the exotic species policies in page 48, section 4.4.4.2.

Pesticide Purchase and Storage
NPS Management Policies section 4.4.5.5 provides guidance on pesticide storage:
"No pesticides may be purchased unless they are authorized and are expected to be used within one year from the date of purchase. Pesticide storage, transport, and disposal will comply with procedures established by the Environmental Protection Agency, the individual states in which parks are located, and Director's Order 13B (Hazardous and Solid Waste Management, in prep), NPS Director's Order 77-1 (Wetland Protection), and NPS Director's Order 77-7 (Integrated Pest Management) (in preparation)."

Natural Resources Management Guideline - DO-77
DO-77: Natural Resource Management Guideline (DO-77) (NPS 1991) provides resource managers with an overview of the integrated pest management concept, summarizes NPS policies regarding pesticide use, and provides direction for the pesticide approval process. DO-77 also provides general guidelines and recommendations for exotic plant management.

In addition, the NPS is developing NPS Director's Order 77-7 (Integrated Pest Management). The purpose of DO 77-7 is to supplement and clarify existing NPS policies on IPM. The NPS Associate Director for Natural Resources Stewardship and Science will also develop and issue Reference Manual 77-7 (RM 77-7). RM 77-7 will provide parks with additional information and procedures for carrying out NPS responsibilities included in DO-77, DO 77-7, and *NPS Management Policies*. Once formalized, policy and guidance included in DO 77-7 and RM 77-7 would apply to any actions taken under the EPMP (EA/AEF). Since DO 77-7 has not been approved, the EPMP (EA/AEF) was developed based on existing policy included in DO-77 and *NPS Management Policies*. However, some concepts included in draft versions of DO 77-7 were incorporated into the EPMP (EA/AEF) to provide additional guidance, where appropriate.

Review and Approval to Use Pesticides
DO-77 provides guidance on the review and approval process for pesticides, biological control, and other treatments, which is the same process described above. The decision by either the Regional IPM Coordinator or National IPM Coordinator to approve a pesticide use proposal is based on its conformance with NPS policies and guidelines, a determination of whether other alternatives are available or feasible, and whether the pesticide is registered for the proposed use. If proposals are denied, the Regional or National IPM Coordinator will provide a written explanation of the denial and suggestions for suitable alternatives.

Reporting Pesticide Use
Under DO-77, parks are required to maintain records of pesticide use, including pesticide use reports, during the year. Pesticide use reports are submitted electronically using the Intranet Based IPM System. Pesticide use reports must be entered into this system by March 15 of each year.

Other Pesticide Related Guidelines
DO-77 also provides guidelines for the following activities: pesticide purchase, pesticide storage, disposal of pesticides, pesticide safety, and contracted pest management services. These guidelines have been incorporated into the safety plan included in annual work plans.

Exotic Species Management
DO-77 also provides guidance on a number of exotic species management topics. These topics include prevention of exotic species invasions, management of established exotic species, biological control, IPM and pesticide use, and environmental compliance and planning documents. This guidance has been used to develop this EA/AEF. DO-77 also includes guidance for NPS concessionaires that manage pests on NPS property or in NPS buildings.

United States Department of the Interior (USDI) Strategic Plan for Managing Invasive Nonnative Plants on National Park Service Lands
This EA/AEF is consistent with the USDI Strategic Plan for Managing Invasive Nonnative Plants on National Park Service Lands (National Park Service, 1996). Adopted in 1999, the plan described impacts of invasive nonnative plants on NPS natural resources and outlined strategies and tactics to help prevent and manage their spread on NPS lands. It requires consideration of nonnative plant management in all levels of planning and project development and implementation as well as adoption and application of an integrated pest management program throughout the NPS system.