

Grand Canyon

National Park Service
U.S. Department of the Interior

Grand Canyon National Park



Environmental Assessment / Assessment of Effect February 2009



Exotic Plant Management Plan Grand Canyon National Park • Arizona

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Summary

Grand Canyon National Park proposes to use Integrated Pest Management (IPM) techniques to control and contain exotic plant species within park boundaries. Currently, 189 exotic plant species are known in Grand Canyon National Park; of these, 82 are of serious concern. These exotic plant species displace natural vegetation and consequently affect long-term health of native plant and animal communities. This Environmental Assessment / Assessment of Effect (EA/AEF) evaluates continuation of current exotic plant species management (Alternative 1, No Action) and one additional alternative to address the purpose and need for action (Alternative 2, Preferred). The preferred alternative includes a) integrated pest management; b) increased education, prevention, and collaboration; and c) manual, mechanical, cultural, and chemical controls. The park proposes an adaptive management strategy whereby control methods may be altered, dependant on updated literature or effectiveness in the field.

Neither alternative would have more than negligible impacts to soundscape, environmental justice, prime and unique farmland, socioeconomic environment, or Indian trust resources. Alternative 2, the preferred alternative, would result in both adverse and beneficial impacts to vegetation, wildlife, special status species, soil resources, water and aquatic resources, air quality, archaeological and historic resources, cultural landscapes, ethnographic resources, visitor experience, wilderness character, public health and safety, and park operations that would range from negligible to moderate. No impairment of park resources would occur with implementation of either alternative.

The park's goal is to provide a solid framework for exotic plant management. This EA/AEF will serve as a planning document to guide exotic plant management for the next ten years, through 2019. In addition, annual work plans will be completed based on information contained in this document to provide site-specific survey and treatment information, updated exotic plant species lists, and other information as available.

Public Comment

If you wish to comment on the EA/AEF, the NPS prefers that you post comments online at <http://parkplanning.nps.gov/grca> or you may mail comments to Steve Martin, Superintendent, Grand Canyon National Park, Attention: Exotic Plant Management Plan, P.O. Box 129 / 1 Village Loop, Grand Canyon, Arizona 86023. This document will be on public review for 30 days.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

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Chapter 1 – Purpose and Need

INTRODUCTION

This document's purpose is to disclose expected effects to the human environment from exotic plant management in Grand Canyon National Park (GRCA). Human environment is defined as the natural and physical environment and the relationship of people with that environment. The project area consists of National Park Service (NPS) land within the park boundary and includes South Rim, North Rim, Colorado River corridor and Inner Canyon (Figure 1).

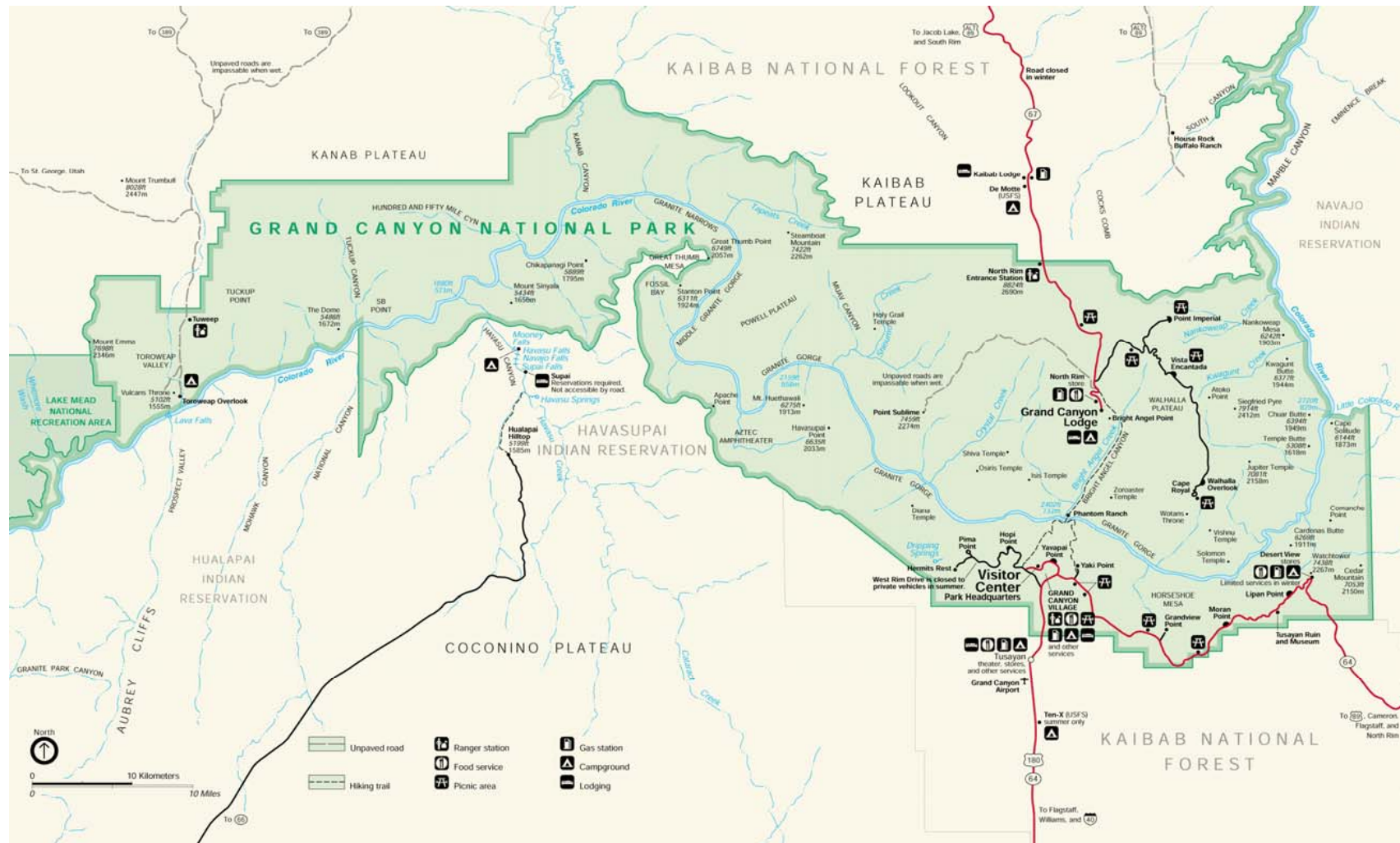
Grand Canyon encompasses approximately 1,217,403 acres and lies on the Colorado Plateau in northwestern Arizona. The land is semi-arid and consists of raised plateaus and structural basins typical of the southwestern United States. The park is nationally and internationally recognized as significant for many reasons beyond the canyon itself. The park's biological diversity includes five of the seven life zones and elements of three of the four North American deserts (the Great Basin, Sonoran, and Mojave). As an ecological refuge, Grand Canyon contains numerous rare, endemic, or specially protected plant and animal species and relatively intact native vegetation communities (National Park Service, 1995). Stewardship of its natural resources requires special attention to limit disruption of these native assemblages by exotic plant species.

BACKGROUND

NPS Management Policies (National Park Service, 2006) defines native species as “all species that have occurred, now occur, or may occur as a result of natural processes on lands designated as units of the national park system. Native species in a place are evolving in concert with each other. Exotic species are those species that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities. Exotic species are also commonly referred to as nonnative, alien, or invasive species. Because an exotic species did not evolve in concert with the species native to the place, the exotic species is not a natural component of the natural ecosystem at that place” (National Park Service, 2006).

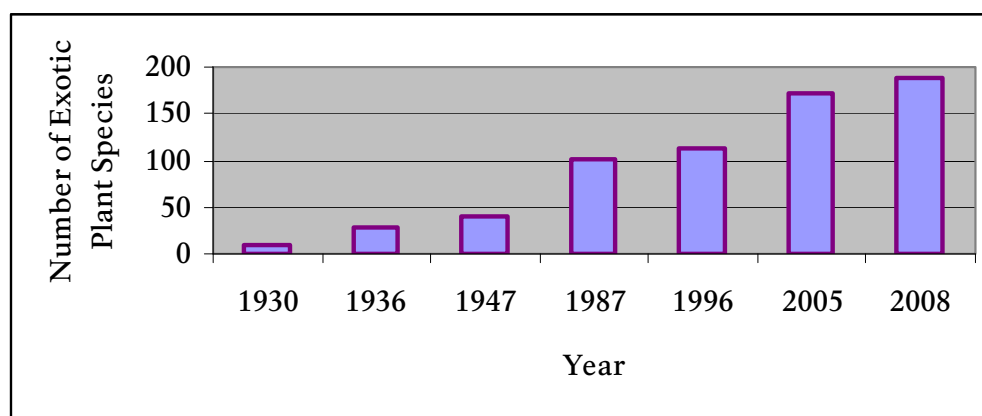
Exotic plants are often the first plants to become established in disturbed areas; these are also known as early successional species. However exotic plants can also be aggressive, replacing established or late-successional native species in habitats relatively free of disturbance (Stohlgren et al., 1999). Although only roughly ten percent of exotic species pose a threat to ecosystems (Williamson, 1996), such species can displace native vegetation by robbing moisture, nutrients, and sunlight from surrounding plants, resulting in native habitat loss and increased soil erosion. These species create long-term changes in plant community composition and structure, affecting entire plant and animal populations (Cronk & Fuller, 2001; National Park Service, 2006; Vitousek et al., 1996).

Figure 1 Map of Grand Canyon National Park



Over the last few centuries the number and abundance of exotic plant species have increased dramatically worldwide. Exotic plant species are considered one of the most serious threats to national parks, with over 2.6 million acres infested in the National Park System (National Park Service, 2002a). Historical plant surveys in Grand Canyon reveal a steady increase in exotic plant species numbers found in the park. Numbers increased from 9 species in 1930 to 29 in 1936 and 41 in 1947 (Hawbecker, 1936; McDougall, 1947; Mead, 1930).

Figure 2 Increased Exotic Plant Species in GRCA, 1930-Present



Today, almost 200 exotic plant species have been found within park boundaries with more expected in the future. It is estimated that roughly half the park's total acreage currently contains exotic plant species; however, the entire park is at risk. Eighty-two plant species found in the park are considered invasive and of particular concern to GRCA managers because they are aggressive and have potential to displace native vegetation.

Some of the first exotic plants introduced to GRCA were planted by early settlers in the 1870s to provide forage, grasses, and herbs for domestic livestock. Other exotics were introduced intentionally for erosion control or for aesthetic purposes. Creation of roads, trails, campgrounds, visitor centers, and picnic areas further contributed to establishment of exotic plant species as seeds were carried in and transported on machinery, in gravel, or contaminated seed mixes. Visitors have also unknowingly introduced and transported seeds on vehicles, mules, hiking boots, and by other means. People, machinery, vehicles, livestock, wildlife, fire, wind, and water have all contributed to exotic plant species establishment and spread.

Exotic plant species control is imperative for GRCA managers charged with preservation and protection of natural resources, processes, systems, and values in an unimpaired condition (National Park Service, 2006). NPS superintendents are expected to use current legislation, executive orders, and NPS regulatory standards to manage exotic plants (see Appendix A). The most fundamental provisions are found in the NPS Organic Act of 1916 and the Redwood Act amendment to the 1970 General Authorities Act.

A number of Federal, state, and local regulatory measures for management of exotic plant species, noxious weeds, and invasive plants are applicable to exotic

plant management. Regulatory measures include laws, executive orders, presidential proclamations, regulations and policies:

- *Federal Laws* – acts passed by the United States Congress and approved by the President. All laws must be consistent with the United States Constitution. Federal laws have supremacy over state and local laws. Legislative history (e.g., committee reports, transcripts of congressional debates) clarifies congressional intent in enacting a law.
- *Executive Orders* – directives from the President to departments and agencies of the executive branch.
- *Presidential Proclamations* – decrees by the President under the Constitution and other authorities (e.g., Antiquities Act).
- *Regulations* – rules for complying with a Federal law developed by the authorized department or agency that also include codification of agency policy. For example, Title 36 Code of Federal Regulation (CFR) Section 1-199 contains general and specific regulations for management and use of the National Park System (these regulations are augmented by the Superintendent's Compendium for each unit).
- *Policies* – guiding principles or procedures that set the framework and provide direction for management decisions. They may prescribe the process by which decisions are made, how an action is to be accomplished, or results to be achieved.

Regulatory measures that guide exotic plant management in Grand Canyon National Park are described in detail in Appendix A and include:

Federal Regulatory Measures

- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- Occupational Health and Safety Administration (OSHA) Hazard Communication Standard
- Executive Order 13112 on Invasive Species
- Government Performance Results Act of 1993 (GPRA)

State Regulatory Measures

- Arizona Noxious Weed List
- Pesticide Handling Certification

National Park Service Policies and Guidelines

- *NPS Management Policies*
- Natural Resources Management Guideline – Director's Order (DO)-77

PURPOSE OF AND NEED FOR ACTION

The purpose of the project is to prevent, control, or contain exotic plant species infestations which threaten natural and cultural resources within GRCA. The proposed project is modeled after and designed to expand upon six management strategies identified by the NPS Strategic Plan for Managing Invasive Nonnative Plants in National Parks (National Park Service, 1996): Prevent invasion; increase public awareness; inventory and monitor nonnative plants; conduct research and transfer technology; integrate planning and evaluation; and manage invasive nonnative plants.

Appropriate Use

The proposed project is considered an appropriate use as defined in *NPS Management Policies* because it is suited to the exceptional natural and cultural resources found in the park and fosters an understanding of and appreciation for park resources and values (National Park Service, 2006). The management and treatment of exotic plant species is further evaluated in this document for consistency with applicable regulatory measures, consistency with the park's General Management Plan (GMP), actual and potential effects to park resources and values, total project cost, and whether public interest will be served. If unanticipated and unacceptable impacts transpire, the superintendent would re-evaluate the purpose and need to further manage, limit, or discontinue the use.

The Overall Project Goal is to preserve or restore natural environmental conditions in GRCA by preventing, containing, significantly reducing, or controlling infestations of exotic plant species.

Supplementary Goals

- Reduce or eliminate the ability of exotic plants to invade natural and development zones, or to re-invade previously treated areas
- Re-establish natural ecosystem function in areas previously impacted by exotic plants
- Accomplish overall goals while minimizing harm to wilderness character, natural resources, natural ecological communities and processes, cultural resources, visitor experience, or human health and safety
- Ensure visitor and employee safety during project implementation
- Conserve native seeds in areas adjacent to infestations to preserve genetic diversity and provide a seed source for future restoration

Objectives

1. Reduce exotic plant cover by 50% within the development zone and disturbance corridors in GRCA over the next ten years, 2009-2019
2. Conduct exotic plant surveys in 25% of GRCA's natural zone priority areas over the next ten years, 2009-2019
3. Identify and control small populations of the most invasive and potentially threatening species park-wide
4. Prevent further introductions of exotic plant species already present in GRCA and introductions by increasing visitor and staff awareness through education
5. Initiate projects to enhance visitor experience and aesthetics in the park
6. Increase cooperation and coordination with adjacent land owners and agencies

MANAGEMENT AND PLANNING HISTORY

NPS Management Policies is the guiding document for management of all national parks within the national park system. It is the basic NPS servicerwide policy document and supersedes the 2001 edition. *NPS Management Policies* is the highest of three levels of guidance documents in the NPS Directives System. As stated in its introduction, "It (NPS Directives System) is designed to provide NPS management and staff with clear and continuously updated information on NPS policy and required and/or recommended actions, as well as any other information that will help them manage parks and programs effectively." *NPS*

Management Policies' Chapter 4, Natural Resource Management is most applicable to this project.

Section 4.4.4.2, page 48 of *NPS Management Policies* allows parks to remove exotic species already present in parks under the following criteria:

“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

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.”

In addition to providing direction on all aspects of park management, *NPS Management Policies* also sets direction for each unit of the national park system to maintain an up-to-date General Management Plan. The primary purpose of a park's GMP is to provide a foundation from which to protect park resources while providing meaningful visitor experiences. The proposed project area spans the entire park and includes all designated management zones including natural, cultural, and development zones. This proposal tiers from the GMP and further refines direction for management of invasive plant species throughout the park. For purposes of this document, management zones are further defined below to address goals and priorities by location.

Development Zone

The development zone (Figure 3) consists of South Rim, including Desert View; North Rim; Tuweep; the GRCA portion of Lees Ferry; and developed Inner Canyon sites such as Indian Garden, Phantom Ranch, and primary corridor trails. Overall goals for the development zone are to prevent introduction of new invasive species into the park; restrict the spread of current invasive species; reduce the number of top priority invasive species; and improve native habitat in areas disturbed by invasive species.

The South Rim developed area (Figure 3) begins at the park's east boundary and includes Desert View and Desert View Drive, South Rim Village, Hermits Rest Road to the west, and South Entrance Station. Included in the South Rim developed area are three meters on both sides of roads and two meters on both

sides of trails. Specific goals for this area are to survey for and treat high priority invasive species along all roads, trails, and within all previously identified exotic plant treatment areas (see Appendix B for priority species list). The Desert View area, South Entrance Station, railroad tracks, and around rim lodges are heavy traffic areas focused on to prevent introduction and spread of invasive species.

North Rim developed area (Figure 3) consists of north entrance, scenic overlooks, NPS residential and administrative areas, and lodge areas. Included in the North Rim developed area are three meters on both sides of roads and two meters on both sides of trails. Specific goals for North Rim are similar to South Rim; to survey for and treat top priority invasive species along all roads, trails, and in all areas identified with exotic plant species (see Appendix B for priority species list). The lodge, campground, residential, and NPS areas are a priority due to the history of invasive species presence in these areas. North Rim has a more pristine nature than the South Rim and therefore fewer numbers of top priority species. High priority species in the North Rim development zone include Dalmatian toadflax, spotted knapweed, houndstongue, foxtail barley, quackgrass, bull thistle, salsify, orchardgrass, and smooth brome.

The Inner Canyon developed area (Figure 3) includes South Kaibab, Bright Angel, and North Kaibab Trails, Indian Garden, Phantom Ranch, Cottonwood and Roaring Springs. The developed area at Indian Garden includes residences, campground, day use area, pump-house, mule tie-up, and Garden Creek. Top priority species in this area are Himalayan blackberry and tamarisk. Other priority species include date palm, horehound, mullein, and Sahara mustard. The developed area at Phantom Ranch includes campground, residences, mule tie-up, and lodge at Phantom Ranch. The top priority species in this area are tamarisk and date palm.

Another park developed area is Lees Ferry. This area consists of campground, boat ramp, orchard, residential area, parking lots, and roads around Lees Ferry. With the cooperation of Glen Canyon National Recreation Area, the adjacent land owner, top invasive plants including Sahara mustard, Ravenna grass, Russian thistle, and Russian olive are monitored and removed regularly.

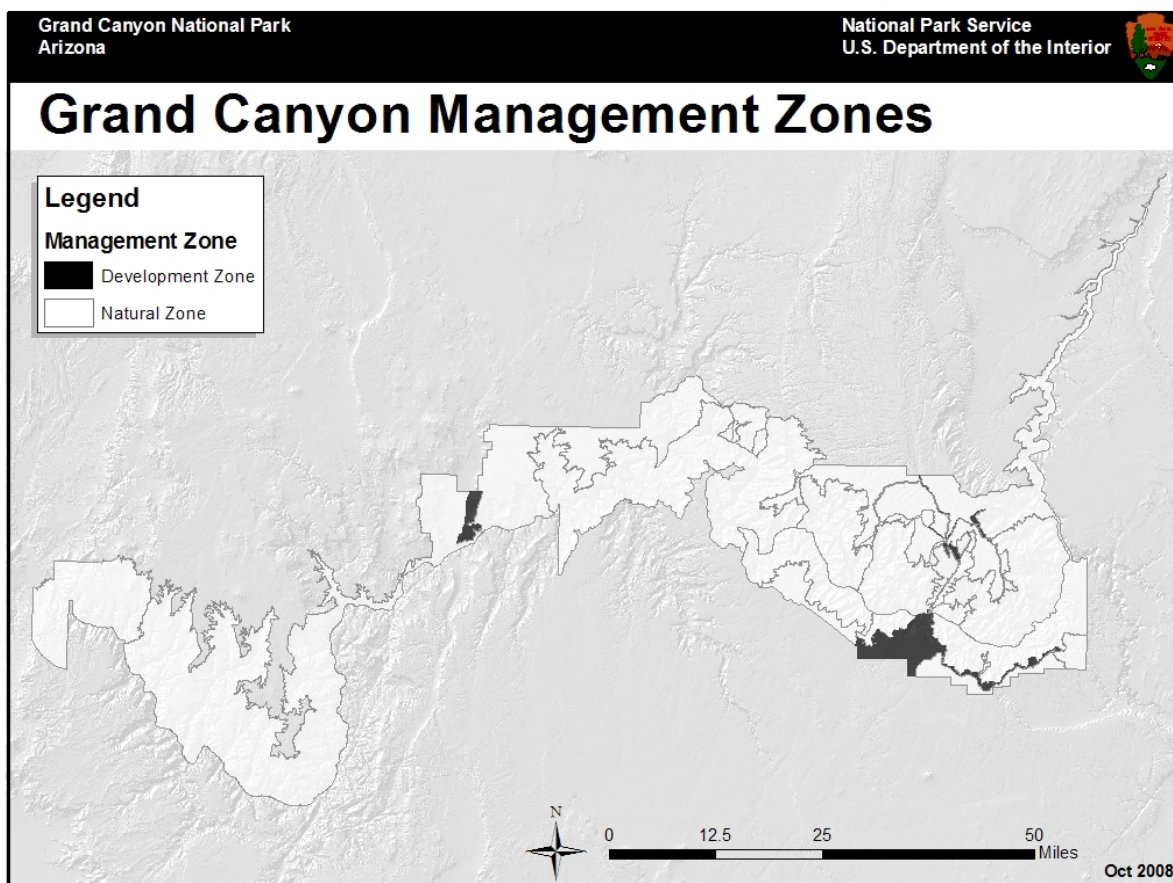
Sahara mustard is also the top priority species at Tuweep, another park developed area. Tuweep, or Toroweap, lies on North Rim approximately 60 miles southwest of Fredonia, Arizona. The developed area is comprised of Tuweep ranger station, entrance road, and Toroweap campground and overlook.

Natural Zone

The natural zone generally includes anything outside developed areas. The GMP describes this zone as including lands and waters managed to conserve natural resources and ecological processes and directs the park to provide for their use and enjoyment by the public in ways that do not adversely affect these resources and processes. Over 90 percent of the park is defined as a natural zone. For the purpose of this document and exotic species management, the natural zone is further broken down into priority areas. Because the natural area is so large, the following areas will be prioritized for surveys and treatment: tributaries, roads and trails, backcountry campsites, river corridor and other areas that have had more human influence or visitation. A majority of the natural zone is proposed wilderness. The park treats proposed wilderness as designated wilderness, and

acts in accordance with the Wilderness Act. See Wilderness Character in Chapter 3 for more information on the relationship between exotic plant management and wilderness resources.

Figure 3 Grand Canyon Management Zones (National Park Service, 1995)



The GMP also sets objectives for exotic plant management to preserve and protect genetic integrity and species composition consistent with natural ecosystem processes and, to the maximum extent possible, restore altered ecosystems to their natural conditions. In managing naturalized ecosystems, ensure preservation of native components through active management of nonnative components and processes.

Previous Treatments and Compliance

GRCA began treatment of exotic plants by manual methods in the early 1990s when it became apparent that Ravenna grass (*Saccharum ravennae*) was a threat to Inner Canyon riparian areas. By 1993, similar control efforts were initiated for Dalmatian toadflax (*Linaria dalmatica*) and Mediterranean sage (*Salvia aethiopis*) populations on South Rim, and Dalmatian toadflax and houndstongue (*Cynoglossum officinale*) on North Rim. By the mid 1990s, Himalayan blackberry (*Rubus discolor*) populations at Indian Garden were added to the control list; in addition to manual and mechanical treatment, this was the first documented use of chemical herbicides in an effort to control exotic plants in GRCA. Current control efforts focus on 28 particularly aggressive species, with techniques such as pulling, digging, and replanting native vegetation the most common management actions.

In 1999, the park used the Alien Plant Ranking System (APRS) to rank 132 of the 145 exotic plant species listed at that time (Makarick, 1999); (Hiebert & Stubbendieck, 1993). APRS provides an objective framework to determine which species are highest priority based on level of impact, ability to become invasive, and feasibility of control. Species having the most impact, were most invasive, and were feasible to control ranked highest. APRS also helps the park identify those species that are not presently a serious threat but have potential to become a threat and, thus, should be monitored closely or managed aggressively before they become established. Potential cost of delaying action is also considered in this analysis. APRS can be downloaded at <http://www.usgs.nau.edu/SWEPIC/aprs/downloads.html>. In 2005, species were re-ranked using APRS to incorporate new exotic plant species and the change in distribution of others.

During the past five years, over 5,500 acres (2,226 hectares) of lands infested with invasive plants have been surveyed. Herbicide has been used on 13 species, with the vast majority of treatment focused on tamarisk (*Tamarix ramosissima*) in the park's backcountry (Makarick, 2006; National Park Service, 2002b; Watters & Makarick, 2008). Herbicide has been applied to individual stems using hand sprayers and paint brushes on most species and has been injected into larger trees, including tamarisk and Russian olive, to minimize environmental impacts. No broadcast spraying has been used in the park.

The GRCA Vegetation Program has been operating under 1) a Programmatic Categorical Exclusion (CE) for fiscal years 2004 through 2008 for routine exotic plant management activities consistent with management policies (National Park Service, 2004), and 2) a Tamarisk Management and Tributary Restoration Environmental Assessment (EA) of 2002 (National Park Service, 2002b).

The Tamarisk Management and Tributary Restoration Program was designed to control tamarisk, restore native plant communities, and prevent any further loss or degradation of existing native biota in side canyons, tributaries, developed areas, and springs in GRCA. Since its initiation in 2002, the Tamarisk Management and Tributary Restoration EA has successfully guided tamarisk removal in most GRCA Colorado River tributaries that do not contain potential southwestern willow flycatcher habitat, a Federally designated endangered bird. The proposed Exotic Plant Management Plan includes routine maintenance and spot treatment of tamarisk throughout the park in previously treated areas and new areas as needed.

Park staff implemented prevention and control measures on exotic plant species based on the previously described documents. Control is accomplished through Integrated Pest Management (IPM) techniques, a process by which available technology, knowledge of exotic plant species biology, health and human safety, and environmental parameters are all considered during decision making. Due to the scope of the program, an environmental assessment is a more appropriate document to analyze impacts of exotic plant management and involve the public, interested agencies, and American Indian tribes. Proposed IPM techniques, under the preferred alternative, include all current practices and also incorporate a more thorough look at fire and its relationship to exotic plant management. Development of work plans, increased coordination, additional prevention, and enhanced education is needed for more successful exotic plant management.

In addition to high priority species treatment, there is also an aesthetic and visitor experience aspect of exotic plant management. Park aesthetics are important and can enhance visitor experience. Both NPS and concessioner employees have requested herbicide use to treat plants growing in sidewalks and curbstones. To date, this use has not been approved. In this EA, use of chemicals for more aesthetic purposes is considered and discussed.

Internal Scoping

Preliminary internal scoping to identify NPS specialists' concerns regarding exotic plant species management began in fall 2004. Park vegetation staff initiated the EA/AEF scoping process through several meetings with an interdisciplinary team of park managers and resource specialists. The project was discussed with the park's interdisciplinary team (IDT) on January 12, 2005 to generate initial issues and concerns, and a smaller project-specific IDT was identified. This project IDT met on January 19, 2005 to develop preliminary alternatives. The park's Project Review Board reviewed the project and several preliminary alternatives on January 31, 2005. An internal review of the draft EA/AEF was initiated in November 2008.

Public Scoping

A public scoping letter, dated March 18, 2005, was distributed to an approximately 300-person GRCA mailing list; this letter was also posted on the park's website.

The purpose of the scoping letter was to describe goals of the exotic plant management plan and preliminary management actions under consideration.

Recipients were asked for input on the purpose and need for this proposal and any issues or concerns regarding actions under consideration. Fourteen (14) responses were received in overall support of exotic plant management; senders were:

- U.S. Fish and Wildlife Service
- Arizona Department of Environmental Quality
- State Historic Preservation Office
- Glen Canyon National Recreation Area
- Sierra Club, Grand Canyon Chapter
- Grand Canyon Private Boaters Association
- Two private individuals
- Six responses asked to be added to the mailing list

A summary of public comments received and how these comments have been addressed is included in Appendix C.

NPS used this scoping response, in combination with other input from the project IDT and other NPS staff to re-evaluate the project's purpose, need, and objectives. Based on this review, NPS developed a preliminary project proposal designed to best meet the purpose and need for taking action and specific identified project objectives.

This EA/AEF has been distributed to those who responded to the public scoping effort, to affiliated tribes, and pertinent agencies. Availability of the EA/AEF for the 30-day public review was advertised via press release and through the NPS planning, environment and public comment (PEPC) website.

At the time of public scoping, NPS also contacted other agencies pertinent to the project including the State Historic Preservation Office (SHPO), all affiliated American Indian tribes, and the U.S. Fish and Wildlife Service (USFWS), initiating

informal consultation and soliciting issues or concerns. NPS methods for contacting these groups, and their responses, are detailed in Chapter 4 and summarized below.

The Arizona SHPO and NPS staff discussed how to fulfill requirements of Section 106 of the National Historic Preservation Act. The SHPO agreed that the use of the Programmatic Agreement (PA) developed for the GMP would be appropriate for exotic plant management. In addition, the park will submit assessments of effect (AEFs) for exotic plant management activities each year. AEFs will be reviewed by the SHPO.

Several consultation meetings were held with affiliated American Indian tribes between 2005 and present. Concerns expressed by the tribes included the eradication of edible and medicinal plants and the desire to collect native plants in the park. The park intends to continue to work with affiliated tribes to address these concerns.

The USFWS responded to the initial scoping letter with a series of comments and concerns including a species list to consider for impact analysis; recommendations to use native species to restore desired ecosystem components; concerns with biological control agent use, specifically regarding the southwestern willow flycatcher; and suggestions to identify priority treatment areas to evaluate effects to listed species. A project-specific biological assessment is being prepared to address specific concerns related to special status species.

ISSUES AND IMPACT TOPICS

National Park Service specialists, with input from Federal, state, and local agencies, identified issues and concerns (i.e., impact topics) affected by this project. After public scoping, issues and concerns were distilled into distinct impact topics to facilitate analysis of environmental consequences, which allows for a standardized comparison between alternatives based on the most relevant information.

Issues may come from the public, from within an agency or department, or from another agency (Freeman & Jenson, 1998). For this project, the interdisciplinary team identified issues with the preliminary project proposal during the internal scoping process. Internal, public, and other agency comments resulted in the following substantive issues:

- Ground disturbance necessary for exotics control may affect archaeological resources or reveal previously unknown sites
- Priorities for action should also include locations where early detection and control efforts can stop an invasive before it becomes established
- Selection of treatment methods needs to include examination of possible effects to Federally listed threatened and endangered species
- Focus native landscape restoration around residences, in developed areas, and along Bright Angel Creek
- Coordinate treatment efforts at Lees Ferry with Glen Canyon National Recreation Area

Other concerns and comments brought forward (Appendix C) included herbicide use, natural resource protection, education, and treatment methods to consider.

Identified issues were used to formulate alternatives and mitigation measures. Impact topics were then selected for detailed analysis based on substantive issues, environmental statutes, regulations, executive orders, and *NPS Management Policies*. A summary of impact topics and rationale for selection or dismissal are below.

RELEVANT IMPACT TOPICS

Native Vegetation – NPS has developed policies and guidance on the topic of native vegetation. Section 4.4 of *NPS Management Policies* addresses biological resource management and states that NPS will “maintain as parts of the natural ecosystems of the parks all native plants and animals.” Exotic plants can inhibit growth of native vegetation, alter vegetative community structure, reduce biodiversity through monoculture creation, increase likelihood of large-scale fires, and alter successional pathways and ecosystem processes. Some exotic plants are allelopathic, producing a substance released to the environment that influences growth and development of neighboring plants and which can make soils uninhabitable for native species. Therefore, native vegetation is discussed in Chapter 3.

General Wildlife – As noted above, Section 4.4 of *NPS Management Policies* states the NPS will “maintain as parts of the natural ecosystems of the parks all native plants and animals.” Exotic plants are known to create undesirable forage or habitat for native insects, birds, reptiles, amphibians, and mammals and may alter wildlife community composition. Some exotic plant species are toxic or have burrs or spines that may cause injury to the mouth, stomach, or intestines of native and domestic grazing animals (Washington State Noxious Weed Control Board, 2001). Exotic plants can displace large tracts of native vegetation resulting in loss of wildlife habitat. Therefore, general wildlife is discussed in Chapter 3.

Special Status Species – Section 7 of the Endangered Species Act requires all Federal agencies to consult with the U.S. Fish and Wildlife Service to ensure any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of listed species or critical habitats. Federally listed threatened and endangered species, species proposed for listing on the Endangered Species List, and species of particular concern to Grand Canyon National Park have potential to be affected by proposed actions. Exotic plants may out-compete native vegetation including rare plant species. They may also endanger populations of special status species wildlife through changes in vegetative community composition and structure, leading to habitat degradation. A Biological Assessment is being prepared for this project to facilitate consultation with the USFWS and will detail potential effects to these species. Therefore, special status species are discussed in Chapter 3.

Soil Resources – According to *NPS Management Policies* (National Park Service, 2006), “The Service will actively seek to understand and preserve the soil resources of parks, and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources.” Hand removal of exotic plant species and use of herbicides could result in some level of disturbance to soil resources. Therefore, soil resources are discussed in Chapter 3.

Water and Aquatic Resources (Riparian, Floodplain, Wetland, and Water Quality) – Executive Order 11990 (Protection of Wetlands), Executive Order 11988 (Floodplain Management), the Clean Water Act of 1972, NPS Director’s Order 77-1 (Wetland Protection) require Federal land management agencies to avoid, where possible, adversely affecting wetlands. *NPS Management Policies* reflect these regulations and direct park managers to:

- perpetuate surface waters and ground waters as integral components of park aquatic and terrestrial ecosystems;
- manage for preservation of floodplain values;
- protect, preserve, and restore natural resources and functions of floodplains;
- preserve and enhance natural and beneficial values of wetlands;
- provide leadership and take action to prevent destruction, loss, or degradation of wetlands; and
- maintain or restore water quality

Proposed routine exotic plant species control actions have potential to affect water and aquatic resources. Therefore, water and aquatic resources are discussed in Chapter 3.

Air Quality – Section 118 of the Clean Air Act requires all Federal facilities comply with existing Federal, state, and local air pollution control laws and regulations. Proposed use of fire to treat exotic plants has potential to affect air quality in GRCA. Therefore, air quality is discussed in Chapter 3.

Cultural Resources (Archaeological Resources, Cultural Landscapes, Historic Structures, and Ethnographic Resources) – NPS managers must comply with Section 106 of the National Historic Preservation Act of 1966, as amended, Archaeological Resources Protection Act of 1979, as amended and NPS Director’s Order 28 (Cultural Resources Management). Exotic plant species management activities could affect archaeological resources, cultural landscapes, historic structures, and ethnographic resources. Therefore, cultural resources are discussed in Chapter 3.

Visitor 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 backcountry areas and along the Colorado River, 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.

Wilderness Character – Most of the park is recommended for wilderness designation. Until Congress formally acts on this recommendation, *NPS Management Policies* require these areas be managed under Wilderness Act provisions. Exotic plant activities that could affect wilderness character include access to backcountry work locations, treatment methods such as manual and chemical, and manipulation of plants inherent in exotic plant management. Therefore, wilderness character is discussed in Chapter 3.

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. Control methods could impact health and human safety, and some exotic plant species contain toxins harmful to humans after prolonged exposure. Therefore, public health and safety is discussed in Chapter 3.

Park Operations – NPS Director’s Order 12 (DO-12) provides guidance to national parks on inclusion of park operations as an impact topic. Although *NPS Management Policies* does not specifically address park operations, virtually every action or proposal evaluated in the NEPA process has either a direct or indirect effect on park operations. Exotic plant species management actions require varying levels of personnel, funding, and time. Each year the NPS spends over 12 million dollars (Beard, 2008) on exotic plant species removal; this number is expected to increase exponentially over the next few decades. Prevention, early detection, and control often decrease long-term management costs. Therefore, park operations are discussed in Chapter 3.

IMPACT TOPICS DISMISSED FROM FURTHER ANALYSIS

Some impact topics have been dismissed from further consideration, as listed below. During internal scoping, the park’s interdisciplinary team conducted a preliminary analysis of resources to determine the context, duration, and intensity of effects that the proposal may have on those resources. If the magnitude of effects was determined to be at the negligible or minor level, there is no potential for significant impact and further impact analysis is unnecessary, then the resource is dismissed as an impact topic. If however, during internal scoping and further investigation, resource effects still remain unknown, or are expected to be minor to moderate in level of intensity, then the resource as an impact topic is carried forward for analysis.

For purposes of this section, an impact of negligible intensity is one that is “at the lowest levels of detection, barely perceptible, and not measurable.” An impact of minor intensity is one that is “measurable or perceptible, but is slight, localized, and would result in a limited alteration or a limited area.” The rationale for dismissing these specific topics is stated for each resource.

Soundscapes –The NPS is mandated by Director’s Order 47 to articulate National Park Service operational policies that require, to the fullest extent practicable, protection, maintenance, or restoration of natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources. Natural sounds are intrinsic elements of the environment often associated with parks and park purposes. They are inherent components of “the scenery and the natural and historic objects and the wild life” protected by the NPS Organic Act. They are vital to the natural functioning of many parks and may provide valuable indicators of the health of various ecosystems. Intrusive sounds are of concern to the NPS because they sometimes impede the Service’s ability to accomplish its mission.

Mechanical treatment activities including use of brush cutters would generate some noise in the development zone above ambient conditions. Noise sources include vehicles, equipment, and additional people conducting work. To protect park soundscape during project implementation, as well as for other reasons such as safety, no noise production will occur outside the curfew established for air tour

overflights (daylight hours). For further information, see mitigation measures developed for this project. Noise impacts from this project would be short term during treatment. After treatment is completed, noise level impacts return to their natural condition. All mechanized equipment use would occur during daylight hours when roads and associated traffic already affect the project area. Therefore, this project would have no measurable effects on soundscape. Similarly, effects of past, present and foreseeable future actions on soundscape would be short term and would not measurably affect soundscape. Potential effects of noise on visitor experience and special status species are addressed under those impact topics. Therefore, soundscape was dismissed from further analysis.

Environmental Justice – Executive Order 12898 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. Executive Order 13045 requires Federal actions and policies to identify and address disproportionately adverse risks to the health and safety of children. None of the alternatives in this EA/AEF would have disproportionate health or environmental effects on minorities or low-income populations or communities. Therefore, this impact topic was dismissed from further analysis.

Prime and Unique Farmland – The Farmland Protection Policy Act of 1981, as amended, requires Federal agencies to consider adverse effects to prime and unique farmlands resulting in conversion of these lands to non-agricultural uses. Prime or unique farmland is defined as soil that particularly produces general crops as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables and nuts. The proposed project's locations and surrounding lands have been evaluated by appropriate park technical area specialists and by specialists from the Natural Resources Conservation Service (NRCS). Based on their observations, the park is not considered prime or unique farmland (Camp, 2002). Therefore, this topic was dismissed from further analysis.

Socioeconomic Environment – Socioeconomic values consist of local and regional businesses and residents, local and regional economy, and park concessions. The local economy and most business in neighboring communities are based on construction, recreation, transportation, tourist sales, services, and educational research; the regional economy is strongly influenced by tourist activity. The GMP Environmental Impact Statement (EIS) discussed socioeconomic environment and impacts extensively. Routine exotic plant species control actions would be small scale, both spatially and temporally, and would not affect regional or local socioeconomics. Exotic plant management activities are unlikely to result in any area closures or deter people from visiting the park or neighboring communities. For these reasons, socioeconomic environment was dismissed from further analysis.

Indian Trust Resources – Secretarial Order 3175 requires any anticipated impacts to Indian trust resources from a proposed project or action by the Department of the Interior agencies be explicitly addressed in environmental documents. The Federal Indian trust responsibility is the 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. Grand Canyon National Park does not have any Indian trust resources. Therefore, this topic was dismissed from further analysis.

ADDITIONAL NEPA ANALYSIS

Alternatives include all reasonably foreseeable connected actions. Environmental effects estimated for this project consider site-specific effects of all foreseeable actions and mitigation measures. Monitoring during and following project implementation would verify mitigation measure effectiveness and impact predictions. This EA/AEF will guide any subsequent project implementation. If new information or unforeseen and unanalyzed actions become necessary in the future, additional site-specific environmental analysis will be conducted before implementation.

Chapter 2 – Alternatives

INTRODUCTION

This document analyzes a No-Action alternative and one action alternative. Analysis of the No-Action alternative is required under NEPA (40 CFR 1502.14(d)). The No-Action alternative provides a baseline for assessment of potential impacts of the action alternative. During alternative development some actions were considered and subsequently dismissed. A description of alternatives considered but dismissed from detailed study is included in this chapter. A summary table that compares alternative components is also presented at the end of this chapter.

The action alternative is based on preliminary designs and best information available at the time of this writing. Specific areas and locations used to describe alternatives are only estimates, and could change during project implementation. If changes during implementation are not consistent with the intent and effects of the selected alternative, additional environmental compliance will be conducted as appropriate.

ALTERNATIVE DEVELOPMENT

As described in Management and Planning History, Chapter 1, multiple meetings and discussions took place with NPS staff regarding this proposed project. Project discussions took place as early as November 2004 and included several preliminary alternatives. Initial resource concerns were identified with park staff, and a purpose and need statement developed in 2005.

From public scoping activities (fully described in the Management History, Chapter 1) 14 responses were received. NPS staff performed content analysis on this information, information gained from internal scoping, and from scoping with other agencies. From this effort, the park developed one action alternative to address project objectives and substantive issues. The NPS believes that no other reasonable alternatives exist to meet project objectives, resolve need, and minimize resource impacts. A number of alternatives were considered, but dismissed. These alternatives and reason for dismissal are in this chapter.

NPS guidelines (Director's Order 12) state that "Normally, an EA should fully analyze a range of reasonable alternatives. However, if the IDT finds that no reasonable alternatives exist and that the proposal does not have potential for significant impacts, the EA may instead include a discussion of alternatives considered but rejected, and the reasons why these were rejected. In this case, the EA would analyze only the no action alternative and the park's proposal."

Criteria used in selection of reasonable alternatives include:

- adherence to Federal and state regulations (see Chapter 1 and Appendix A)
- potential for preserving and protecting the park's natural and cultural resources
- maximizing quality of visitor experience

- effectiveness at controlling exotic plant infestations
- ability to ensure human safety

Both alternatives involve prevention and IPM techniques to reduce or control exotic plant infestations. Alternative 1, the No Action alternative, continues current management practices. Alternative 2 proposes additional prevention actions and an expanded range of IPM techniques including some use of fire and additional chemical treatments. In addition, mitigation measures common to all alternatives are included after the alternative descriptions.

The GRCA Vegetation program referred to in the alternatives is part of the Division of Science and Resource Management. Currently, this program has nine employees: a Vegetation Program Manager, Invasive Plant Coordinator, Horticulturist, Hazard Tree Coordinator, Vegetation Crew Leader, two seasonal Biological Sciences Technicians, and two part-time Data Entry Technicians. Beginning in 2009, the program will have an Invasive Plant Coordinator for the park's backcountry areas, a Restoration Biologist for parkwide projects, three to four additional seasonal employees, and four to six interns throughout the year.

ALTERNATIVE DESCRIPTIONS

Alternatives are described below. Table 5 (page 44) summarizes each alternative's primary components, Table 6 (page 47) compares alternatives with project objectives, and Table 7 (page 48) summarizes expected implementation impacts.

Alternative 1: No Action – Continue Current Management Practices

Alternative 1 implementation continues current management practices to reduce exotic plant infestations. The existing exotic plant management program includes the following components:

- ◆ Prioritization and Planning
- ◆ Early Detection and Prevention
- ◆ Treatments
- ◆ Monitoring and Record Keeping

PRIORITIZATION AND PLANNING

Current planning efforts for exotic plant management would continue under Alternative 1 including prioritization and development of annual work plans.

Prioritization

As discussed in Management and Planning History, Chapter 1, GRCA uses the Alien Plant Ranking System (APRS) to determine which species have or could have greatest impact to park resources or adjacent land (agro/economic) activities. Those species having most impact, are most invasive, and are feasible to control rank highest (See Table 1). This prioritization would continue under Alternative 1.

Table 1 Exotic Plant Species Currently Controlled in GRCA Based on APRS Ranking

Common Name	Scientific Name
African mustard	<i>Malcolmia africana</i>
Broadleaved pepperweed	<i>Lepidium latifolium</i>
Brome grasses	<i>Bromus spp.</i>
Bull thistle	<i>Cirsium vulgare</i>
Camelthorn	<i>Alhagi maurorum</i>
Canada thistle	<i>Cirsium arvense</i>
Canadian horseweed	<i>Conyza canadensis</i>
Common mullein	<i>Verbascum thapsus</i>
Common sowthistle	<i>Sonchus oleraceus</i>
Dalmatian toadflax	<i>Linaria dalmatica</i>
Date palm	<i>Phoenix dactylifera</i>
Diffuse knapweed	<i>Centaurea diffusa</i>
Field bindweed	<i>Convolvulus arvensis</i>
Field sowthistle	<i>Sonchus arvensis</i>
Himalaya blackberry	<i>Rubus discolor</i>
Horehound	<i>Marrubium vulgare</i>
Houndstongue	<i>Cynoglossum officinale</i>
Johnsongrass	<i>Sorghum halepense</i>
Jointed goatgrass	<i>Aegilops cylindrical</i>
Kentucky bluegrass	<i>Poa pratensis</i>
Mediterranean sage	<i>Salvia aethiopis</i>
Nodding plumeless thistle	<i>Carduus nutans</i>
Pampus grass	<i>Cortaderia selloana</i>
Poison hemlock	<i>Conium maculatum</i>
Prickly lettuce	<i>Lactuca serriola</i>
Puncture vine	<i>Tribulus terrestris</i>
Rush skeletonweed	<i>Chondrilla juncea</i>
Russian knapweed	<i>Acroptilon repens</i>
Russian olive	<i>Elaeagnus angustifolia</i>
Russian thistle	<i>Salsola tragus</i>
Sahara mustard	<i>Brassica tournefortii</i>
Scotch thistle	<i>Onopordum acanthium</i>
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>
Spiny sowthistle	<i>Sonchus asper</i>
Spotted knapweed	<i>Centaurea stoebe ssp. Micranthos</i>
Tree of heaven	<i>Ailanthus altissima</i>
Whitetop	<i>Cardaria draba</i>
Yellow salsify	<i>Tragopogon dubius</i>

Annual Work Plans

In 2008, a complete work plan for all park exotic plant management was developed (see outline, Appendix D). A similar plan would be completed each year to identify project areas, site specific survey information, monitoring and exotic plant removal protocols, herbicide details, safety information, blank data forms, and any

additional project specific information. Work plans would not only guide Vegetation staff, but also provide a communication method with other resource staff on topics such as sensitive species, wilderness, and cultural resources. Under Alternative 1, work plans would continue to be completed on an annual basis.

EARLY DETECTION AND PREVENTION

Early detection and prevention actions currently implemented in GRCA include public and employee education, community outreach, and collaboration within the park and beyond park boundaries.

Education

The current Vegetation program has incorporated education through volunteer programs, publications, and both formal and informal presentations.

Volunteer projects provide a unique education opportunity. Through a hands-on work experience, volunteers often develop a heightened sense of issues and are committed to continued stewardship efforts. Volunteers have helped reduce acreage infested with exotic plants. Over 9,500 hours of volunteer time were devoted to controlling exotic plant species in Fiscal Year 2007.

Publications are another education effort. Twice a year articles in *The Guide*, a quarterly publication provided to park visitors, highlight the program's invasive plant management work. Site Bulletins have been prepared for tamarisk management work, Himalaya blackberry removal, and backcountry invasive plant management efforts. A pamphlet titled *Fight the Invasion! Controlling invasive plant species at Grand Canyon National Park* is provided to backcountry visitors and the general public, and a brochure titled *Invasive Plant Species Observation* is given to GRCA employees and backcountry guides during training. A pamphlet titled *What's in Your Backyard* is provided to park residents in an effort to increase awareness and encourage hands-on participation in invasive plant removal efforts.

Vegetation staff contributes education and outreach at the local school. The school is in the process of initiating a new curriculum requiring middle school students to participate in volunteer projects as part of their classes, and the Vegetation staff is working with school officials to include the park's vegetation program. Vegetation staff work with interpretative staff to implement a School-to-Work curriculum at the Grand Canyon School.

In addition to these efforts, trainings are provided to GRCA work groups throughout the year. Vegetation staff also give presentations to Grand Canyon Field Institute guides, college and university groups, local organizations (i.e., Rotary, Master Naturalists), and other groups upon request.

Collaboration

In a proactive effort, GRCA has joined Federal, state and local government agencies, tribal governments, private landowners, non-profit organizations, businesses, and other partner organizations to develop joint strategies to curb the exotic plant threat.

The park participates in the Northern Arizona Weed Council, a partnership among public and private organizations and individuals to promote cooperation and coordination. Vegetation staff contributes information to the San Francisco

Peaks Weed Management Area (WMA), the Moenkopi WMA, and the Arizona Strip WMA. Due to the park's size, the Vegetation Program intends to form a separate Grand Canyon WMA in the future.

Vegetation staff participated in the Arizona Wildlands Invasive Plant Working Group's efforts to prioritize state invasive exotic plants. The park is a collaborator with the Southwest Exotic Plant Information Clearinghouse (SWEPIC) and provides annual invasive plant management information for the regional database.

GRCA biologists coordinate invasive plant management efforts with Glen Canyon National Recreation Area (GLCA) staff. GRCA conducts several exotic plant management projects a year at Lees Ferry where the boundaries of GRCA and GLCA overlap. GRCA hosts one to two week work projects for regional NPS Exotic Plant Management Team (EPMT). The EPMT is a mobile task force providing on-the-ground support for park invasive plant management efforts.

GRCA communicates with Arizona Department of Transportation (ADOT) regarding exotic plant management efforts on roads directly outside the park boundary. Vegetation staff also works closely with Kaibab National Forest regarding overlapping concerns and projects, particularly in Tusayan and Desert View areas. GRCA and Grand Canyon Railroad are currently working on plans to treat persistent invasives along park railroad tracks to minimize fire hazard and address invasive species.

Collaboration as described would continue under Alternative 1.

Project Mitigation Measures

All compliance documents for park projects assess exotic plant species risks, analyze potential treatment of high-risk sites for invasive plant establishment and spread, and identify prevention techniques. These prevention techniques or mitigation measures limit introduction and spread of exotic plant species. Mitigation measures include pressure washing vehicles and equipment entering the park, approved fill material use, pre-construction exotic plant surveys, and post-construction site restoration. (Appendix E contains detailed mitigation measures).

Vegetation Program staff work closely with other park staff to ensure sufficient funding is included in construction-related projects. Vegetation staff attends pre-construction meetings to stress importance of exotic plant prevention measures. Under Alternative 1, these project mitigation measures would continue.

TREATMENTS

Alternative 1 proposes to continue current exotic plant treatments including cultural, manual, mechanical, and chemical.

CULTURAL TREATMENTS

Cultural treatments are practices that promote growth of desirable plants and reduce opportunities for exotic plants to grow. Treatments include seeding, planting, prescribed fire, livestock exclusion, flooding, manual addition of carbon sources (e.g. sugar and sawdust), and mulching. Current cultural methods that would continue under Alternative 1 include seeding, mulching, and restoration.

Seeding

Seeding is used to encourage re-establishment of native plants and prevent establishment of exotic plants. Seeding is not required in areas where native plant diversity is adequate within and surrounding treated exotic infestations. GRCA currently collects and stores a very limited amount of native plant seed for future restoration, and this would continue under Alternative 1.

Mulching

Mulching is used in disturbed areas to promote water retention and reduce exotic plant species competition. Mulch is generated in the park; trees cut for construction projects, fire management activities, or as part of the hazard tree management program are chipped and stockpiled for mulch. Mulch use would continue under Alternative 1.

Restoration

Restoration is defined as a method used to mitigate disturbed areas or control exotic plant problems by restoring native vegetation communities that existed prior to disturbance or invasion. In some cases, active restoration may not be necessary if bare ground or rock is the desired condition or if there is enough desired vegetation in proximity to occupy niches opened by exotic plant control procedures (James, 1992). However, when desired vegetation canopy is nonexistent or inadequate for site conditions, active restoration is required to speed recovery of a healthy plant community. This is often the case in newly disturbed areas in park developed areas.

Current site restoration efforts focus on funded construction or rehabilitation projects. Methods vary depending on site and project, and often include a combination of soil scarification, collection and storage of native seed, spreading of seed and mulch on site, addition of soil amendments, and planting native plant species. Restoration efforts would continue under Alternative 1.

MANUAL TREATMENTS

GRCA uses manual treatments to control invasive plants, and these methods would continue under Alternative 1. Manual methods include removal of entire plants below the root crown, and minimizing seed production using pruners, loppers, shears, and knives to remove seed heads. Manual treatments use these hand tools to cut, clear, or prune herbaceous and woody species. Vegetation crews cut plants above ground level, hand pull, or dig plants to prevent re-sprouting and re-growth. Hand tools used in manual treatments include geology picks, trowels, shovels, pulaskis, McLeods, hand saws, axes, shovels, rakes, machetes, hoes, brush hooks, and hand clippers. Although costly and labor intensive, manual treatment is species-selective and can be used in sensitive habitats and remote areas inaccessible to ground vehicles.

MECHANICAL TREATMENTS

GRCA uses mechanical treatments to control invasive plants and would continue these efforts under Alternative 1. Mechanical actions primarily involve removal of entire plants above the root crown with hand held brush cutters in developed areas; however, on pre-disturbed construction sites, tractors have been used to remove exotic plant species prior to site disturbance. Heavy equipment such as tractors and mowers are only used to control large exotic plant infestations.

CHEMICAL TREATMENTS

Chemical treatments use herbicides to eliminate exotic plants or greatly reduce vigor. Herbicides can reduce photosynthesis, disrupt reproduction, or interrupt production of essential proteins. Proper use of chemical herbicides is dependent on many factors including: 1) treatment objective; 2) accessibility, topography, and size of infested area; 3) the life history of the target species; 4) density of infestation; 5) location of sensitive species or sensitive areas in the immediate vicinity; 6) timing of application in relation to plant growth and weather conditions; 7) herbicide toxicity and degradation time; 8) soil attributes; and 9) cost. Under Alternative 1, herbicide application would continue to be scheduled and designed to minimize potential impacts to non-target plants and animals and, to ensure minimum risk to human health and safety, would follow all recommended application rates.

Under Alternative 1, herbicide would continue to be used only on exotic plant species that cannot be controlled in any other feasible manner (see Table 2). All herbicide would continue to be manually applied as direct application on targeted individuals. Herbicide used in riparian areas would continue to be formulated for aquatic use and application would be limited.

MONITORING AND RECORD KEEPING

Field crews currently map all areas in which exotic plant species control occurs, record all pertinent information about control actions taken, and gather additional site information. The GRCA Vegetation Program Manager develops and implements monitoring procedures to determine effectiveness of control techniques. Monitoring of treatment areas would continue and data entered into the park's vegetation database. Herbicide records are currently maintained on a daily basis; records include herbicide amount used and area treated for each plant species. Monitoring and record keeping would continue under Alternative 1.

Table 2 Current Chemicals Used for Exotic Plant Management, GRCA

Active Ingredient	Trade Names	Target Plants
Glyphosate	Rodeo, Roundup	Dalmatian toadflax, Himalaya blackberry, rush skeletonweed, diffuse knapweed, poison hemlock, Johnson grass, Russian knapweed, white top, yellow star thistle, spotted knapweed, Canada thistle
Aminopyralid	Milestone	Spotted knapweed, Russian knapweed, diffuse knapweed, Canada thistle
Triclopyr	Garlon 3A, Garlon 4, Pathfinder II, Tahoe 3A, Tahoe 4E	Tamarisk, Russian olive, Siberian elm, tree of heaven

Alternative 2: Preferred Alternative – Expanded use of IPM techniques

Alternative 2 would include all actions described in Alternative 1, as well as expansion of IPM techniques to include those available both now and in the future for proactive, adaptive, responsible integrated exotic plant management, as funding permits.

Additional techniques proposed in Alternative 2 include increased education, collaboration, planning, and prevention; increased chemical use as appropriate; and use of fire treatments. Other types of IPM techniques including biological control are not evaluated in this document, but may be considered in the future and analyzed in a separate NEPA document.

The description of the preferred alternative includes all actions described in Alternative 1 and includes the following topics:

- ◆ Prioritization and Planning
- ◆ Early Detection and Prevention
- ◆ Treatments
- ◆ Monitoring and Record Keeping

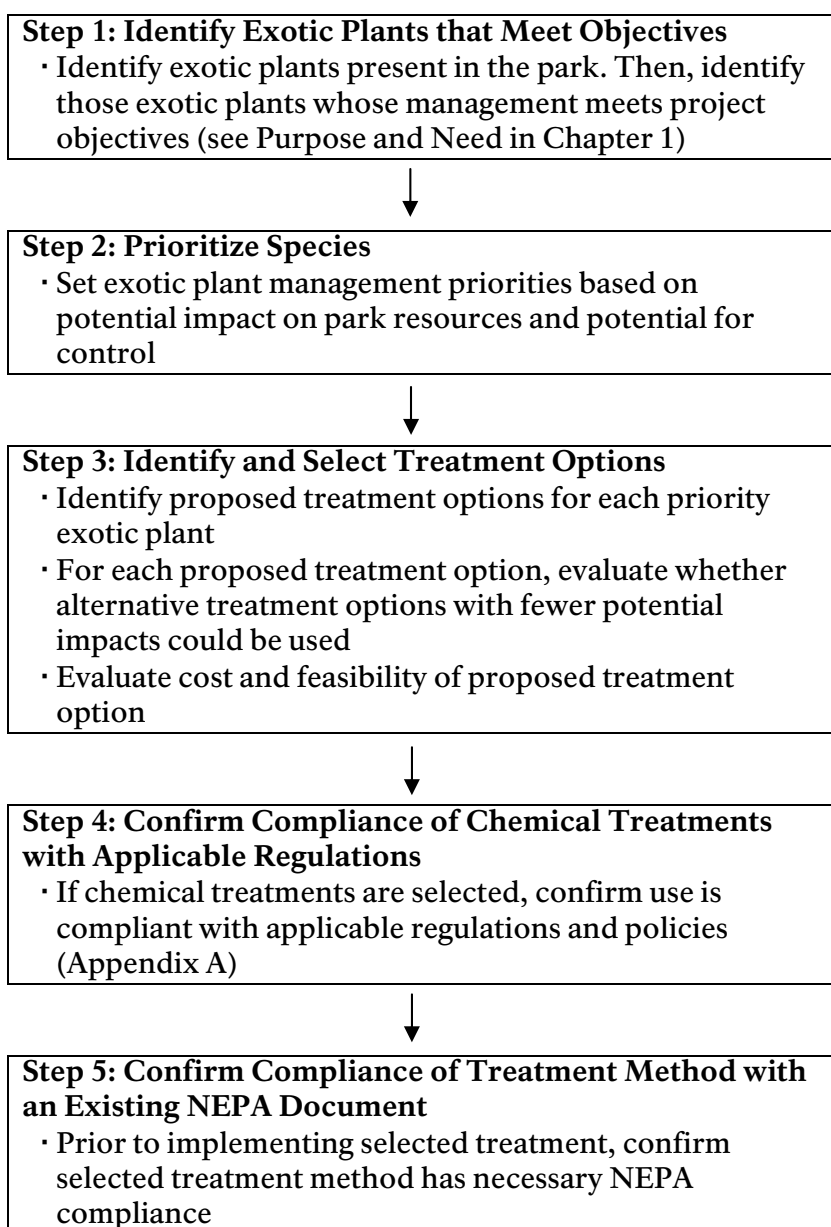
PRIORITIZATION AND PLANNING

Planning efforts proposed under Alternative 2 include use of a Decision-making Tool and continued use of annual work plans.

Decision-making Tool and Prioritization

Under Alternative 2, GRCA proposes to use the following Decision-making Tool to prioritize and determine treatment for exotic plant species. Currently, the Vegetation Program prioritizes exotic plant species for treatment and then determines the best type of treatment using an IPM technique. However, the decision making process is not documented.

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. The park would also be able to use results to explain to the public how each of these factors was accounted for in selecting treatment methods. Figure 4 provides an overview of the decision-making tool. The decision-making process is described in detail as well.

Figure 4 Decision-making Tool**Step 1 – Identify Exotic Plants That Meet Project Objectives**

This step identifies exotic plants that meet at least one project objective identified in Chapter 1 of this document. These project objectives are desired outcomes the park wants to achieve, and are specific, so overall effectiveness of the exotic plant management program can be evaluated. One objective of the plan and for exotic plant management is to reduce exotic plant cover by 50% in GRCA developed areas and disturbance corridors over the next ten years. Therefore, treatment of high priority species would aid in accomplishment of this objective. GRCA Vegetation Program staff would also review objectives on a regular basis to address the ever-changing exotic plant management issues.

As described in Management and Planning History, Chapter 1, the park's GMP separates the park into three management zones: development, natural, and

cultural. For this document's purposes, these zones are described further to guide exotic plant management.

In the development zone, including South and North Rim, Tuweep, and developed Inner Canyon sites, priority areas include roads, trails, previously identified exotic treatment areas, entrance stations, railroad tracks, campgrounds, stock use areas, and around rim lodges where heavy traffic exists. In the natural zone, over 90% of the park, priority areas include tributaries, roads, trails, backcountry campsites, the river corridor and other areas that have had more human influence or visitation. The cultural zone is not specifically identified in this document; instead cultural resources will be considered throughout the park, in both development and natural zones.

In addition, exotic plants would be managed in residential areas and throughout identified cultural landscapes. The GRCA housing policy would be revised to identify species that cannot be planted or brought into the park. Invasive species planting by residents would not be allowed. Previously planted invasive plants could be removed based on species priority.

NPS Management Policies restricts management to only those exotic plants whose management is prudent and feasible. The exotic plant must currently, or have potential to, meet at least one of the following criteria: interfere with natural processes, disrupt genetic integrity of native species, disrupt accurate presentation of cultural landscapes, damage cultural resources, hamper management of park or adjacent lands, pose a health hazard, or create a hazard to public safety.

Step 2 – Prioritize Species

This step would assist the park in determining priority species based on potential impacts to park resources and potential for controlling the exotic plant. Instead of using only the Alien Plant Ranking System as described under Alternative 1, high priority for control would be given to exotic plants that meet any of these criteria:

- Rank high using APRS. Essentially, the species have a high level of impact, are able to become invasive, and are feasible to control
- Are considered a disruptive species in GRCA
- Rank high on Arizona's list of invasive plants that threaten wildlands
- Are listed on Arizona's noxious weed list
- Are listed by the state and/or county as high priority for eradication or control
- Affect biodiversity or ecosystem processes
- Threaten rare plant species in the park
- Occur in developed or other areas where seed can be rapidly dispersed to other park areas
- Threaten integrity of an historic landscape
- Occur within 0.5 mile of park boundary and threaten to spread onto neighboring lands; or
- Are new exotic plant species infestations that have never occurred in the park

Appendix B provides a list of prioritized exotic plant species found in GRCA; however, this list is not static and will change based on new information and

studies, park priorities, and status of exotic plant management throughout the park. Two examples of how the priority of a species may change are given here:

1. Cheatgrass (*Bromus tectorum*) is listed as a “Low Priority” species. This species ranks low based on its widespread distribution and because treatment of cheatgrass across the entire park would not be feasible. If the treatment area were redefined into a smaller, more specific area (i.e. burn unit), treatment would become more feasible and the species would move up in priority.
2. Japanese pagoda trees (*Sophora japonica*) were planted as ornamental trees in the South Rim developed area and are not prioritized in Appendix B because there are very few plants and they are not invasive. However, these trees are dying and have become hazard trees. The pagoda trees would become a high priority for removal based on their hazard tree status.

Additional changes in priorities would occur over the next ten years and would be documented by Vegetation Program staff.

Step 3 – Selection of Treatment Options

GRCA would select treatment options for exotic species considered high priority. Treatments that would be least intrusive and would be successful in treating high priority species would be identified. Cost, available resources, impacts, and effectiveness would be considered. If more than one treatment option is identified feasible and effective, the treatment with least impact would be selected.

GRCA would recommend specific actions for each of the 82 exotic plant species (see Appendix B). If it is determined that eradication is not feasible, the park would attempt to suppress the exotic plant population or conduct limited control or containment in sensitive park areas (National Park Service, 2006). For example with Russian knapweed (*Acroptilon repens*) one plant would require action. Herbicide would be used on this species, even if just one plant is found. However, although finding one diffuse knapweed plant (*Centaurea diffusa*) would also require action, it would not warrant herbicide use. A single diffuse knapweed can be controlled by manual removal.

Treatment options beyond those described in this document would be considered under Alternative 2 if the treatment would have similar impacts to those described in the analysis in Chapter 3. If additional impacts would occur, additional NEPA documentation would be required as described in Step 4 below.

Step 4 – Confirm Compliance for Chemicals

If chemical application is selected as the treatment method, Vegetation Program staff would need to confirm these treatments are justified and compliant with NPS policies. Requirements include:

- *NPS Management Policies* requires a designated IPM specialist also confirm the need for chemical treatment
- NPS-77 requires that chemicals be registered by the U.S. Environmental Protection Agency (EPA)
- Pesticides must be used in accordance with product labels
- Some pesticides have use restrictions that prohibit use under certain conditions. Pesticides having use restrictions would only be used for sites that meet conditions specified on the product label

- Pesticide use proposals (PUPs) must be submitted to the Regional IPM Coordinator prior to use

All of these requirements would be met under Alternative 2 if chemical treatment is selected.

Step 5 – Confirm Compliance of Proposed Treatment Method with NEPA

This step would be used to confirm the selected treatment method complies with NEPA. The Vegetation Program Manager would use this document to confirm the selected treatment method has been adequately analyzed. If there is a question about NEPA adequacy, the Vegetation Program Manager would consult with the park's Office of Planning and Compliance.

The following questions would be asked for each proposed exotic plant management treatment:

- Is the selected treatment included in the GRCA Exotic Plant Management Plan (EPMP) or another approved plan and accompanying NEPA document?
- Are potential selected treatment impacts consistent with the GRCA EPMP or another approved plan and accompanying NEPA document?
- Is the EPMP or another approved plan and accompanying NEPA document accurate and up-to-date?

If selected treatment(s) comply with approved GRCA EPMP or another NEPA document, documentation of this would be included in the annual work plan. The park would specifically review the scope of work each year to assess impacts to cultural resources and special status species. If impacts beyond those identified in Chapter 3 of this document would result, additional compliance and consultation completed, and/or mitigations measures implemented.

If proposed treatment method has not been adequately addressed in the EPMP or in another NEPA document, preparation of a new document would be required to comply with NEPA.

Annual Work Plans (See Work Plan Template in Appendix D)

As described under Alternative 1, annual work plans would be developed to guide exotic plant management actions.

EARLY DETECTION AND PREVENTION

All early detection and prevention actions described under Alternative 1 would continue under Alternative 2. Additional prevention actions proposed under Alternative 2 include increased education, communication, and collaboration; park-wide exotic plant surveys; and expanded mitigation measures.

Education

The Vegetation Program would increase efforts to inform the public and staff about exotic plant species and park management strategy. Potential methods to increase visitor and staff awareness include:

- Promote and support interpretive programs
- Promote and expand in-school programs
- Design visitor center and orientation plaza displays and additional brochures and site bulletins

- Develop a training manual for identification and control of invasive plants in the park's developed areas for park staff
- Update the exotic plant species information on the GRCA website
- Prepare additional press releases each year
- Submit additional articles for publication
- Provide hands-on training opportunities for NPS employees
- Participate in other agency vegetation management trainings
- Develop cross-training opportunities with neighboring park units
- Include exotic species information with backcountry and river permits
- Possibly request that all backcountry staff and visitors visit seed brushing stations at trail heads prior to entering the backcountry

GRCA would continue to work with volunteers to control exotic plant species, and seek to expand the volunteer program.

Collaboration

Collaboration would continue as described in Alternative 1. Increased collaboration would include efforts to coordinate exotic species management with the U.S. Forest Service and Arizona Department of Transportation, and consultation with sister parks in Mexico and China. GRCA Vegetation Program staff would also continue steps required to form the Grand Canyon WMA described in Alternative 1.

Coordination with GRCA Fire Activities

Fire and fire management has potential to introduce and spread exotic plant species. Fire timing and plant lifecycles are important variables in exotic species establishment. To prevent infestation and spread, Alternative 2 proposes the following measures for Fire Management (pre-fire, pre-incident training, and plans), Wildfires (except when human life or property is at risk), Prescribed Fire, Wildfire Use, and Fire Rehabilitation:

- Provide invasive plant awareness and prevention training and educational materials to GRCA Fire Program staff and Resource Advisors. Resource Advisors would be responsible for presenting information to the Incident Management Team when wildfire or control operations occur in or near a noxious weed area, and to Burn Rehabilitation Teams when applicable
- Provide exotic plant spatial data to Fire Program semi-annually, and avoid ignition and burning in areas with high priority invasive plant infestations
- To prevent new exotic plant infestations and spread of existing exotic plants, avoid or remove sources of exotic plant seed and propagules, or manage fire as an aid in control of exotic plants
- Ensure equipment is free of exotic plant seed and propagules before park entry
- Locate helibases, camps, and staging areas in already disturbed areas that are more or less free of invasive plant species
- Avoid creating soil conditions that promote invasive plant germination and establishment
- Use appropriate suppression tactics to reduce suppression-induced disturbances to soil and vegetation while minimizing seedbed creation due to disturbance from fire effects

- As fire crews conduct pre-burn assessments and install Fire Effects monitoring plots, they will gather invasive plant species information, assess potential risks, and share data with the Vegetation Program
- Evaluate invasive plant status and risks in Burned Area Emergency Rehabilitation plans. When appropriate, apply for Burned Area Emergency Rehabilitation and restoration funding
- To prevent conditions favoring invasive plant establishment, re-establish vegetation on bare ground caused by project disturbance as soon as possible using either natural recovery or artificial techniques as appropriate to site objectives. This is dependent on availability of genetically suitable seed or plant material
- Seed and straw mulch used for burn rehabilitation (for wattles, straw bales, dams, etc.) need to be inspected and certified free of weed seed and propagules

Surveys

Alternative 2 proposes to survey priority areas throughout the park as described under management zones in Chapter 1. More in-depth and extensive annual surveys are proposed that are not currently being completed.

Expanded Mitigation Measures

Mitigation measures described in Alternative 1 would continue to be implemented and the following measures are proposed under Alternative 2:

- Use only fill and gravel free of high priority invasive plant seed in all park construction and maintenance activities
- Request all construction equipment be cleaned prior to entering the park to prevent introduction of exotic plant seeds
- All hay and forage must be weed seed free. This mitigation measure would be enforced after the Weed Seed Free Hay and Forage Standard Operating Procedure, currently under review by park management, is finalized

GRCA Vegetation Program staff would also review and amend park Construction Guidelines to include more detailed mitigation measures as they are developed. Staff would visit all potential borrow pits spring and fall yearly to complete exotic plant species surveys. This data would be provided to Project Management Team (PMT) staff. Vegetation Program leads would work more closely with PMT staff to ensure adherence to mitigation measures by park staff and contractors.

TREATMENTS

Treatments described under Alternative 1 are proposed to continue under Alternative 2 as well. In addition, this alternative proposes to increase cultural treatments, including limited fire use; increase chemical types used as appropriate; and add limited broadcast spraying in developed areas.

CULTURAL TREATMENTS

Cultural methods proposed under Alternative 2 include those described for Alternative 1 and also include increased seed collection and storage, use of additional carbon sources and barriers, increased restoration, and use of fire treatments. Other cultural treatments that would be considered include the use of hot water and similar low impact treatments as they are developed.

Seeding (including post-fire seeding)

Increased native plant seed collection and storage for future restoration would occur under Alternative 2. Seed collection and seeding would focus on genetic integrity maintenance. Vegetation staff would initiate efforts to install native grass seed production fields in the park. Areas disturbed by construction or fire activities, for example, would be seeded as soon as possible, dependent, however, on seed availability.

Mulching and Use of Additional Carbon Sources

Under Alternative 2, vegetation crews would continue to use mulch and would also consider use of other carbon sources (e.g. sugar or sawdust) to control nitrogen-loving exotic plants such as brome grasses (*Bromus* spp).

Barrier Treatments

The use of barriers is proposed in Alternative 2. These barriers would be placed on top of or vertically around exotic plants to inhibit growth. Various materials would be considered for use as barriers including plastic, fabric, and metal. These techniques would generally be used on smaller populations to minimize impacts to surrounding native vegetation and soils.

Restoration

Restoration would continue and be expanded under Alternative 2. Planting more native shrubs and trees as feasible is proposed under Alternative 2.

Fire Treatments

Use of fire to treat exotic species would be considered under Alternative 2. Pile burning, controlled burning, and propane torches (also known as spot burning) would be used on a limited basis for certain species.

Pile burning involves burning a pile of plant material off the ground. Metal barrels may also be used to burn plant material. Plant material would be placed in barrels and then burned onsite. Barrels would be placed on fire-proof blankets for safety. Ashes generated in barrels would be packed out by boat or other appropriate means.

Controlled burning involves burning across an area to target a specific species or multiple species of exotic plants. A fire is ignited to spread across the controlled area and subsequently burns above-ground portion of the plants.

Propane torches, also known as spot burning, uses a propane flame directed at an individual plant. A thin blast of heat boils water in the cell stalk which generates pressure, the cell explodes, and a cross section of the stalk ruptures. Plant food and water cannot move from roots to leaves through the ruptured stalk and the plant withers and dies. The plant does not catch fire. The torch flame burns the target plant as opposed to starting a ground fire as proposed in pile or controlled burning.

Currently, the only species being considered for fire treatment is camelthorn along the Colorado River corridor. However, it is expected that fire would be considered for other species such as bindweed, as well. All fire treatment would be coordinated with GRCA Fire personnel.

MANUAL AND MECHANICAL TREATMENTS

Manual and mechanized methods would be expanded in Alternative 2 to include a wider variety of both hand and power tools such as mowers and chainsaws in developed areas. Vegetation Program staff would continue to use only hand tools in park backcountry areas. In the future, if mechanized equipment use was determined the best alternative in backcountry areas, a Minimum Requirement Analysis would guide that decision making process.

CHEMICAL TREATMENTS

Chemical application would continue as described in Alternative 1; in addition, new species would be targeted as funding allows, limited broadcast spraying would be incorporated, and additional herbicides would be used as appropriate under Alternative 2. Table 3 includes a list of chemicals currently in use and proposed. Additional herbicides beyond this list would be considered as well over the next ten years.

On a case-by-case basis, and in developed areas only, methodology would be expanded to include limited broadcast spraying (e.g. along railroad tracks to reduce fire hazard or around fire boundaries to prevent spread of invasive species). Broadcast herbicide spraying would be used in accordance with the herbicide specimen label. It would be used on large infestations in disturbed areas (e.g. rush skeleton weed along railroad tracks) in the development zone only. Broadcast spraying application would use a boom sprayer on a truck or rail vehicle and would spray directly on the ground in a target area. Herbicide would spray approximately eight feet behind and on either side of the sprayer as it moves down the track. This target area would only include the area necessary to accomplish a project (e.g. to reduce fire hazard along railroad tracks). Aerial spraying is not proposed for exotic plant management at this time.

Another action considered on a case-by-case basis is herbicide to treat plants for more aesthetic or safety purposes. These may include, but would not be limited to, plants growing in sidewalks, curbstones, road sides related to aesthetics, and medians with vegetation related to safety and specifically sight distances. Manual treatment of these plants has been completed in the past. NPS or concessioner staff would work with the park's Vegetation staff to determine if proposed herbicide use would be appropriate and necessary. Vegetation staff would help decide what type of herbicide could be used. Herbicide use would be tracked, and applicators trained to standards set forth in this document. Use would be limited and only approved after careful review by Vegetation staff.

Table 3 Summary of Active Ingredients, Mode of Action, and Application for Proposed Pesticides
(Bolded items are newly proposed in Alternative 2)

Active Ingredients	Registered Use	Target Plants	Mode of Action	Method of Application
Aminopyralid (Milestone)	General Use Rangeland, grass pastures, non-cropland areas, natural areas	Broadleaf plants	Kills target species by mimicking plant growth hormone auxin (indole acetic acid) and, when administered at effective doses, causes uncontrolled and disorganized plant growth that leads to plant death	Spot treatment with hand-held sprayers or backpack sprayers; ground application
Clopyralid (Curtail, Stinger, Transline)	General Use Cropland, grass pastures, rangeland, and non-crop areas	Annual and perennial broadleaf herbs, especially knapweeds, thistles, and other members of the sunflower, legume, and knotweed families		Spot treatment with hand-held sprayers or backpack sprayers; ground application
Glyphosate (AquaMaster, Eagre, Glypro, Rodeo, Roundup)	General Use Forests and non-crop sites	Annual and perennial weeds and woody plants	Inhibits synthesis of aromatic amino acids necessary for protein formation in susceptible plants	Spot treatment with hand-held sprayers or backpack sprayers; ground application
Imazapyr (Plateau, Habitat)	General Use Pastures, rangeland, and non-crop areas	Annual and perennial broadleaves and grasses. Can be used as a pre- and post-emergent herbicide	Inhibits production of branched chain amino acids necessary for protein synthesis and cell growth	Spot treatment with hand-held sprayers or backpack sprayers; ground application
Triclopyr (Garlon 3A, Garlon 4, Pathfinder II, Tahoe 3A, Tahoe 4E, Renovate, Element 3A, Element 4)	General Use Non-crop areas	Woody plants, especially tamarisk, Russian olive and Siberian elm and annual and perennial broadleaf herbs	Kills target species by mimicking plant growth hormone auxin (indole acetic acid) and, when administered at effective doses, causes uncontrolled and disorganized plant growth that leads to plant death	Spot treatment with hand-held sprayers or backpack sprayers; ground application
Triclopyr + clopyralid (Redeem R&P)	General Use Rangeland and permanent grass pastures, non-crop areas	Annual and perennial broadleaf plants		Spot treatment with hand-held sprayers or backpack sprayers; ground application

Source: National Park Service, 2005

Table 4 Environmental Fate and Effects of Proposed Pesticides

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatilization	Solubility	Potential for Leaching	Surface Waters	Toxicity
Aminopyralid (Milestone)	At least moderately persistent Half-life 31-533 days	Studies suggest Aminopyralid weakly sorbs to soil Primarily degraded by photolysis	Is not volatile and does not evaporate easily	Highly water soluble	High water solubility of aminopyralid suggests a high potential for run-off into surface water and leaching to groundwater	When it does reach surface water, aminopyralid is expected to persist	Soil microorganisms – no information available Plants – contact with non-target plants may injure or kill plants Aquatic animals – low toxicity to aquatic invertebrate animals; not expected to bioaccumulate Terrestrial animals – practically non-toxic to birds, mammals, and bees
Clopyralid (Curtail, Stinger, Transline)	May be present in anaerobic soils or soils with low microorganisms Half-life 15-287 days	Active in soil, usually absorbed from soil by plants Soil microorganisms break down Clopyralid	Does not evaporate easily	Highly water soluble	Because clopyralid is highly soluble in water, does not absorb to soil particles; not readily decomposed in soils, may leach into ground water. Ground water may be contaminated if clopyralid is applied to areas where soils are very permeable and water table is shallow	Because clopyralid is highly soluble in water, potential for surface waters to be contaminated if clopyralid is applied directly to bodies of water or wetlands	Soil microorganisms – no information available Plants – contact with non-target plants may injure or kill plants Aquatic animals – low toxicity to fish and aquatic invertebrate animals; does not bioaccumulate in fat tissues Terrestrial animals – low toxicity to birds and mammals; not toxic to bees
Glyphosate (AquaMaster, Eagre, Glypro, Rodeo, Roundup)	Soil microorganisms break down glyphosate. Half-life can range 3 to 130	Generally not active in soil. Not usually absorbed from soil by plants	Does not evaporate easily	Dissolves easily in water	Leaching potential low. Glyphosate and surfactant in Roundup strongly absorbed by soil	Very low Glyphosate concentrations have been observed in surface water following heavy	Soil microorganisms –no known effects Plants – contact with non-target plants may injure or kill plants Aquatic animals – no more than slightly toxic to fish, and practically non-toxic to aquatic

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatilization	Solubility	Potential for Leaching	Surface Waters	Toxicity
	days Surfactant in Roundup has half-life of less than one week				particles. Half-life for Glyphosate in water ranges 35 to 65 days. The surfactant half-life ranges 3 to 4 weeks	rains up to 3 weeks after application	invertebrate animals; does not bioaccumulate in fish. Rodeo practically non-toxic to freshwater fish and aquatic invertebrate animals. Roundup moderately to slightly toxic to freshwater fish and aquatic invertebrate animals Terrestrial animals –practically non-toxic to birds and mammals; practically non-toxic to bees
Imazapyr (Plateau, Habitat)	Binds weakly to moderately with most soil types. Adsorption increases with decreasing soil pH and increasing clay and organic matter Half-life can range from 120-140 days.	Moderately persistent	Does not volatilize from soil surface Photolytic breakdown on soils is negligible	Soluble, but not degraded in water	Has not been found to move laterally with surface water. Breaks down rapidly in aqueous solution, with a half-life of one or two days. Has limited horizontal mobility (6 to 12 inches; up to 18 in sandy soils)	Rapidly degraded by sunlight in aqueous solution, but not registered for use in aquatic systems	Soil microorganisms - no information available Plants – contact with non-target plants may injure or kill plants Aquatic animals – moderately toxic to fish Terrestrial animals – low toxicity to birds and mammals; does not bioaccumulate in animals; rapidly excreted in urine and feces

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatilization	Solubility	Potential for Leaching	Surface Waters	Toxicity
Triclopyr (Garlon 3A, Garlon 4, Pathfinder II, Tahoe 3A, Tahoe 4E, Renovate, Element 3A, Element 4)	Microorganisms degrade triclopyr rapidly Average half-life in soil is 46 days	Triclopyr is active in soil and absorbed by plant roots	Very low potential	Moderate to low	Depends on soil type, acidity, and rainfall conditions. Triclopyr should not be a leaching problem under normal conditions since it binds to clay and organic matter in soil. Triclopyr may leach from light soils if rainfall is very heavy.	Sunlight rapidly breaks down triclopyr in water. Half-life in water is less than 24 hours. Irrigation ditches or waters used for irrigation or domestic use should not be polluted by triclopyr	Soil microorganisms - slightly to practically non-toxic Plants - toxic to many plants, very small amounts may injure some Aquatic animals - low toxicity to fish; the ester form of triclopyr, found in Garlon 4, is more toxic, but in normal conditions, rapidly breaks down to less toxic form; and does not bioaccumulate in fish; slightly toxic to practically non-toxic to aquatic invertebrates Terrestrial animals - slightly toxic to mammals; most triclopyr is excreted, unchanged, in urine; very low toxicity to birds; non-toxic to bees

Sources: National Park Service, 2005; U.S. Environmental Protection Agency, 2004

MONITORING AND RECORD KEEPING

Monitoring and record keeping would continue as described under Alternative 1. Treatment and removal results would be evaluated informally throughout the season and formally at the end of each season. Treatment strategies would be altered to reach objectives and goals described in Chapter 1. New actions proposed for Alternative 2 include creating survey and treatment maps for year-end reporting, interpretive use, and educational outreach; posting year-end reports on the park's website; and providing mapping data to the Southwest Exotic Plant Information Clearinghouse (SWEPIC), a regional invasive plant database.

ALTERNATIVES CONSIDERED BUT DISMISSED FROM DETAILED ANALYSIS

A number of alternatives were developed based on results of internal and external scoping. Alternatives are different ways to meet purpose and objectives, while resolving needs or issues. The following section discusses those alternatives considered, but eliminated from further study. This discussion also includes explanation of why these alternatives did not warrant additional analysis. These alternatives and issues were eliminated from detailed study because they did not meet criteria below.

1. The alternative must be consistent with NPS management policies and guidelines
2. The alternative must respond to the purpose of and need for action
3. The alternative must be feasible from a technical and economic standpoint, while remaining environmentally responsible
4. The alternative must be compatible with policies and regulations of other agencies and jurisdictions
5. The alternative must be capable of being implemented in a timely manner because purpose of and need for action is immediate
6. The alternative must not result in unacceptable impacts

Several alternatives were considered and eliminated from detailed study. Each alternative, and rationale for its elimination from further study, is described below.

No Chemical Use Alternative – Based on scoping responses and concerns with chemical use to treat exotic species, GRCA considered an alternative that would not include chemical use. Under this alternative, GRCA managers would conduct exotic plant species control work without herbicides. This alternative affords less long-term protection of natural resources than the preferred alternative. Some species, like field bindweed (*Convolvulus arvensis*), cannot be effectively controlled without herbicides. There would be a large risk of losing native flora and fauna due to ineffective management of some exotic plant species. For these reasons, a no chemical use alternative was dismissed.

Chemical Use In Developed Areas Alternative – Based on scoping responses and concerns with use of chemicals, GRCA considered an alternative that would not

include chemical use outside developed areas. Under this alternative, GRCA managers would only use herbicides on corridor trails and developed areas. Only other control methods would be allowed in other management zones. To have an effective long-term exotic plant species control program, a full suite of IPM control methodology must be considered parkwide. Without full use of IPM techniques, there would be a moderate risk of losing native flora and fauna due to ineffective control of some exotic plant species.

No Chemical Use In Riparian Zones Or Sensitive Habitats Alternative – In response to scoping and concerns with chemical use to treat exotic species in riparian zones or sensitive habitats, GRCA considered an alternative that would not include chemical use in these areas. However, some highly invasive riparian exotic plant species (e.g. tamarisk, Russian olive, and tree of heaven) cannot be effectively controlled without herbicides. There would be a moderate risk of losing native flora and fauna due to ineffective control of some exotic plant species.

Full Use of IPM techniques – This alternative would include all actions described in Alternatives 1 and 2 and would expand IPM techniques to create a more aggressive program. Control efforts would target a greater number of exotic plant species. Mechanized methods would be expanded to include techniques such as plowing, scraping soil surface with heavy machinery, and using power tools outside developed zones. Chemical application would be expanded, use of a broader suite of application tools, and consideration of a wider variety of herbicides. Full use of biological control agents and use of prescribed fire on a large scale would be permitted.

Biological control uses plant-eating organisms (insects, pathogens, and grazing mammals) to suppress, inhibit, or control selected vegetation. This treatment method has many advantages (e.g. requires no fossil fuel energy), although it will not eradicate target exotics. Instead, biological control agents reduce exotic plant population densities and allow native plants to better compete for resources. Problems can arise with biological treatments when control organisms are non-selective and damage desirable native vegetation. This is a problem with insect, pathogen, and grazing control agents. Livestock use for biological control can also become problematic when soil compaction or erosion is possible. When using grazing animals, several factors must be considered including: 1) target and non-target plant species presence, 2) infestation size, 3) target and non-target plant species growth stage, 4) target and non-target plant species palatability, 5) selectivity of target and non-target plant species by the grazing animal, 6) soil type and potential for compaction and erosion, and 7) logistics and cost of introducing livestock to the area.

Biological control may be a long-term solution for controlling some exotic species that are too widespread for control by other means, or for exotic plants readily invading the park. Biological control is best suited for infestations of a single, dominant invasive plant species not closely related to native plant species.

Prescribed fire treatments involve planned application of fire to wildland fuels in their natural or modified state, under specified conditions of fuels, weather, and other variables, to allow the fire to remain in a predetermined area and achieve site-specific

fire and resource management objectives. Prescribed burning management objectives include control of certain species; enhancement of growth, reproduction, or vigor of certain species; fuel loads management; and maintenance of vegetation community types. Fire severity is important in determining vegetation recovery, with both moderate and high severity fire creating openings for exotic plant invasion. Therefore, prescribed fire should be used only when environmental conditions are met, and after pre-assessment surveys for native and exotic plants of the proposed burn area.

Without identification of the types of biological control needed to treat invasive species, impact analysis is not possible. Use of fire on a large scale is also difficult to analyze without specific goals and locations. Chemical treatment and increased efforts are neither necessary nor financially feasible. Therefore, biological control, increased chemical application, and use of prescribed fire on a large scale were dismissed from further analysis. However, biological control and prescribed fire may be considered in the future as tools to manage exotic plants, and would be addressed in separate NEPA documentation.

IDENTIFICATION OF THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is determined by applying criteria suggested in the National Environmental Policy Act of 1969 which guides the Council on Environmental Quality (CEQ). CEQ provides direction that “[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA Section 101”:

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations
2. Assure for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings
3. Attain the widest range of beneficial uses of the environment without degradation, risk of 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 that supports diversity and variety of individual choice
5. Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources

Through the process of internal and public scoping, the environmentally preferred alternative selected is Alternative 2, the preferred alternative. Alternative 2 best meets the purpose and need for action and best addresses overall park service objectives and evaluation factors while minimizing impacts to park resources. Alternative 2 promotes active control of exotic plant species throughout the park and would enhance the native landscape, assure pleasing surroundings, allow attainment of the widest beneficial uses of the environment, and preserve cultural and natural aspects of our national heritage. Alternative 1 would result in inadequate control and prevention thereby jeopardizing the quality of the park's natural and cultural resources and

visitor experience. Alternative 2 best achieves the balance between resource use and visitor experience, as specifically identified in numbers 3 and 4 above, while also minimizing new resource impacts as identified in numbers 2, 4, and 5 above.

MITIGATION MEASURES AND BEST MANAGEMENT PRACTICES

To minimize resource impacts, the integral design features (i.e., mitigation measures and best management practices) below would be followed during implementation, and are analyzed as part of both alternatives. If there are integral design features necessary for an individual alternative, these are listed in the description for that alternative. These actions were developed to lessen the alternatives' adverse effects, in combination with foreseeable future actions, and have proven very effective in reducing environmental impacts on previous projects.

Special Status Species 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 park 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 California condor, Mexican spotted owl, southwestern willow flycatcher, California brown pelican, western yellow-billed cuckoo, Yuma clapper rail, bald eagle, Kanab ambersnail, humpback chub, razorback sucker, relict leopard frog, Mohave desert tortoise, sentry milk-vetch, Brady pincushion cactus, and Fickeisen plains cactus are evaluated in detail in a project specific biological assessment (BA). All mitigation measures developed through the BA will be adhered to for this project and incorporated into the decision document.

Soundscapes and Wilderness To minimize impacts on soundscapes and wilderness, the following mitigation measures would be incorporated into the action alternative

- To reduce noise, mechanized equipment would not be used any longer than necessary, and no mechanized equipment would be used at night
- Efforts would be made to minimize trip number and reduce visibility, duration, and sounds of IPM activities in proposed wilderness
- Additional minimum requirement analyses would be completed as needed to address equipment used, group size, access methods

Cultural Resources The park's General Management Plan Programmatic Agreement will be adhered to and assessments of effect will be developed annually based on annual work plans. To minimize impacts on cultural resources, the following mitigation measures would be incorporated into the action alternative:

- 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 1995 Programmatic

Agreement among the National Park Service, Arizona State Historic Preservation Officer, and Advisory Council on Historic Preservation regarding the General Management Plan/Environmental Impact Statement, Grand Canyon National Park, Arizona

- 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
- 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
- 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 Grand Canyon National Park 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
- Annual work plans would be reviewed by GRCA Cultural Resources staff to evaluate project areas, crew size, and invasive vegetation treatment types and associated ground disturbing activities
- Cultural Resources staff would provide maps to Vegetation Program Crew Leaders showing location of archaeological sites in relation to vegetation treatment areas in the park. Maps showing location of archaeological sites would be returned at the end of the project
- 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
- 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
- Accessing work / treatment areas should be planned to avoid walking through archaeological sites whenever possible
- Work crews would be split into small teams of two to four people when working around archaeological sites
- Work crews would not walk across archaeological features such as constructed features, middens, or artifact concentrations
- Work crews would avoid creating paths and trails in loose soils and sand
- Work crews would avoid walking on bedrock surfaces that contain artifact concentrations to avoid crushing artifacts

- Work crews would report all previously unrecorded archaeological sites using Grand Canyon National Park's Site Discovery form
- All inadvertent damage to archaeological sites would be documented by recording GPS coordinates, map location, photographs and description of damage
- If vegetation removal or herbicide use were anticipated at historic wall foundations or mortar joints, the park's Historical Architect would be consulted prior to treatment to avoid any adverse impacts to these resources

Visitor Experience The following mitigation measures would be incorporated into the action alternative to minimize impacts on visitor experience:

- Unless otherwise approved by the park, operation of mechanized equipment would be restricted to dawn to dusk, year-round
- As time and funding allow, information regarding project implementation and other foreseeable future projects would be shared with the public through park publications (such as *The Guide*) and other appropriate means during construction periods. This may take the form of an informational brochure or flyer distributed at the gate and sent to those with reservations at park facilities, postings on the park's website, press releases and/or other methods. The purpose would be to minimize potential for negative impacts to visitor experience during project implementation and other planned projects during the same construction season

Air Quality Air quality impacts of the action alternatives are expected to be temporary and localized. To minimize impacts, the following actions would be taken:

- To reduce tailpipe emissions, equipment and vehicles used for exotic plant management would not be left idling any longer than is necessary for safety and mechanical reasons
- To reduce re-entrained road dust, all vehicles will observe posted speed limits and travel at low speed on unpaved roads

Best Management Practices

- Primary field crew leaders, concessionaires, and other NPS employees would be required to attain Arizona pesticide certification. Although all currently used and proposed herbicides do not require such certification, this is an extra measure to ensure safety for employees and visitors
- Workers without pesticide certification would be able to apply non-restricted use herbicide under supervision of a certified field crew leader
- Vegetation Program Managers will prepare a safety plan and job hazard analyses (JHAs) for all exotic plant management activities prior to project implementation
- Vegetation Program Managers will ensure all NPS and GRCA rules, regulations, and standard operating procedures (SOP) are followed
- Vegetation staff will post signs in pedestrian and high use areas when herbicide is being applied
- Other precautions for reducing and eliminating risk to humans during exotic plant activities include posting notice of activity in high use areas or timing

- technique (when possible) during low visitor use to the area (both time of day and time of year)
- Crews would be informed of special status species locations including Mexican spotted owl protected activity centers (PACs), California condor and southwestern willow flycatcher nests
 - Crews would practice low impact field techniques and leave no trace methods
 - Herbicides with low toxicity that target disruption of plant physiology and do not harm animals would be selected
 - Herbicides would be applied directly to plants to minimize herbicide drift
 - Crews would need to ensure application would not take place on windy days and only small backpack-sized applicators would be used
 - Applicators would have small nozzles to focus herbicide streams directly onto targeted exotic plant species
 - Herbicides would be transported in leak-proof, spill proof containers and handled and disposed according to label specifications and park policies
 - Fire treatments would be coordinated with GRCA Fire personnel to ensure proper techniques and safety measures
 - Crews would refrain from interactions with bighorn sheep and haze any individuals that approach camp sites
 - Crews would avoid camping near snags or live damaged trees to avoid disturbance to special status wildlife, including bats

ALTERNATIVES AND PROJECT OBJECTIVES

Project objectives are described in Chapter 1 and listed here. The proposed Exotic Plant Management Plan is guided by the GMP vision and the purpose and need for action developed specifically for this project. Specific objectives for the planning effort include:

1. Reduce exotic plant cover by 50% in GRCA development zone and disturbance corridors over the next ten years, 2009-2019
2. Conduct exotic plant surveys in 25% of GRCA's natural zone priority areas over the next ten years, 2009-2019
3. Identify and control small populations of the most invasive and potentially threatening species parkwide
4. Prevent further introductions of exotic plant species already present in GRCA as well as new introductions by increasing visitor and staff awareness through education
5. Initiate projects to enhance visitor experience and aesthetics in the park
6. Increase cooperation and coordination with adjacent land owners and agencies

The preferred alternative clearly addresses each objective. Alternatives considered but dismissed from further analysis were dismissed in part because they did not sufficiently address one or all of these objectives. Table 5 displays alternative components and Table 6 compares ability of the alternatives to meet project objectives.

Table 5 Summary of Alternative Elements

Elements	Alternative 1 No Action	Alternative 2 Preferred
Prioritization and Planning	<p>GRCA's current planning methods include:</p> <ul style="list-style-type: none"> • Prioritization of exotic plants using Alien Plant Ranking System (APRS) <ul style="list-style-type: none"> • Annual Work Plans 	<p>Planning would change from current (Alternative 1) to provide a more accountable system for prioritization and treatment selection and would include:</p> <ul style="list-style-type: none"> • Decision-making Tool to provide a framework for selecting treatment of exotic plant species • Prioritization of exotic plants as part of decision-making tool using APRS and an additional set of criteria to target species • Annual Work Plans
Early Detection and Prevention Surveys Education	<p>GRCA's current early detection and prevention includes:</p> <ul style="list-style-type: none"> • Surveying for new populations of exotic plant species in target areas • Awareness of exotic plants on adjacent lands <p>GRCA's current education components of exotic plant management include:</p> <ul style="list-style-type: none"> • Volunteer programs • Publications including <i>The Guide</i>, press releases, site bulletins, pamphlets and brochures • Formal and informal presentations • Produce and present educational materials for park staff and the general public • Maintain up-to-date information on park website 	<p>GRCA would continue prevention efforts listed under Alternative 1 and would also:</p> <ul style="list-style-type: none"> • Complete more in-depth and extensive annual surveys • Coordinate with GRCA fire activities • Expand mitigation measures for construction projects • Increase communication and education <p>GRCA would continue education as listed for Alternative 1 and would also:</p> <ul style="list-style-type: none"> • Increase efforts to inform the public and staff about exotic plants and park management strategy • Promote and support interpretive programs and in-school programs • Design displays and additional brochures for visitors • Update exotic species information on park website • Publish additional press releases and articles • Initiate new outreach and education program(s)

Elements	Alternative 1 No Action	Alternative 2 Preferred
Collaboration	GRCA currently collaborates with: <ul style="list-style-type: none"> • Northern Arizona Weed Council • Arizona Wildlands Invasive Plant Working Group • Southwest Exotic Plant Information Clearinghouse • Weed Management Areas (WMAs) • Glen Canyon National Recreation Area • NPS Exotic Plant Management Team • Arizona Department of Transportation • Kaibab National Forest • Grand Canyon Railroad 	GRCA would continue collaboration efforts listed under Alternative 1 and would also: <ul style="list-style-type: none"> • Collaborate with additional landowners and agencies including the U.S. Forest Service, Coconino National Forest; and neighboring park service units • Work with residents and GRCA fire staff • Work towards forming a Grand Canyon WMA
Treatments	GRCA's current treatment methods include:	GRCA would continue cultural methods listed under Alternative 1 and would also:
Cultural Methods	<ul style="list-style-type: none"> • Collect and store native plant seed for future restoration • Mulch disturbed areas to promote water retention and reduce exotic plant species competition • Restore disturbed sites using native seed and plants, mulch and soil amendments as needed • Current management actions do not include fire as a control technique 	<ul style="list-style-type: none"> • Use additional carbon sources to decrease survival of nitrogen-loving annual species such as brome grasses • Expand use of mulch • Consider use of barriers, hot water, and other low impact techniques • Finalize and enforce Weed Seed Free Hay and Forage Standard Operating Procedure • Pile burning, controlled burning, and propane torches (spot burning) would be used on species- and location-specific basis • Use of fire would be coordinated with GRCA's fire program
Manual Control	<ul style="list-style-type: none"> • Remove entire plants below root crown by hand using picks, shovels, pulaskis, and McLeods • Minimize seed production by using pruners, loppers, shears, and knives to remove seed heads 	Manual methods would remain the same as those described in Alternative 1

Elements	Alternative 1 No Action	Alternative 2 Preferred
Treatments continued Mechanical Control Chemical Control	<ul style="list-style-type: none"> Remove entire plants above root crown with brush cutters (in developed areas only) On pre-disturbed construction sites, use tractors to remove exotic plant species prior to site restoration <ul style="list-style-type: none"> Herbicide treatment of exotic plant species that cannot be controlled in any other feasible manner Herbicide would be manually applied as a direct application on targeted individuals Herbicide used in riparian areas would continue to be formulated for aquatic use, and application would be limited 	<p>GRCA would continue use of mechanical methods listed under Alternative 1 and would also:</p> <ul style="list-style-type: none"> Use mowers and chainsaws in developed areas <p>GRCA would continue use of chemical control listed under Alternative 1 and would also:</p> <ul style="list-style-type: none"> Target new species as funding allows On a case-by-case basis and in developed areas only, methodology could be expanded to include limited broadcast spraying
Monitoring and Record Keeping	<ul style="list-style-type: none"> Map all exotic plant control actions Record pertinent information about control actions Develop and implement monitoring procedures to determine effectiveness of control techniques Enter all data in project database Maintain herbicide use records 	<p>GRCA would continue monitoring and record keeping as described for Alternative 1 and would also:</p> <ul style="list-style-type: none"> Evaluate treatment and removal results throughout the season informally and then formally at the end of each season Alter treatment strategies based on evaluations

Table 6 Summary of Project Objective Accomplishment

Project Objective Accomplishment	Alternative 1	Alternative 2
Objective 1 Reduce exotic plant cover by 50% in GRCA development zone and disturbance corridors over next ten years (2009-2019)	Alternative 1 would work toward this long-term goal with current methodologies	Alternative 2 would work toward this long-term goal and be more successful due to increased prevention, including education and collaboration, and limited use of fire treatments and broadcast spraying
Objective 2 Conduct exotic plant surveys of 25% GRCA's natural zone priority areas over next ten years (2009-2019)	Alternative 1 would work toward this long-term goal at the same rate with no measurable increase in surveys or survey locations	Alternative 2 would work toward this long-term goal at a faster rate due to proposed increased and more in-depth surveys
Objective 3 Identify and control small populations of the most invasive and potentially threatening species parkwide	Identification and control of small populations of exotic plants is current practice and would continue under Alternative 1	This technique would also continue under Alternative 2.
Objective 4 Prevent further introductions of exotic plant species already present in GRCA as well as new introductions by increasing visitor and staff awareness through education	Current education and prevention would continue under Alternative 1. Education techniques include volunteer programs, publications, and presentations. Prevention methods include surveys, awareness of adjacent lands, education, and outreach	Alternative 2 proposes to increase visitor and staff awareness through education and continue to implement and increase prevention techniques
Objective 5 Initiate projects to enhance visitor experience and aesthetics in the park	Current management does not include opportunities to enhance visitor experience and aesthetic in the park	Alternative 2 would address the need to treat exotic species to benefit visitor experience and aesthetics
Objective 6 Increase cooperation and coordination with adjacent land owners and agencies	There would not be an increase in cooperation and coordination under Alternative 1	Alternative 2 proposes to increase cooperation and coordination with adjacent land owners and agencies
Overall Accomplishment of Project Objectives	Does not achieve all project objectives	Achieves all project objectives

Table 7 Comparative Summary of Environmental Impacts

Impact Topic	Alternative 1 No Action	Alternative 2 Preferred	Cumulative Impacts of Preferred Alternative
Native Vegetation	<p>Beneficial impacts to native vegetation including reduced competition with exotic plant species would be localized, long term, minor to moderate</p> <p>Adverse impacts including trampling and inadvertent vegetation damage during exotic plant treatment localized, short term, minor</p>	<p>Beneficial impacts including decreased competition are expected even greater than in Alternative 1 based on increased prevention, education, and treatment options for exotic plant management. Beneficial impacts localized, short to long term, moderate</p> <p>Adverse impacts same as those in Alternative 1</p>	<p>Cumulative impacts adverse, localized, long term, minor</p> <p>Alternative 2 would have a negligible contribution to cumulative effect due to the beneficial impact exotic plant management has on native vegetation</p>
General Wildlife	<p>Beneficial impacts including native plant habitat restoration for shelter and associated food sources localized, long term, seasonal to year-round, minor</p> <p>Adverse effects including noise disturbance, habitat modification, and effects of chemical control localized, short term, minor based on use of best management practices and implementation of mitigation measures</p>	<p>Slightly more beneficial impacts based on increased prevention efforts and more aggressive exotic plant treatment; however, impacts still minor</p> <p>Adverse impacts would also be slightly increased when compared to Alternative 1 based on increase in chemical control and use of fire; however, impacts would be minor</p>	<p>Cumulative impacts would be adverse, localized, long term, minor</p> <p>Alternative 2 would have a negligible contribution to this cumulative adverse effect because exotic plant management in itself is beneficial to wildlife</p>
Special Status Species	<p>Beneficial impacts including restoration of native plant habitat for shelter and associated food sources long term, minor</p> <p>Adverse, localized, short to long term, minor. Adverse impacts include noise disturbance, habitat modification, and potential direct effects of herbicide use</p>	<p>Similar impacts to Alternative 1. Development of conservation measures for special status species would provide them specific protection. Alternative 2 would have slightly increased beneficial impacts and decreased adverse impacts over Alternative 1. Beneficial impacts long term, minor</p>	<p>Cumulative impacts adverse, local, short to long term, minor</p> <p>Alternative 2 would have a negligible contribution to this cumulative adverse effect because exotic plant management in itself is beneficial to special status animal and plant species</p>

Impact Topic	Alternative 1 No Action	Alternative 2 Preferred	Cumulative Impacts of Preferred Alternative
		Adverse impacts minor, short and long term	
Soil Resources	Adverse effects from trampling, resultant erosion, and damage to biological soil crusts would be local, short to long term, minor Beneficial impacts including increased water retention from mulch and plant material left onsite local, long term, minor	Impacts to soil resources similar to those under Alternative 1. Adverse impacts slightly increased due to potential impacts to soil from fire and increased use of herbicides. However, impacts remain minor Beneficial impacts long-term minor	Cumulative adverse, local, long term, minor Alternative 2 would have a negligible contribution to this cumulative effect
Water and Aquatic Resources	Beneficial effects from increased water flow and velocity following removal of exotic plants would be local, short to long term, seasonal to year-round, moderate Adverse effects from increased turbidity, erosion, loss of soil-stabilizing plants, and changes to water quality parameters local, short to long term, seasonal to year-round, minor	Beneficial impacts similar to Alternative 1 localized, short to long term, seasonal to year-round, moderate Adverse effects increased compared to Alternative 1 due to addition of fire treatments and limited broadcast spraying of herbicides. Adverse impacts local, short to long term, seasonal to year-round, negligible to minor	Cumulative impacts beneficial, long term, minor Alternative 2 would result in a minor contribution to this cumulative effect
Air Quality	Impacts resulting from vehicle use and dust generated from exotic plant management activities adverse, localized, short term, negligible	Impacts increased compared to Alternative 1. Impacts from vehicle use, dust generated from exotic plant management activities, and use of fire adverse, localized, short term, minor	Cumulative impacts adverse, local, short term, minor Alternative 2 would have a negligible contribution to this cumulative effect
Archaeological and Historic Resources	Adverse impacts from increased erosion and soil compaction short to long term, minor Beneficial impacts including soil protection and stabilization from vegetative material left onsite short	Impacts the same as Alternative 1	Cumulative impacts adverse short to long term, minor Alternative 2 would have a negligible contribution to this cumulative adverse effect

Impact Topic	Alternative 1 No Action	Alternative 2 Preferred	Cumulative Impacts of Preferred Alternative
	to long term, minor		
Cultural Landscapes	Beneficial impacts including restoration of native plants and removal of nonnative plants that are not key features in the landscape minor long term. Adverse impacts from changes in vegetation negligible, short to long term	Impacts as described for Alternative 1	Cumulative impacts adverse, local, short term, moderate Alternative 2 would have a negligible contribution to cumulative adverse effect
Ethnographic Resources	Beneficial impacts including soil protection and stabilization from vegetative material left onsite short to long term, minor. Adverse impacts from increased erosion and soil compaction short to long term, minor	Impacts same as for Alternative 1	Cumulative impacts adverse, local, short term, minor Alternative 2 would have a negligible contribution to this cumulative effect
Visitor Experience	Beneficial impacts including overall actions to restore native ecosystem would be local, long term, minor Adverse impacts resulting from presence of crews, specifically in backcountry; and use of mechanized equipment, and chemicals to treat exotic plants local, short to long term, minor	Similar impacts to Alternative 1. Increased beneficial impacts would occur due to more education and restoration of the native ecosystem Some increased adverse impacts could also occur from use of fire as a treatment method; however, impacts are not expected to be more than minor	Cumulative impacts long term, beneficial, moderate Alternative 2 would have a negligible contribution to this cumulative effect.
Wilderness Character	Adverse impacts from presence of crews and visibility of crews and exotic plant management actions. Adverse impacts generally short term, negligible to minor. Beneficial impacts including overall	Additional adverse effects when compared to Alternative 1 include decreased visibility from smoke. Impacts would be minor, short to long term. Although there may be some short	Cumulative impacts when combined with Alternative 1 would be adverse, short to long term, moderate Alternative 2 would have a negligible contribution to this cumulative adverse effect

Impact Topic	Alternative 1 No Action	Alternative 2 Preferred	Cumulative Impacts of Preferred Alternative
	actions to restore native ecosystem would be long term, minor	term adverse impacts, there will be long term benefits improving natural conditions and overall quality and integrity of the resource. Beneficial impacts long term, minor	
Public Health and Safety	Adverse effects from use of hand tools, mechanized tools, and herbicides localized, short to long term, minor	Effects to public health and safety from use of hand tools, mechanized equipment, chemicals, and fire adverse, local, short to long term, minor	Cumulative impacts beneficial, long term, minor Alternative 2 would have a negligible contribution to this cumulative adverse effect
Park Operations	Adverse effects from time and money needed to treat exotic plant species short to long term, minor Beneficial impacts from use of effective and efficient methods to treat exotic plant species short to long term minor	Adverse impacts would be the same as those described in Alternative 1 Beneficial impacts from use of most effective and efficient methods to treat exotic plant species short to long term, minor	Cumulative impacts beneficial, local, minor. Alternative 2 would have a negligible contribution to this cumulative adverse effect

Chapter 3 – Affected Environment and Environmental Consequences

INTRODUCTION

This chapter describes the present condition (i.e. affected environment) within the project area and changes (i.e. environmental consequences) expected from implementing the action alternative or taking no action at this time. The No-Action Alternative sets the environmental baseline for comparing effects of the action alternative. Impact topics (see Chapter 1) define the scope of environmental concern for this project. Environmental effects or changes from present baseline condition described in this chapter reflect identified relevant impact topics and include intensity and duration of the action, mitigation measures, and cumulative effects.

The National Environmental Policy Act requires environmental documents disclose environmental impacts of proposed Federal actions, reasonable alternatives to that action, and any unavoidable adverse environmental effects should the proposed action be implemented.

Grand Canyon National Park encompasses approximately 1.2 million acres in northern Arizona. Proposed project locations occur on South Rim, North Rim and throughout the Inner Canyon, representing a wide variety of management zones and habitat types. Elevations range from 1,200 feet along the Colorado River to 8,000 feet on North Rim. Many exotic plant populations occur in disturbed developed areas on South and North Rims and along backcountry trails; however, infrequently visited areas are also susceptible.

Methodology

The impact analysis and conclusions contained in this chapter were based on park staff knowledge of resources and site, review of existing literature and park studies, information provided by specialists within the National Park Service and other agencies, and professional judgment. Detailed information on natural and cultural resources in Grand Canyon National Park summarized in the 1995 GMP and EIS was specifically referenced for information on affected resources in the project area.

Potential impacts in this chapter are described in terms of type (are effects beneficial or adverse?), context (are effects site-specific, local or even regional?), duration (are effects short or long term?), and intensity (negligible, minor, moderate, major). Because definitions of type, context, duration, and intensity can vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this EA/AEF.

For purposes of impact analysis in this Chapter, the following definitions are used to characterize impacts discussed:

- Adverse – a negative change that moves the resource away from a desired condition or detracts from its appearance or degrades its condition
- Beneficial – a positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition

Cumulative Impacts

Cumulative impact is defined as the impact on the environment that results from the incremental impact of 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. Cumulative impacts can result from individually minor, but collectively significant actions, taking place over a period of time (40 CFR 1508.7).

Major past, present, and reasonably foreseeable future actions considered in this analysis include fire management activities, trespass cattle grazing, stock use, human use, construction projects, ongoing exotic plant management, and park planning efforts. Relevant projects and plans are described in Appendix F.

Exotic plant management efforts are ongoing on adjacent lands, including Kaibab National Forest, Glen Canyon National Recreation Area, Lake Mead National Recreation Area, Grand Canyon-Parashant National Monument, Navajo Nation, Hualapai Tribe, Havasupai Tribe, and Bureau of Land Management. GRCA has partnerships with many of these entities.

To effectively assess resource impacts, including cumulative impacts, priority areas or areas where a majority of exotic plant management actions would occur have been identified. Priority areas are described in Chapters 1 and 2 and include roads, trails, previously identified exotic treatment areas, entrance stations, railroad tracks, campgrounds, stock use areas, and around rim lodges where heavy traffic exists in the development zone. Natural zone priority areas include tributaries, roads and trails, backcountry campsites, the river corridor, and other areas with more human influence or visitation.

A cumulative impact analysis was conducted for full GMP implementation, and is documented in the GMP EIS. The general finding in the GMP EIS for cumulative effects to natural resources was a net reduction in natural habitat in the park and region, but a net reduction less than that for two other alternatives analyzed and not selected for implementation. Cumulative effects to ethnographic resources could occur, specifically to traditional cultural properties, but a planned ethnographic survey program would minimize this likelihood. Cumulative effects were not expected to historic structures under the assumption that existing cultural resources within the park would be protected and preserved and some historic buildings would be rehabilitated and restored. Cumulative effects to visitor experience under GMP implementation were expected to be positive overall as the result of additional food service and accommodations and contributions to regional and national efforts to expand informational resources and interpretive and educational opportunities, and disperse tourism in the area. Because the GMP was a general concept plan and because it required site-specific analyses be conducted for identified projects, a cumulative effects analysis more specific to impact topics pertaining to exotic plant species management is provided below.

Impairment

In addition to determining environmental consequences of implementing alternatives, National Park Service policy (National Park Service, 2006) requires analysis of potential effects to determine whether actions would impair park resources.

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. National Park Service managers must always seek ways to avoid or minimize, to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the National Park Service 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 affected resources and values. Although Congress has given the National Park Service management discretion to allow certain impacts within parks, discretion is limited by statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. Prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm integrity of park resources or values, including opportunities otherwise present for enjoyment of those resources or values. An impact to any park resource or value may constitute impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the park's establishing legislation or proclamation
- key to the park's natural or cultural integrity; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. Potential for impairment is discussed for each applicable resource for each alternative in this chapter. Results of this evaluation are included in the conclusion statement at the end of the environmental consequences section for each applicable resource in this chapter.

Unacceptable Impacts

In addition to impairment, unacceptable impacts are also considered in analysis of alternatives. Although an action may not result in impairment, it could be determined unacceptable within the park's environment (National Park Service, 2006). Park managers are tasked with determining whether a project's associated impacts on park resources and values are acceptable. In its role as steward of park resources, the National Park Service must ensure allowed park uses would not cause impairment of, or unacceptable impacts on, park resources and values.

Human activities in a park have some effect on park resources or values, but that does not mean impacts are unacceptable or that a particular use must be prohibited. Therefore, as defined in *NPS Management Policies*, unacceptable impacts are impacts that, individually or cumulatively, would

- be inconsistent with a park's purposes or values, or
- impede 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 tranquillity, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park, NPS concessioner or contractor operations or services

Unacceptable impacts may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. Direct, indirect, and cumulative impacts to all relevant impact topics analyzed in this chapter were reviewed in context with criteria of unacceptable impacts above to determine if potential for unacceptable impact exists. Because neither alternative would create adverse impacts inconsistent with park purposes or values or that would prevent attainment of desired future conditions for park resources, create an unsafe or unhealthful environment, diminish opportunities for current or future enjoyment of the park, or unreasonably interfere with park programs or activities, concessioner or contractor operations, there would be no unacceptable impacts to park resources or values from implementation of either alternative. The result of this evaluation is given in the conclusion statement for each applicable impact topic for each alternative.

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

In this EA/AEF, impacts to historic properties are described in terms of type, context, duration, and intensity, as described above, consistent with regulations of the Council on Environmental Quality that implement the National Environmental Policy Act. This EA/AEF is intended, however, to comply with requirements of NEPA and §106 of the National Historic Preservation Act. To achieve this, a §106 summary is included under the Preferred Alternative for each cultural resource topic carried forward. The §106 Summary is intended to meet requirements of §106. A letter dated January 25, 2008 was sent to the State Historic Preservation Office initiating consultation on this project and informing them of the park's intention to complete a combined document to meet §106 obligations. The SHPO agreed to use the GMP PA to satisfy §106 obligations for this EA/AEF. In addition, the SHPO requested AEFs for annual work plans and site-specific treatments be submitted each year for review.

Under Advisory Council's regulations, the agency official shall apply criteria of either adverse effect or no adverse effect for affected historic properties either 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 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 characteristics of the cultural resource that qualify it for inclusion in the National Register of Historic Places. An undertaking can be modified to avoid adverse effects and result in a determination of no adverse effect.

In accordance with Advisory Council on Historic Preservation regulations implementing §106 of NHPA (36 CFR Part 800, Protection of Historic Properties), impacts to historic properties for this project are identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects either listed in or eligible to be listed in the National Register of Historic Places; (3) applying 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 National Park Service'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 mitigation would be in reducing intensity of a potential impact (e.g. reducing 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 effectiveness of mitigation under NEPA only. It does not suggest that level of effect as defined by §106 is similarly reduced. Although adverse effects under §106 may be mitigated, effect remains adverse.

NATURAL RESOURCES

NATIVE VEGETATION

Affected Environment

Due to GRCA's immense size and variety of geology, climate, and microhabitats, a vast array of plant life exists in the park. Within GRCA, vegetation from five of the seven life zones (Lower Sonoran, Upper Sonoran, Transition, Canadian, and Hudsonian), and three of the four North American Deserts (Great Basin, Mojave, and Sonoran) are represented (National Park Service, 1995).

At least 129 distinct vegetation communities occur in Grand Canyon, with many more likely to be identified during the current vegetation mapping effort. Broadly, these communities fall within the broader habitat types of forested areas (10% of the park), woodlands (29%), desertscrub (42%), and a mixture of habitat types (19%) (Warren et al., 1982). Forested communities are dominated by blue spruce (*Picea pungens*), Engelmann spruce (*Picea engelmannii*), and subalpine fir (*Abies lasiocarpa*) at the highest elevations (8,700 – 9,200 feet). Ponderosa pine (*Pinus ponderosa*), Gambel oak (*Quercus gambelii*), and New Mexico locust (*Robinia neomexicana*) dominate dryer ponderosa pine forests at elevations beginning around 6,800 feet with white fir (*Abies concolor*), quaking aspen (*Populus tremuloides*), and Douglas-fir (*Pseudotsuga menziesii*) joining in at intermediate elevations. Pinyon pine (*Pinus edulis*) and juniper (*Juniperus* spp.) dominate lower elevation woodlands (5,500 – 6,800 feet elevation) (Warren et al., 1982).

Other GRCA vegetation types include Great Basin desertscrub dominated by big sagebrush (*Artemisia tridentata*), rabbitbrush (*Ericameria* spp.) and Mormon tea (*Ephedra* spp.); Mojave desertscrub including blackbrush (*Coleogyne ramosissima*), turpentine broom (*Thamnosma montana*), and Mexican bladder sage (*Salazaria mexicana*); and Sonoran desertscrub with dominant species of brittle bush (*Encelia farinosa*), catclaw acacia (*Acacia greggii*), ocotillo (*Fouquieria splendens*) and desert willow (*Chilopsis linearis*). The park also contains interior chaparral such as manzanita (*Arctostaphylos* spp.) and silktassel (*Garrya* spp.); and

riparian communities with willow (*Salix* spp.), cottonwood (*Populus fremontii*), and tamarisk (*Tamarix* spp.). Meadows, hanging gardens, and other microhabitat communities are also components of GRCA's diverse environment (Warren et al., 1982).

Human activity has altered native vegetation. Among the most important disturbance events that historically affected understory vegetation of southwestern conifer forests were fire-suppression, livestock over-grazing, and increased shade from resultant unnaturally dense forests. A shift in species composition has likely occurred in understory of these forests, with the possibility of a total loss of select fire-dependent, very palatable, or shade-intolerant species. In addition, prior to GRCA establishment in 1919, mining, logging, and livestock grazing activities introduced exotic plants into the area. Park development, increased visitation, and Glen Canyon Dam construction further contributed to establishment and spread of exotic plants in GRCA. Developed areas including roads, campgrounds, visitor centers, employee housing, and utility areas contain the largest concentrations of exotic plants. In addition to human activities, natural disturbances such as fire and flash flooding have greatly influenced the park's vegetative communities. Combinations of natural and human disturbances contributed to the great number of exotic plant species found in the park today.

There are approximately 1,737 known vascular plants species, 167 fungi species, 64 moss species, and 195 lichen species in GRCA. This variety is largely due to the 8,000 foot elevation change from river to North Rim's highest point. Grand Canyon boasts a dozen endemic plants (known only in park boundaries) while only ten percent of park flora is exotic. Sixty-three plants found here have been given special status by the U.S. Fish and Wildlife Service, and are listed in Table 8. For analysis of impacts to native vegetation from exotic plant management, non-Federally listed special status plants are included.

Environmental Consequences

Methodology

Baseline information used to assess impacts to vegetation is 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 within the National Park Service and other agencies, and professional judgment. Detailed information on natural and cultural resources in GRCA summarized in the 1995 GMP EIS was specifically referenced for information on affected resources. Additional sources of information on vegetation used for this evaluation are as described above in the affected environment section.

For the purposes of this impact analysis, vegetation is defined as individual native plants and communities, including non-Federally listed special status plant species.

Thresholds of change for intensity of impact on vegetation are defined as:

Negligible Changes to native vegetation would be so small it would not be measurable or perceptible

Minor	Changes to native vegetation would be measurable and perceptible but small, localized, and of little consequence. Any adverse effect can be effectively mitigated
Moderate	Changes to native vegetation would be measurable and perceptible, localized, but large and of consequence. Mitigation could be extensive, but most likely effective
Major	Change to native vegetation would be measurable and perceptible, large and/or widespread, and could have permanent consequences for the resource. Mitigation to offset adverse impacts may be extensive and success is not assured

Duration Short term One year or less
Long term Greater than one year

Context Regional A large area of the park with greater than 25% of park land affected
Localized A small area of the park; a single site

All effects to vegetation from various methods proposed under Alternatives 1 and 2 would be **localized**.

Alternative 1 – No Action

Direct/Indirect Impacts: Use of crews for survey or treatment may have direct effects on vegetation from trampling and trail creation. Crews could also introduce or spread exotic plant species from seed transport on clothing, vehicles, or tools. These actions would have an adverse short to long term negligible to minor impact on native vegetation.

Overall beneficial impacts to native vegetation from removal of exotic plants by methods described below would include reduced competition with exotic plants, reduced fuel loads, removal of allelopathic plants that limit native plant growth, reduction of monocultures, and increased biodiversity. Beneficial impact would be long term minor to moderate depending on treated area size and native plant population.

Prevention Prevention actions include education, community outreach, early detection, and monitoring. Early detection and monitoring would involve field work and surveys; therefore, impacts to native vegetation would be negligible adverse short term as described above for surveys. Minor short- to long-term beneficial impacts to native vegetation would result from prevention because it would support early detection and limit exotic plant infestations.

Cultural Control Cultural methods include seed collection, mulch, and restoration. Collection of too much seed from an area or plant could affect reproductive success and health of the native plant community. These actions would have an adverse, long-term, negligible effect on vegetation. Application of mulch to disturbed areas would promote water retention and change carbon-to-nitrogen ratios, indirectly affecting vegetation vigor and growth rate which could have beneficial short- to long-term minor effects on vegetation.

Manual Control Manual methods include removal of entire plants using picks, shovels, pulaskis and McLeods, and treatment to minimize seed production using pruners, loppers, shears, and knives. These actions would have direct effects on vegetation and could include native vegetation removal, trampling, or other damage. Indirect adverse impacts could include replacement of removed species with other, potentially more competitive exotic plant species. Adverse effects would be short to long term negligible to minor.

Mechanical Control Mechanical methods, used only in developed areas, include use of brush cutters, tractors, and construction equipment. Brush cutters would be used to remove exotic plants above the root crown. Crews could trample or inadvertently cut native plants, cover native plants with above-ground material left onsite as a mulch layer, or impede native vegetation growth which would result in direct adverse impacts to native vegetation. Tractors would be used on pre-disturbed construction sites to remove exotic plant species. Tractor use could impact native plant species in the project area, and equipment could introduce or spread exotic plant species. Mechanical control would have adverse short- to long-term, minor impacts on vegetation. Indirect beneficial effects could include increased water retention and nutrient levels from above-ground plant material left onsite as a mulch layer. These beneficial impacts to native vegetation would be short term minor.

Chemical Control Manual application of selected herbicides on targeted individuals may directly affect surrounding native plant species when the herbicide is absorbed into soil during spray application or if spray drifts in wind. Non-targeted native plant species may react to the herbicide and could exhibit reduced vigor or mortality. Indirect impacts on vegetation from herbicides include effects from soil chemistry changes as herbicide absorbed by exotic plants is exuded from plant roots into adjacent soils.

Adverse effects on vegetation from chemical use would be short to long term and minor if best management practices are followed. Measures include restricting herbicide application on windy days and allowing crews to use only small backpack-sized or handheld applicators with small nozzles to focus herbicide streams directly onto targeted exotic plants. Herbicides would be selected to target exotic plant species only; therefore, having minimum impacts on native plants.

Cumulative Impacts Cumulative impacts on native vegetation were determined by combining impacts of Alternative 1 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, stock use, human activities, and ongoing exotic plant management efforts in the park and on adjacent lands. These actions have caused adverse impacts such as vegetation loss, damage, and trampling; trailing; reduced species diversity; and changed community composition. Beneficial impacts to native vegetation have resulted from ongoing exotic plant management efforts. Several of these activities, including prescribed and wildland fire, 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. Impacts to native vegetation from these activities are adverse, long term, and moderate. Beneficial impacts from ongoing exotic plant management efforts are long term minor.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. Removal of native vegetation has been or will be required in each of these projects. Salvage of native plants is implemented to retain as much native vegetation as possible. However, impacts to native vegetation would be long term minor adverse.

Foreseeable future projects include the Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. Similar to projects described above, vegetation removal will be required for these future projects. Therefore, impacts would be long term minor adverse.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse, localized, long term, minor effects on vegetation. Alternative 1 would have a negligible contribution to this cumulative adverse effect because many of the impacts from exotic plant management are beneficial to native vegetation.

Conclusion

Under current management of exotics (Alternative 1), beneficial impacts to native vegetation including reduced competition with exotic plant species would be localized, long term, minor to moderate. Adverse impacts to vegetation including trampling and inadvertent damage to vegetation during treatment of exotic plants would be localized short term minor. Cumulative impacts would be adverse localized long term minor. No impairment of or unacceptable impacts to native vegetation would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: As described in Alternative 1, use of crews for survey or treatment may have direct impacts on vegetation from trampling and creation of trails. Crews could also introduce or spread exotic plant species from seed transport on clothing. These actions would have an adverse short- to long-term negligible to minor impact on vegetation. Also described above, beneficial impacts to native vegetation would include reduced competition with exotic plants, reduced fuel loads, removal of allelopathic plants that limit native plant growth, reduction of monocultures, and increased biodiversity. Beneficial impacts would be long term minor to moderate depending on size of treated area and native plant population.

Prevention Prevention methods under Alternative 2 would include more in-depth and extensive annual surveys, but impacts would remain similar to Alternative 1. Additional prevention actions proposed under Alternative 2 would have no additional adverse impact to native vegetation. Beneficial impacts to native vegetation would be increased from Alternative 1 because more extensive annual surveys would further limit exotic plant establishment and spread.

Other actions under Alternative 2 include closer coordination with GRCA's fire program, prioritization of ecological restoration activities, selection of appropriate native seed for future restoration seed collection, and finalization of Weed Seed Free Hay and Forage Standard Operating Procedure. These actions would have no direct impact on native vegetation.

Manual Control Alternative 2 includes a greater variety of hand tools, but effects to vegetation would be similar to Alternative 1. Adverse effects would be short to long term negligible to minor.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 includes use of mowers and chainsaws in developed areas; however, effects to vegetation would be similar to Alternative 1. As described, mechanical control would have adverse short- to long-term, minor impacts on vegetation. Indirect beneficial effects could include increased water retention and nutrient levels from above-ground plant material left onsite as a mulch layer. Beneficial impacts to native vegetation would be short term minor.

Cultural Control Alternative 2 includes addition of carbon sources, expanded use of mulch, use of barriers, an increase in collection and storage of native seed, and use of fire, which would all have direct effects on vegetation. Addition of carbon sources and mulch could adversely indirectly affect vegetation composition and health from direct changes to soil chemistry. Crew foot travel impacts would be similar to those previously described. Adverse impacts to vegetation would be short to long term negligible to minor. Addition of carbon sources would also change the carbon-to-nitrogen ratio, promote water retention, and possibly increase plant vigor and growth rate. This would have beneficial short- to long-term minor effects on vegetation.

Use of fire to control exotic plant species has potential to effect vegetation. Controlled burning across an area has highest likelihood of damage to native vegetation within a burn area, whereas pile burning, on the ground or in a barrel, and use of propane torches would more specifically target exotic plant species. Use of fire also has potential to stimulate growth of native species which would result in beneficial impacts. Therefore, impacts to vegetation from fire would range from adverse to beneficial and would be negligible.

Chemical Control Alternative 2 would include use of additional herbicides and herbicide application on a greater number of species than Alternative 1. However, effects on vegetation and mitigations would be similar to Alternative 1. Inclusion of limited broadcast spraying may increase risk of herbicide drift (in the wind) to non-targeted native plants. Broadcast spraying could have adverse short- to long-term minor to moderate effects on native vegetation. Mitigation measures and best management practices would be employed to minimize impacts to vegetation.

Cumulative Impacts Past, present, and reasonably foreseeable actions with potential cumulative impacts to vegetation include those described for Alternative 1. Fire management activities including prescribed and wildland fires, trespass cattle grazing, human activities, ongoing exotic plant management, and construction projects would have overall adverse localized long-term minor impacts. Alternative 2 would result in a negligible contribution to this cumulative effect.

Conclusion

Under Alternative 2 beneficial impacts including decreased competition would be localized, short to long term, moderate due to increased treatment options.

Adverse impacts to vegetation would be localized, short to long term, minor.

Adverse impacts include trampling and inadvertent damage to native plants during exotic plant treatment activities. Cumulative impacts would be adverse localized long term minor. No impairment of or unacceptable impacts to native vegetation would result.

GENERAL WILDLIFE

Affected Environment

Due to its large size and diverse environments, approximately 355 bird, 89 mammal, 47 reptile, 9 amphibian, 17 fish (including five native species), and thousands of aquatic and terrestrial invertebrate species can be found in GRCA. Habitats include riparian, desert scrub, woodlands, and coniferous forests.

Riparian wildlife

Common mammals occurring in riparian habitat and side canyons include: bats, beaver, coyote, ringtail, and desert woodrat. Other, less common, mammals that use riparian zones include bobcats, gray fox, and mountain lion. Mule deer and desert bighorn sheep also frequent the river corridor. The most common amphibians in riparian areas are canyon treefrog, red-spotted toad, and Woodhouse's toad. As with many mammals, reptiles use all habitats, but riparian areas support higher densities.

Lush vegetation and plant species diversity in riparian zones create a wide variety of bird habitats in a relatively small area. Of 355 bird species recorded in the greater Grand Canyon region, 250 are found in the Colorado River corridor. Forty-eight bird species regularly nest along the river while others use the river as a migration corridor or over-wintering habitat. Nineteen waterfowl species are regularly reported between Lees Ferry and Soap Creek, at a density of 136 ducks per mile in late December and early January.

Of eight native fish species found in the river before 1963, three species are now extirpated: the Colorado squawfish, bonytail chub and roundtail chub. Two species are Federally listed as endangered: humpback chub and razorback sucker. The remaining three native species—speckled dace, flannelmouth sucker, and bluehead sucker—still have adequate populations. Nonnative fish introduction has contributed to competition and direct mortality of native fish species. Predation on native fish has been documented for channel catfish, brown trout, and rainbow trout, and competition is implied for many other introduced fish species.

Insect species commonly found in the river corridor and tributaries are midges, caddis flies, mayflies, stoneflies, black flies, mites, beetles, butterflies, moths, and fire ants. Numerous species of spiders and several scorpion species, including the bark scorpion (and the giant hairy scorpion) inhabit the riparian zone.

Desertscrub and woodland wildlife

Mammalian fauna in the desertscrub and woodland communities consists of mostly rodents and bats. Amphibians are generally absent from dry desert uplands

over one mile from a water source. Reptiles and desert-adapted rodents thrive in these habitats.

Approximately 30 bird species breed primarily in Inner Canyon desert uplands and cliffs. Common bird species include Canyon wren, wild turkey, and Gambel's quail.

Numerous insects and arachnids live in GRCA's desert scrub, woodlands, and coniferous forest habitats. Some common insects found at elevations above 2,000 feet are orange paper wasps, honey bees, black flies, tarantula hawks, stink bugs, beetles, black ants, and monarch and swallowtail butterflies. While scorpions are found mostly in lower elevations, solpugids, wood spiders, garden spiders, black widow spiders, and tarantulas can be found crawling around in higher elevations.

Coniferous forest wildlife

Coniferous forests provide habitat for porcupines, voles, shrews, red squirrels, tassel-eared Kaibab and Abert squirrels, mountain lion, mule deer (*Odocoileus hemionus*), and elk. Common amphibians and reptiles of this habitat include Utah tiger salamander, Great Basin spadefoot toad, and mountain short-horned lizard.

Of approximately 90 bird species that breed in coniferous forests, 51 are summer residents and at least 15 of these are known neotropical migrants. Common bird species include Steller's jay, pinyon jay, red-tailed hawk and American kestrel.

Environmental Consequences

Methodology

Baseline information used to assess impacts to general wildlife populations is 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 Grand Canyon National Park summarized in the 1995 GMP and EIS was specifically referenced for information on affected resources in the project area.

Thresholds of change for intensity of impact on wildlife are defined as:

- | | |
|-------------------|--|
| Negligible | Impacts to wildlife and/or habitats would not be perceptible or measurable. Impacts would not be of any consequence to wildlife populations or supporting habitat |
| Minor | Impacts to wildlife and/or habitat would be small, measurable, and perceptible, but of little consequence. Population numbers, population structure, genetic variability, and other demographic factors for species might have slight changes but characteristics would remain stable. Key ecosystem processes might have slight disruptions within natural variability, and habitat for all species would remain functional |
| Moderate | Impacts to wildlife and/or habitat would be perceptible and measurable. Population numbers, population structure, genetic variability, and other demographic factors for species would have measurable changes creating declines, which could result from |

displacement, but would be expected to rebound to pre-impact numbers. No species would be at risk of being extirpated from the park, key ecosystem processes might have slight disruptions that would be outside natural variability, and habitat for all species would remain functional.

Major Impacts to wildlife and/or habitat would be perceptible and measurable. Population numbers, population structure, genetic variability, and other demographic factors for species might have large, short-term declines with long-term population numbers considerably depressed. In extreme cases, species might be extirpated from the park, key ecosystem processes like nutrient cycling might be disrupted, or habitat for any species may be rendered not functional.

Duration Short term One year or less for 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
Localized Impacts are confined to a small part of the population, habitat, or range

All effects to wildlife from various methods proposed under all alternatives would be localized.

Alternative 1 – No Action

Direct/Indirect Impacts: Use of crews for survey or treatment may have direct and indirect effects on wildlife throughout riparian, desertscrub, woodland, and conifer habitats. Impacts include disturbance to wildlife due to crew presence in territories or nesting areas, and noise generated by crews during treatment activities. In response to disturbance, animals may avoid an area, abandon a nest or den site, flush from fright, modify behavior, become habituated to humans, be injured, die, or more exposed to predation. Disturbances tend to be a direct result of presence of humans especially when they cross an animal's territory (Knight & Cole, 1991).

Crews can indirectly affect wildlife by altering wildlife habitat if they trample vegetation or create trails. This includes riparian and fish habitat when crews cross creeks to access or survey for exotic plants. Crew actions would have adverse, short-term, negligible impacts on wildlife. Best management practices would include education of crews on how to conduct themselves to minimize wildlife disturbance particularly in sensitive wildlife habitat; crews would be instructed not to approach or feed wildlife. Crews would use minimum impact techniques including removal of all trash and waste from treatment sites.

Beneficial effects to wildlife from reduction and removal of exotic plant species, by any method described below, include restoration of native plant habitat for shelter and associated food sources (seeds, insects, birds, reptiles, small mammals, etc). This beneficial effect on wildlife would be short to long term minor.

Prevention Crews surveying for new exotic plant species populations would have impacts described above. No other prevention actions would have impacts on wildlife.

Manual Control Manual control methods include removal of exotic plant species by uprooting entire plants using picks, shovels, pulaskis, and McLeods. Crews would have direct effects to wildlife as described above. Indirect effects of habitat alteration could result from vegetation removal, trampling, or damage. These actions would have an adverse short-term negligible to minor effect on wildlife.

Minimizing seed production using pruners, loppers, shears, and knives could reduce food sources for seed-eating birds and pollinating insects. This method would have adverse short-term negligible effects on wildlife.

Mechanical Control Noise from brush cutters and similar mechanized tools used in developed areas to remove exotic plants would have a direct effect on wildlife. These direct effects would be adverse short term negligible. Above-ground plant material left onsite as a mulch layer could provide shelter and refuge for small mammals. Water retention from mulch may also benefit animals. This would have a beneficial short-term negligible effect on wildlife.

Cultural Control Crews collecting native seed could affect wildlife as described above and could possibly reduce the food source for some animals if too much seed from one area or one plant is collected. These actions would have an adverse short-term negligible effect on wildlife.

Mulching disturbed areas would promote water retention and create shelter and refuge for small mammals. Water retention resulting from mulch may also benefit many types of animals. Impacts to wildlife would be beneficial short term negligible.

Chemical Control Manual application of selected herbicides on targeted individual plants may directly affect wildlife through inhalation or ingestion of chemicals or treated plants, and has potential to indirectly poison wildlife forage or water sources. Effects could be adverse short to long term minor. Best management practices would limit adverse impacts to wildlife (see Mitigation Measures and Best Management Practices in Chapter 2). In the unlikely event of a herbicide spill, standard operating procedures for containment and remediation would be implemented immediately to minimize impacts to wildlife. Effects of foot traffic from crews applying herbicides are discussed above.

Cumulative Impacts Cumulative impacts on general wildlife were determined by combining impacts of Alternative 1 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, and ongoing exotic plant management efforts in the park 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 wildlife, specifically to habitat and food sources, have resulted from ongoing exotic plant management efforts. Several of these activities, including prescribed and wild fire, 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 wildlife from these activities are localized short to long term minor. Beneficial impacts from ongoing exotic plant management efforts are long term minor.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. Removal of native vegetation has been or will be required in each of these projects resulting in loss of habitat and greater potential for habitat fragmentation. Impacts to wildlife from these projects would be long term minor adverse.

Foreseeable future projects include the Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. Similar to projects described above, vegetation removal will be required for these future projects. Therefore, impacts would be long term minor adverse.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse localized long-term minor effects on general wildlife. Alternative 1 would have a negligible contribution to this cumulative adverse effect because exotic plant management in itself is beneficial to wildlife.

Conclusion

Under Alternative 1 beneficial impacts including restoration of native plant habitat for shelter and associated food sources would continue to be localized long term minor. Adverse effects to wildlife including noise disturbance, habitat modification, and effects of chemical control would be localized short term minor. Cumulative impacts would be adverse long term minor. No impairment of or unacceptable impacts to general wildlife would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: Crew impacts would be the same as Alternative 1, and the same best management practices would be used to ensure protection of wildlife. Beneficial effects to wildlife would also be same as described for Alternative 1.

Prevention More in-depth and extensive annual surveys under Alternative 2 could increase potential for wildlife impacts over no action. Impacts would be from crew foot travel (see Direct/Indirect Impacts under Alternative 1). Similar to Alternative 1, impacts to wildlife would be adverse short term negligible.

Under Alternative 2 preparation of detailed work plans, development of a long-term monitoring program, preparation of intensive public outreach, expanded collaboration with adjacent land managers, and other prevention actions would have no impact on wildlife.

Manual Control Alternative 2 includes a greater variety of hand tools, but effects to wildlife would be similar to Alternative 1. Crews could directly affect wildlife as described in Alternative 1. Indirect effects of habitat alteration could result from vegetation removal, trampling, or damage. These actions would have adverse short-term minor effects on wildlife. Minimization of seed production could reduce food sources and could result in adverse short-term negligible effects on wildlife.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 includes use of mowers and chainsaws in developed areas. These tools would increase disturbance to wildlife due to louder noise and longer duration of treatment. Impacts to wildlife from power tool noise could be adverse short to long term minor. Mitigation measures could include seasonal or time of day restrictions on use of mowers and chainsaws. In sensitive wildlife habitat, alternative non-mechanized tools may be required. Adverse impacts from crew foot traffic would be as described under Alternative 1. Indirect effects to wildlife habitat include trampling, uprooting and trailing resulting in adverse short-term negligible impacts to wildlife.

Cultural Control Addition of carbon sources, expanded use of mulch, use of barriers, and an increase in collection and storage of native seed under Alternative 2 would affect wildlife similar to Alternative 1.

Use of fire to control exotic plant species has potential to adversely affect wildlife. Controlled burning across an area has the highest likelihood of damage to habitat and potential for mortality of wildlife, compared with pile burning, on the ground or in a barrel, and use of propane torches. Other impacts from fire include change in movement or behavior of wildlife due to heat and smoke. Impacts to wildlife from fire would be adverse short term negligible to minor.

Chemical Control Alternative 2 would include herbicide application on a greater number of species compared to Alternative 1. Effects on wildlife would be similar to those described under Alternative 1. Inclusion of limited broadcast spraying may increase risk of herbicide drift (in wind) to non-targeted native plants and wildlife forage and water sources. Potential for wildlife to inhale or ingest herbicides would increase with use of broadcast spray methods. Broadcast spraying could have adverse short- to long-term minor effects on wildlife if best management practices are followed as described in Chapter 2.

Cumulative Impacts Past, present, and reasonably foreseeable actions with potential to have cumulative impacts to general wildlife include those described for Alternative 1. Fire management activities including prescribed and wildland fires, trespass cattle grazing, human presence and activities, ongoing exotic plant management, and construction projects would have overall adverse localized long-term minor impacts. Alternative 2 would result in a negligible contribution to this cumulative effect.

Conclusion

Alternative 2 implementation would result in beneficial impacts including restoration of native plant habitat for shelter, and associated food sources would be localized long term minor. Adverse impacts including noise disturbance, habitat modification, chemical control, and use of fire would be minor localized short

term. Cumulative impacts would be adverse localized to regional short to long term minor. No impairment of or unacceptable impacts to general wildlife would result.

SPECIAL STATUS SPECIES

Affected Environment

The Endangered Species Act of 1973, as amended (16 USC 1531 et seq.), requires the NPS identify and manage Federally listed threatened or endangered species and consult with the U.S. Fish and Wildlife Service (USFWS) prior to planning or implementing any park project.

Table 8 lists threatened, endangered and other special status species known to occur or suspected in the park, and which could occur in exotic plant management project areas. In-depth discussions of Federally listed species in relation to exotic plant management activities are subjects of a separate biological assessment (BA).

Federally Listed Species Not Affected

The following Federally listed species would not be affected by implementation of either alternative: brown pelican (*Pelecanus occidentalis californicus*), Mojave desert tortoise (*Gopherus agassizii*), razorback sucker (*Xyrauchen texanus*), or Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*). As described in the associated BA, these species have narrow ranges and limited distributions and management actions are not anticipated for these areas. Mitigation measures are being developed in the project-specific BA to minimize potential for effect to these species.

Other Special Status Species Not Affected

The Desert tortoise (*Gopherus agassizii*) Sonoran population is listed as a special status species, but because this species has limited park distribution and management actions are not currently planned for this area, no effect is anticipated on this species. The Grand Canyon cave pseudoscorpion (*Archeolarca cavicola*) is also listed as a special status species, but has only been found in three GRCA caves. Due to its limited distribution, and absence of exotic vegetation in caves, no effect is anticipated on this species.

Table 8 Special Status Species Known or Suspected to Occur in GRCA
(Species identified with an asterisk (*) are the subject of the BA mentioned above)

Common Name	Scientific Name	Status			
		Federal	State	Navajo	Other
Wildlife					
Invertebrates					
Grand Canyon cave pseudoscorpion	<i>Archeolarca cavicola</i>	-	-	-	SC
*Kanab ambersnail	<i>Oxyloma haydeni kanabensis</i>	E	-	-	EN2
*Niobrara ambersnail	<i>Oxyloma haydeni, closely related to Oxyloma haydeni kanabensis</i>	-	WSC	-	SC
Fish					
Flannelmouth sucker	<i>Catostomus latipinnis</i>	-	-	-	SC
*Humpback chub	<i>Gila cypha</i>	E	WSC	G2	-
*Razorback sucker	<i>Xyrauchen texanus</i>	E	WSC	G2	-
Amphibians					
Northern leopard frog	<i>Rana pipiens</i>	-	WSC	G2	
*Relict leopard frog	<i>Rana onca</i>	C	WSC	-	-

Common Name	Scientific Name	Status			
		Federal	State	Navajo	Other
Reptiles					
*Desert tortoise (Mojave population)	<i>Gopherus agassizii</i>	T	WSC	-	-
Desert tortoise (Sonoran population)	<i>Gopherus agassizii</i>	-	WSC	-	SC
Birds					
American peregrine falcon	<i>Falco peregrinus anatum</i>	-	WSC	-	SC
*Bald eagle	<i>Haliaeetus leucocephalus</i>	D	WSC	-	-
*California brown pelican	<i>Pelecanus occidentalis californicus</i>	E	-	-	-
*California condor	<i>Gymnogyps californianus</i>	E,XN	WSC	-	-
*Mexican spotted owl	<i>Strix occidentalis lucida</i>	T	WSC	G3	-
Northern goshawk	<i>Accipiter gentilis</i>	-	WSC	-	-
*Southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	E	WSC	G2	-
*Western yellow-billed cuckoo	<i>Coccyzus americanusoccidentalis</i>	C	WSC	G3	-
*Yuma clapper rail	<i>Rallus longirostris yumanensis</i>	E	WSC	-	-
Mammals					
Allen's lappet-browed bat	<i>Idionycteris phyllotis</i>	-	-	-	SC
Desert bighorn sheep	<i>Ovis canadensis mexicana</i>	-	-	G3	-
Greater western mastiff bat	<i>Eumops perotis californicus</i>	-	-	-	SC
Long-legged myotis bat	<i>Myotis volans</i>	-	-	-	SC
Mexican long-tongued bat	<i>Choeronycteris mexicana</i>	-	WSC	-	SC
Pale Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	-	-	-	SC
Pocketed free-tailed bat	<i>Nyctinomops femorosacca</i>	-	-	-	SC
Southwestern myotis bat	<i>Myotis auriculus</i>	-	-	-	SC
Spotted bat	<i>Euderma maculatum</i>	-	WSC	-	SC
Western red bat	<i>Lasiurus blossevillii</i>	-	WSC	-	-
Plants					
Arizona rubberweed	<i>Hymenoxys subintegra</i>	-	-	-	EN2
Brittlebush	<i>Encelia resinifera ssp. tenuifolia</i>	-	-	-	SC,EN1
Bunchflower evening primrose	<i>Camissonia confertiflora</i>	-	-	-	SC,EN1
California bearpoppy	<i>Arctomecon californica</i>	-	-	-	SC,EN1
Deer goldenbush	<i>Ericameria cervina</i>	-	-	-	SC,EN2
Flagstaff rockcress	<i>Arabis gracilipes</i>				SC,EN2
Grand Canyon agave	<i>Agave phillipsiana</i>	-	SR	-	SC
Grand Canyon beavertail cactus	<i>Opuntia basilaris var. longiareolata</i>	-	SR	-	EN2
Grand Canyon cave-dwelling primrose	<i>Primula specuicola</i>	-	SR	-	SC,EN2
Grand Canyon glowweed	<i>Hesperodoria scopulina var. scopulina</i>	-	-	-	EN2
Grand Canyon rose	<i>Rosa stellata ssp. Abyssa</i>	-	-	-	SC,EN2
Kaibab agave	<i>Agave utahensis ssp. kaibabensis</i>	-	SR	-	SC,EN2
Kaibab paintbrush	<i>Castilleja kaibabensis</i>	-	-	-	SC,EN2
Kaibab Plateau beardtongue	<i>Penstemon pseudoputus</i>	-	-	-	SC,EN2
Kaibab suncup	<i>Camissonia specuicola ssp. Specuicola</i>	-	-	-	SC,EN2
Kaibab suncup (Grand Canyon evening-primrose)	<i>Camissonia specuicola ssp. Hesperia</i>	-	-	-	SC,EN2
Kaibab whitlowgrass	<i>Draba asprella var. kaibabensis</i>	-	-	-	SC,EN2
Kearney's mustard	<i>Thelypodopsis purpusii</i>	-	-	-	SC
Macdougal Indian parsley	<i>Aletes macdougalii ssp. Macdougalii</i>	-	-	-	EN2
McDougal's yellowtops	<i>Flaveria mcdougallii</i>	-	SR	-	SC,EN1
Mt. Dellenbaugh sandwort	<i>Arenaria aberrans</i>	-	-	-	EN2
Narrow scorpionweed	<i>Phacelia filiformis</i>	-	-	-	SC,EN2
Newberry's yucca	<i>Hesperoyucca newberryi</i>	-	SR	-	EN2
Pillar false gumweed	<i>Vanderveea stylosa</i>	-	-	-	EN2

Common Name	Scientific Name	Status			
		Federal	State	Navajo	Other
Roaring Springs prickly poppy	<i>Argemone arizonica</i>	-	-	-	SC,EN1
Rough whitlowgrass	<i>Draba asprella</i> var. <i>stelligera</i>	-	-	-	SC,EN2
*Sentry milk-vetch	<i>Astragalus cremnophylax</i> var. <i>cremnophylax</i> <i>Astragalus</i> spp. (Cape Final population to be named)	E	-	-	EN1
Spiked ipomopsis	<i>Ipomopsis spicata</i> ssp. <i>tridactyla</i>	-	-	-	SC,EN1
Straightbranched catchfly	<i>Silene rectiramea</i>	-	-	-	SC,EN1
Tusayan flameflower	<i>Pemmeranthus validulus</i> (syn. <i>Talinum validulum</i>)	-	-	-	SC,EN2
Willow glowweed	<i>Hesperodoria salicina</i>	-	-	-	SC,EN1
Marble Canyon spurge	<i>Euphorbia aaron-rossii</i>	-	-	-	SC,EN2
Special Status Species Known to Occur on Adjacent Lands (future searches may document occurrences in GRCA)					
*Brady pincushion cactus	<i>Pediocactus bradyi</i>	E	-	-	-
*Fickeisen plains cactus	<i>Pediocactus peddesianus</i> var. <i>fickeiseniae</i>	C	-	-	-
SOURCE: 66 FR 54808; 50 CFR 17.11–17.12; (ARIZONA DEPARTMENT OF GAME AND FISH, 2008; BRIAN, 2000; NATIONAL PARK SERVICE, 2003A) SPECIES NAMES CONFORM TO THE INTEGRATED TAXONOMIC INFORMATION SYSTEM (ITIS).					
FEDERAL STATUS: E —ENDANGERED, IN DANGER OF EXTINCTION C —CANDIDATE FOR LISTING AS THREATENED OR ENDANGERED D —DELISTED T —THREATENED, SEVERELY DEPLETED					
XN —EXPERIMENTAL, NON-ESSENTIAL POPULATION; IN GRAND CANYON CONDORS MANAGED AS FEDERALLY ENDANGERED					
STATE STATUS: WSC — WILDLIFE OF SPECIAL CONCERN IN ARIZONA E —ENDANGERED, STATE LISTING SR —LISTED AS SALVAGE RESTRICTED BY THE ARIZONA DEPARTMENT OF AGRICULTURE; THE PLANT IS SUBJECT TO DAMAGE BY THEFT OR VANDALISM; A STATE PERMIT AND SALVAGE FEES REQUIRED FOR REMOVAL					
NAVAJO ENDANGERED SPECIES LIST: GROUP 1 (G1) —NO LONGER OCCURS ON NAVAJO NATION LANDS. ARIZONA GAME AND FISH DEPARTMENT, 1996 GROUP 2 (G2) —PROSPECT OF SURVIVAL OR RECRUITMENT IS IN JEOPARDY GROUP 3 (G3) —PROSPECT OF SURVIVAL OR RECRUITMENT IS LIKELY TO BE IN JEOPARDY IN THE FORESEEABLE FUTURE ** NAVAJO STATUS DETERMINATION IS NOT USED BY ANY OTHER AFFILIATED GRAND CANYON TRIBES					
OTHER: H — KNOWN TO OCCUR ON HUALAPAI RESERVATION; NOT CURRENTLY DOCUMENTED WITHIN GRCA BOUNDARY SC —SPECIES OF CONCERN. SOME INFORMATION SHOWING VULNERABILITY OR THREAT, BUT NOT ENOUGH TO SUPPORT LISTING UNDER THE ENDANGERED SPECIES ACT. SOME OF THESE SPECIES ARE FORMER USFWS CATEGORY 1, 2, AND 3 SPECIES (NOTE: THE SOUTHWEST REGION OF THE USFWS NO LONGER MAINTAINS A LIST OF CATEGORY 1, 2, OR 3 SPECIES) EN1 — ENDEMIC TO GRCA. THESE SPECIES ARE ONLY KNOWN TO OCCUR IN GRCA, POPULATIONS AND TRENDS SHOULD BE MONITORED EN2 — ENDEMIC TO THE GRCA REGION, INCLUDING KNOWN POPULATIONS OUTSIDE OF PARK BOUNDARIES, BUT VERY LIMITED IN OVERALL DISTRIBUTION					

Special Status Species That May Be Affected

Federally listed species that have potential to be affected by exotic plant management activities include California condor (*Gymnogyps californianus*), Mexican spotted owl (*Strix occidentalis lucida*), bald eagle (*Haliaeetus leucocephalus*), yellow-billed cuckoo (*Coccyzus americanus*), Yuma clapper rail (*Rallus longirostris yumanensis*), southwestern willow flycatcher (*Empidonax traillii extimus*), Kanab ambersnail (*Oxyloma haydeni kanabensis*), humpback chub (*Gila cypha*), relict leopard frog (*Rana onca*), sentry milk-vetch (*Astragalus cremnophylax* var. *cremnophylax*), and Brady pincushion cactus (*Pediocactus bradyi*). More information on these species including a brief species description, habitat requirements, legal status, and data sources used for analysis are included in Appendix G.

Other special status species with potential to be affected by proposed actions include (see Appendix G for descriptions):

- Aquatic and riparian species (flannelmouth sucker, northern leopard frog)
- Birds (American peregrine falcon, northern goshawk)
- Mammals (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, desert bighorn sheep)

Non-Federally listed special status plants are included under native vegetation in the previous section.

Environmental Consequences

Methodology

Baseline information used to assess impacts to special status species 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 GRCA summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area.

Thresholds of change for intensity of impact on special status species are defined as:

- | | |
|-------------------|---|
| Negligible | Special status species would not be affected, or effects would be at or below level of detection. A negligible effect would equate with a "no effect" determination under section 7 of Endangered Species Act regulations for threatened and endangered species |
| Minor | Impacts to special status species would be perceptible or measurable, but severity and timing of changes to parameter measurements are not expected to be outside natural variability and are not expected to have effects on populations of special status species. Impacts would be outside critical periods. A minor effect would equate with a determination of "not likely to adversely affect" or "likely to adversely affect" under section 7 of Endangered Species Act regulations |
| Moderate | Impacts to special status species would be perceptible and measurable, and severity and timing of changes to parameter measurements are expected to be sometimes outside natural variability, and changes within natural variability might be long term. Populations of special status species might have small to moderate declines, but are expected to rebound to pre-impact numbers. No species would be at risk of being extirpated from the park. Some impacts might occur during key time periods. A moderate effect would in most cases equate with a determination of "likely to adversely effect" under section 7 of Endangered Species Act regulations |
| Major | Impacts to special status species would be measurable, and severity and timing of changes to parameter measurements are |

expected to be outside natural variability for long periods of time or even be permanent; changes within natural variability might be long term or permanent. Populations of special status species might have large declines, with population numbers significantly depressed. In extreme cases, a species might be at risk of being extirpated from the park, key ecosystem processes like nutrient cycling might be disrupted, or habitat for any species might be rendered not functional. Substantive impacts would occur during key time periods. Impacts would be long term to permanent. A major effect would equate with an “adverse affect with/without a jeopardy opinion” under section 7 of Endangered Species Act regulations

Duration	<u>Short term</u>	One year or less for an individual or habitat; five years or less for a population
	<u>Long term</u>	Greater than one year for individual or habitat; greater than five years for a population
Context	<u>Regional</u>	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
	<u>Localized</u>	Impacts are confined to a small part of the population, habitat or range

Alternative 1 – No Action

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 park and could disturb special status wildlife. Prevention, mechanical, manual, cultural, and chemical treatments would be used to control exotic plants.

Mitigation measures developed in the project-specific BA and best management practices identified in Chapter 2 would be followed to minimize impacts to special status species that could result from any current treatment method.

Beneficial impacts to all special status species are anticipated minor long term based on the overall objective of exotic plant management to restore native plant communities that provide habitat and support native wildlife.

Mexican spotted owl: Exotic plant management activities have potential to impact the owl 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, specifically 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, cultural, mechanical, and chemical.

Mexican spotted owl (MSO) restricted, protected, or critical habitat occurs primarily in remote park backcountry 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.

Treatments would be focused on exotic species only and would not alter in any substantial way, the native species in these areas, and would not disturb or alter primary elements of MSO habitat. While use of herbicides to treat exotic plant infestations in the park 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, 2004b) have been reviewed for applicability to MSO. All relevant MSO protective measures guiding use of herbicides would be followed as part of this plan, to minimize potential for adverse impacts. Chemical treatments could have potential for secondary poisoning (i.e., poisoning of prey); however, no herbicides that can cause secondary poisoning are currently in use.

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

California condor: California condor nesting habitat is generally limited to Inner Canyon cliffs and caves. The highest priorities for exotic plant management are in developed areas of North and South Rims and not in areas of potential condor nesting habitat. However, exotic plant surveys and treatments would occur below the rims and have potential to occur near condor nest areas or preferred roosting areas depending on locations of exotic plant infestations. Crews may need to survey for, monitor, or treat exotic plant populations near condor nesting areas or preferred roosting areas, or may need to travel through these areas to get to a project site. Exotic plant treatments would not disturb potential canyon nesting habitat or alter nesting habitat components for condors. However, activities could result in noise disturbance to nesting areas if in the project vicinity.

The main concern with California condors in relation to implementing the exotic plant management plan is potential contact with humans. Condors are naturally curious and it is not uncommon for them to be seen frequenting areas of high human activity, such as Grand Canyon Village on South Rim. Noise and activity associated with management activities (survey work, manual and mechanical treatments, chemical treatments, etc.) have potential to attract condors to project sites and can increase potential for interaction between condors and humans. Survey crews or treatment crews would generally be small groups with limited potential to disturb or attract condors. Occasionally, however, large volunteer crews may be used to treat an infestation. Condor contact with humans would be of concern if work crews harass the birds or if the birds become habituated to humans. Mitigation measures to educate work crews of condor concerns and to cease activities if condors are present would reduce potential disturbance from management activities on the birds. Hazing by permitted park employees would ensure condors do not become habituated to humans. While exact timing and duration of project components is not known at this time, NPS acknowledges that

the shorter the duration of work in any one particular area, the less impact to condors. NPS would make every effort to reduce length of work periods as is practical.

While use of herbicides to treat exotic plant infestations in the park is a component of this plan, use near condor nesting or roost habitat would be limited due to location, terrain, and presence of exotic plant species. USFWS Pesticide Protection Measures have been reviewed for applicability to condors. All relevant condor protective measures guiding use of herbicides would be followed as part of this plan, to minimize potential for adverse impacts.

Impacts to condors under Alternative 1 from crews surveying for or treating exotic plants would be adverse localized short term negligible to minor.

Bald eagle: Bald eagles do not breed in the park, but are present in riparian habitats along the Colorado River during the wintering season. Exotic plant surveys and treatments may be necessary along the river corridor and in side canyons or tributaries to treat tamarisk and other exotic species. For this reason, impacts to wintering eagles are possible.

Wintering eagles along the river corridor are selecting riparian habitat for roosting, and typically select large trees in the overstory. Exotic plant treatments would not be occurring in this habitat and would not result in any disturbance to potential roost trees or perches for eagles while foraging. If other winter roosts are located in other park areas, such as South or North Rim developed area, where they have been occasionally observed in the past, these areas would 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 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 (Steidl & Anthony, 1995) studied effects of non-motorized recreational boating on non-breeding bald eagles in Alaska and found that 50% flushed in response to rafts approaching. Crews hiking or working in morning and evening hours are more likely to flush perched or foraging eagles. January through March is the time of year when bald eagles congregate in upper portions of the river corridor at mouths of creeks to feed on trout, and 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 are not currently being used in GRCA.

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

Yellow-billed cuckoo: It is generally unknown whether GRCA provides nesting habitat for yellow-billed cuckoos, but information indicates they have used riparian habitat along the 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, cottonwood, and willow habitats. Alternative 1 includes continued treatment of tamarisk in side canyons of the Colorado River only. 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 are not 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 camping or congregating near occupied or suitable habitat.

While use of herbicides to treat exotic plant infestations in the park is a component of this plan, use in the Inner Canyon where cuckoo habitat occurs would be limited 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 an effective way of treating larger tamarisk and may be used as part of this project. All relevant southwestern willow flycatcher protective measures guiding herbicide use would be followed as part of this plan, to minimize potential for adverse impacts.

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 GRCA.

Southwestern willow flycatcher: Continued tamarisk removal, primarily in Colorado River side canyons, 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. Exotic plant treatments are not currently planned for any areas where breeding locations have been identified through survey. 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 in the park 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 be treated in tributaries to the Colorado River as well as seeps and springs along the mainstem. 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 Pesticide Protection Measures 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.

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 and no work would occur in designated critical habitat. 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 they use for habitat.

Kanab ambersnail: The Kanab ambersnail has a very limited distribution within GRCA and only occurs naturally at one location (Vaseys Paradise), with one surviving translocated population (Upper Elves Chasm) and one location where a closely related relative, the Niobrara snail, occurs (Indian Garden). Vaseys Paradise and Upper Elves Chasm are not areas where exotic plant activities are currently planned or anticipated and can be avoided during all exotic plant management activities. Vaseys Paradise and Upper Elves Chasm are relatively remote areas not easily accessed nor in need of exotic plant treatments or survey. The Niobrara population is not as remote and actually occurs within the developed area at Indian Garden near Bright Angel Trail. The specific spring habitat within which it occurs is not readily accessible by visitors, and efforts have been made by park staff to ensure visitor trampling and disturbance does not occur here by ensuring trails and paths avoid the area. Because this site is within the cross-canyon corridor and has need for exotic plant treatments occasionally (Himalayan blackberry removal in 2004 for example), activities have potential for Niobrara ambersnail habitat disturbance. Treatment and survey efforts will be coordinated with the park's wildlife biologists to get up-to-date maps of habitat and minimize disturbance to the ambersnail.

Implementation of Alternative 1 would result in negligible to minor adverse short-term localized impacts to the Niobrara ambersnail.

Humpback chub: Exotic plant management activities are not planned for areas adjacent to the river where humpback chub are known to congregate. In general, tributary confluences where they are currently found are not places where exotic plant management activities are planned. However, indirect effects are possible due to pesticide use and slash disposal from mechanical treatments if occurring near the mainstem or tributary confluences. Because fish occur throughout the river itself, treatments with potential for inputs into the river system (e.g. pesticide runoff or woody slash) have potential impact to the species. It is likely, though, that some survey and treatments would be necessary in some backcountry sites over the life of the plan and conservation measures are necessary to ensure any indirect adverse impacts to humpback chub are minimized.

Due to the large size and volume of the Colorado River, relatively minor inputs into the system (such as woody debris generated from tamarisk treatment) are likely to have little effect on fishes. However, large woody debris deposited in the river can cause log jams and areas where debris can pile, creating small debris piles that create shaded conditions that can alter microclimatic conditions for fish. There are no areas along the river corridor or along primary tributaries where large inputs of woody debris are expected; however, conservation measures being developed in the BA would minimize potential for this action to adversely impact humpback chub.

To avoid contaminating water or wetland habitats used by humpback chub during their life cycle, herbicide use in proximity to the river corridor or perennially tributaries will be limited and carefully monitored. While it is unlikely herbicides would be used in or near areas where humpback chub spawn (such as the Little Colorado River confluence) or in areas where concentrations could affect water quality, there are USFWS Pesticide Protection Measures to protect humpback chub during herbicide use which would be followed for this project.

Implementation of Alternative 1 would result in negligible to minor adverse short-term localized impacts to humpback chub.

Razorback sucker: Exotic plant management activities are not planned for areas adjacent to the river where razorback suckers may occur in small numbers. However, indirect effects are possible due to pesticide use and slash disposal from manual treatments if occurring near the mainstem or tributary confluences. Because fish may occur throughout the river itself, treatments with potential for inputs into the river system (e.g. herbicide runoff or woody slash) have potential for impact to the species. It is likely, that some survey and treatments would be necessary in backcountry sites over the life of the plan and conservation measures are necessary to ensure that any indirect adverse impacts to razorback sucker are minimized.

Due to the large size and volume of the Colorado River, relatively minor inputs into the system (such as woody debris generated from tamarisk treatment) are likely to have little effect on fishes. However, large woody debris deposited in the river can cause log jams and areas where debris can pile, creating small debris piles that create shaded conditions or otherwise change existing microclimate for an indefinite period. There are no areas along the river corridor or along primary tributaries where large inputs of woody debris are expected; however, conservation measures would minimize potential for this action to adversely impact razorback sucker.

To avoid contaminating water or wetland habitats used by razorback suckers herbicide use in proximity to the river corridor or perennially tributaries will be limited and carefully monitored. Razorback sucker are not thought to be spawning in GRCA and if any individuals are present within the river system within GRCA, they are suspected to be mature adults. While it is unlikely herbicides would be used in areas where concentrations could affect water quality, there are USFWS Pesticide Protection Measures to protect razorback sucker during herbicide use which would be followed for this project.

Implementation of Alternative 1 would result in negligible to minor adverse short-term localized impacts to the razorback sucker.

Relict leopard frog: Due to the extremely limited distribution of relict leopard frogs in GRCA and the fact that recent surveys have been conducted and no additional populations having been found, it is unlikely exotic plant management activities would result in disturbance to this species. However, a portion of GRCA is within potential Management Zone and includes the Colorado River, Surprise Canyon, and habitat along other tributaries in the lower end of the park.

While exotic plant surveys and treatments may be necessary over time in portions of Surprise Canyon where leopard frogs are known to occur, frog habitat can be avoided and treatments carefully planned to ensure no indirect impacts to habitat would occur (such as trampling, woody debris deposits, etc.).

It should be noted control of nonnative species in riparian and wetland habitats is identified as a criteria for conservation since certain detrimental nonnative species, such as tamarisk, can reduce frog habitat by reducing areas of open water and can reduce forb cover used for shade. If done carefully, tamarisk removal efforts in occupied or potential habitat could have beneficial impacts to relict leopard frogs.

A threat to frog populations is introduction of nonnative species and diseases, sometimes through inadvertent transfer of mud from shoes into frog habitat. Exotic plant survey and treatment crews would ensure proper techniques are used to rinse shoes before entering any aquatic areas and ensure use of Leave No Trace principals whenever working in or near wetland habitats that may contain suitable relict leopard frog habitat to avoid inadvertent disturbance from detergents and soaps, trampling, and transfer of materials on clothing and shoes from one stream system to another.

Herbicide use has potential for adverse impacts to water quality and amphibian habitat. Herbicide use would adhere to all protection measures as outlined in USFWS Pesticide Protection Measures for Chihuahuan leopard frogs (measures were not available for relict leopard frogs).

Adverse impacts to leopard frogs from Alternative 1 would be short term localized negligible to minor. Beneficial impacts would be long term localized negligible to minor.

Sentry milk-vetch: Sentry milk-vetch has extremely limited distribution in GRCA and occurs in very specific habitat types along South Rim. While these areas are within the South Rim developed zone, exotic plant management treatments are not planned or expected in these specific areas, except as necessary to maintain habitat suitability for sentry milk-vetch. Exotic plants are not prevalent in habitat preferred by sentry milk-vetch; nothing more than occasional manual treatments to remove individual high priority exotic species are expected in or near these habitat areas. However, it is possible crews may traverse potential habitat areas that have not had adequate survey and could inadvertently trample plants, or exotic plant treatments could occur in proximity to unsurveyed potential habitat and create disturbance. For this reason, adverse impacts from exotic plant management activities are possible, but slight.

Removal of exotic plant species would have direct beneficial localized long-term minor impacts on sentry milk-vetch by reducing competition and freeing resources; however, exotic species competition is not identified as a threat to sentry milk-vetch in the 2006 Sentry Milk-vetch Recovery Plan (United States Fish and Wildlife Service, 2006).

Brady pincushion cactus: Brady pincushion cactus is not known to occur in GRCA boundaries but occurs in close proximity in the Marble Canyon area; it is possible that unsurveyed suitable habitat exists within the park. However, in this extreme northeastern end of the park where the park boundary hugs the river corridor, there is little need for exotic plant management. If treatments are necessary in this area, it is more likely they would be needed below the rim and not on the rim itself, where this cactus occurs. However, if exotic plant surveys are necessary in this area and if treatments are deemed necessary, NPS staff would avoid all known occupied habitat when accessing survey or treatment locations. This cactus is small, inconspicuous, and easily missed; it is sensitive to trampling and off-road vehicle use. Access through this area would remain on established roads only and crews would be instructed in species identification so any off-road hiking to survey or treatment sites would carefully avoid occupied habitat. Surveys for this species would be conducted in all suitable habitats if any activities are proposed in this habitat prior to any exotic plant treatments to ensure individuals are not disturbed.

Impacts to Brady pincushion cactus from Alternative 1 would be negligible localized short term.

Fickiesen plains cactus: Due to the similarity in preferred habitats, known occurrence records and similar life histories, analysis presented here is similar to Brady pincushion cactus.

Fickeisen plains cactus is not known to occur in GRCA boundaries, but occurs in close proximity in the Marble Canyon area; it is possible that unsurveyed suitable habitat exists within the park. However, in this extreme northeastern end of the park where the park boundary hugs the river corridor, there is little need for exotic plant management activities. If treatments are necessary in this area, it is more likely they would be needed below the rim and not on the rim itself, where this cactus occurs. However, if exotic plant surveys are necessary in this area and if treatments are deemed necessary, NPS staff would avoid all known occupied habitat when accessing survey or treatment locations. This cactus is small, inconspicuous, and easily missed; it is sensitive to trampling and off-road vehicle use. Access through this area would remain on established roads only and 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 in all suitable habitats if any activities are proposed in this habitat, prior to any exotic plant treatments, to ensure individuals are not disturbed.

Impacts to Fickeisen plains cactus from Alternative 1 would be negligible localized short term.

Aquatic and riparian species (flannemouth sucker, northern leopard frog): Impacts to flannemouth sucker and northern leopard frog would be similar to

those described for humpback chub, razorback sucker, and relict leopard frog earlier in this section. Extensive surveys in 2003 and 2004 failed to locate any northern leopard frog populations in GRCA. If the species does persist in Grand Canyon, mitigation measures described above for relict leopard will limit impact to this species to negligible to minor localized short term.

Flannel mouth sucker: Limited exotic plant management activities are planned for areas adjacent to the river where flannel mouth suckers may occur, but impacts are expected to be minor. Indirect effects are possible due to pesticide use and slash disposal from manual treatments when occurring near the mainstem or tributary confluences. Because fish may occur throughout the river itself, treatments with potential for inputs into the river system (e.g. herbicide runoff or woody slash) have potential impact to the species.

Due to the large size and volume of the Colorado River, relatively minor inputs into the system (such as woody debris generated from tamarisk treatment) are likely to have little effect on fishes. However, large woody debris deposited in the river can cause log jams and areas where debris can pile, creating small debris piles that create shaded conditions or otherwise change the existing microclimate for an indefinite period. There are no areas along the river corridor or along primary tributaries where large inputs of woody debris are expected. Minor debris inputs could benefit the species by increasing forage base for flannel mouth sucker.

To avoid contaminating water or wetland habitats used by flannel mouth sucker, herbicide use in proximity to the river corridor or perennially tributaries will be limited and carefully monitored. While it is unlikely herbicides would be used in areas where concentrations could affect water quality, there are USFWS Pesticide Protection Measures to protect razorback sucker during herbicide use which would be followed for this project.

Implementation of Alternative 1 would result in negligible to minor adverse short-term localized impacts to flannel mouth sucker.

Birds (American peregrine falcon, northern goshawk): 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 GRCA, and annual coordination with the Park Wildlife Program Manager will limit impacts to this species

Implementation of Alternative 1 would result in negligible to minor adverse short-term localized impacts to peregrine falcon and northern goshawk.

Mammals (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, desert bighorn sheep):

Long-legged myotis, southwestern myotis, and western red bat 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 near snags or live damaged trees. Allen's lappet-browed bat, greater western mastiff bat, Mexican long-tongued bat, Townsend's big-eared bat and spotted bat 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.

Desert bighorn sheep in Grand Canyon are tolerant of human disturbance; the impact of more concern is the possibility backcountry crews will increase the chance of bighorn becoming habituated to human activity. This can lead to increased adverse interactions with humans and disruptions of normal foraging patterns. Crews will be instructed to refrain from interactions with bighorn sheep and to haze any individuals that approach campsites. Additionally, USFWS Pesticide Protection Measures for mammals will be followed to minimize adverse impacts.

Implementation of Alternative 1 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.

Cumulative Impacts Cumulative impacts on special status species were determined by combining impacts of Alternative 1 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 park 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 wild fire, 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 that could have a cumulative effect when combined with Alternative 1 include South Entrance Road Improvements,

Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. 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 long term minor adverse. Short-term minor adverse impacts would occur to some species during construction.

Foreseeable future projects include Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. 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 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse localized long-term minor effects on special status species. Alternative 1 would have a negligible contribution to this cumulative adverse effect because exotic plant management in itself is beneficial to special status animal and plant species.

Conclusion

Continuation of current exotic plant management in Alternative 1 would result in adverse localized short- to long-term minor impacts. Adverse impacts would include noise disturbance, habitat modification, and potential direct effects of herbicide use. Beneficial impacts including restoration of native plant habitat for shelter and associated food sources would be long term minor. Cumulative impacts would be adverse localized long term minor. No impairment of or unacceptable impacts to special status species would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: Exotic plant management activities under Alternative 2 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 2, more in-depth and extensive annual surveys would occur, a greater variety of hand and mechanized tools would be used, additional coordination efforts with GRCA'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 minor long term based on the overall objective of exotic plant management to restore native plant communities that provide habitat and support native wildlife.

Mexican spotted owl: Exotic plant management activities proposed under Alternative 2 would have similar impacts to Alternative 1. Additional techniques and treatments are not expected to have added adverse impacts on MSO. Additional mechanized equipment is proposed; however, MSO restricted,

protected, or critical habitat occurs primarily in remote areas of the park's backcountry where mechanized equipment would generally 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 1. Use of additional chemicals to treat exotic plants has potential to impact MSO; however, impacts would be the same as described for Alternative 1. Again, no herbicides that cause secondary poisoning (i.e., poisoning of prey) are currently in use. Use of fire to treat exotic 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 2 implementation would result in a minor adverse short-term impact to MSO.

California condor: Impacts to California condor under Alternative 2 would be similar to those described for Alternative 1. Increased surveys and coordination are not expected to have additional impacts on condors. Mechanized equipment has potential to attract condors; however, mitigation measures will be followed to minimize impacts. Expanded use of herbicides would have impacts similar to Alternative 1, and all protection measures would be followed. Use of fire to treat exotic species is not anticipated in or near condor nest or roost sites; however, best management practices will be followed to minimize impacts. Impacts to condors under Alternative 2 would be adverse localized short term negligible to minor.

Bald eagle: As described under Alternative 1, bald eagles do not breed in the park, but are present in riparian habitats along the Colorado River during the wintering season. Exotic plant surveys and treatments would have similar impacts on bald eagles as those described for Alternative 1. Increase in surveys and treatment types would slightly increase potential adverse impacts to the bald eagle. Fire use as proposed in Alternative 2 is not expected to have additional impacts on bald eagle beyond those described for Alternative 1. Alternative 2 implementation would have negligible to minor short-term localized adverse impacts to bald eagles.

Yellow-billed cuckoo: Potential impacts to the yellow-billed cuckoo under Alternative 2 would be similar to those described under Alternative 1. Fire use is not expected to have additional impacts on the yellow-billed cuckoo. Impacts to the yellow-billed cuckoo under Alternative 2 would be adverse negligible to minor short term localized. Long-term minor beneficial impacts would result from removal of exotic plant species and restoration of riparian vegetation in GRCA.

Southwestern willow flycatcher: Alternative 2 implementation would result in similar impacts on SWWF to those described for Alternative 1. 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, and no work would occur in designated critical habitat. 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 they use for habitat.

Kanab ambersnail: Impacts to the Kanab ambersnail under Alternative 2 would be similar to those described for Alternative 1. Increased surveys and treatment methods are not expected to impact the ambersnail over those impacts described for Alternative 1. Treatment and survey efforts will be coordinated with the park's wildlife biologists to get up to date maps of habitat and minimize disturbance to the Niobrara ambersnail at Indian Garden. Alternative 2 implementation would result in negligible to minor adverse short-term localized impacts to the Niobrara ambersnail.

Humpback chub: Alternative 2 implementation would have similar impacts to those described under Alternative 1. Additional indirect effects are possible due to fire treatments near the river. Fire use to treat camelthorn and other species is a component of this plan. Fire use near the river corridor has potential to introduce isolated woody debris and ash into the river system. Due to the large size and volume of the Colorado River and the fact that these treatments, if used, would be small-scale, isolated, and used essentially to "spot treat" particular species in small areas along the river or its tributaries, impacts are minimized. There are no areas along the river corridor or along any primary tributaries where widespread fire use to treat exotic plants is expected. Alternative 2 implementation would result in negligible to minor adverse short-term localized impacts to humpback chub.

Razorback sucker: Alternative 2 implementation would have similar impacts to those described under Alternative 1. Additional indirect effects are possible due to fire treatments near the river. Exotic plant management activities are not planned for areas adjacent to the river where razorback suckers may occur in small numbers. Fire use to treat camelthorn and other species is a component of this plan. Fire use near the river corridor has potential to introduce isolated woody debris and ash into the river system. Due to the large size and volume of the Colorado River and the fact that these treatments, if used, would be small-scale, isolated, and used essentially to "spot treat" particular species in small areas along the river or its tributaries, effects are minimized. There are no areas along the river corridor or along any primary tributaries where widespread fire use to treat exotic plants is planned; however, conservation measures would minimize potential for this action to adversely impact razorback sucker. Alternative 2 implementation would result in negligible to minor adverse short-term localized impacts to razorback sucker.

Relict leopard frog: Impacts beyond those described for relict leopard frogs under Alternative 1 are not anticipated. However, effects of fire on amphibians are poorly known but assumed to be detrimental in some situations if increased surface runoff and sediment loads enter frog habitat. Higher nitrogen and phosphorus levels can be toxic to frogs and other amphibians. While prescribed fire is a tool proposed as part of this plan to control certain species of exotic plants, it would be used in a very localized and limited way, primarily to treat camelthorn. No fire treatments would be used in Surprise Canyon or in or near any other areas that contain potentially suitable habitat for relict leopard frogs. Adverse impacts to leopard frogs from Alternative 2 would be short term localized negligible to minor. Beneficial impacts would be long term localized negligible to minor.

Sentry milk-vetch: Additional survey and treatments proposed under Alternative 2 are not expected to have impacts on sentry milk-vetch beyond those described for Alternative 1. Fire treatments would not occur in habitat for sentry milk-vetch and all mitigation measures would be followed to protect the species from adverse impacts. Removal of exotic plant species in general would have direct beneficial localized long-term minor impacts on sentry milk-vetch by reducing competition and freeing resources.

Brady pincushion cactus: Changes in exotic plant management proposed under Alternative 2 are not expected to result in additional impacts on Brady pincushion cactus when compared with Alternative 1. As described in Alternative 1, exotic plant treatments are more likely to occur below the rim and not on the rim itself, where this cactus occurs. In addition, if exotic plant surveys are necessary in this area, and if treatments are deemed necessary, NPS staff would avoid all known occupied habitat when accessing survey or treatment locations. Fire treatments would not occur in habitat for Brady pincushion cactus. Impacts to Brady pincushion cactus from Alternative 2 would be negligible localized short term.

Fickiesen plains cactus: Due to the similarity in preferred habitats, known occurrence records and similar life histories, analysis presented here is similar to Brady pincushion cactus and similar to Alternative 1. Exotic plant treatments are more likely to occur below the rim and not on the rim itself, where this cactus occurs. If exotic plant surveys are necessary in this area, and if treatments are deemed necessary, NPS staff would avoid all known occupied habitat for Fickiesen plains cactus. Impacts to Fickeisen plains cactus from Alternative 2 would be negligible localized short term.

Aquatic and riparian species (flannemouth sucker, northern leopard frog): Impacts to flannemouth sucker and northern leopard frog would be similar to those described for humpback chub, razorback sucker, and relict leopard frog earlier in this section. Impacts are also the same as those described for Alternative 1: negligible to minor adverse localized short term.

Birds (American peregrine falcon, northern goshawk): Similar to Alternative 1, impacts on peregrine falcon and northern goshawk would be minor adverse short term localized. Impacts would result in behavior modification in the birds and potential to leave a roosting or nesting area. See analysis under Alternative 1 for detailed information.

Mammals (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, desert bighorn sheep): Impacts to mammals under Alternative 2 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. Bighorn sheep are also not likely to be disturbed by these activities as they are tolerant of human activity. Best management practices would be followed to minimize interactions with bighorn sheep.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would result in the same

level of impact described for Alternative 1. Impacts would have an overall adverse localized short- to long-term minor effect on special status species. Alternative 2 would result in an adverse localized short- to long-term negligible contribution to cumulative effect.

Conclusion

Alternative 2 implementation would have adverse localized short- to long-term minor impacts on special status species, if mitigation measures are followed. Adverse impacts would include noise disturbance, habitat modification, and direct effects of chemical and fire treatments. Beneficial impacts including restoration of native plant habitat for shelter and associated food sources would be localized short to long term minor. Cumulative impacts would be adverse localized short to long term minor. No impairment of or unacceptable impacts to special status species would result.

SOIL RESOURCES

Affected Environment

Geology and slope strongly influence most Grand Canyon soils (National Park Service, 2008c). Currently, soils throughout the canyon are categorized as poorly developed. Soils are highly variable, ranging from moist forest soils of North Rim to shallow, dry mineral soils and bedrock exposures of the Inner Canyon. Inner Canyon soil textures are sandy loam, sands, or loamy sands. It is likely there are a few silt loams or clay loams in the Hermit and Bright Angel Shales and in Toroweap Valley.

Most GRCA soil types erode very easily and regenerate slowly. Their sandy nature allows water to be absorbed immediately, leaving the ground dry shortly after rain showers. Soils are typically fragile and require little disturbance to create erosion problems. Large park areas show essentially no human impacts to soils. Other areas, used for recreational activities, have heavily impacted soils.

Biological soil (cryptogamic) crusts are very sensitive soil systems, specific to arid lands. These crusts cover a significant portion of Inner Canyon soil. Cyanobacteria form the crust while other bacteria, algae, fungi, lichens, and mosses are often present. Crusts play important roles in reducing soil erosion, increasing water conservation, and in promoting nitrogen fixation. They create a more favorable environment for vascular plants to germinate under arid conditions. Crusts are highly susceptible to trampling and air pollution.

Environmental Consequences

Methodology

Baseline information used to assess impacts to soil resources 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 Grand Canyon National Park summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area. Additional sources of information on soil resources used as a basis for this evaluation are as described above in the affected environment section.

Thresholds of change for intensity of impact on soil resources are defined as:

Negligible Adverse impacts to soils, including biological crusts, would not be perceptible or measurable. Beneficial impacts would improve the condition of soils at minute levels. Any changes to soil productivity, integrity, stability, or fertility would be imperceptible.

Minor Beneficial or adverse effects to soils and biological crusts would be barely perceptible or measurable. Any adverse impacts to soil productivity, integrity, stability, or fertility would be small and reversible. Beneficial effects would improve the condition of soils slightly. If mitigation was needed to offset adverse effects, it would be relatively simple to implement and would likely be successful. A beneficial effect would slightly reduce the level of mitigation needed.

Moderate Beneficial or adverse impacts to soils and biological crusts would be readily perceptible and measurable. Effects to soil productivity, integrity, stability, or fertility would be readily apparent, and they would result in a change to the soil character. Mitigation measures would be necessary to offset adverse effects and would likely be successful. Beneficial effects would substantially improve the condition of soils, greatly reducing the amount of necessary mitigation.

Major Adverse impacts to soils and biological crusts would be readily perceptible, measurable, and constitute a substantial change from natural conditions. Effects to soil productivity, integrity, stability, or fertility would be readily apparent and would substantially change the character of the soils. Mitigation measures to offset adverse effects would be needed, they would be extensive, and their success would not be guaranteed. Beneficial effects would return soils back to natural conditions, and mitigation would not be necessary.

Duration Short term One year or less and soils return to pre-disturbance condition the next year

Long term Greater than one year

Context Regional A large area of the park with greater than 25% of the park land affected

Localized A small area of the park; a single site

All effects to soils from various methods proposed under all alternatives would be **localized**.

Alternative 1 – No Action

Direct/Indirect Impacts Use of crews for survey or treatment may have direct effects on soils by causing erosion and compaction and possible trampling of biological soil crusts from foot travel. This would have an adverse short- to long-term negligible to minor impact on soil resources. Impacts to fragile biological soil crusts are long term because when trampled it takes many years to recover;

however, the vast majority of areas in which surveys would occur are previously disturbed and do not typically contain intact biological soil crusts. In addition, crews would be educated about how to avoid creating new trails and injuring soil crusts.

Beneficial impacts would result from removal of certain exotic species, such as tamarisk. Tamarisk, also known as saltcedar, has the ability to create saline soils by taking up salts from soil and groundwater. The plant then exudes the salt through its leaves and drops the leaves to the ground resulting in increased soil salinity (Wiesenborn, 1996). Beneficial impacts from exotic plant removal on soil resources would be localized long term minor.

Allelopathic exotic plants, including Russian knapweed, have ability to change soil chemistry by producing chemicals and exuding them into the soil (Alford et al., 2007). These species inhibit growth of other plant species, an adverse impact on native vegetation. Removal of allelopathic exotic plants would have minor beneficial long-term localized effects on native vegetation.

Prevention Prevention actions under Alternative 1 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 impact on soil resources.

Manual Control Removal of exotic plant species using manual methods could have direct effects to soils including disturbance from digging, and effects from crew foot travel as described above. Indirect effects of uprooting entire plants using picks, shovels, and pulaskis include potential increased erosion from loss of soil-stabilizing plants and increased overland water flow. Adverse impacts to soil resources would be short to long term negligible to minor if mitigation measures were followed. Measures include refilling holes and replacing removed soils, tamping disturbed soil, reseeding with native seed, and educating crews about how to avoid creating new trails and damaging biological soil crusts.

Mechanical Control Indirect effects from removal of exotic plants above the root crown using brush cutters may increase soil erosion due to increased overland water flow and above-ground vegetation loss. Adverse effects to soils 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 a mulch layer. This would have a beneficial short-term minor effect on soil resources.

Use of tractors on pre-disturbed construction sites to remove exotic plant species prior to site restoration would disturb, compact, and destabilize soils. This action would have adverse short- to long-term minor to moderate impacts on soil resources. These moderate adverse impacts would be mitigated to minor by refilling holes, replacing soils, seeding with native species, and mulching the site.

Use of gas powered tools introduces potential for gas and/or oil spills. A spill plan would be in place and, in the unlikely event of a spill, containment and clean-up procedures would be employed immediately. Mitigation measures and best management practices, including proper storage and transport techniques listed in Chapter 2, have been identified to minimize potential for a spill.

Cultural Control Collection of native plant seed would only affect soils that crews walk on to access plants as described above. Application of mulch to disturbed areas would promote water retention and change carbon-to-nitrogen ratios thereby having beneficial minor short- to long-term effects on soil resources.

Chemical Control Manual application of selected herbicides on targeted individual plants may directly affect soil chemistry when absorbed into soil during spray application. Application of herbicide is primarily done with handheld or backpack sprayers and applied directly to plants. In this type of application, there is little or no direct application to soils.

Foot traffic from crews applying herbicides would have impacts as described above. Indirect impacts on soils from plant mortality would include increased erosion potential due to loss of soil-stabilizing plants and increased overland water flow. Indirect impacts could also include changes in soil chemistry because herbicide absorbed by plants is exuded through plant roots. Adverse impacts on soil resources from chemical control would be localized short term negligible.

Potential for herbicide spills directly onto soils is unlikely. Herbicides are transported in leak-proof, spill proof containers handled according to label specifications. In the unlikely event of a spill, resource managers would immediately implement standard operating procedures for containment and remediation of spills.

Cumulative Impacts Cumulative impacts on soil resources were determined by combining impacts of Alternative 1 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 wild fires, trespass cattle grazing, stock use, human activities, and ongoing exotic plant management efforts in the park and on adjacent lands. These actions have caused adverse impacts such as vegetation loss, erosion, and compaction. Beneficial impacts to soils have resulted from ongoing exotic plant management efforts particularly removal of plants that change soil chemistry such as tamarisk. Several of these activities, including prescribed and wild fire, stock use, human activities, and exotic plant management in the park and on adjacent lands are ongoing and are considered in this analysis as in-progress and future actions as well as past activities. Impacts to soil resources from these activities are adverse long term minor. Beneficial impacts from ongoing exotic plant management efforts are minor.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. Removal of vegetation has been or will be required in each of these projects, compaction of soils will occur, and erosion will increase. Impacts to soils would be long term minor adverse. Beneficial impacts to soil result from formalizing trails and limiting multiple trails and resultant erosion and compaction. These beneficial impacts would be localized long term negligible to minor.

Foreseeable future projects include Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. Similar to projects described above, vegetation removal will be required for these future projects. Therefore, adverse impacts would be long term minor. Beneficial impacts would result from designation of trails and walkways which limit multiple trails and minimize erosion and compaction. These beneficial impacts would be localized long term negligible to minor.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse localized long-term minor effects on soil resources. Alternative 1 would have a negligible contribution to this cumulative effect.

Conclusion

Under Alternative 1 adverse effects from trampling, chemical residue, resultant erosion, and damage to biological soil crusts would continue to be localized short to long term minor. Beneficial impacts, including removal of plants that change soil chemistry and increased water retention from mulch and vegetative material left onsite, would be localized long term minor. Cumulative impacts would be adverse localized short to long term minor. No impairment of or unacceptable impacts to soil resources would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: As described for Alternative 1, Use of crews for survey or treatment may have direct effects on soils from foot travel, an adverse short- to long-term negligible to minor impact on soil resources. Impacts to fragile biological soil crusts would be long term.

Removal of exotic plants that change soil chemistry including tamarisk and Russian knapweed discussed in Alternative 1 would have minor localized long-term beneficial impacts on soils.

Prevention More in-depth and extensive annual surveys could slightly increase potential for soil impacts over Alternative 1. No additional prevention actions would impact soil resources.

Manual Control Alternative 2 proposes the same type of manual control currently used, therefore effects to soils and mitigation measures would be similar to Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in the developed area. However, effects to soil resources and mitigation measures would be similar to Alternative 1.

Cultural methods Alternative 2 includes addition of carbon sources and expanded use of mulch, which would have direct effects on soil resources. Addition of carbon sources and mulch would change soil chemistry and structure. Adverse impacts to soil resources would be short to long term negligible to minor. Addition of carbon sources would also change the carbon-to-nitrogen ratio and promote water retention. This would have beneficial short- to long-term minor effects on soil resources.

Fire use to control exotic plant species has potential to adversely affect soils by increasing erosion. Controlled burning that would affect all vegetation in the burn area has the highest likelihood of damage to soils. Pile burning, on the ground or in a barrel, and use of propane torches would have very limited impacts to soils as these methods target individual plants. Impacts to soil resources from fire would be adverse negligible to minor.

Chemical Control Alternative 2 would include herbicide application on a greater number of species than Alternative 1, use of an increased number of chemicals, and limited broadcast spraying in park developed areas. Specific impacts of each proposed chemical are identified in Table 4. Of five chemicals proposed for use, only Imazapyr is moderately persistent in soils. The other chemicals are absorbed from soil by plants or broken down by sunlight. Application of these herbicides is proposed primarily as spot treatment with handheld or backpack sprayers; therefore little or no soil contact is anticipated. Chemicals used for broadcast spraying would be selected to have minimal impacts on soil resources.

Cumulative Impacts Past, present, and reasonably foreseeable actions with potential cumulative impacts to soil resources include those described for Alternative 1. Fire activities, trespass cattle grazing, human activities, stock use, ongoing exotic plant management, and construction projects would have overall adverse localized long-term minor impacts. Alternative 2 would result in a negligible contribution to this cumulative effect.

Conclusion

Under Alternative 2 adverse impacts to soil resources, including compaction, erosion from vegetation loss, and damage to biological soil crust would be localized short to long term minor. Beneficial impacts including increased water retention from mulch and vegetative material left onsite would be localized long-term minor effects. Cumulative impacts would be adverse localized long term minor. No impairment of or unacceptable impacts to soil resources would result.

WATER AND AQUATIC RESOURCES

(WETLAND, FLOODPLAIN, RIPARIAN RESOURCES AND WATER QUALITY)

Affected Environment

Water sources in GRCA can be perennial or intermittent, with the source coming from regional and local water-bearing sedimentary rocks that drain Colorado Plateau aquifer systems. Many of these sources have small discharges and become intermittent during part of the year. Many of GRCA's springs, seeps, and riparian areas are among the least altered remaining in the southwest, and are rare and important resources. These areas exhibit unparalleled aesthetic, recreational, educational, and scientific value. They are also the most productive and biologically diverse terrestrial ecosystems, and commonly host 100-500-fold higher species concentrations than surrounding landscapes (Stevens, 1989). Adjacent to water sources, floodplains are subject to recurring floods and are continually changing environments. Wetlands are areas saturated by either ground or surface water and contain water-loving plant species.

Water quality in GRCA is generally considered to be good in most areas (i.e., below state and Federal standards) though localized exceedances in arsenic, selenium, nutrients, radionuclides and seasonal, brief exceedances in turbidity do occur.

Water quality degradation exists in areas of high visitor use. Through limited sampling, giardia (*Giardia lamblia*) has been detected occasionally and fecal coliform / fecal Streptococcus have been identified in all areas sampled (Gerba et al., 1997).

Environmental Consequences

Methodology

Baseline information used to assess impacts to aquatic and water resources is 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 GRCA summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area. Additional aquatic and water resource information sources used for this evaluation are as described above in the affected environment section.

Thresholds of change for intensity of impact on aquatic and water resources are:

Negligible Impacts to the aquatic resources would not result in detectable effects. Chemical, physical, or biological changes to water quality would not be detectable

Minor Adverse Impacts to aquatic resources would result in detectable effects. These changes would be temporary and the resource would return to pre-impact condition within a few days. Chemical, physical, or biological changes to water quality would be detectable and would degrade water quality, but would be within historical baseline or desired water quality conditions.

Beneficial Impacts to aquatic resources would result short-term improvements to these resources. Impacts would result in detectable improvements to water quality.

Moderate Adverse Impacts to aquatic resources would result in detectable effects; these changes would not be permanent, and the resource would rebound to pre-impact conditions after one season. Chemical, physical, or biological changes to water quality would be detectable, but historical baseline or desired water quality conditions would only be temporarily degraded.

Beneficial Impacts would result in improved aquatic resource conditions and detectable improvements to water quality and overall achievement of desired water quality conditions.

Major Adverse Impacts to aquatic resources would result in detectable effects which would likely result in long-term to permanent changes. In extreme cases, species may be extirpated from the park due to loss of habitat. Chemical, physical, and biological changes to water quality would represent a significant degradation from historical baseline water quality conditions. Alternations could be long term.

Beneficial Impacts would result in the restoration of aquatic resources and native species habitat. Significant improvements in water quality would also result.

Duration	<u>Short term</u>	One day or less for water quality; one year or less for aquatic resources
	<u>Long term</u>	Greater than one day for water quality; greater than one year for aquatic resources
Context	<u>Localized</u>	A single seep, spring, wetland, or tributary
	<u>Regional</u>	Aquatic and water resources covering several park seeps, springs, wetlands and tributaries

Alternative 1 – No Action

Direct/Indirect Impacts: Effects from crew foot travel for survey or treatment through wetland and riparian communities and floodplains would have similar effects to those described under Soil, Vegetation and Wildlife resources. Crew activities could also directly affect water quality parameters from creek crossings and soil disturbance. These actions would have an adverse, localized, short-term, negligible impact on aquatic and water resources. Crews would use low impact creek crossing techniques to minimize impacts to soils and aquatic resources.

Beneficial effects following removal of exotic plants by any method include increased water flow and velocity. These beneficial impacts would have a long-term minor to moderate effect on aquatic and water resources.

Prevention Surveys for new populations of exotic plant species on park lands would send crews across the park. This would have impacts as described above. Other prevention actions under Alternative 1 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 water and aquatic resources.

Manual Control Removal of exotic plant species through manual methods would have direct effects as described above. Picks, shovels, pulaskis, and McLeods would be used to uproot entire plants which would have direct effects on soils and vegetation and indirect effects on water quality. These effects include increased turbidity, erosion, vegetation damage from trampling, loss of soil-stabilizing plants, and changes to water quality parameters and availability. Adverse impacts to aquatic and water quality resources would be short to long term localized negligible to minor.

Actions to minimize seed production using pruners, loppers, shears, and knives to remove seed heads would only affect aquatic and water resources from crew foot travel as previously described.

Mechanical Control Removal of exotic plants above the root crown using brush cutters would have a direct and indirect adverse effect to aquatic and water resources in locations where crews would need to cross creeks, wetland, and/or riparian communities to access exotic plants. Above-ground material left onsite could adversely impact water quality parameters such as temperature, nutrient levels, turbidity, dissolved oxygen, and pH. Adverse effects to aquatic and water

resources would be short to long term localized negligible to minor. Crews could mitigate adverse impacts by spreading cut, above-ground exotic plant material throughout the treatment area. Indirect beneficial effects could include increased water flow and velocity following removal of exotic plants and could have a beneficial short-term minor to moderate effect on aquatic and water resources.

Tractors would not be used in riparian and wetland areas; therefore there would be no impacts from these actions on aquatic and water resources.

Cultural Control Native plant seed collection would only affect aquatic and water resources where crews cross creeks, wetland, and/or riparian areas to access plants. Reseeding areas would have beneficial effects through promotion and subsequent establishment of native wetland and riparian vegetation. Application of mulch in disturbed areas would promote soil stabilization and minimize runoff resulting in minor beneficial short to long-term effects on aquatic and water resources.

Chemical Control Foot traffic from herbicide application would have impacts as described above. Manual application of selected herbicides on targeted exotic plants may indirectly affect water quality during spray application through drift, and could leach and runoff after application. Manual application could also indirectly impact native riparian and/or aquatic vegetation. Indirect impacts on aquatic and water resources from plant mortality would include increased erosion potential due to loss of soil-stabilizing plants and increased overland water flow. This erosion and overland water flow could lead to alterations in water quality parameters. Adverse effects on aquatic and water resources from chemical control would be short term for aquatic resources and short to long term for water quality localized negligible to minor.

Cumulative Impacts Cumulative impacts on water resources were determined by combining impacts of Alternative 1 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 wild fires, trespass cattle grazing, stock use, human activities, and ongoing exotic plant management efforts in the park and on adjacent lands. These actions have caused adverse impacts such as loss of soil-stabilizing plants, erosion, increased turbidity, and changes to water quality parameters and availability. Beneficial impacts to water resources have resulted from ongoing exotic plant management efforts particularly removal of tamarisk, Himalaya blackberry and other exotic plants that deplete water resources. Impacts to water resources from these activities are adverse long-term minor. Beneficial impacts from ongoing exotic plant management efforts are localized moderate.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative 1 include prescribed and wild fire, stock use, human activities, and exotic plant management in the park and on adjacent lands. Impacts to water resources from these activities are as described above: adverse long term minor. Beneficial impacts from ongoing exotic plant management efforts are minor to moderate. The Colorado River Management Plan (CRMP) was

also considered in this analysis. The CRMP, a visitor use plan, evaluated potential impacts to water quality and aquatic resources. Use along the Colorado River and its tributaries has impacts to water resources including changes to water quality, increased turbidity, and erosion. Adverse impacts are adverse long term minor. Beneficial impacts from the CRMP are long term moderate.

Foreseeable future projects include fire activities and Backcountry Management Plan (BMP). Adverse impacts to water quality from fire activities including increased turbidity would be negligible as most fire activity is on the rim and away from water sources. Beneficial impacts would result from BMP analysis of backcountry visitor use; the plan would specifically consider impacts to water resources. These beneficial impacts would be long term moderate.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in beneficial long-term minor impacts on aquatic and water resources. Alternative 1 would result in a minor contribution to this cumulative effect.

Conclusion

Continuation of current exotic plant management under Alternative 1 would result in localized short to long term minor adverse effects to aquatic and water resources from increased turbidity, erosion, soil-stabilizing plant loss, and changes to water quality parameters. Beneficial effects from increased water flow and velocity following removal of exotic plants would be localized short to long term moderate. Cumulative impacts would be adverse short to long term minor. No impairment of or unacceptable impacts to water resources would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: Effects from crew foot travel for survey or treatment through wetland and riparian communities and floodplains would have similar effects to those described under Soil, Vegetation and Wildlife resources. Crew activities could also directly affect water quality parameters from creek crossings and soil disturbance. These actions would have an adverse localized short to long term negligible to minor impact on aquatic and water resources. Crews would use low impact creek crossing techniques to minimize impacts to vegetation, soils, and aquatic organisms.

Prevention More in-depth and extensive annual surveys could increase potential for aquatic and water resources impacts over Alternative 1. Similar to Alternative 1, impacts to aquatic and water resources would include direct effects from survey crew foot travel as described above. Other prevention actions under Alternative 2 include preparation of detailed work plans, development of a long-term monitoring program, preparation of intensive public outreach, expanded collaboration with adjacent land managers, and keeping current with literature on exotic plant management results from other regional land managers. These actions would have no measurable impact on aquatic and water resources.

Manual Control Alternative 2 proposes the same manual control currently used, therefore effects to aquatic and water resources would be similar to Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in developed areas.

GRCA managers would not use mowers in wetland and riparian areas. Use of chainsaws would have similar effects to aquatic and water resources and would require similar mitigation measures as Alternative 1.

Cultural Methods Alternative 2 includes addition of carbon sources, expanded mulch use, and an increase in collection and storage of native seed. Only addition of carbon sources could have direct effects on aquatic and water resources differing from those impacts described under Alternative 1. Addition of carbon sources could change water quality parameters, in particular nutrient levels and pH. Crew foot travel impacts would be similar to those described above. Adverse impacts to aquatic and water resources would be localized short to long term negligible to minor.

Other actions under Alternative 2 include planning actions such as closer coordination with GRCA's fire program, prioritization of ecological restoration activities, selection of appropriate native seed for future restoration seed collection, and finalization of Weed Seed Free Hay and Forage Standard Operating Procedure. These actions would have no direct impact on aquatic and water resources.

Fire use to control exotic plant species has potential to adversely affect aquatic and water resources by increasing erosion and changing water quality parameters if ash or burned materials get into a water source. Controlled burning that would affect all vegetation in the burn area has highest likelihood of contamination and erosion. Pile burning, on the ground or in a barrel, and use of propane torches would have less impacts to water resources since these methods target individual plants. Impacts to water resources from fire would be adverse negligible to minor. Mitigation measures to minimize the chance for burned materials to get into water would be employed.

Chemical Control Alternative 2 would include herbicide application on a greater number of species than Alternative 1 and inclusion of limited broadcast spraying. In addition to impacts described for Alternative 1, potential impacts from broadcast spraying and project-based on aesthetic objectives would increase adverse impacts to water and aquatic resources. However, if potential for water contamination exists, herbicide formulated for aquatic use would be employed and all mitigation measured would be followed; therefore similar impacts described for Alternative 1 would result.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be similar to Alternative 1. Cumulative impacts to aquatic and water resources would be beneficial long term minor. Alternative 2 would result in a minor contribution to this cumulative effect.

Conclusion

Under Alternative 2 adverse effects to aquatic and water resources from increased turbidity, erosion, soil-stabilizing plant loss, and changes to water quality parameters would be increased from Alternative 1 due to addition of fire treatments, limited broadcast spraying, and additional herbicide use. Adverse impacts would be localized short to long term minor. Beneficial effects from increased water flow and velocity following removal of exotic plants would be

localized short to long term moderate. Cumulative impacts would be adverse localized to regional short to long term minor. No impairment of or unacceptable impacts to water resources would result.

AIR QUALITY

Affected Environment

Clean, clear air is essential to preserve GRCA resources and for visitors to appreciate the canyon's most valued characteristics — the visual grandeur of its scenery, scale, form, colors, and wilderness qualities. GRCA is a Federally mandated Class I area under the Clean Air Act, a status requiring the most stringent protection against air pollution increases and further degradation of air quality-related values (AQRVs), as well as restoration of natural visibility conditions.

Park air quality is generally good with pollution levels below those established by the Environmental Protection Agency (EPA) to protect human health and welfare. However, pollution levels are high enough to create visibility-reducing haze. Most of this pollution originates far outside park boundaries and arrives as a well-mixed regional haze as opposed to distinct plumes. Exotic plant management, including fire use and resultant smoke, could affect air quality.

Relatively little air pollution is generated by activities in GRCA, excepting wildland fires. However, since these pollutants are released in the park, reducing smoke can still help improve park air quality. Efforts to reduce pollution set a good example for over four million annual park visitors, especially when combined with interpretive messages. Several park programs (including mass transit, conversion of outboard motors from 2- to 4-stroke engines, efficient facility design, etc.) benefit air quality. The park's fire management program complies fully with Emission Reduction and Smoke Management Techniques prescribed by the state of Arizona (Arizona Administrative Code R18-2-1509 & 1510), and the park actively monitors behavior to reduce its impacts on the park and surrounding areas. Park fire management staff will obtain permits for broadcast and pile burning from the Arizona Department of Environmental Quality.

Environmental Consequences

Methodology

Baseline information used to assess impacts to air quality 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 within the National Park Service and other agencies, and professional judgment. Detailed information on natural and cultural resources in GRCA summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area. Additional sources of information on air quality used as a basis for this evaluation are as described above in the affected environment section.

Thresholds of change for intensity of impact on air quality are defined as:

Negligible No visibility impacts (exhaust plumes, exhaust odors, haze) are produced, or emission levels would be less than 50 tons per year for each pollutant

Minor	Visibility and odor impacts are of very short duration and limited aerial extent, and emission levels would be less than 100 tons per year for each pollutant
Moderate	Visibility impacts from cumulative emissions would be likely (based on past visual observations), or emission levels would be greater than 100 tons per year for any pollutant
Major	Visibility impacts from cumulative emissions would be likely (based on modeling or monitoring), or emission levels would be equal to or greater than 250 tons per year for any pollutant

Duration Air quality is in a constant state of flux, responding to production of air pollutants and the atmosphere's ability to disperse, dilute, or remove those pollutants. Local impacts, like smoke from a fire treatment, generally dissipate quickly. Local haze and pollutant concentrations are very responsive to pollution production, and pollutants are generally removed from the canyon over a period of hours (in summer) to a few days (during winter inversion episodes)

Timing Fire treatments would occur during daylight hours when dispersion is generally greater. Time of day has a bearing on effects to air quality since canyon winds often blow upstream during day and downstream at night. Seasonal conditions such as winter stagnation periods would tend to reduce dispersion potential resulting in potentially greater impacts. Winter cold fronts and high spring winds tend to disperse river-related pollutants rapidly, removing them from the canyon in a few days at most

Context All impacts would be localized due to size of treatment areas

Alternative 1 – No Action

Direct/Indirect Impacts Dust generated by exotic plant management activities would directly impact GRCA air quality. Vehicle use could also impact air quality.

Prevention Activities related to prevention include education and outreach, exotic plant species surveys, and inclusion of exotic plants and measures to minimize impacts in planning documents. Generally these activities would have no effect on air quality. However, vehicles may be used to access survey areas which could have some negligible impacts on air quality.

Manual Control Removal of exotic plant species through manual methods includes the use of picks, shovels, pulaskis, and McLeods to uproot entire plants, and use of pruners, loppers, shears, and knives to remove seed heads. Impacts to air quality from these activities could include dust from ground disturbance and vehicles use to access work sites. However, Impacts are expected to be negligible.

Mechanical Control Use of brush cutters to remove exotic plants above the root crown, tractors to pre-treat for exotics on construction sites, and vehicles use to access work sites could have a direct impact on air quality. However, these adverse impacts to air quality are expected to be negligible short term localized.

Cultural Control Native plant seed collection, reseeding, mulch application, and native plant species replanting would have negligible beneficial impacts on air

quality due to mitigation of potential dust from bare, disturbed areas. Vehicle use to access worksites could have adverse negligible short-term localized impacts to air quality.

Chemical Control Manual application of selected herbicides on targeted exotic plants would have no impact on air quality. Again, vehicles use to access work sites could have adverse negligible short-term localized impacts on air quality.

Cumulative Impacts Cumulative impacts on air quality were determined by combining Alternative 1 impacts with other past, present, and reasonably foreseeable future actions having impacts in priority areas for exotic plant management described at this chapter's beginning (i.e., trails, roads, entrance stations, heavily trafficked areas).

Past activities considered in this analysis include fire management actions including prescribed and wild fires, transportation and vehicle use, and construction projects. These actions have caused adverse impacts including increased pollutants, limited visibility, and human health impacts from smoke. These activities are ongoing and considered in this analysis as in-progress and future actions as well as past activities. Impacts to air quality from these activities in the past, present and future are adverse short term localized minor.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and the Rim Visitor Transportation Plan (SRVTP). Vehicles and heavy equipment are used for construction in these projects which have local short-term impacts on air quality. Dust would also be generated in ground-disturbing components of these projects. These actions would have adverse short-term local minor impacts on air quality. In the SRVTP, the park made decisions to promote mass transportation through increased shuttle service which would limit vehicle emissions inside the park. The South Rim Road Improvements project was initiated in part to decrease wait times and thus decrease idling and vehicle emissions at the entrance station. Beneficial impacts from these projects would be localized minor.

Foreseeable future projects include Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. Similar to projects described above, construction equipment and ground disturbance would create vehicle exhaust and dust generation. Impacts from these projects would be long term minor adverse.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse localized short-term minor effects on air quality. Alternative 1 would have a negligible contribution to this cumulative adverse effect.

Conclusion

Under Alternative 1, continuation of current exotic plant management, impacts to air quality resulting from vehicle use and dust generated from exotic plant management activities would be adverse localized short term negligible. Cumulative impacts would be adverse localized short term minor. No impairment of or unacceptable impacts to air quality would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: Smoke and dust generated by exotic plant management techniques would directly impact air quality in GRCA. Vehicle use could also impact air quality.

Prevention Impacts would be the same as those described in Alternative 1.

Manual Control Impacts would be the same as those described in Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in developed areas. These gas-powered tools would have some impact on air quality; however, use is expected to be limited and would have negligible short-term localized adverse impacts to air quality.

Cultural methods In addition to actions and subsequent impacts described under Alternative 1, fire use is proposed to treat exotic plant species. All fire treatments would be coordinated with the GRCA fire crew to ensure compliance with state permits. Fire use, specifically pile burning and controlled burning, would have adverse impacts on air quality. Impacts to air quality would depend on size of pile or area burned and location. Fire is not proposed for use on a large scale due to potential adverse impacts to resources, including air quality. Fire would be used when it poses the least threat to resources, which is one of the key principles of IPM. Pile and controlled burning would have adverse impacts to air quality; impacts would be minor localized short term. Use of propane torches for spot burning would have negligible impacts on air quality because plants would not actually ignite. Vehicles used for fire activities could also have impacts on air quality; however, impacts are expected to be negligible.

Chemical Control Impacts would be the same as those described in Alternative 1.

Cumulative Impacts Past, present, and reasonably foreseeable actions with potential to have cumulative impacts to vegetation include those described for Alternative 1. Fire management activities including prescribed and wild fires, transportation and vehicle use, and construction projects would have overall adverse localized short term minor impacts. Alternative 2 would result in a negligible contribution to this cumulative effect, although it would be more of a contribution than Alternative 1 which does not include limited use of fire to treat exotic species.

Conclusion

Under Alternative 2, impacts to air quality resulting from vehicle use, dust generated from exotic plant management activities, and fire use would be adverse localized short term minor. Cumulative impacts would be minor adverse localized short term. No impairment of or unacceptable impacts to air quality would result.

CULTURAL 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.

GRCA cultural resources reflect the region's long history of human presence, and reveal the changing human relationship with landscape. Archeologists generally divide nearly 12,000 years of human history in the American Southwest into five broad periods – Paleoindian, Archaic, Formative, Late prehistoric and Historic – all of which are represented in Grand Canyon (Coder, 2000). This history is represented by archaeological sites, historic structures, cultural landscapes, and ethnographic resources.

ARCHAEOLOGICAL AND HISTORIC RESOURCES

Affected Environment

Archaeological Resources

Only a small portion of the park has been formally surveyed for archaeological sites, but nearly 4,000 sites have been recorded (National Park Service, 2008a). Archeologists estimate there may be as many as 60,000 sites in the park although less than six percent have been formally recorded. Park archaeological sites appear in all ecological zones and vegetation types, but are much denser in rim pinyon-juniper woodlands. No one ecological zone appears favored by humans during the entire human occupation of the canyon (National Park Service, 1995).

Only two of over 4,000 identified individual properties in Grand Canyon are listed on the National Register of Historic Places – the Tusayan Ruin archeological site on East Rim and the Little Jug site west of Toroweap Valley on North Rim. Although only these two sites are listed as individual properties, all previously recorded and newly discovered GRCA archeological sites have been determined eligible for listing by virtue of a 1984 multiple properties nomination (National Park Service, 1984). These archeological sites are considered important at local and regional levels, and contribute to the overall understanding of Grand Canyon human history.

Archaeological sites can be broadly categorized as prehistoric or historic, based on age. Prehistoric sites can be further categorized as undated prehistoric, Paleoindian (10,000-12,000 years old), Archaic (2,500-10,000 years old), Formative (700-2,500 years old), and late Prehistoric (450-700 years old). Historic sites can be categorized as Historic Native American and Historic Euro-American. The distribution of known archeological sites is:

South Rim –South Rim includes 70,360 acres of which 19,148 (27%) have been surveyed for archaeological sites. A total of 1,135 sites have been identified, including 33 Archaic, 361 Formative, 4 Proto-Historic, 258 Historic, 211 multi-

component, and 268 sites of unknown temporal affiliation. Overall site density on South Rim is one site per 16.9 acres.

North Rim –North Rim includes 189,202 acres of which 38,522 acres (20%) have been surveyed for archaeological sites. A total of 1,040 sites have been identified, including 26 Archaic, 591 Formative, 4 Proto-Historic, 91 Historic, 85 multi-component, and 243 sites of unknown temporal affiliation. Overall site density on North Rim is one site per 37 acres.

Inner Canyon –Inner Canyon includes 933,060 acres of which 27,761 acres (3%) have been surveyed for archaeological sites. A total of 1,471 sites have been identified, including one Paleo-Indian, 25 Archaic, 565 Formative, 24 Proto-Historic, 115 Historic, 227 multi-component, and 541 sites of unknown temporal affiliation. Inner Canyon site density is one site per 18.2 acres.

Historic Resources

The vast majority of historic buildings and structures are concentrated in GRCA's historic districts. In addition, 336 buildings are listed on the NRHP, some 40 buildings are classified as National Register-eligible. Eight hundred and eighty structures are listed on the park's List of Classified Structures. Buildings listed on the NRHP are primarily associated with tourism, park administration and operations, and mining enterprises.

On South Rim, Grand Canyon Village National Historic Landmark Historic District has the largest and most diverse assemblage of park architecture in the national park system. The District consists of 257 buildings, including four designated National Historic Landmarks—El Tovar Hotel, park operations building, Grand Canyon powerhouse, and Grand Canyon railroad station. El Tovar Hotel opened in 1905. The railroad station was completed in 1910. The powerhouse was built by the Santa Fe Railway to supply power to the railroad and nearby facilities. The park operations building was completed in 1929 and remodeled in 1938.

The Mary Jane Colter Historic District consists of four widely separated buildings, each designed by Mary Jane Colter. These are Hermits Rest, Hopi House, Desert View Watchtower, and Lookout Studio. Hermits Rest opened in 1914, Hopi House in 1905, Desert View Watchtower in 1932, Lookout Studio in 1914. Hopi House and Lookout Studio are also contributing properties to Grand Canyon Village National Historic Landmark District.

Tusayan Ruins includes a significant ancestral Puebloan site, and an archaeological museum built in 1932. The Orphan Mine Historic District is located between South Rim's Maricopa Point and Powell Memorial. The District includes resources from both turn-of-the-century copper mining operations and 1950s and 1960s uranium production. Between 1953 and 1969, Orphan Mine was one of the leading producers of high-grade uranium on the Colorado Plateau (National Park Service, 1995). This District is not listed on the NRHP, but has been determined eligible.

On North Rim, Grand Canyon Lodge Historic District consists of the main lodge building, 23 deluxe cabins, and 91 standard cabins located on Bright Angel Point. Grand Canyon North Rim Headquarters Historic District contains two structure

groupings that include residences, a garage, a ranger station, maintenance buildings, a resource management office, and barn. Buildings and structures date between the late 1920s and early 1930s. Grand Canyon Inn (North Rim Inn) and Campground Historic District includes a main building, 30 frame and 10 log cabins. An NPS campground was constructed nearby. North Rim Inn was built in 1929. Some cabins were built in 1929, others in 1934.

Other National Register properties include the Cross Canyon Corridor Historic District and the Trans-Canyon Telephone Line Historic District. The Cross Canyon Corridor includes 44 buildings and Bright Angel, South Kaibab, North Kaibab and connecting River Trails. The District's principal structures are four trailside shelters and the Phantom Ranch complex. Five of the original Phantom Ranch stone buildings were designed by Mary Jane Colter and built in 1922. The Telephone Line crosses approximately 18 canyon miles from South Rim to Roaring Springs. It consists of metal poles with copper-weld wire installed in 1935 and modified in 1938–1939.

Environmental Consequences

Methodology

Baseline information used to assess impacts to archaeological and historic resources is 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 within the National Park Service and other agencies, and professional judgment. Detailed information on natural and cultural resources in GRCA that is summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area. Additional sources of information on archaeological and historic resources used as a basis for evaluation are as described above in the affected environment section.

Thresholds of change for intensity of impact on archaeological and historic resources are defined as:

- Negligible** Impact 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”
- Minor** Adverse Disturbance of an archeological or historic resource(s) results in little, if any, loss of integrity. For purposes of Section 106, determination of effect would be “no adverse effect”
 - Beneficial Maintenance and preservation of an archeological or historic resource(s). For purposes of Section 106, determination of effect would be “no adverse effect”
- Moderate** Adverse Disturbance of an archeological or historic resource(s) results in loss of integrity and detection of artifact depletion or displacement (based on baseline information), and effects to elements having research potential or increased instability of site landscape. For purposes of Section 106, determination of effect would be “adverse effect.” A memorandum of agreement (MOA) 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 Stabilization of an archeological or historic resource(s). For purposes of Section 106, determination of effect would be “no adverse effect”

Major **Adverse** Disturbance of an archeological or historic resource(s) results in loss of overall integrity and changes to character-defining, cultural or structural elements to the extent the property would no longer be eligible for inclusion in the National Register. For purposes of Section 106, the 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 or execute a MOA in accordance with 36 CFR 800.6(b)

Beneficial Active intervention is undertaken to preserve the site. 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 resource 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)

Timing Archaeological site visibility may be more pronounced during spring growing season, as trampling young vegetation may lead to increased trailing and soil compaction

Alternative 1 – No Action

Direct/Indirect Impacts All methods that include use of crews for survey or treatment may have direct effects on archaeological and historic resources from ground disturbance and resultant trampling, trail creation, and erosion.

Prevention Prevention actions under Alternative 1 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 archaeological or historic resources.

Manual Control 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 increased erosion from soil-stabilizing plant loss. Mitigation measures including consultation and

communication with GRCA Cultural Resource staff to minimize impacts to all cultural resources. Annual work plans prepared by GRCA Vegetation Program staff would be reviewed by Cultural Resource staff to identify areas of concern. If an adverse effect would occur due to manual control proposed, 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, exotic plant treatment would not occur. Therefore, adverse impacts to archaeological and historic resources would be short to long term negligible to minor.

Mechanical Control 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.

Cultural Control 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 discussion, cultural control would result in negligible to minor effects on archaeological and historic resources.

Chemical Control 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. Because of 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. Therefore, chemical control would have a negligible to minor impact on archaeological and historic resources.

Cumulative Impacts Cumulative impacts on archaeological and historic resources were determined by combining impacts of Alternative 1 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 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 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. Ground disturbance in several 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.

Foreseeable future projects include Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. 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 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse short to long-term minor effects on archaeological and historic resources. Alternative 1 would have a negligible contribution to this cumulative adverse effect.

Conclusion

Under Alternative 1 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 minor. Cumulative impacts would be adverse short to long term moderate. No impairment of or unacceptable impacts to archaeological and historic resources would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: As described for Alternative 1, use of crews for survey or treatment may have direct effects on archaeological or historic resources from foot travel. This would have a short to long-term negligible adverse impact on archaeological or historic resources.

Prevention More in-depth and extensive annual surveys could slightly increase potential for ground disturbance over Alternative 1. No additional prevention actions would impact archaeological or historic resources.

Manual Control Alternative 2 proposes the same type of manual control currently used, therefore effects to archaeological and historic resources and mitigation measures would be similar to Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in the developed area. However, effects to archaeological and historic resources and mitigation measures would be similar to Alternative 1.

Cultural methods Alternative 2 includes addition of carbon sources and expanded use of mulch and use of barriers, which would not have direct effects on archaeological or historic resources. Addition of carbon sources and mulch would promote water retention and minimize erosion. Therefore, negligible beneficial impacts to archaeological and historic resources would result.

Alternative 2 would introduce limited fire use to treat exotic plants. 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 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. Fire would have negligible to moderate adverse long-term impacts on archeological and historic resources if mitigation measures (developed in the Fire Management Plan to protect these resources) were followed and areas were surveyed prior to burning. Additionally, any fire treatments would be coordinated with GRCA's fire program to ensure for safety and compliance.

Chemical Control Alternative 2 would include herbicide application on a greater number of species than Alternative 1 and would also include limited broadcast spraying, but effects on archaeological and historic resources and mitigation measures would be similar to Alternative 1.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be similar to Alternative 1. Impacts would have adverse short to long-term moderate effects on archaeological and historic resources. Alternative 2 would have a negligible contribution to this cumulative effect.

106 Summary A programmatic agreement (PA) was completed for Grand Canyon's 1995 GMP. This PA is the foundation section 106 documentation for the Exotic 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.

Conclusion

Under Alternative 2 adverse impacts to archaeological and historic resources from increased erosion and soil compaction would be localized short to long term moderate. Beneficial impacts including soil protection and stabilization from vegetative material left onsite would be short to long term minor. Cumulative

impacts would be adverse short to long term moderate. No impairment of or unacceptable impacts to archaeological or historic resources would result.

CULTURAL LANDSCAPES

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. Historic districts mentioned above are examples of human manipulation and adaptation of Grand Canyon. Cultural Landscape Inventories have been commissioned by GRCA to assess the character of the natural world that includes and encompasses five of these historic districts. These inventories are Desert View (John Milner Associates/OCULUS, 2003), Grand Canyon Village (John Milner Associates Inc., 2004a), Indian Garden (John Milner Associates Inc., 2005), North Rim Bright Angel Peninsula Developed Area (John Milner Associates Inc., 2003), and West Rim Drive (John Milner Associates Inc., 2004b). Inventories are in various stages of completion. 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 exotic 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 described above would be used in management of vegetation within historic districts and cultural landscapes throughout the park.

Environmental Consequences

Methodology

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 GRCA summarized in the 1995 GMP EIS 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.

Thresholds of change for intensity of impact on cultural landscapes are defined as:

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	<u>Short term</u>	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)
	<u>Long term</u>	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)

Alternative 1 – No Action

Direct/Indirect Impacts All methods that include exotic plant removal could have direct effects on cultural landscapes due to an alteration of one 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. Adverse impacts would be negligible short to long term. Beneficial impacts would be minor long term.

Prevention Prevention actions under Alternative 1 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 cultural landscapes.

Manual Control Exotic plant species removal using manual methods could have direct effects on cultural landscapes through actual removal of plants as described above.

Mechanical Control Exotic plant species removal using mechanical methods could have direct effects on cultural landscapes through actual removal of plants as described above.

Cultural Control 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.

Chemical Control Manual application of selected herbicides on targeted individual plants has potential to directly affect cultural landscapes through treatment and subsequent elimination of exotic plants as described above.

Cumulative Impacts Cumulative impacts on cultural landscapes were determined by combining impacts of Alternative 1 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 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 park 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 long term minor.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. Ground disturbance in several 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 cultural landscapes are considered in all construction projects and mitigation measures developed to minimize impacts to these resources.

Foreseeable future projects include Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. 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 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse short-term minor effects on cultural landscapes. Alternative 1 would have a negligible contribution to this cumulative adverse effect.

Conclusion

Under Alternative 1 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 nonnative plants not key features in the landscape would be minor long term. Cumulative impacts would be adverse short to long term minor to moderate. No impairment of or unacceptable impacts to cultural landscapes would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: As described for Alternative 1, the removal of exotic plant species could have adverse and beneficial effects on cultural landscapes. The impacts would be the same as those described in Alternative 1, adverse impacts would be short to long-term and negligible to minor, and beneficial impacts would be negligible to minor and long-term.

Prevention More in-depth and extensive annual surveys could slightly increase potential for ground disturbance over Alternative 1. No additional prevention actions would impact cultural landscapes.

Manual Control Alternative 2 proposes the same type of manual control currently used; therefore, effects to cultural landscapes and mitigation measures would be similar to Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in developed areas.

However, effects to cultural landscapes and mitigation measures would be similar to Alternative 1.

Cultural methods Alternative 2 includes addition of carbon sources and expanded mulch use and use of barriers, which would not have direct effects on cultural landscapes.

Alternative 2 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. Fire would have negligible to moderate adverse long-term impacts on cultural landscapes if mitigation measures were followed.

Chemical Control Alternative 2 would include herbicide application on a greater number of species than Alternative 1 and would also include limited broadcast spraying, but effects on cultural landscapes and mitigations would be similar to Alternative 1.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be similar to impacts described for Alternative 1. Cumulative impacts to cultural landscapes would be adverse short to long term minor. Alternative 2 would result in a minor contribution to this cumulative effect.

106 Summary A programmatic agreement was completed for Grand Canyon's 1995 GMP. This PA is the foundation 106 documentation for the Exotic 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 2 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 would be adverse short to long term minor. No impairment of or unacceptable impacts to cultural landscapes would result.

ETHNOGRAPHIC RESOURCES

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)]. GRCA lands are traditionally affiliated with the following tribes: Havasupai, Hopi, Hualapai, Kaibab-Paiute, Navajo Nation, Paiute Indians Utah, Pueblo of Zuni, San Juan Southern Paiutes, Las Vegas and Moapa Bands of Paiute, and the Yavapai Apache Nation (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 ethnographic research (Ferguson, 1998; Hart, 1995; Hualapai Cultural Resources Division of Hualapai Wildlife Management Department, 1993; Roberts et al., 1995; Stevens, 1996; Stoffle et al., 1996). 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. As a result of the Glen Canyon Dam Final Environmental Impact Statement, TCPs were identified along the Colorado River corridor by various culturally affiliated tribes (Bureau of Reclamation, 1995). 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 available to the park.

Environmental Consequences

Methodology

Baseline information used to assess impacts to ethnographic resources 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 GRCA summarized in the 1995 GMP EIS 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.

Thresholds of change for intensity of impact on ethnographic resources are defined as:

- 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

Alternative 1 – No Action

Direct/Indirect Impacts 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 1 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 Control Exotic plant species removal using manual methods could have direct effects on ethnographic 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 increased erosion from soil-stabilizing plant loss. Adverse impacts to ethnographic resources would be short to long term negligible to moderate. Mitigation measures would be implemented to bring moderate impacts to negligible intensity. These measures would include consultation and communication with GRCA Cultural Resources staff. Annual work plans prepared by Vegetation Program staff would be reviewed by Cultural Resources staff to identify areas of concern. If an adverse effect would occur due to manual 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, exotic plant treatment would not occur. A list of

proposed treatment areas and treatment types would be sent to each affiliated tribe for review.

Mechanical Control 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. Adverse effects to ethnographic resources would be short to long term negligible to minor. 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.

Cultural Control 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.

Chemical Control Manual 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 negligible to minor.

Cumulative Impacts Cumulative impacts on ethnographic resources were determined by combining impacts of Alternative 1 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 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 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. Ground disturbance in several of these projects has prompted mitigation of archeological sites through excavation which is an adverse effect on these resources. Impacts are adverse long term local moderate. 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 Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. 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 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse short-term minor effects on ethnographic resources. Alternative 1 would have a negligible contribution to this cumulative adverse effect.

Conclusion

Under Alternative 1, 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 adverse short to long term minor. No impairment of or unacceptable impacts to ethnographic resources would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: As described for Alternative 1, 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 Alternative 1. No additional prevention actions would impact ethnographic resources.

Manual Control Alternative 2 proposes the same type of manual control currently used, therefore effects to ethnographic resources and mitigation measures would be similar to Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in developed areas. However, effects to ethnographic resources and mitigation measures would be similar to Alternative 1.

Cultural methods Alternative 2 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 2 would introduce limited use of fire to treat exotic plants. Fire has potential to directly impact ethnographic resources. Coordination with cultural resource staff 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.

Chemical Control Alternative 2 would include herbicide application on a greater number of species than Alternative 1 and would also include limited broadcast spraying, but effects on ethnographic resources and mitigations would be similar to Alternative 1.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be similar to those described for Alternative 1 and would result in an adverse short to long-term minor effect on ethnographic resources. Alternative 2 would result in a negligible contribution to this cumulative effect.

106 Summary A PA was completed for Grand Canyon's 1995 GMP. This PA is the foundation 106 documentation the Exotic 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 2 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 adverse short to long term minor. No impairment of or unacceptable impacts to ethnographic resources would result.

SOCIAL RESOURCES

VISITOR EXPERIENCE

Affected Environment

Visitor experience, as it relates to exotic plant management, includes access, visual quality, noise, encounter levels, and opportunities for solitude. Other aspects of visitor experience, such as recreation opportunities and orientation would generally be affected by the actions proposed.

Grand Canyon 2007 visitation was over 4.5 million (4,515,733) people (National Park Service, 2008d). Canyon recreation activities include hiking, backpacking, camping, viewing (nature, wildlife, cultural sites, canyon vistas, and astronomy), white-water rafting, mule rides (limited to three trails), photography, painting, lodging at Phantom Ranch, and enjoying backcountry wilderness settings or front country social settings.

Development Zone

In the park's developed areas (South Rim, North Rim, Tuweep, and Cross-Canyon Corridor), visitation is highest. The majority of park visitors spend time in South Rim's Grand Canyon Village during their stay. Grand Canyon Village presents a fast-paced, "urban" experience complete with many amenities found in town settings such as lodging, restaurants, a bank, and paved walkways. Approximately 10 percent of Grand Canyon visitation occurs at North Rim. North Rim visitors encounter less traffic congestion and parking problems than South Rim visitors, and North Rim provides a more leisurely pace and a more traditional park experience than South Rim.

Corridor trails provide the main visitor access to destinations below the rim including the Colorado River, and connect North and South Rim. Corridor trails include Bright Angel, South Kaibab, North Kaibab Trails, and the section of Tonto

Trail between Bright Angel and South Kaibab Trails. Day hikers, backpackers, and mule riders make these routes the most heavily used of Inner Canyon trails.

Natural Zone

In 2007, there were 35,596 overnight backcountry users (not including day hikers, river users, or people staying at Phantom Ranch Lodge). Approximately 44% of backcountry use occurred outside the developed Cross-Canyon Corridor. In 2007, there were 24,735 recreational participants on river trips between Lees Ferry and Diamond Creek (National Park Service, 2008b). Combined, visitor use outside the Cross Canyon Corridor was approximately 40,450 river and backcountry users, making up about 9% of park visitors.

Grand Canyon's backcountry is comprised of four management zones: Cross-Canyon Corridor, Threshold, Primitive, and Wild. These zones are based on criteria including use type and amount, opportunity for solitude, current resource conditions, and management uses. As described above, the Corridor is a developed inner-canyon area with campgrounds and facilities and is not included in proposed wilderness. However, corridor trails act as threshold to wilderness areas and are adjacent to proposed wilderness.

The other three management zones (Threshold, Primitive, and Wild) lie within proposed wilderness. GRCA managers seek to provide outstanding opportunities for solitude or a primitive and unconfined type of recreation, and opportunity for connection with undisturbed nature in these zones. Visitor use limits are in place for all backcountry overnight use to help provide for these opportunities. Backcountry use permits are issued up to four months in advance and on a first-come first-served basis.

The threshold management zone, which includes Hermit Creek and Clear Creek, generally has designated campsites to concentrate use and allows a maximum of 56 people per use area per night. The primitive management zone includes Boucher and Nankoweap and limits use to 40 people per use area per night. Most primitive areas have at-large camping as opposed to designated campsites and are accessed by primitive trails and routes. The wild management zone includes Cheyava and Phantom Creek which are more remote, accessed primarily by routes, and allow up to 16 people per use area per night.

Environmental Consequences

Methodology

Baseline information used to assess impacts to visitor experience 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 GRCA summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area. Additional sources of information on visitor experience used as a basis for this evaluation are as described above in the affected environment section.

Thresholds of change for intensity of impact on visitor experience are defined as:

- Negligible** A majority of all visitors would not notice any effects of changes in visitor use patterns and levels and the effects would not change their experience of park resources and values. Mitigation would not be necessary
- Minor** Visitors might be able to detect the effects of changes in visitor use patterns and levels, and the changes might have a slight but detectable effect on their experience of park resources and values. If mitigation was needed to offset adverse effects to visitor experience, it would be relatively simple to implement and would likely be successful
- Moderate** Visitors would be aware of the effects of changes in visitor use patterns and levels, as well as the effects on their experience of park resources and values. Some visitors might feel displaced and need to pursue their desired visitor experience in another area of the park or outside the park. Mitigation measures would probably be necessary to offset adverse effects and would likely be successful.
- Major** A majority of visitors would be highly aware of the effects associated with changes in visitor use patterns and levels, as well as the effects on their experience of park resources and values. Many visitors would feel displaced and need to pursue their desired visitor experience in other areas of the park or outside the park. 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 An effect transitory or that largely disappears over a period of hours or days

Long term An effect lasts months or years

Alternative 1 – No Action

Direct/Indirect Impacts All methods that include use of crews for survey or treatment may have direct effects on visitor experience from overall presence of crews and resultant impacts from foot travel discussed in previous sections including trampling, creation of trails, and erosion.

Presence of crews for treatment of exotic plants through manual, mechanical, cultural, and chemical methods would result in different levels of impact in the natural zone compared to the development zone. Greater, adverse impacts to visitor experience could result in the natural zone where there is generally less human activity. Backcountry and river users could also come across work of crews where plants have been manipulated (i.e., cut stumps, dead plant material). To minimize impacts, vegetation crews would adhere to backcountry regulations, post site bulletins at trail heads and send to backcountry users as appropriate, and use techniques to disguise cut stumps and excess plant material to the extent possible. Impacts to visitor experience in the development zone would be less than those in the natural zone due to increased number of people and human activities in the development zone.

Removal and subsequent restoration of native plant communities would have an overall beneficial impact on visitor experience. Management of exotic plants helps contribute to one of the main NPS goals, “to manage park resources in such a manner by such means as will leave them unimpaired for the enjoyment of future generations” (National Park Service, 2006). Therefore, both current and future visitor experience would be impacted.

Prevention Prevention actions under Alternative 1 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 a minor beneficial long-term impact on visitor experience.

Manual Control Removal of exotic plant species using manual methods could have direct effects on visitor experience from presence of crews and effects from crew foot travel as described above. Adverse impacts to visitor experience would be short term negligible to minor.

Mechanical Control Direct effects to visitor experience from use of brush cutters in the development zone to remove exotic plants above the root crown may include noise and presence of crews. Adverse effects to visitor experience would be short term negligible to minor. Tractor use on pre-disturbed construction sites to remove exotic plant species prior to site restoration would result in short-term minor adverse impacts on visitor experience.

Cultural Control Crews would collect and spread seed, apply mulch, and plant native plants as cultural control. Presence of crews and related foot traffic would have some of the impacts described above. This type of control does not include specific treatment of exotics (i.e., cutting or digging plants, applying herbicide). Therefore, cultural control would result in negligible effects on visitor experience.

Chemical Control Manual application of selected herbicides on targeted individual plants has potential to directly affect visitor experience. Presence of crew and foot traffic from crews applying herbicides would have impacts as described above. Areas being treated with herbicide could be closed temporarily to visitor use and therefore would adversely affect visitor experience. Other impacts related to public health and safety are discussed later in this chapter. Therefore, adverse impacts on visitor experience from chemical control would be short-term negligible to minor.

Cumulative Impact Cumulative impacts on visitor experience were determined by combining Alternative 1 impacts with other past, present, and reasonably foreseeable future actions having impacts in priority areas for exotic plant management described at this chapter’s beginning (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 use, aircraft overflights, and construction projects. These actions have caused adverse impacts including increased noise, decreased visibility from smoke, traffic delays from construction, and overall aesthetics. Beneficial impacts have also resulted from these activities, including improved access and quality of experiences throughout the park.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, Colorado River Management Plan, and South Rim Visitor Transportation Plan. These projects all have a visitor experience component and are intended to have long-term beneficial impacts. Some short-term adverse impacts are expected during construction.

Foreseeable future projects include Greenway Trail – Phase V, and Bright Angel Trailhead. Again, these projects are designed to benefit visitors although would have some short-term adverse impacts on visitor experience during construction.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in long-term beneficial moderate effects on visitor experience. Alternative 1 would have a negligible contribution to this cumulative effect.

Conclusion

Under Alternative 1 adverse impacts to visitor experience would result from crew presence, specifically in the backcountry; use of mechanized equipment; and chemicals to treat exotic plants. Adverse impacts would be localized short to long term minor. Beneficial impacts including overall actions to restore native ecosystems would be localized long term minor. Cumulative impacts would be beneficial long term moderate. No unacceptable impacts to visitor experience would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: As described for Alternative 1, use of crews for survey and treatment would have direct effects on visitor experience from presence of crews and related foot travel.

Beneficial impacts described for Alternative 1 are expected to be similar for Alternative 2.

Prevention More in-depth and extensive annual surveys could slightly increase potential for ground disturbance over Alternative 1, but impacts are expected to be similar. Increased education and outreach would result in some additional beneficial impacts to visitor experience.

Manual Control Alternative 2 proposes the same type of manual control currently used; therefore, effects to visitor experience and mitigation measures would be similar to Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in developed areas. However, effects to visitor experience and mitigation measures would be similar to Alternative 1.

Cultural methods Alternative 2 includes addition of carbon sources, use of barriers, and expanded mulch use, which would not result in additional impacts to visitor experience. Fire use would have some impact on visitor experience in the

vicinity of the fire treatment activities. Smoke and decreased visibility would impact visitor experience. Impacts would be adverse short term minor.

Chemical Control Alternative 2 would include herbicide application on a greater number of species than Alternative 1 and would also include limited broadcast spraying and treatment of exotic plants for aesthetic purposes. Use of broadcast spraying could have additional adverse impacts on visitor experience due to the way broadcast spraying is perceived. Additional public outreach would be conducted to inform visitors on this method. Adverse impacts would be short term negligible to minor. Treatment of exotic species to enhance visitor experience, including treatment of species growing in sidewalks and curbstones, would have a short- to long-term negligible to minor impact on visitor experience.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be similar to those described for Alternative 1 and would result in a beneficial long-term moderate effect on visitor experience. Alternative 2 would result in negligible contribution to this cumulative effect.

Conclusion

Under Alternative 2 adverse impacts to visitor experience, include presence of crews, specifically in the backcountry, fire use, mechanized equipment, and chemicals to treat exotic plants. These adverse impacts would be minor adverse localized short to long term. Beneficial impacts would be minor localized short to long term. Cumulative impacts would be beneficial long term moderate. No unacceptable impacts to visitor experience would result.

WILDERNESS CHARACTER

Affected Environment

Over ninety percent of Grand Canyon National Park is recommended for inclusion in the National Wilderness Preservation System. The Wilderness Act of 1964 required the Secretaries of Agriculture and Interior evaluate land under their jurisdiction for possible wilderness classification. The Grand Canyon National Park Enlargement Act of January 3, 1975, as amended by the Act of June 10, 1975, required the Secretary of the Interior to prepare a wilderness recommendation. In 1976, the NPS prepared a draft environmental statement and preliminary wilderness proposal that was reviewed by the public. In 1977, a wilderness recommendation was sent to the Department's Legislative Counsel, where it was held in abeyance pending completion of the park's first comprehensive River Management Plan. Upon completion of the 1980 Colorado River Management Plan, the park submitted to the Department a proposal to designate 980,088 acres as wilderness and an additional 131,814 acres as potential wilderness.

In 1993, the park conducted an internal review and update of the 1980 Wilderness Recommendation. Recent acquisition of grazing, mineral and other leases and completion of land use studies necessitated a revision of the recommendation. The update was based on changes in land status of recommended potential wilderness and refinements in acreage estimates determined by Geographical Information Systems (GIS). All modifications were consistent with the intent of the 1980 recommendation. In 1993, the park superintendent transmitted this

recommendation to the Director of the NPS. Action on this recommendation is still pending.

The 1993 Final Wilderness Recommendation includes two units totaling 1,139,077 acres. Of this total, 1,109,257 are recommended for immediate wilderness designation; and 29,820 are recommended for designation as potential wilderness. Potential wilderness areas include places that do not qualify for immediate designation as wilderness due to temporary non-conforming or incompatible conditions.

The Wilderness Act and NPS Policy

Section 4 of the Wilderness Act describes authorized uses of wilderness areas. Subsection 4(a) declares, with specific legislative references, that the Wilderness Act shall be supplemental to the purposes for which the national forests, parks, and refuges have been established.

Subsection 4(b) states in part, “Except as otherwise provided in this Act, each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character.” Thus, except for specified provisions in the legislation, wilderness areas shall be devoted to recreational, scenic, scientific, educational, conservation, and historical uses.

Subsection 4(c) prohibits certain uses (unless specifically provided elsewhere in the Act) inconsistent with wilderness preservation. With the exception of the minimum actions needed for administrative duties and emergency health and safety procedures, the Act prohibits temporary roads, motor vehicle use, motorized equipment or motorboats, landing of aircraft, mechanical transport, structures, and installations.

Chapter 6 of *NPS Management Policies* states in part: “The National Park Service will take no action that would diminish the wilderness eligibility of an area possessing wilderness characteristics until the legislative process of wilderness designation has been completed. Until that time, management decisions 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 existing non-conforming conditions allow. The National Park Service will apply the principles of civic engagement and cooperative conservation as it determines the most appropriate means of removing the temporary, nonconforming conditions that preclude wilderness designation from potential wilderness.”

NPS wilderness management policy requires management decisions be consistent with a minimum requirement concept. When determining minimum requirement, potential disruptions of wilderness character and resources will be considered. The minimum requirement concept applies to all administrative activities. The park has established minimum requirement protocols to document decisions related to administrative activities. This analysis is incorporated into analysis of impacts to wilderness character.

Defining Wilderness Character

According to the park's GMP, areas proposed for wilderness offer visitors opportunities for solitude and primitive recreation. An important provision in the GMP states: "The management of these areas should preserve wilderness values and character. Non-wilderness undeveloped areas should continue to serve primarily as primitive thresholds to wilderness. Visitors traveling through the canyon on the Colorado River should have the opportunity for a variety of personal outdoor experiences, ranging from solitary to social. Visitors should be able to continue to experience the river corridor with as little influence from the modern world as possible. The river experience should help visitors to intimately relate to the majesty of the canyon (National Park Service, 1995)." Visitor experience is discussed in other sections of this document.

Subsection 2(c) of the Wilderness Act defines wilderness as follows:

A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.

The same subsection 2(c) further defines wilderness as having the following characteristics:

- Undeveloped land retaining its primeval character in influence without permanent improvements or human habitation
- Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation
- May contain ecological, geological, scientific, educational, scenic, or historical value

This EA adopts definitions and concepts developed through an interagency process to establish a framework for monitoring conditions related to wilderness character (Landres, 2005). All wilderness areas, regardless of size, location, or any other feature, are unified by the statutory definition. These four qualities of wilderness are:

- **Untrammelled**—wilderness is essentially unhindered and free from modern human control or manipulation. This quality pertains to actions that manipulate or control ecological systems
- **Natural**—wilderness ecological systems are substantially free from effects of modern civilization. In the context of exotic plant management, this quality pertains to intended and unintended human-caused effects on natural and cultural resources conditions
- **Undeveloped**—wilderness is essentially without permanent improvements or modern human occupation. This quality pertains to presence and development level of trails, campsites and structures and facilities within the proposed wilderness
- **Outstanding opportunities for solitude or a primitive and unconfined type of recreation**—wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including values of inspiration and physical and mental challenge. This quality pertains to visitor opportunities to experience a primitive setting that may include solitude and adventure

Environmental Consequences

Methodology

Baseline information used to assess impacts to wilderness character is described in the methodology section at the beginning of this chapter and includes park staff knowledge of resources and sites, 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 GRCA summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area. Additional sources of information on wilderness character used as a basis for this evaluation are as described above in the affected environment section.

Under each alternative, wilderness is considered and addressed through the description of impacts to “wilderness character.” As stated in the Wilderness Act of 1964, wilderness character is made up of qualities such as “untrammeled”, “natural”, “undeveloped”, and “potential for primitive recreation/solitude.” The impact analysis to follow is also the minimum requirement analysis (MRA). The actual MRA can be found in Appendix H. Additional sources of information on GRCA wilderness used as a basis for this evaluation are as described above in the affected environment section.

Thresholds of change for intensity of impact to wilderness character are defined as:

- | | |
|-------------------|---|
| Negligible | Impacts would have no discernible effect on wilderness character. Natural conditions would prevail. There would be no permanent visual improvements or human occupation. There would be outstanding opportunities for solitude or a primitive and unconfined type of recreation |
| Minor | Impacts would be slightly detectable within limited areas of the wilderness. Natural conditions would predominate. There would be no permanent visual improvements or human occupation. While there might be short-term impacts within the wilderness, over the long term, outstanding opportunities for solitude or a primitive and unconfined type of recreation would prevail, but may vary by season. |
| Moderate | Impacts would be readily apparent within limited areas of the wilderness. It would be apparent that man has altered natural conditions within such areas. There would be no permanent visual improvements or human occupation. Outstanding opportunities for solitude or a primitive and unconfined type of recreation would be restricted in limited areas and during limited times of the year |
| Major | Impacts would substantially alter the wilderness resource throughout the wilderness area. Natural conditions would have been substantially altered by man. Improvements made by man, while not permanent, would be long-term and become part of the landscape. Outstanding opportunities for solitude or a primitive and unconfined type of recreation would be restricted throughout the wilderness |

Duration Short term Transitory or largely disappears over a period of hours or days
Long term Months or years

Alternative 1 – No Action

Direct/Indirect Impacts All methods that include crews for survey or treatment may have direct effects on wilderness character from crew presence. Overall treatment of exotic plants would also have impacts to wilderness character as:

Untrammelled—The proposed project would manipulate exotic plants to move toward restoration of native plant communities. No further manipulation or control would continue at a specific site after an exotic plant population is successfully treated. Therefore, short- to long-term minor impacts would occur to the untrammelled nature of proposed wilderness throughout the park.

Natural—Impacts to natural and cultural resources would continue as described in those sections of this document. Human use would continue throughout proposed wilderness areas as described in this document and other park management guidance documents. No ecological systems, with the exception of vegetation, would be measurably affected by the current exotic plant management program.

Undeveloped—Number and type of facilities and management activities in proposed wilderness would remain unchanged. The proposed project does not include further construction; therefore, impacts to the undeveloped nature of proposed wilderness would be negligible.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation—Impacts to visitor use and experience would continue as described in this document. Proposed work would not result in long-term impacts to natural sights and sounds, solitude, risk adventure or other attributes of proposed park wilderness. However, potential encounters with exotic plant management crews could result in minor short-term impacts to sounds and sights (including crew noise, and visual evidence of exotic plant management) would result. Impacts to outstanding opportunities would be short to long term negligible to minor.

Cumulative Impacts Cumulative impacts on wilderness character was determined by combining impacts of Alternative 1 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 human presence and recreation, use of mechanized equipment in and adjacent to proposed wilderness, fire management activities, maintenance of trails and campsites, and aircraft overflights. These actions have caused adverse impacts including human activity, increased noise, and would result in decreased opportunities for solitude or primitive types of recreation. Impacts to wilderness character from these activities are adverse generally short term minor to moderate.

Recently completed, in-progress projects, and foreseeable future projects that could have a cumulative effect when combined with Alternative 1 include the Colorado River Management Plan and, as mentioned above, human presence and

recreation, use of mechanized equipment in and adjacent to proposed wilderness, maintenance of backcountry trails and campsites, fire management activities, and aircraft overflights. Impacts are adverse short term moderate.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in adverse short- to long-term moderate effects on wilderness character. Alternative 1 would have a negligible contribution to this cumulative adverse effect.

Conclusion

Under Alternative 1 adverse impacts to wilderness character would result from presence of crews and visibility of both crews and exotic plant management actions. These adverse impacts would be generally short term negligible to minor. Beneficial impacts including overall actions to restore the native ecosystem would be long term minor. Cumulative impacts would be adverse short to long term moderate. No impairment of or unacceptable to wilderness character would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: As described for Alternative 1, crews for survey and treatment would have direct effects on wilderness character. Overall treatment of exotic plants within proposed wilderness would have impacts on the untrammeled, natural, and undeveloped nature of wilderness as well as opportunities for solitude or a primitive and unconfined type of recreation. Impacts would be the same as those described for Alternative 1.

Untrammeled—The proposed project would manipulate exotic plants to move toward restoration of native plant communities. No further manipulation or control would continue at a specific site after an exotic plant population is successfully treated. Therefore, short- to long-term minor impacts would occur to the untrammeled nature of proposed wilderness throughout the park.

Natural—Impacts to natural and cultural resources would continue as described in those sections of this document. Human use would continue throughout proposed wilderness areas as described in this document and other park management guidance documents. No ecological systems, with exception of vegetation, would be measurably affected by the current exotic plant management program.

Undeveloped—Number and type of facilities and management activities in proposed wilderness would remain unchanged. The proposed project does not include further construction; therefore, impacts to the undeveloped nature of proposed wilderness would be negligible.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation—Impacts to visitor use and experience would continue as described in this document. The proposed work would not result in long-term impacts to natural sights and sounds, solitude, risk adventure or other attributes of proposed park wilderness. However, potential encounters with exotic plant management crews could result in minor short-term impacts to sounds and sights (including noise from the crew and visual evidence of exotic plant management). Decreased visibility of natural sights could occur from proposed fire treatments; however, these are expected to be local short term. Overall impacts to outstanding opportunities would be short to long term negligible to minor.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be similar to those described for Alternative 1, and would result in an adverse short- to long-term moderate effect on wilderness character. Alternative 2 would result in negligible contribution to this cumulative effect.

Conclusion

Under Alternative 2, adverse effects to wilderness character from presence of crews, decreased visibility from smoke, and visual signs of human manipulation would be minor short- to long-term. Although there may be some short-term adverse impacts, there will be long-term benefits to wilderness character improving natural conditions and overall resource quality and integrity. These beneficial impacts would be long term minor. Cumulative impacts would be adverse short to long term moderate. No impairment of or unacceptable to wilderness character would result.

PUBLIC HEALTH AND SAFETY

Affected Environment

GRCA managers seek to provide a safe and healthful environment for visitors and employees. GRCA staff provides visitors with safety bulletins, press releases, and up-to-date information about management actions and potential risks. Standard Operating Procedures and Job Hazard Analysis guide daily operations in an effort to provide the safest possible environment for park employees. Park managers from each park divisions prepare a comprehensive safety plan, reviewed by the park's Safety Officer.

Some exotic plant management techniques have potential to harm humans. Injuries can occur when using everything from a shovel or saw to fire and herbicide. Visitors and other staff can be harmed if management is occurring in areas the public frequent. For this reason, job hazard analyses are developed for many techniques, such as sawing and using herbicide. 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 technique, and mitigate problems and injuries while performing the particular technique. These are reviewed every year for thoroughness and are required readings for anyone (volunteer or staff) participating in the activities described.

Environmental Consequences

Methodology

Baseline information used to assess impacts to public health and safety 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 GRCA summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area. 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.

Thresholds of change for intensity of impact on public health and safety are:

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 consequences

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

Alternative 1 – No Action

Direct/Indirect Impacts 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 Prevention actions under Alternative 1 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 impact on public health and safety.

Manual Control Removal of exotic plant species using manual methods could have direct effects on public health and safety from actual tool use and potential for injury by the tools themselves. Adverse impacts to public health and safety would be short term negligible to minor.

Mechanical Control 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 negligible to minor. Tractors use on pre-disturbed construction sites to remove exotic plant species prior to site restoration would result in short-term minor adverse impacts on public health and safety.

Cultural Control 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 negligible effects on public health and safety.

Chemical Control Manual application of selected herbicides on targeted individual plants has potential to directly affect public health and safety resources through direct application of herbicide. Mitigation measures would be followed to minimize potential for adverse effects. Therefore, adverse impacts on public health and safety from chemical control would be short to long term minor.

Cumulative Impacts Cumulative impacts on public health and safety were determined by combining impacts of Alternative 1 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 wild fires and construction projects. These actions have has some adverse impacts on park operations including increased safety risks in and around construction sites, and inherent risks in fire management and aircraft use. The park 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 1 include South Entrance Road Improvements, Desert View Improvements, Parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. These projects were all 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.

Foreseeable future projects include Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. Again, these projects are designed to address safety concerns and have safety plans in place during construction. Therefore, impacts from these projects would be long term minor beneficial. Some short-term adverse impacts would occur during construction.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in beneficial long-term minor effects. Alternative 1 would have a negligible contribution to this cumulative adverse effect.

Conclusion

Under Alternative 1, adverse effects to public health and safety from use of hand tools, mechanized tools, and herbicides would continue to be localized short to long term minor. Cumulative impacts would be beneficial long term minor. No unacceptable impacts to public health and safety would result.

Alternative 2 – Preferred

Direct/Indirect Impacts: As described for Alternative 1, use of tools and herbicide may have impacts on public health and safety.

Prevention More in-depth and extensive annual surveys could slightly increase potential for ground disturbance over Alternative 1. No additional prevention actions would impact public health and safety.

Manual Control Alternative 2 proposes the same type of manual control currently used; therefore effects to public health and safety and mitigation measures would be similar to Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in the developed area. However, effects to public health and safety and mitigation measures would be similar to Alternative 1.

Cultural methods Alternative 2 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.

Fire use treatments would increase safety and health concerns due to smoke and inherent risks associated with fire use. However, if mitigation measures are followed and fire use treatment is coordinated with NPS Fire personnel, impacts to health and safety would be adverse short term negligible to minor.

Chemical Control Alternative 2 would include herbicide application on a greater number of species than Alternative 1, and would include limited broadcast spraying and some treatment of plants for aesthetic purposes, but effects on public health and safety and mitigation measures would be similar to Alternative 1.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be similar to those described for Alternative 1. Alternative 2 would result in a negligible contribution to this beneficial minor long-term cumulative effect.

Conclusion

Under Alternative 2 effects to public health and safety from use of hand tools, mechanized equipment, chemicals, and fire would be adverse localized short to long term minor. Cumulative impacts would be beneficial long term minor. No unacceptable impacts to public health and safety would result.

PARK OPERATIONS

Affected Environment

Park operations refer to adequacy of staffing levels and quality and effectiveness of park infrastructure in protecting and preserving park resources and providing for effective visitor experience. It also refers to level and implications of park staff, budget, and time needed to accomplish proposed activities.

GRCA's Superintendent is ultimately responsible for park management, including all park operations. In 2007 the park employed approximately 500 full-time staff to manage operations including visitor services and facilities, resource management and preservation, emergency medical services, law enforcement, search and rescue operations, fire management, air operations, maintenance, science and research, interpretation and education, public affairs, planning and compliance, and administrative duties. The Division of Science and Resource Management is responsible for the treatment of exotic plants. Other divisions that could be impacted by the program include Visitor and Resource Protection, specifically Fire and the River District, Project Management Team, the Office of Planning and Compliance, and Facility Management. Concessions could also be impacted if they request herbicide use and work with Vegetation staff on projects.

The Division of Science and Resource Management is comprised of resource management specialists (cultural, wildlife, vegetation, water, earth sciences, and social sciences) and research program managers. Science and Resource Management has primary responsibility for inventory, monitoring, and mitigation for resources and visitor experiences. Science and Resource Management employees design and implement management projects to address resource concerns and impacts, including exotic plant species impacts to other natural and cultural resources and wilderness and visitor experience. The current exotic plant species management program requires approximately 3800 hours of labor per year with a staff of one and a half full-time employees and two seasonal employees. These staff members count on various partnerships, contractors, and volunteer groups to complete field work.

Cost is also a part of park operations. Treatment of exotic plants can be very expensive and although it is not the only factor in selection of control techniques, cost is considered in the context of size, location, integrity of resources threatened, and management goals (eradication, suppression, containment). Typically, the cost of prevention or control is far less than the cost to contain a large infestation and revegetate. Choice of technique and management strategy has both short and long-term cost implications. Short-term impacts are generally negative and include both cost of initial treatment and possible changes in certain activities (closing hiking trails, removing livestock for a period of time) to allow an area to recover. However, protection of the larger surrounding non-infested areas or ecosystem functions is a long-term solution.

Environmental Consequences **Methodology**

Baseline information used to assess impacts to park operations 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 GRCA summarized in the 1995 GMP EIS was specifically referenced for information on affected resources in the project area. Additional sources of information on park operations used as a basis for this evaluation are as described above in the affected environment section.

Thresholds of change for intensity of impact on park operations are:

Negligible	A change in operations not measurable or perceptible
Minor	A change in operations slight and localized with few measurable consequences
Moderate	A change in park operations readily apparent with measurable consequences
Major	A severely adverse or exceptionally beneficial change in park operations

Duration Short term A few days to one month
Long term Greater than one month

Alternative 1 – No Action

Direct/Indirect Impacts Use of crews for survey or treatment would not have measurable effects on park operations.

Prevention Prevention actions under Alternative 1 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 a minor beneficial long-term impact on park operations.

Manual Control Removal of exotic plant species using manual methods could have direct effects on park operations based on labor required to manually treat exotic plants. Adverse impacts to park operations would be short-term negligible to minor.

Mechanical Control Impacts to park operations from use of brush cutters and tractors would be beneficial. These methods would be very effective in treating large areas in a short amount of time resulting in short-term negligible to minor beneficial impacts on park operations.

Cultural Control Crews would walk to access plants as described above. This work is not generally considered an adverse impact on park operations. Therefore, cultural control would result in negligible effects on park operations.

Chemical Control Application of selected herbicides on targeted individual plants would have an impact on park operations from overall effectiveness of herbicides on certain exotic species. Impacts would be beneficial negligible to minor.

Cumulative Impacts Cumulative impacts on park operations were determined by combining impacts of Alternative 1 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 wild fires, routine park functions such as maintenance, visitor and resource protection, and administration, construction projects, and transportation planning. These actions have caused both adverse and beneficial impacts. Adverse impacts include increased work load, decreased efficiency and productivity, and increased cost to the park. Beneficial impacts to park operations include projects and programs that are more efficient, productive, and cost effective. These activities are ongoing and are considered in this analysis as in-progress and future actions as well as past activities. Impacts to park operations from these activities are adverse long term localized minor.

Recently completed and in-progress projects that could have a cumulative effect when combined with Alternative 1 include South Entrance Road Improvements, Desert View Improvements, parkwide Restrooms, Hermit Road Rehabilitation, North Rim Development Plan, and South Rim Visitor Transportation Plan. Effects to park operations are considered in all construction projects and mitigation measures are developed to minimize impacts. Therefore, beneficial negligible to minor long-term impacts would result.

Foreseeable future projects include Greenway Trail – Phase V, Employee Housing, and Bright Angel Trailhead. Construction of new facilities and trails has potential to impact park operations. Impacts from these projects would be long term negligible to minor beneficial.

Cumulatively, effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in beneficial short to long-term minor effects on park operations. Alternative 1 would have a negligible contribution to this cumulative adverse effect.

Conclusion

Under Alternative 1, continuation of current exotic plant management, adverse effects to park operations from time and money needed to treat exotic plant species would be short to long term minor. Beneficial impacts from use of effective and efficient methods to treat exotic plant species would be short to long term minor. Cumulative impacts would be beneficial short to long term minor. No unacceptable impacts to public health and safety would result.

Alternative 2 – Preferred

Direct/Indirect Impacts Goals for control or containment of new exotic plant species are expected to be more efficiently achieved with Alternative 2 than under current management techniques. This alternative would most likely be successful in prevention of unacceptable levels of exotic plant species through the most economical means and with least amount of hazard to people, property, and the environment. It would also meet the directive established in Director's Order 77-7 (Natural Resources Protection) that calls for "IPM procedures to be used to determine when to control pests and whether to use mechanical, physical, chemical, cultural, or biological means."

Prevention More in-depth and extensive annual surveys and additional prevention actions are expected to have some impact on park operations due to increased staff time and funding needed to complete surveys and produce additional prevention and education materials. Impacts are expected to be negligible adverse.

Manual Control Alternative 2 proposes the same type of manual control currently used, therefore effects to park operations and mitigation measures would be similar to Alternative 1.

Mechanical Control In addition to power tools described in Alternative 1, Alternative 2 would include use of mowers and chainsaws in the developed area. However, effects to park operations and mitigation measures would be similar to Alternative 1.

Cultural methods Alternative 2 includes addition of carbon sources, use of barriers, and expanded use of mulch, which would not have direct effects on park operations.

Fire use to treat exotic plants would require additional staff (GRCA Fire personnel). Quantity of staff needed would be based on location and size of area to be treated. Therefore, negligible to minor adverse impacts to park operations would result.

Chemical Control Alternative 2 would include herbicide application on a greater number of species than Alternative 1, and would also include limited broadcast spraying and selective aesthetic treatment in developed areas, but effects on park operations and mitigations would be similar to Alternative 1.

Cumulative Impacts Cumulatively, effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would result in similar impacts to those described for Alternative 1. Impacts to park operations would be beneficial short to long term minor. Alternative 2 would contribute negligibly both adverse and beneficial impacts to this cumulative effect.

Conclusion

Under Alternative 2 adverse effects to park operations from time and money needed to treat exotic plant species would be short to long term minor. Beneficial impacts from use of the most effective and efficient methods to treat exotic plant species would be short to long term minor. Cumulative impacts would be beneficial short to long term minor. No unacceptable impacts to park operations would result.

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

LITERATURE CITED

- Alford, É.R., Perry, L.G., Qin, B., Vivanco, J.M., & Paschke, M.W. (2007) A putative allelopathic agent of Russian knapweed occurs in invaded soils. *Soil Biology and Biochemistry*, 39, 1812-1815.
- Anderson, B.W. & Laymon, S.A. (1989). Creating habitat for the yellow-billed cuckoo (*Coccyzus americana*). USDA Forest Service Gen. Tech. Report PSW-110: 272-277.
- Arizona Department of Game and Fish (1996). Ecology of Grand Canyon Backwaters. Prepared for the Bureau of Reclamation, Upper Colorado Region. Glen Canyon Environmental Studies, Flagstaff, AZ.
- Arizona Department of Game and Fish (2001a). *Catostomus latipinnis*. Unpublished abstract compiled and edited by the Heritage Data Management System Phoenix. Available online at <http://www.azgfd.com/wildlife_conservation/edits/hdms_abstracts_fish.html>. Phoenix, Arizona.
- Arizona Department of Game and Fish (2001b). *Idionycteris phyllotis*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.azgfd.com/wildlife_conservation/edits/hdms_abstracts_mammals.html>. Phoenix, AZ.
- Arizona Department of Game and Fish (2002a). *Eumops perotis*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.gf.state.az.us/w_c/edits/documents/Eumopeca.fi.pdf>. Phoenix, AZ.
- Arizona Department of Game and Fish (2002b). *Rana pipiens*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.azgfd.com/wildlifeconservation/edits/hdms_abstracts_amphibians.html>. Phoenix, AZ.
- Arizona Department of Game and Fish (2003a). *Accipiter gentilis*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at: <http://www.azgfd.gov/w_c/edits/documents/Accigent.d_002.pdf>. Phoenix.
- Arizona Department of Game and Fish (2003b). *Corynorhinus townsendii pallescens*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.azgfd.gov/w_c/edits/documents/Corytopa.fi_000.pdf>. Phoenix, AZ.
- Arizona Department of Game and Fish (2003c). *Euderma maculatum*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.gf.state.az.us/w_c/edits/documents/Eudemacu.fi_000.pdf>. Phoenix, AZ.
- Arizona Department of Game and Fish (2003d). *Lasiurus blossevillii*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.gf.state.az.us/w_c/edits/documents/Lasiblos.fi.pdf>. Phoenix, AZ.

Arizona Department of Game and Fish (2003e). *Myotis volans*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.gf.state.az.us/w_c/edits/documents/Myotvola.fi_000.pdf>. Phoenix, AZ.

Arizona Department of Game and Fish (2003f). *Nyctinomops femorosacca*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.gf.state.az.us/w_c/edits/documents/Nyctfemo.fi_000.pdf>. Phoenix, AZ.

Arizona Department of Game and Fish (2006). *Choeronycteris mexicana*. Unpublished abstract compiled and edited by the Heritage Data Management System. Available online at <http://www.gf.state.az.us/w_c/edits/documents/Choemexi.fi_001.pdf>. Phoenix, AZ.

Arizona Department of Game and Fish (2008) Species in Arizona Heritage Data Management System.

Beard, R. (2008) Personal communication (via electronic mail) from Rita Beard, National Park Service Invasive Plant Coordinator, regarding National Park Service funding for invasive plant management (ed L. Makarick), Grand Canyon National Park.

Bowden, T.S. (2008) Mexican spotted owl reproduction, home range, and habitat associations in Grand Canyon National Park. MS Thesis, Montana State University, Bozeman, MT.

Brian, N.J. (2000) A Field Guide to the Special Status Plants of Grand Canyon National Park Science Center, Grand Canyon National Park, AZ.

Brown, B.T. & Stevens, L.E. (1997) Winter Bald Eagle Distribution Is Inversely Correlated with Human Activity along the Colorado River, Arizona. *Journal of Raptor Research*, 31, 7-10.

Brown, D.E. (1994) Biotic communities - Southwestern United States and Northwestern Mexico. University of Utah Press. Salt Lake City.

Bureau of Reclamation (1995). Operations of Glen Canyon Dam Colorado River Storage Project Coconino County, Arizona - Final Environmental Impact Statement.

Camp, P. (2002) Personal communication (via electronic mail) from Phil Camp, Natural Resources Conservation Service regarding prime and unique farmlands in Grand Canyon National Park (ed C. Crocker-Bedford), Grand Canyon National Park.

Coder, C.M. (2000) An Introduction to Grand Canyon Prehistory Grand Canyon Association, Grand Canyon National Park, AZ.

Crawford, J.C. (2006). Sentry milk-vetch, *Astragalus cremnophylax* var. *cremnophylax*, 2005-2006 Monitoring Report. Grand Canyon National Park.

Cronk, Q.C.B. & Fuller, J.L. (2001) *Plant Invaders: The Threat to Natural Ecosystems* Earthscan Publications, London.

Ferguson, T.J.-H.C.P.O. (1998). Salt Canyon and the Colorado River: The Hopi People and the Grand Canyon - Final Ethnohistoric Report for the Hopi Glen Canyon Environmental Studies Project. contract 1425-96-PD-81-20489, Bureau of Reclamation, Hopi, AZ.

Freeman, L.H. & Jenson, S.L. (1998) How to write quality EIS's and EA's Shipley Environmental, Inc. through Franklin Covey, Bountiful, UT.

Gaines, D. & Laymon, S.A. (1984) Decline, status, and preservation of the yellow-billed cuckoo in California. West, 15, 49-80.

Gerba, C.P., Enriquez, C., & Gaither, M. (1997). Occurrence of Giardia, Cryptosporidium, and Viruses in the Colorado River and Its Tributaries. Department of Microbiology and Immunology, University of Arizona.

Halterman, M.D., Gilmer, S.A., Laymon, S.A., & Falxa, G.A. (2003) Status of the yellow-billed cuckoo in California. Unpublished abstract, Cooper Ornithological Society 75th annual meeting, Flagstaff, AZ.

Hart, R.E. (1995). A Glen Canyon Environmental Studies Report - Zuni GCES Ethnohistorical Report. Institute of the North American West.

Hawbecker, A.C. (1936). Plants of Grand Canyon National Park. Field Division of Forestry, National Park Service, U.S. Department of the Interior.

Hiebert, R.D. & Stubbendieck, J. (1993). Handbook for Ranking Exotic Plants for Management and Control, Rep. No. Natural Resources Report NPS/NRMWRO/NRR-93/08. U.S. Department of the Interior, National Park Service, Natural Resources Publication Office, Denver, CO.

Hoffmeister, D.F. (1986) Mammals of Arizona. University of Arizona Press, Tucson, AZ.

Hualapai Cultural Resources Division of Hualapai Wildlife Management Department, T. (1993). Hualapai Tribe Ethnographic and Oral Historical Survey for Glen Canyon Environmental Studies and the Glen Canyon Dam Environmental Impact Statement. Report Prepared for United States Bureau of Reclamation in compliance with CA # 10FC-40-10930, Peach Springs, AZ.

Hughes, J.M. (1999) Yellow-billed cuckoo (*Coccyzus americanus*) in The Birds of North America, No. 418 (A. Poole and F. Gill, eds.) Birds of North America, Inc., Philadelphia, PA.

James, D. (1992) Some principles and practices of desert revegetation seeding. Arid Lands Newsletter, 32, 22-27.

John Milner Associates Inc. (2003). North Rim Bright Angel Peninsula Developed Area Cultural Landscape Report: 100% draft submission. Prepared for Grand Canyon National Park, National Park Service, U.S. Department of the Interior., Charlottesville, Virginia.

John Milner Associates Inc. (2004a). Grand Canyon Village National Historic Landmark District Cultural Landscape Report. Prepared for Grand Canyon

National Park, National Park Service, U.S. Department of the Interior.,
Charlottesville, Virginia.

John Milner Associates Inc. (2004b). West Rim Drive, Trail, and Overlooks Area. Cultural Landscape Assessment and Treatment Recommendations. Prepared for Grand Canyon National Park, National Park Service, U.S. Department of the Interior., Charlottesville, Virginia.

John Milner Associates Inc. (2005). Indian Garden Cultural Landscape Report. Prepared for Grand Canyon National Park, National Park Service, U.S. Department of the Interior. Charlottesville, Virginia.

John Milner Associates/OCULUS (2003). Desert View Cultural Landscape Inventory and Treatment Recommendations. Prepared for Grand Canyon National Park, National Park Service, U.S. Department of the Interior., Charlottesville, Virginia.

Knight, R.L. & Cole, D.N. (1991) Effects of Recreational Activity on Wildlife in Wildlands. In Transactions of the 56th North American Wildlife and Natural Resources Conference, pp. 238-244.

Landres, P., Boutcher, S., Merigiano, L., Barns, C., Davis, D., Hall, T. Henry, S., Hunter, B., Janiga, P., Laker, M., McPherson, A., Powell, D., Rowan, M., Sater, S. (2005). Monitoring Selected Conditions Related to Wilderness Character: A National Framework, Rep. No. Gen. Tech. Rep. RMRS-GTR-151. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

LaRue, C.T., Dickson, L.L., Spence, J.R., Stevens, L.E., & Brown., N.L. (2001) Recent bird records from the Grand Canyon Region, 1974-2000. *Western Birds*, 32, 101-118.

Laymon, S.A. & Halterman, M.D. (1987) Can the western subspecies of the yellow-billed cuckoo be saved from extinction? *Western Birds*, 18, 19-25.

Makarick, L. (1999). Draft Exotic Plant Species Management Plan for Grand Canyon National Park. U.S. Department of the Interior, National Park Service, Grand Canyon National Park.

Makarick, L. (2006). Grand Canyon National Park Vegetation Program - unpublished reports, databases, and files. U.S. Department of the Interior, National Park Service, Grand Canyon National Park.

Marshall, M. (2008) Update to park staff on condor status.

McDougall, W.B. (1947) Plants of Grand Canyon National Park - revised checklist. In Bulletin 10. Grand Canyon Natural History Association, Grand Canyon, Arizona.

McKinney, T., D. W. Speas, R. S. Rogers, and W. P. Persons (1999). Rainbow Trout in the Lees Ferry Recreational Fishery below Glen Canyon Dam, Arizona, Following Establishment of Minimum Flow Requirements. Final Report submitted

to Grand Canyon Monitoring and Research Center, Flagstaff, AZ. Arizona Department of Game and Fish, Phoenix, AZ.

Mead, P. (1930) An ecological description of the Kaibab Plateau, Arizona, University of Chicago, Chicago, IL.

Miller, D.M., R. A. Young, T. W. Gatlin, and J. A. Richardson (1982) Amphibians and Reptiles of the Grand Canyon. Monograph 4. Grand Canyon Natural History Association.

Minckley, W.L., Marsh, P.C., Brooks, J.E., Johnson, J.E., & Jensen, B.L. (1991) Management Toward Recovery of the Razorback Sucker. Pages 303-357 in: W.L. Minckley and J.E. Deacon (editors). Battle against extinction: Native fish management in the American Southwest. University of Arizona Press. Tucson. 517 pp.

National Park Service (1984) Archeological Resources of Grand Canyon National Park (Multiple Resources Partial Inventory: Prehistoric and Historic Archeological Sites, Historic and Architectural Properties, February 23, 1994, Grand Canyon National Park, Arizona.

National Park Service (1991) Natural Resources Management Guideline, NPS-77. United States Department of Interior, Washington, D.C.

National Park Service (1996) A Strategic Plan for Managing Invasive Nonnative Plants on National Park System Lands. U.S. Department of the Interior.

National Park Service (2002a) Exotic Plant Management Team Annual Report. U.S. Department of the Interior.

National Park Service (2002b). Environmental Assessment / Assessment of Effect - Tamarisk Management and Tributary Restoration. Grand Canyon National Park, Arizona.

National Park Service (2003a). Grand Canyon National Park Federally Listed and Other Special Status Plants. Grand Canyon National Park, Arizona.

National Park Service (2003b). Views of the National Parks, Grand Canyon Wildlife Research Expeditions: Bighorn Sheep Studies. Available online at <http://www.nature.nps.gov/synthesis/views/Sites/GRCA/HTML/Bighorn/Bighorn_ET.htm>.

National Park Service (2004). GRCA Project proposal and environmental screening form - Parkwide programmatic invasive plant management program. Grand Canyon National Park, Arizona.

National Park Service (2005). Northern Great Plains Exotic Plant Management Plan and Environmental Assessment, Northern Great Plains Parks.

National Park Service (2006) Management Policies - <http://www.nps.gov/policy/MP2006.pdf>.

National Park Service (2008a). Archeological site files. Grand Canyon National Park, Arizona.

National Park Service (2008b). Backcountry Information Center Statistics: Calendar Year 2007, Grand Canyon National Park, Arizona.

National Park Service (2008c) Grand Canyon National Park Website.

National Park Service (2008d) Grand Canyon Park Profile 2008.
<http://www.nps.gov/grca/parkmgmt/upload/2008grcaProfile.pdf>. Grand Canyon National Park, Arizona.

National Park Service, D.S.C. (1995) Final General Management Plan and Environmental Impact Statement, Grand Canyon National Park, Arizona.

Roberts, A., Begay, R.M., & Kelley, K.B., eds. (1995) The River of Neverending Life. Submitted to Glen Canyon Environmental Studies Program, Upper Colorado Regional Office, Bureau of Reclamation. Submitted by Alan S. Downer, Navajo Nation Historic Preservation Department, Window Rock, AZ.

Sorensen, J.A. (2004) Meeting Minutes from the Kanab Ambersnail Working Group Meeting, January 6, 2004. Phoenix Zoo, Phoenix, Arizona.

Spence, J. (1996). The Controlled Flood of 1996: Effects on Vegetation and Leopard Frogs (*Rana pipiens*) at RM [REDACTED], Colorado River, Glen Canyon. Resource Management Division, Glen Canyon National Recreation Area, Page, AZ.

Steidl, R.J. & Anthony, R.G. (1995). Recreation and Bald Eagle Ecology on the Gulkana National Wild River - unpublished final report to the Bureau of Land Management, Alaska.

Stevens, L.E. (1989) Mechanisms of riparian plant community organization and succession in the Grand Canyon, Arizona, Northern Arizona University, Flagstaff, AZ.

Stevens, R.H. (1996). Hualapai Tribe's Traditional Cultural Properties on and along the Colorado River through the Grand Canyon: A Hualapai Tribe Research Report to the United States Department of the Interior Bureau of Reclamation, for Glen Canyon Environmental Studies and Glen Canyon Dam Environmental Impact Statement. Hualapai Tribe, Office of Cultural Resources and R.H. Stevens, Ethnographic Consultant, Peach Springs, AZ.

Stoffle, R.W., Halmo, D.B., Evans, M.J., & Austin, D.E. (1996). Southern Paiute Ethnographic Resource Inventory and Assessment for Colorado River Corridor, Glen Canyon National Recreation Area, Utah and Arizona, and Grand Canyon National Park, Arizona - Report to the National Park Service, Rocky Mountain Regional Office and David Wegner, Glen Canyon Environmental Studies, Bureau of Reclamation, Rep. No. Project # GLCA-R92-0071.

Stohlgren, T.J., Binkley, D., Chong, G.W., Kalkhan, M.A., Schell, L.D., Bull, K.A., Otsuki, Y., Newman, G., Bashkin, M., & Son, Y. (1999) Exotic Plant Species Invade Hot Spots of Native Plant Diversity. Ecological Monographs, 69, 25-46.

U.S. Environmental Protection Agency (2004). EFED Science Chapter: Environmental Fate and Ecological Risk Assessment for the Registration of

Aminopyralid. Office of Pesticide Programs - Environmental Fate and Effects Division.

United States Fish and Wildlife Service (2002). Final Recovery Plan Southwestern Willow Flycatcher (*Empidonax traillii extimus*). August 2002., Albuquerque, New Mexico.

United States Fish and Wildlife Service (2006). Sentry Milk-vetch (*Astragalus cremnophylax* var. *cremnophylax*) Recovery Plan. September 2006. Arizona Ecological Services Office, USFWS, Phoenix, Arizona. Prepared for Southwest Region (Region 2) USFWS, Albuquerque, New Mexico.

United States Fish and Wildlife Service & Interior, U.S.D.o.t. (2002). Biological Opinion, Lake Mead National Recreation Area Land Management Plan. Arizona Ecological Services (consultation number 02-21-01-F-0263), October 7, 2002.

United States Fish and Wildlife Service & United States Department of the Interior (1985). Brady Pincushion Cactus Recovery Plan. USFWS, Albuquerque, New Mexico. Iv + 68 pp.

United States Fish and Wildlife Service & United States Department of the Interior (1994). Endangered and Threatened Animals and Plants: Determination of Critical Habitat for the Colorado River Endangered Fishes: Razorback Sucker, Colorado Squawfish, Humpback Chub, and Bonytail Chub. Federal Register 59 (54), p. 13374, March 21, 1994.

United States Fish and Wildlife Service & United States Department of the Interior (1995). Kanab Ambersnail (*Oxyloma haydeni kanabensis*) Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado.

United States Fish and Wildlife Service & United States Department of the Interior (1996) Endangered and Threatened Wildlife and Plants; Establishment of a Nonessential Experimental Population of California Condors in Northern Arizona. Federal Register 61, No. 201: 54043-54060.

United States Fish and Wildlife Service & United States Department of the Interior (1998). Razorback Sucker (*Xyrauchun texanus*) Recovery Plan. Denver, Colorado. 81 pp.

United States Fish and Wildlife Service & United States Department of the Interior (2004a). Prescribed Burns on Imperial National Wildlife Refuge at Field 12 and Island Lake, Yuma County, Arizona. Biological Opinion, January 29, 2004. Consultation number AESO/SE 2-21-04-F-0080. Arizona Ecological Services Field Office, Phoenix, Arizona.

United States Fish and Wildlife Service & United States Department of the Interior (2004b). Recommended protection measures for pesticide applications in Region 2 of the U.S. Fish and Wildlife Service, Austin, TX.

United States Fish and Wildlife Service & United States Department of the Interior (2007). Species Assessment and Listing Priority Assignment Form - Fickeisen plains cactus. Region 2, April.

United States Geological Survey (2008). Southwestern willow flycatcher habitat: Characteristics and examples. <<http://sbsc.wr.usgs.gov/cprs/research/projects/swwf/wiflhab.asp>>. Accessed 12/12/2008.

Valdez, R.A., Carothers, S.W., Borkan, R.E., Jonas, L.M., Kingsley, K.J., Leibfried, W.C., Monks, G.W., & Wegner, D.L. (1998). The Aquatic Ecosystem of the Colorado River in Grand Canyon: Grand Canyon Data Integration Project Synthesis Report. SWCA Environmental Consultants, Flagstaff, AZ.

Valdez, R.A. & Ryel, R.J. (1995). Life History and Ecology of the Humpback Chub (*Gila cypha*) in the Colorado River, Grand Canyon, Arizona. Final report. Prepared for the Bureau of Reclamation.

Vitousek, P.M., D'Antonio, C.M., Loope, L.L., & Westbrooks, R. (1996) Biological invasions as global environmental change. *American Scientist*, 84, 468-478.

Ward, R.V. (2000) Abundance and Distribution of Nesting Peregrine Falcons in Grand Canyon National Park. Final report. On file at Grand Canyon National Park, AZ.

Ward, R.V. (2008) RV Ward, Park Wildlife Program Manager with Deborah Lutch, Park Planner at a meeting regarding the Exotic Plant Management Plan.

Ward, R.V. (2009) Personal communication, review comments on Environmental Assessment. Information transmitted via electronic mail from RV Ward to Rachel Stanton on January 23, 2009.

Warren, P.L., Reichhardt, K.L., Mouat, D.A., Brown, B.T., & Johnson, R.R. (1982). Technical Report Number 9 - Vegetation of Grand Canyon National Park. Contracts No. CX8210-7-0028 and CX8000-9-0033 Contribution No. 017/06. Prepared for National Park Service, Grand Canyon National Park. Cooperative National Park Resources Studies Unit, University of Arizona, Tucson, AZ.

Washington State Noxious Weed Control Board (2001) Puncture vine (*Tribulus terrestris* L.).

Watters, K. & Makarick, L. (2008). Final 2007 Management and Monitoring Report - Management and Control of Tamarisk and Other Invasive Vegetation at Backcountry Seeps, Springs and Tributaries in Grand Canyon National Park (Phase II-A, First Year of Phase II of Comprehensive Project). Grand Canyon National Park and Grand Canyon National Park Foundation.

Wiesenborn, W.D. (1996) Saltcedar Impact on Salinity, Water, Fire Frequency and Flooding. In Saltcedar Management Workshop, June 12, 1996. Sponsored by University of California Cooperative Extension, Imperial County and UC Davis and the California Exotic Pest Plant Council, Rancho Mirage, California.

Wiggins, D. (2005) Yellow-billed Cuckoo (*Coccyzus americanus*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available at <http://www.fs.fed.us/r2/projects/scp/assessments/yellowbilledcuckoo.pdf> accessed 27 July 2008.

Williamson, M. (1996) Biological Invasions Chapman & Hall, London.

Chapter 4 – Consultation and Coordination

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Julie Crawford	Former Plant Ecologist	Alternatives, vegetation
Cole Crocker-Bedford	Former Natural Resources Branch Chief	Natural Resources
Lenore Grover-Bullington	Former Natural Resource Specialist	Preliminary document preparation
Greer Chesher	Writer/Editor	Editing
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Linda Jalbert	Outdoor Recreation Planner	Visitor Experience and Wilderness Character
Deborah Lutch	Former Environmental Protection Specialist	Overall document review
Lori Makarick	Vegetation Program Manager	Alternatives, vegetation, overall document review
Ken McMullen	Overflights Project Manager	Soundscapes
Mary Killeen	Chief, Office of Planning and Compliance	Overall document review
Kassandra Theobald	Vegetation Crew Coordinator	Alternatives
R.V. Ward	Wildlife Program Manager	Wildlife and special status species

Agency Consultation and Public Involvement

NPS began the public scoping process in March 2005 with distribution of a general scoping letter describing several preliminary alternatives under consideration for exotic plant species treatment. This letter was distributed to the park's approximately 300-person compliance mailing list, which includes state and Federal agencies and Native American tribes, was posted on the park's website, and included in a press release. Recipients were asked to respond with issues or concerns to described alternatives, and with whether they wished to receive a copy

of the environmental assessment/assessment of effect when distributed for public review. Fourteen responses received are briefly described in Chapter 1. NPS used this scoping response, in combination with other input from the project IDT and other NPS staff to re-evaluate project purpose, need, and objectives. Based on this, NPS developed a preliminary project proposal designed to best meet the purpose and need for taking action and specific project objectives identified.

State Historic Preservation Office NPS initiated consultation with SHPO and requested comments on preliminary alternatives under consideration and input on the framework for consultation under Section 106 of NHPA in March 2005, in a letter distributed during the first public scoping period. In response, SHPO sent a letter dated April 18, 2005 stating the office would look forward to the agency's §106 consultation for this undertaking. NPS sent a letter in January 2008 to initiate consultation and inform the SHPO of the NPS decision to complete a combined EA/AEF to fulfil §106 consultation. Through several conversations in person and by e-mail, SHPO and the park agreed use of the Programmatic Agreement developed for the General Management Plan would be appropriate for this plan. In addition, the park will submit annual assessments of effect based on proposed exotic plant management activities each year. AEFs will be reviewed by the SHPO.

Native American Tribes NPS initiated consultation with all affiliated American Indian tribes and requested comments on several preliminary alternatives in March 2005 in a letter distributed during the first public scoping period. No comments were received from the tribes in response to this letter. During a tribal consultation meeting with the Havasupai Tribe in February 2007, the tribe expressed concern with eradication of edible and medicinal plants and added that all plants need consideration and respect. The tribe also commented on the scope of project and asked how the park would complete proposed work. During a tribal consultation meeting with the Hualapai Tribe in March 2007, the tribe expressed their interest in collecting native plants in the park and requested a meeting with vegetation staff to exchange ideas on dealing with invasive and toxic plants. At a pan tribal meeting in July 2007, no comments were received. In September 2007, the park sent a letter to all affiliated tribes to inform them of the NPS decision to complete a combined EA/AEF to fulfil §106 consultation. A copy of the EA/AEF was distributed to all affiliated tribes for review and comment.

Arizona Department of Environmental Quality NPS received a letter from the Arizona Department of Environmental Quality in response to the March 2005 public scoping effort. Comments from ADEQ included 1) controlling or eradicating invasive exotic plants will help preserve natural plant communities and enhance biodiversity. Support NPS efforts to protect and conserve native plant communities by preventing, controlling, or eradicating invasive exotic plant infestations; 2) use of synthetic herbicides should be limited to only those exotic species which cannot be controlled by any other manner; 3) herbicides in riparian areas and along the Colorado River and tributary streams must be approved for aquatic use on waters of the U.S. and must be accomplished with strict adherence to label instructions.

Glen Canyon National Recreation Area NPS received a letter from GLCA in response to the March 2005 public scoping letter. The letter requested that Grand Canyon work with Glen Canyon on joint approaches in the Lees Ferry area.

U.S. Fish and Wildlife Service NPS requested comments on several preliminary alternatives in March 2005, in a letter distributed during the first public scoping period. USFWS sent several comments in a letter to the park dated April 25, 2005. These comments included: 1) impact analysis should include possible effects to bald eagle (T), brown pelican (E), California condor (E), Mexican spotted owl (T), southwestern willow flycatcher (E), yellow-billed cuckoo (C), Yuma clapper rail (9E), Mojave desert tortoise (T), relict leopard frog (C), humpback chub (E), Kanab ambersnail (E), and sentry milk-vetch (E); 2) site-specific threatened and endangered species surveys need to be done for each treatment area to verify presence or absence; 3) selection of treatment methods needs to include examination of possible effects to listed species; 4) each potential component of the six control methods identified in the scoping letter needs to be identified and evaluated for possible effects to listed species. This includes controls that may extend beyond boundaries of areas to be treated; 5) seeding of competitive plants may result in unintended effects to listed species. Use native species to minimize effects; 6) herbicides may directly affect listed species and may significantly affect various components of habitat or have effects outside the treatment area; 7) USFWS has several concerns with use of biocontrol agents; 8) address original causes and means of how exotic plants arrived and were established; 9) emphasize prevention of new occurrences or establishment of exotics; 10) emphasize restoration of desired ecosystem components; reestablish desired native plants after treatment; 11) describe and explain treatment area prioritization process; and 12) make a list of areas where control is necessary and create a ranking system to identify priority areas to make site-specific evaluation of effects to listed species easier. NPS met with USFWS in May 2008 to confirm the species list for inclusion in a biological assessment for the project. A programmatic biological assessment is currently being prepared.

EA/AEF Review

A letter announcing the availability of the EA/AEF will be sent to persons who responded to scoping efforts and hard copies sent those that specifically requested a copy. A printed copy of the EA/AEF will also be sent to affiliated tribes. A press release will announce the availability of the EA/AEF during the public review period, along with a brief project description. The EA/AEF will be posted to the planning, environment and public comment (PEPC) NPS site, where the public can comment via the website.

Public Involvement

The NPS sent a public scoping letter describing the parkwide exotic plant management proposal to an approximately 300-person mailing list on March 18, 2005. Comments in response to the scoping letter were received from: United States Fish and Wildlife Service, which provided a species list; the State Historic Preservation Officer offering no specific comment; the Arizona Department of Environmental Quality and the Sierra Club, both supporting the plan; Glen Canyon National Recreation Area which is working on its own exotic plant management plan and EA/AEF; and eight unaffiliated persons either showing support for the plan or requesting the final version upon completion.

ACRONYMS AND GLOSSARY

ACHP	Advisory Council on Historic Preservation
ADOT	Arizona Department of Transportation
AEF	Assessment of Effect
AISAC	Arizona Invasive Species Advisory Council
ATV	All Terrain Vehicle
BLM	Bureau of Land Management
CE	Categorical Exclusion
CFR	Code of Federal Regulations
DO	Director's Order
DWLOC	Drinking Water Level of Comparison
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
EPMT	Exotic Plant Management Team
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
GMP	General Management Plan
GLCA	Glen Canyon National Recreation Area
GPRA	Government Performance Results Act
GRCA	Grand Canyon National Park
HTP	Human Toxicity Potential
IDT	Interdisciplinary Team
IPM	Integrated Pest Management
MCS	Multiple Chemical Sensitive
MOA	Memorandum of Agreement
MSDS	Material Safety Data Sheet
NAU	Northern Arizona University
NEPA	National Environmental Policy Act
NMP	National Management Plan
NPS	National Park Service
NRCS	Natural Resources Conservation Service
OSHA	Occupational Safety and Health Administration
PEFO	Petrified Forest National Park
PEPC	Planning, Environment and Public Comment
PPE	Personal Protective Equipment
PUP	Pesticide Use Approval

SWEMP	Southwest Exotic Mapping Project
SWEPIC	Southwest Exotic Plant Information Clearinghouse
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
USGS	United States Geological Survey
WMA	Weed Management Area

Glossary of Terms

Allelopathic Chemicals – Allelopathy is suppression of growth of one plant species by another due to release of toxic substances. Allelopathic chemicals are those substances released by one plant species (in the course of its growth and development) that coincidentally suppress other plant species.

Biological Control – Use of insects, mammals, or pathogens to stress exotic plants.

Broadcast Spraying – Broadcast spraying is a technique to dispense herbicides over a broad area. The basic method is to place the herbicide in a pressurized spray canister and then dispense the chemicals toward the target area.

Chemical Control – Use of herbicides to kill or severely stress exotic plants.

Contain – To confine an infestation so it does not expand, but does not usually indicate a reduction of the current infestation.

Controlled Burning – Burning across an area to target a specific species or multiple species of exotic plants. A fire is ignited to spread across the controlled area and subsequently burn the above-ground portion of plants.

Cultural Control - Practices that promote growth of desirable plants and reduce opportunities for exotic plants to grow. Examples include seeding and planting of native plant species, application of mulch, and use of fire.

Eradicate – Complete elimination of an exotic plant species, including live roots, rhizomes, and seeds. Eradication of an exotic plant species within a management area is very difficult unless it is present in small populations or numbers.

Exotic Plant Species – The NPS defines exotic species as those species that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities. Because an exotic species did not evolve in concert with species native to the place, the exotic species is not a natural component of the natural ecosystem at that place (National Park Service, 2006).

Integrated Pest Management (IPM) – A decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while

posing the least possible risk to people, resources, and the environment (National Park Service, 2006).

Invasive Plant – An aggressive exotic plant known to displace native plant species in otherwise intact native vegetation communities. Invasive plant species are unwanted plants harmful or destructive to humans or other organisms. Not all exotic plants are invasive.

Low Risk Methods – Use of hot water (steam) to scald exotic plants, or use of natural chemicals that may contain biodegradable soap, acetic acid, sugar compounds, or plant proteins.

Mechanical Control – Use of power tools to remove plants by mowing, digging, or cutting seed heads and plants.

Native Plant Species – The NPS defines native plants as all species that have occurred or now occur as a result of natural processes on lands designated as units of the national park system. Native species in a place are evolving in concert with each other (National Park Service, 2006). A goal of the NPS is to perpetuate native plants and animals as part of the natural ecosystem.

Nonnative Plant Species – see Exotic Plant Species defined above

Pile Burning – Burning a pile of plant material removed from the ground.

Prevention – Preventing or reducing the likelihood of future exotic plant infestation establishment.

State Listed Noxious Weeds – Exotic plants prohibited or restricted by Arizona Law. Many exotic plants known in GRCA fall into this category (see Appendix A). Transport of seed or parts of these plants, or allowing them to seed on one's property is prohibited. GRCA proposes to control a few exotic plants not State Listed Noxious Weeds because they pose a threat to the park's natural resources.

Succession, successional – Gradual and orderly process of ecosystem development brought on by changes in species populations that culminates in production of a climax ecological community characteristic of a particular geographic area.

Suppress – To reduce abundance of an exotic plant species, typically as measured or estimated in terms of canopy cover or plants density.

Spot Burning – A propane flame is directed at an individual plant and a thin blast of heat (over 1,000° C) boils water in the cell stalk. This generates pressure, the cell explodes, and a cross section of stalk ruptures. Plant food and water cannot move from roots to leaves through the ruptured stalk and the plant withers and dies. The plant does not catch on fire. The flame on the torch burns the target plant as opposed to starting a ground fire as proposed in spot burning. This technique is also known as flaming or torching.

Weed – The generic word for a plant growing in a spot where it is not wanted. The notion of "wanted" is of course entirely in the eye of the beholder. A weed in one situation might be a wildflower in another.

APPENDIX A 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 certification 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 (MSDSs) about these substances and provide employees with a copy of the sheets if requested. MSDSs 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 MSDSs 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.

Table A-1 Exotic plant species found in GRCA and on the Arizona Noxious Plant List

Common Name	Scientific Name	Common Name	Scientific Name
Camelthorn	<i>Alhagi maurorum</i>	Puncturevine	<i>Tribulus terrestris</i>
Canada thistle	<i>Cirsium arvense</i>	Quackgrass	<i>Elymus repens</i>
Dalmatian toadflax	<i>Linaria dalmatica</i>	Rush skeletonweed	<i>Chondrilla juncea</i>
Diffuse knapweed	<i>Centaurea diffusa</i>	Russian knapweed	<i>Acroptilon repens</i>
Field bindweed	<i>Convolvulus arvensis</i>	Scotch thistle	<i>Onopordum acanthium</i>
Field sandbur	<i>Cenchrus spinifex</i>	Spotted knapweed	<i>Centaurea stoebe</i> ssp. <i>Micranthos</i>
Field sowthistle	<i>Sonchus arvensis</i>	Whitetop	<i>Cardaria draba</i>
Jointed goatgrass	<i>Aegilops cylindrical</i>	Yellow star thistle	<i>Centaurea solstitialis</i>
Little hogweed	<i>Portulaca oleracea</i>		

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 A-1) and the park is 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.

APPENDIX B List of GRCA Exotic Plants

Table B-1 Prioritized List of GRCA Exotic Plants

High Priority Species		GRCA Location			Treatment Type <u>Mechanical/Manual</u> <u>Chemical Cultural Or All</u>
Scientific Name	Common Name	North Rim	South Rim	Inner Canyon	
<i>Acroptilon repens</i>	Russian knapweed		X		A
<i>Aegilops cylindrical</i>	Jointed goatgrass		X		A
<i>Ailanthus altissima</i>	Tree of heaven			X	A
<i>Alhagi maurorum</i>	Camelthorn				A
<i>Brassica tournefortii</i>	Sahara mustard	X	X		M C
<i>Bromus inermis</i>	Smooth brome	X	X	X	A
<i>Cardaria draba</i>	Whitetop, hoary cress		X		A
<i>Carduus nutans</i>	Musk thistle		X		A
<i>Centaurea biebersteinii</i>	Spotted knapweed	X	X		A
<i>Centaurea diffusa</i>	Diffuse knapweed		X		A
<i>Centaurea solstitialis</i>	Yellow starthistle		X		A
<i>Chondrilla juncea</i>	Rush skeletonweed		X		A
<i>Cirsium arvense</i>	Canada thistle		X		A
<i>Conium maculatum</i>	Poison hemlock		X		A
<i>Cortaderia selloana</i>	Pampas grass			X	M
<i>Cynoglossum officinale</i>	Houndstongue	X			A
<i>Elaeagnus angustifolia</i>	Russian olive		X	X	A
<i>Elymus repens</i>	Quackgrass	X			A
<i>Hordeum jubatum</i>	Foxtail barley	X	X		A
<i>Linaria dalmatica</i>	Dalmatian toadflax	X	X		A
<i>Nepeta cataria</i>	Catnip		X	X	M
<i>Onopordum acanthium</i>	Scotch thistle		X		A
<i>Rubus discolor</i>	Himalaya blackberry			X	A
<i>Saccharum ravennae</i>	Ravenna grass			X	M C
<i>Salvia aethiopis</i>	Mediterranean sage		X		M C
<i>Tamarix aphylla</i> – see <i>Tamarix ramosissima</i>	Athel			X	A
<i>Tamarix chinensis</i> – see <i>Tamarix ramosissima</i>	Tamarisk			X	A
<i>Tamarix ramosissima</i>	Tamarisk	X	X	X	A
<i>Tribulus terrestris</i>	Puncturevine		X		M Ch
<i>Ulmus pumila</i>	Siberian elm		X		A

Medium Priority Species		GRCA Location			Treatment Type <u>Mechanical Chemical</u> <u>Cultural Or All</u>
Target Species	Common Name	North Rim	South Rim	Inner Canyon	
<i>Alcea rosea</i>	Hollyhock		X		M C
<i>Cirsium vulgare</i>	Bull thistle	X	X		A
<i>Lepidium latifolium</i>	Perennial pepperweed			X	A
<i>Marrubium vulgare</i>	Horehound	X	X	X	M C
<i>Phoenix dactylifera</i>	Date palm			X	M Ch
<i>Sisymbrium altissimum</i>	Tumble mustard		X	X	M C
<i>Sisymbrium irio</i>	London rocket		X	X	M C
<i>Solanum elaeagnifolium</i>	Silverleaf nightshade		X	X	M C
<i>Sorghum halepense</i>	Johnsongrass		X		A
<i>Vinca minor</i>	Periwinkle		X		M C

Low Priority Species		GRCA Location			Treatment Type
Target Species	Common Name	North Rim	South Rim	Inner Canyon	<u>M</u> echanical <u>C</u> hemical <u>C</u> ultural Or <u>A</u> ll
<i>Amaranthus retroflexus</i>	Red-root amaranth, pigweed			X	M
<i>Arundo donax</i>	Giant reed			X	A
<i>Bromus diandrus</i>	Ripgut brome		X	X	M
<i>Bromus japonicus</i>	Japanese brome	X	X		A
<i>Bromus rubens</i>	Red brome	X	X	X	A
<i>Bromus tectorum</i>	Cheatgrass	X	X	X	A
<i>Cenchrus spinifex</i>	Field sandbur			X	M C
<i>Chenopodium album</i> and <i>C. murale</i>	Lambsquarter	X	X	X	A
<i>Chenopodium ambrosioides</i>	Spanish or mexican tea	X	X		A
<i>Chenopodium murale</i>	Nettleleaf goosefoot	X	X		A
<i>Chenopodium rubrum</i>	Red goosefoot	X	X		A
<i>Convolvulus arvensis</i>	Field bindweed	X	X		A
<i>Conyza canadensis</i>	Horseweed	X	X	X	A
<i>Echinochloa crus-galli</i>	Barnyardgrass	X	X	X	M C
<i>Erodium cicutarium</i>	Filaree	X	X	X	M C
<i>Festuca trachyphylla</i>	Hard fescue			X	M C
<i>Hordeum marinum</i>	Seaside barley		X	X	A
<i>Hordeum murinum</i>	Bulbous barley		X	X	A
<i>Hordeum murinum</i> ssp. <i>Glaucum</i>	Smooth barley		X	X	A
<i>Hordeum muinum</i> ssp. <i>Leporinum</i>	Lepor barley		X	X	A
<i>Kochia scoparia</i>	Kochia		X	X	M C
<i>Lactuca serriola</i>	Prickly lettuce	X	X	X	M C
<i>Leucanthemum vulgare</i>	Oxeye daisy	X			A
<i>Matricaria discoidea</i>	Disc mayweed	X			M
<i>Medicago sativa</i>	Alfalfa		X	X	M C
<i>Melilotus indicus</i>	Annual sweet clover		X	X	M C
<i>Melilotus officinalis</i>	Yellow sweet clover	X	X	X	M C
<i>Pennisetum glaucum</i>	Yellow foxtail			X	A
<i>Phleum pratense</i>	Common timothy	X	X		A
<i>Poa pratensis</i>	Kentucky bluegrass	X	X		A
<i>Rumex acetosella</i>	Sheep sorrel	X	X		A
<i>Rumex obtusifolius</i>	Bitter dock			X	A
<i>Salsola tragus</i>	Russian thistle	X	X	X	M C
<i>Solanum nigrum</i>	Black nightshade			X	M C
<i>Sonchus asper</i>	Spiny sowthistle			X	M C
<i>Sonchus oleraceus</i>	Common sowthistle		X	X	M C
<i>Taraxacum officinale</i>	Common dandelion	X	X	X	M C
<i>Thinopyrum intermedium</i>	Intermediate wheatgrass		X		M C
<i>VerbascumThapsus</i>	Common mullein	X	X	X	M C
<i>Veronica arvensis</i>	Corn speedwell	X			M

Table B-2 Other Exotic Plants Found in GRCA (considered low priority; these species may be treated over the next 10 years following guidance in this document)

		GRCA Location			Treatment Type
Target Species	Common Name	North Rim	South Rim	Inner Canyon	<u>M</u> echanical <u>C</u> hemical <u>C</u> ultural Or <u>A</u> ll
<i>Acer saccharinum</i>	Silver maple		X		M, CH
<i>Agropyron desertorum</i>	Desert wheatgrass		X	X	A
<i>Agrostis stolonifera</i>	Redtop	X	X	X	A
<i>Alopecurus geniculatus</i>	Marsh meadow-foxtail	X			M, CH
<i>Alyssum minus</i>	Alyssum		X		M, CH

Target Species	Common Name	GRCA Location			Treatment Type	
		North Rim	South Rim	Inner Canyon	Mechanical Cultural	Chemical Or All
<i>Amaranthus albus</i>	Tumble pigweed			X	A	
<i>Anthemis cotula</i>	Mayweed		X		M	
<i>Apium graveolens</i>	Common celery			X	M	
<i>Atriplex rosea</i>	Redscale saltbush		X	X	M	
<i>Avena fatua</i>	Wild oat	X	X	X	M	
<i>Bassia hyssopifolia</i>	Smother weed			X	A, CH	
<i>Bromus arvensis</i>	Field brome		X	X	A	
<i>Bromus berterianus</i>	Chilean brome			X	A	
<i>Bromus catharticus</i>	Rescue grass		X	X	A	
<i>Bromus hordeaceus ssp. hordeaceus</i>	Soft chess		X		A	
<i>Bromus madritensis</i>	Compact brome			X	A	
<i>Bromus secalinu</i>	Chess	X			A	
<i>Bromus sterilis</i>	Sterile brome	X			A	
<i>Bupleurum rotundifolium</i>	Hare's ear		X		M	
<i>Camelina microcarpa</i>	Littlepod false flax		X		M	
<i>Cannabis sativa</i>	Marijuana		X	X	M	
<i>Capsella bursa-pastoris</i>	Shepardspurse		X		M	
<i>Ceratocephala testiculata</i>	Bur buttercup		X		A	
<i>Chorispora tenella</i>	Blue mustard		X	X	M, CH	
<i>Cichorium intybus</i>	Chicory		X	X	M, CH	
<i>Conioselinum scopulorum</i>	Rocky Mountain hemlock-parsley	X			M, CH	
<i>Conringia orientalis</i>	Hare's ear mustard	X			M, CH	
<i>Corispermum nitidum</i>	Shiny bugseed			X	A	
<i>Crepis capillaris</i>	Smooth hawksbeard		X		M, CH	
<i>Cynodon dactylon</i>	Bermudagrass			X	A	
<i>Dactylis glomerata</i>	Orchardgrass	X	X		A	
<i>Descurainia Sophia</i>	Flixweed		X	X	M, C	
<i>Digitaria sanguinalis</i>	Large crabgrass			X	A	
<i>Eragrostis cilianensis</i>	Stinkgrass			X	A	
<i>Eragrostis curvula</i>	Weeping lovegrass			X	A	
<i>Erysimum repandum</i>	Repand wallflower		X	X	M	
<i>Ficus carica</i>	Common fig			X	M, CH	
<i>Galium aparine</i>	Bedstraw	X		X	M	
<i>Hedera helix</i>	English ivy			X	A	
<i>Hieracium aurantiacum</i>	Orange hawkweed			X	M, CH	
<i>Hutchinsia procumbens</i>	Prostrate hutchinsia			X	M, CH	
<i>Iva frutescens</i>	Jesuit's-bark			X	A	
<i>Lepidium perfoliatum</i>	Clasping pepperweed		X		A	
<i>Lolium arundinaceum</i>	Tall fescue	X			A	
<i>Lolium perennE</i>	Perennial ryegrass	X	X	X	A	
<i>Lolium perenne ssp. multiflorum</i>	Annual ryegrass	X	X	X	A	
<i>Lolium pratense</i>	Meadow fescue			X	A	
<i>Lotus corniculatus</i>	Birdfoot deervetch	X			M	
<i>Macroptilium gibbosifolium</i>	Variableleaf bushbean			X	M	
<i>Mahonia aquifolium</i>	Hollyleaved barberry		X		M	
<i>Malcolmia africana</i>	African mustard			X	M	
<i>Malus sylvestris</i>	European crabapple			X	M	
<i>Malva neglecta</i>	Cheeseweed	X	X	X	M, CH	
<i>Malva parviflora</i>	Cheeseweed mallow			X	M, CH	
<i>Medicago lupulina</i>	Black medic	X	X	X	A	
<i>Melilotus alba</i>	White sweetclover	X	X	X	A	
<i>Mollugo cerviana</i>	Thread-stem carpetweed	X			M	
<i>Nicotiana glauca</i>	Tree tobacco			X	M, CH	
<i>Olea europaea</i>	Olive			X	M, CH	
<i>Paspalum dilatatum</i>	Dallisgrass			X	A	

Target Species	Common Name	GRCA Location			Treatment Type	
		North Rim	South Rim	Inner Canyon	Mechanical Cultural	Chemical Or All
<i>Piptatherum miliaceum</i>	Smilo grass			X	A	
<i>Plantago lanceolata</i>	Buckhorn plantain	X	X	X	M	
<i>Plantago major</i>	Common plantain		X	X	M	
<i>Platanus wrightii</i>	Arizona sycamore			X	M	
<i>Poa annua</i>	Annual bluegrass			X	A	
<i>Poa compressa</i>	Canada bluegrass	X			A	
<i>Polygonum argyrocoleon</i>	Silversheath knotweed			X	A	
<i>Polygonum aviculare</i>	Prostrate knotweed	X	X		A	
<i>Polygonum convolvulus</i>	Black bindweed	X			A	
<i>Polygonum persicaria</i>	Lady's thumb		X	X	A	
<i>Polypogon interruptus</i>	Ditch polypogon			X	A	
<i>Polypogon monspeliensis</i>	Rabbitfoot grass	X		X	A	
<i>Polypogon viridis</i>	Beardless rabbitsfoot grass			X	A	
<i>Populus x canadensis</i>	Carolina poplar		X		M	
<i>Portulaca oleracea</i>	Little hogweed		X	X	M	
<i>Potamogeton crispus</i>	Curly pondweed			X	M	
<i>Prunella vulgaris</i>	Healall	X			M	
<i>Prunus persica</i>	Peach		X	X	M	
<i>Pseudognaphalium luteoalbum</i>	Jersey cudweed	X		X	A	
<i>Puccinellia distans</i>	European alkali grass			X	A	
<i>Punica granatum.</i>	Pomegranate			X	M	
<i>Ranunculus sceleratus</i>	Celeryleaf buttercup			X	A	
<i>Rorippa nasturtium-aquaticum</i>	Water cress			X	M	
<i>Rosmarinus officinalis</i>	Rosemary		X	X	M	
<i>Rumex crispus</i>	Curly dock	X	X	X	M, CH	
<i>Rumex dentatus</i>	Toothed dock	X	X	X	M, CH	
<i>Schismus arabicus</i>	Arabian schismus			X	A	
<i>Schismus barbatus</i>	Mediterranean grass			X	A	
<i>Setaria verticillata</i>	Bur bristlegrass			X	A	
<i>Setaria viridis</i>	Green foxtail			X	A	
<i>Silene noctiflora</i>	Nightflowering silene	X			A	
<i>Solanum lycopersicum</i>	Garden tomato				M	
<i>Solanum physalifolium</i>	Hairy nightshade			X	M	
<i>Sophora japonica</i>	Japanese pagoda tree		X		M, CH	
<i>Spergularia salina</i>	Salt sandspurry			X	M	
<i>Spiraea X vanhouttei</i>	Van Houtt's spirea		X		M	
<i>Stellaria media</i>	Common chickweed	X	X		M	
<i>Tanacetum vulgare</i>	Common tansy		X		A	
<i>Taraxacum laevigatum</i>	Rock dandelion		X		A	
<i>Thlaspi arvense</i>	Field pennycress		X		A	
<i>Tragopogon dubius</i>	Yellow salsify, goatsbeard	X	X		M	
<i>Tragopogon porrifolius</i>	Purple salsify			X	M	
<i>Trifolium hybridum</i>	Alsike clover			X	A	
<i>Trifolium repens</i>	White clover	X	X		A	
<i>Triticum aestivum</i>	Wheat		X		A	
<i>Typha angustifolia</i>	Narrowleaf cattail			X	M	
<i>Veronica anagallis-aquatica</i>	Blue water speedwell			X	M	
<i>Viburnum opulus</i>	Viburnum		X		M	

APPENDIX C Public Scoping Summary

Table C-1 Summary of Comments in Response to Exotic Plant Species Management Plan Scoping Letter (March 2005)

Concerns/Comments	NPS Response
Priorities and Ranking	
Priorities for action should include locations where early detection and control can stop invasion before it gets going. Early detection warning systems should be a part of this.	Prevention is a key component of all alternatives. C coordination and collaboration also addresses this concern.
Begin with areas most altered by people, Phantom Ranch and Grand Canyon Village – lead by example; set the standards for native planting around residential areas.	A majority of efforts focus on developed areas, but natural, less disturbed areas are prioritized as well. Residential/housing areas will be addressed in planning, and planting guidelines will be provided in park housing policy.
Describe and explain the prioritization process in discussion of the proposed action. This will yield a list of areas where control is necessary.	NPS prioritization focuses on species. This document provides guidance on areas of concern, including entry and dispersal corridors which will be a top priority.
Develop a ranking system to identify priority by which specific sites should be treated. By doing so, both the location of each site to be treated and the occurrence of listed species/habitat will be known, site-specific evaluation of the effects can be identified.	Annual work plans will be divided into zones and specific sites in each zone. Within these sites, specific species will be identified for treatment.
Education	
The plan should include effective education on extreme ecological and economic impacts, actions that can be taken to reduce the spread, and contact information for reporting outbreaks	This is a component of all alternatives and discussed in this EA/AEF.
How expensive is this project and where will funding come from and who will be doing the work?	Funding will come from National Park Service, Department of the Interior, Arizona state, partner organizations, and other funding sources as applicable. Park staff and volunteers will accomplish work. An Exotic Plant Management Team may be used as funding allows.
General Questions to answer in the EA	
Which exotic plant species are “too widespread for control”?	“Too wide spread” refers to species whose control would not be feasible due to areas infested; however, this is determined on a species by species basis.
Will park employee residences be surveyed for exotic plants?	Yes, surveys are proposed in the alternatives and will be included in

Concerns/Comments	NPS Response
	annual work plans. Residential areas are discussed under the preferred alternative description in Chapter 2.
Will Phantom Ranch be included in the survey for exotic plants?	Yes, Phantom Ranch will be surveyed and exotic species will be treated as part of annual work plans.
Monitoring	
The plan should include details on how and when monitoring will occur and how it will be funded.	Monitoring is discussed under all alternatives. Funding will come from National Park Service, Department of the Interior, Arizona state, partner organizations, and other funding sources as applicable.
Control Methods	
NPS should consider Fire use as a control method.	Some fire use is included in the action alternative described in Chapter 2. In addition, the park's vegetation program and fire program will work closely to develop protocols for large-scale fires that benefit both programs, and determine methods that help both programs attain goals.
NPS should consider the use of flooding as a control method.	Site-specific flooding is more often used in agricultural and more controlled settings. This treatment method is not currently proposed due to requirements for flooding, amount of water necessary, and cost.
Use Thomas Egan's Seven Point Approach to Site Restoration and Maintenance for Salt Cedar.	Yes, the park proposes to use Thomas Egan's seven point approach.
The use of synthetic herbicides should be limited to only those exotic species which cannot be controlled in any other manner.	IPM is designed specifically for this purpose, to use appropriate techniques and limit herbicide use.
Selection of appropriate control methods should be influenced by the possible effects to listed species. Treatments in areas with listed species should be tailored to result in the least possible effect while still meeting objectives.	The Biological Assessment being prepared for this project addresses this concern; the NPS intends to minimize adverse impacts to listed species.
For cultural control methods, use species native in the project area to minimize unintended effects.	Use of native species is current practice and is proposed to continue in both alternatives.
Use of biological control agents could result in significant impacts to listed species and to composition, structure and function of both natural and exotic ecosystems- we have several concerns with their	Biological control agents were initially considered, but dismissed in this document. Additional compliance will be necessary if biological control is proposed in the future.

Concerns/Comments	NPS Response
use.	
Resource Protection/Potential Effects	
The plan should follow minimum requirements analysis (MRA) and methods that are compatible with wilderness values.	This EA/AEF follows the MRA process (see Wilderness Character section in Chapter 3). Additional MRAs will be completed as needed for projects in or adjacent to proposed wilderness.
NPS had done landscaping work at Phantom Ranch and it has resulted in damage to fish habitat in Bright Angel Creek (removal of beavers, planting of nonnative trees).	Overall changes to habitat at Phantom Ranch are outside the scope of this project. However, exotic plant species at Phantom Ranch will be surveyed and prioritized for treatment.
The use of herbicides with riparian areas and along the Colorado River and its tributaries must be accomplished with strict adherence to label instructions and approved for aquatic use.	Only herbicides approved for aquatic use will be used in riparian areas and around water sources. All label instructions will be followed.
Consider threatened and endangered species in your project area.	Threatened and endangered species are considered in this EA/AEF as well as in annual work plans. The Biological Assessment identifies appropriate mitigation measures and outlines when additional consultation is needed.
Cultural, natural herbicides, synthetic herbicides, and biological control may have more complex effects that may extend beyond the boundaries of the areas to be treated.	All anticipated effects of proposed methods are addressed in the impact analysis of this document, see Chapter 3.
Cultural methods, particularly seeding of competitive plants, may result in effects to listed species beyond those that occur with the use of other methods, or unintended effects.	Selection of species for seeding does consider competitiveness and effects. Additionally, only native species are used in seeding. The BA fully addresses listed species.
Herbicide use may result in effects outside the treatment area and may directly affect listed species – use USFWS Region 2 guidance.	The Biological Assessment for this project addresses all expected effects including indirect effects and is based on Region 2 guidance.
Use of biological control agencies could result in significant impacts to listed species and to composition, structure and function of both natural and exotic ecosystems- we have several concerns with their use.	Biological control agents were initially considered, but dismissed in this document. Additional compliance will be necessary if biological control is proposed in the future.
Use Appendix G of the Southwestern Willow Flycatcher Recovery Plan (2002) for exotic plant management in areas where flycatcher habitat is involved.	The Southwestern Willow Flycatcher Recovery Plan will be used where flycatcher habitat is involved.
Consider joint approaches to the Lees Ferry area where you share	Continued collaboration with Glen Canyon NRA is included in the

Concerns/Comments	NPS Response
a small boundary with Glen Canyon NRA—also a hotbed of exotics.	project proposal.
Suggested Alternatives or Alternative Components	
NPS should consider an alternative that incorporates the lowest risk control method.	Integrated Pest Management (IPM), proposed for exotic plant management, is designed to use the lowest risk control method for each plant species.
NPS should consider planting narrowleaf cottonwoods at Phantom Ranch to shade buildings and allow the creek to return to a more stable condition with beaver reintroduction.	Planting narrowleaf cottonwoods at Phantom Ranch is outside the scope of this project. At this time GRCA does not have the funding or staff to complete this project; however, compliance has been completed and the project could be implemented in the future.
Restore Bright Angel Creek so that native plants and trees can flourish.	See previous comment.
The proposed action should include an evaluation of situations where ongoing management practices contribute to or facilitate establishment or spread of exotic plants and how this will be evaluated and modified.	Mitigation measures are included in this document to address ongoing management practices that could contribute to the spread of exotic plants (i.e., fire activities, construction, livestock use).
The proposed action should include an expanded prevention component; follow the lead of USFS and BLM that have developed extensive general and specific guidelines to address ways various planned projects (prescribed fire, forest restoration) can be managed to prevent establishment of exotic plants.	The preferred alternative includes increased prevention. Additional mitigation measures are also proposed for planned projects to address exotic plant species.
The proposed action should include simultaneous or subsequent restoration of desired ecosystem components (e.g. native plants displaced by invaders) to control or eliminate exotic plants. If these components are not re-established after treatment, reinvasion will be the same.	Cultural treatments including seeding and planting will be used to restore areas as feasible.

APPENDIX D Annual Work Plan Outline

I. Introduction

- A. Review of Park Management Areas (see Chapter 1)
- B. Goals and Objectives of the Invasive Plant Work Plan (see Chapter 1)
- C. 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 <ul style="list-style-type: none"> a. Herbicide Training Log b. Job Hazard Analyses c. Pesticide Use Proposal Forms d. Herbicide Use Log
Appendix 3	Herbicide Labels
Appendix 4	GRCA Vegetation Program Safety Plan
Appendix 5	Additional Species Information

APPENDIX E Mitigation Measures Addressing Exotic Plants

The following mitigation measures are used in typical GRCA construction projects. These measures were taken from the South Rim Visitor Transportation Plan Finding of No Significant Impact:

- 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 park's 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.
- All construction equipment that will leave the road (e.g., bulldozers and backhoes) will be pressure-washed before entering the park. The location selected for vehicle washing, in addition to that selected for the batch plant, will be approved by a supervisory biologist.
- Staging area locations for construction equipment will be park approved, and the need to treat for nonnative vegetation will be considered.
- Vehicle parking will be limited to existing roads or the staging areas.
- Any fill, rock, or additional topsoil needed will be obtained from a park-approved source. Topsoil from the project area will be retained whenever feasible.
- A revegetation plan will be developed by the park's vegetation program manager in consultation with a landscape architect. Any revegetation efforts will use site-adapted native species and/or site-adapted native seed, and park policies regarding revegetation and site restoration will be incorporated. The plan will consider, among other things, 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*.
- 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.
- Nonnative species encroachment and distribution will be monitored for two to three years after construction.
- Revegetation efforts will be initiated as soon as possible following construction to minimize the competition of native species with nonnative species.
- The NPS will provide visitors with educational and advisory materials about driving vehicles from areas that have nonnative species infestations outside the park and bringing these species into contact with areas that have little to no current nonnative species infestations inside the park.

APPENDIX F Recently Completed, In-Progress, and Foreseeable Actions

Recently Completed and In-Progress Projects and Plans

Construction Related Projects and Plans

Desert View Improvements – Activities included realignment of Desert View Drive to move traffic away from the rim; construction of a new parking lot and shuttle bus transit facility; installation of additional visitor orientation services facility; construction of trails, utilities, picnic, and other visitor facilities; and rehabilitation of the south entrance road and portions of Desert View Drive. As part of this project, a new entrance station has been constructed. Approximately 1.5 acres needed to be cleared of vegetation to provide for the footprint of the new entrance station.

North Rim Development Plan – This plan completed in 2005 was written to improve visitor orientation and interpretation, vehicle and non-vehicular circulation, employee housing, and use of various North Rim buildings. Some projects including installation of an orientation kiosk at the entrance station have been completed; some are in progress including Phase IV of the Greenway Trail; and others are planned for the future. The plan provides a comprehensive look at all aspects of visitor and administrative use on North Rim.

Parkwide Restrooms – This project titled *Construct, Rehabilitate and Repair Restrooms Parkwide* was initiated to address a need for these actions throughout the park. Many projects identified in the environmental assessment have been completed. Several are planned for construction and rehabilitation in 2009 including South Kaibab Trailhead, Three Mile and Pipe Creek along Bright Angel Trail, and Desert View.

Hermit Road Rehabilitation – The rehabilitation project on seven-mile-long Hermit Road is currently underway. Hermit Road is located on South Rim between Grand Canyon Village and Hermits Rest. Actions include widening and resurfacing the road, improving existing trails, overlooks and parking areas, and constructing a multi-modal greenway trail.

South Entrance Road Improvements – Implementation of improvements to the South Entrance Road (Highway 64) between the community of Tusayan and the entrance station has started. The park worked collaboratively with the Arizona Department of Transportation (ADOT) to address proposed work in the ADOT right-of-way south of the park boundary. The purpose of these improvements is to provide an effective system to address crowding and safety issues that can occur during high visitor use season at the park's south entrance. The project includes construction of up to two additional northbound lanes and an independent bypass lane that will be available to transit vehicles, employees and residents, and other users as determined by the National Park Service. The bypass lane recently completed diverges from SR 64 between the park boundary and the park sign and merges back into the highway just north of the entrance station. If needed, an additional northbound lane may be added as a feeder lane for the bypass lane. This lane would extend from just north of the Tusayan Ranger District access road to the south end of the bypass lane.

South Rim Visitor Transportation Plan – The purpose of the South Rim Visitor Transportation Plan is to provide a transportation system that addresses the

park's most pressing transportation issues through the year 2020. The plan would accommodate current and anticipated levels of visitation to South Rim, facilitate enhanced visitor experiences and protect park resources. Alternatives under consideration may include new parking areas near Canyon View Information Plaza (CVIP), or outside the park north of Tusayan; expanded shuttle bus transit from Tusayan to CVIP; expanded shuttle bus transit within the Village and to Hermits Rest; improvements at South Entrance Station to reduce wait times, such as additional vehicle lanes and tour bus parking/management. The EA is complete and is planned from 2008-2012.

Other Plans and Management Activities

Colorado River Management Plan (CRMP)/Monitoring and Mitigation Plan/Implementation Framework – The 2006 CRMP regulates recreational use on the Colorado River through GRCA by regulating daily launches, group size, seasonal use of motorized and non-motorized boats, trip length, and number and distribution of commercial and non-commercial trips. The Monitoring and Implementation Plan will provide the framework for monitoring and mitigating visitation effects to cultural and natural resources and visitor experience.

Fire Management Plan – GRCA released a draft environmental impact statement (EIS) on the Fire Management Plan for the park. The plan includes prescribed burns, suppression of fires, and use of wildfires.

Foreseeable Future Actions

Construction Related Projects and Plans

Greenway Trail – Phase V (Greenway V) – The park proposes to construct an approximately one-mile long paved trail from Pipe Creek Vista, an overlook along Desert View Drive, to the South Kaibab Trailhead. Completion of this trail segment would connect the paved rim trail from Mather Point to the South Kaibab Trailhead. The majority of the trail alignment would use existing disturbed corridors to minimize new ground disturbance. Pipe Creek Vista and South Kaibab Trailhead are both accessible by shuttle bus and Pipe Creek Vista also provides some vehicular parking. The scope of the project includes reconfiguring parking at the Overlook for enhanced safety and to provide adequate room for the trail to cross the overlook area; creation of an accessible path from the South Kaibab Trailhead parking area to the trailhead itself with improved site amenities; and identification of a connector trail between the South Entrance Road and the project area for Arizona Trail users, bicyclists, and equestrians.

Employee Housing – The National Park Service currently has a shortage of housing for park employees; many have to share quarters that are too small or in disrepair. Through this project, approximately 32 housing units will be constructed in four eight-plex apartment buildings in Phase I, with a potential for four more buildings in the future (a total of 64 units). Buildings, parking, access, and utilities will be placed south of Albright Training Center in a previously disturbed area, where trailer housing units are currently located. This project is anticipated to begin in 2009 and go through 2010. Total estimated disturbance is five to ten acres.

To help further meet housing needs, the National Park Service is currently constructing up to 40 trailer pad sites and utilities: 20 sites for park employees and up to 20 sites for shuttle bus transit operators. The 20 pad sites for shuttle bus operators would include five sites to meet immediate needs and 10 for the new bus operation (part of the no-action alternative). An additional five sites could be constructed in the near term for additional staff.

Bright Angel Trailhead – The National Park Service proposes to develop and implement a design plan for Bright Angel Trailhead in Grand Canyon Village on South Rim. Proposed actions include development of a plaza area near the primary trailhead; enhancing trail connections and wayfinding; construction of a new restroom near the proposed plaza and existing mule corral; and differentiating vehicle circulation in the parking area from pedestrian zones in the project area. Future phases of the project, if funded, would include hardening the parking area surface and delineating parking spaces for approximately 79 vehicles, additional revegetation and landscaping, enhanced wayfinding, and interpretive signage and creation of an interpretive node at Kolb Garage.

Other Plans and Management Actions

Backcountry Management Plan – The National Park Service is initiating the process to revise the 1988 Backcountry Management Plan. The 1988 plan needs to be updated to comply with the 1995 General Management Plan and *NPS Management Policies 2006*. The scope of the plan is still being considered, but is expected to include visitor use and access into the backcountry, natural and cultural resource stewardship and recommended wilderness. The plan will complement other recently completed or in-progress plans such as the Colorado River Management Plan and the Fire Management Plan. It is expected that corridor trails (Bright Angel, South Kaibab and North Kaibab) and use areas along these trails will be included in the plan.

APPENDIX G Wildlife and Plant Descriptions**Federally Listed Species:**

Mexican Spotted Owl – Threatened – The Mexican spotted owl (MSO) was listed as a threatened species in March 1993. Mexican spotted owls nest and roost primarily in closed-canopy forests or rocky canyons. Forests used for roosting and nesting often contain mature or old growth stands with complex structure. Mexican spotted owls do not build nests, but use naturally occurring sites, often in large diameter trees, cliff cavities, and abandoned hawk or raven nests. Spotted owls prey mainly on small mammals, birds, insects, and reptiles. Spotted owls are known to occur in cool canyon habitat of GRCA. Currently 41 PACs have been designated in the park and occur in the natural zone. No MSO nests are known to occur on GRCA's plateau areas, but MSO have infrequently been found to forage on North and South Rim plateaus in close proximity to the rim (Bowden, 2008).

Southwestern willow flycatcher – Endangered – The southwestern willow flycatcher (SWWF) was listed as endangered in 1995. In 1997, 599 river miles of critical habitat were designated in southwestern New Mexico, southern California, and Arizona. GRCA critical habitat includes a portion of the main Colorado River corridor, from River Mile (RM) 39 downstream to RM 71.5; the boundaries also include areas within the 100-year floodplain (Fed. Reg. 1997). Southwestern willow flycatchers generally arrive at breeding grounds between early May and early June, although a few individuals may establish territories in late April (USFWS 2002c). This small migratory bird occurs in dense riparian habitats along rivers, streams, or other wetlands where cottonwood, willow, box elder, tamarisk, Russian olive, buttonbush, and arrowweed are present. One of the most important characteristics of the habitat appears to be the presence of dense vegetation throughout all vegetation layers (United States Geological Survey, 2008). Almost all SWWF breeding habitats are within close proximity (less than 20 yards) of water or very saturated soil.

The Grand Canyon population is small (average number of nests per year is less than two) and restricted to a particular reach of the main corridor (RM 28 to 71), and near the western boundary of the park at RM 259-275. There are no historic or current records of SWWF breeding in the tributaries of the Colorado River in GRCA.

California condor – Threatened - The California condor was listed as an endangered species in March 1967. In December 1996 the first condors, part of a nonessential experimental population, were released in the Vermilion Cliffs area of Coconino County, Arizona, approximately 30 miles north of GRCA. Subsequent releases have occurred 1997- 2008 in the same vicinity, and in the Hurricane Cliff area, about 60 miles west of Vermilion Cliffs. By declaring the population experimental, nonessential, the USFWS can treat this population as threatened, and develop management regulations less restrictive than mandatory prohibitions covering endangered species. Within GRCA, the condor has the full protection of a threatened species (National Park Service, 1991).

California condor nesting habitat includes various rock formations such as crevices, overhung ledges, and potholes. Roost sites include cliffs and tall trees, including snags (USFWS & USDO, 1996). California condors typically forage in

open terrain, although recent records are indicating foraging is occurring in close proximity to clusters of trees. GRCA forested areas with fairly closed canopy have been used recently by condors feeding on elk and deer carcasses. Typical foraging behavior includes long-distance reconnaissance flights, lengthy circling flights over a carcass and hours of waiting at a roost or on the ground near a carcass. As of 2008, the population of free-flying condors in Arizona totals 64 (Marshall, 2008).

California brown pelican – Endangered - The California brown pelican was listed as endangered in 1970. The brown pelican is found occasionally along rivers and lakes in Arizona. Brown pelicans were observed along the Colorado River corridor in GRCA in mid-to-late June 2004. These were thought to be immature pelicans moving upstream from areas such as Lake Mohave. Reports include an aggressive pelican at Phantom Ranch near the boat docking area and one bird fishing and approaching boats near Hermit Creek. There was also a report of a possible dead pelican at Lava Chuar in late June 2004. It is not known if sightings were of the same or different pelicans.

Western yellow-billed cuckoo – Candidate - The western subspecies of the yellow-billed cuckoo (*Coccyzus americanus occidentalis*) was once a common neotropical migrant among river bottoms from British Columbia to Mexico. Loss of riparian habitat and sensitivity to pesticides led to rapid population declines and range contraction (Gaines & Laymon, 1984; Hughes, 1999; Laymon & Halterman, 1987). By the 1990s known breeding populations were restricted to California, Arizona, and New Mexico (Gaines & Laymon, 1984; Hughes, 1999). These birds arrive on breeding grounds in mid-to-late May, where they breed in dense riparian patches of willow and Fremont cottonwood (Anderson & Laymon, 1989; Gaines & Laymon, 1984; Hughes, 1999; Laymon & Halterman, 1987; Wiggins, 2005). Nests are often placed in willows, in dense foliage, and close to water, while foraging largely takes place in nearby cottonwoods (Anderson & Laymon, 1989). Cottonwood-willow patches with a closed canopy constitute preferred habitat (Laymon & Halterman, 1987). However, along the Colorado River in Arizona and southern California, breeding pairs have been detected in smaller patches of vegetation with less closed canopy and “recent studies in Arizona have found cuckoos nesting in mesquite (*Prosopis spp.*) and hackberry (*Celtis occidentalis*)” (Halterman et al., 2003; Wiggins, 2005). In an unpublished study conducted jointly by the Arizona Department of Game and Fish and U.S. Geological Survey 1998-99, yellow-billed cuckoos were detected in 117 vegetation patches primarily dominated by cottonwood and willow. In other patches dominant species included mesquite, sycamore, alder, ash, and rarely tamarisk. In GRCA, a single yellow-billed cuckoo record exists prior to 1984, and an individual was observed at Lees Ferry and at river mile 14.2 in June 1995 (LaRue et al., 2001).

Yuma clapper rail – Endangered - The Yuma clapper rail was listed as endangered in 1967. Critical habitat has not been designated. The current range of the species includes the Colorado River from the lower Virgin River to Mexico and various locations in the Gila River drainage. This bird inhabits freshwater or brackish stream-sides and marshes under 4,500 feet. It is associated with dense riparian and marsh vegetation dominated by cattails. Nests are built three-to-six inches above water in sloughs and backwaters supporting dense stands of bulrush and cattails. Breeding occurs from March to early July. Most Yuma clapper rails do not migrate. Very little is known about dispersal of adult or juvenile birds, but there is evidence of populations expanding northward along the lower Colorado

River, Salton Sea, and central Arizona over the last 80 years (United States Fish and Wildlife Service & United States Department of the Interior, 2004a). Presence of Yuma clapper rails was recorded between Spencer Canyon (RM 246) and GRCA boundary (RM 276) in 1996 and 1997 during southwestern willow flycatcher surveys. These are the only known recorded observations in GRCA.

Bald Eagle – Delisted – The bald eagle, listed as endangered in 1967, was reclassified as threatened in the lower 48 states in 1995, and was proposed for delisting in 1999. The bald eagle is listed by the Arizona Game and Fish Department as a wildlife species of special concern. Bald eagles are found in all counties of Arizona, typically near lakes and rivers where they forage for fish (AGFD 2002b). They arrive in Grand Canyon as early as the last week of October and typically leave by the third week of March. Bald eagles roost and nest in large trees or on cliffs or pinnacles near water; nesting does not occur in the canyon (Brown & Stevens, 1997). In the 1980s and early 1990s many bald eagles congregated at the mouth of Nankoweap Creek to feed off spawning rainbow trout. Numbers have been greatly reduced in recent years since changes in stream morphology have hampered movement of trout into the creek and reduced foraging opportunities for eagles.

Kanab ambersnail – Endangered - The Kanab ambersnail (KAS) was listed as endangered in 1992 and a Recovery Plan issued in 1995. This terrestrial land snail is a rare endemic with restricted habitat, and is found in wetlands, springs, and seeps at the base of sandstone or limestone cliffs around 2,900 feet. Three naturally-occurring populations were known to exist on the Colorado Plateau as of 1991; two in southern Utah near Kanab, Utah and one at Vaseys Paradise in GRCA (United States Fish and Wildlife Service & United States Department of the Interior, 1995). KAS requires either shallow or standing water or a perennially wet soil surface. Grass or sedge cover is also necessary. Adults feed on live and dead plant tissue, and enter dormancy in winter months. Surveys of populations before and after winter months reveal a large percentage of the population might die during this time.

There is only one naturally occurring KAS population in the park and one translocated population. The Niobrara ambersnail, a non-listed relative of the KAS, is documented at one GRCA location. The site was surveyed in 2003, and both habitat conditions and snails were noted as abundant (Sorensen, 2004). A Himalayan blackberry removal project (an exotic species) was initiated in this area by GRCA in 2004 and was successful in removing this invasive species while avoiding impacts to the nearby Niobrara snail habitat. For purposes of this analysis, the Niobrara snail population at Indian Garden is considered a KAS population and will be managed as if it were the Federally listed species.

Humpback chub – Endangered - The humpback chub was listed as endangered in 1967 with critical habitat designated in 1994. The humpback chub is endemic to the Colorado River Basin, and was historically known to occur along portions of the Colorado River between Nevada and Arizona, on the Green River in Wyoming, and on the Yampa River in Colorado. Current range of the species includes the mainstream Colorado River in Grand Canyon and Marble Canyon and in the lower Little Colorado River. It is also found in portions of the Colorado and Green Rivers of Utah and Colorado as well as portions of the Yampa River in Colorado. The population in the Colorado and Little Colorado Rivers in Grand Canyon is the

largest remaining in the basin (United States Fish and Wildlife Service & United States Department of the Interior, 1994). They spawn in the spring between March and May in the Little Colorado River when water temperatures are between 60.8 and 71.6°F.

Razorback sucker – Endangered - The razorback sucker was listed as endangered in 1991. Records for this long-lived species indicate it was abundant in the Lower Colorado and Gila River drainages in the late 1800s and early 1900s (Minckley et al., 1991). Razorback suckers have been declining for much of the last century as a result of extensive water development projects that depleted flows, altered flow regimes, changed water quality, and fragmented habitat (United States Fish and Wildlife Service & United States Department of the Interior, 1998). Introduction of nonnative fishes that predate on razorback suckers has also caused a significant decline in recruitment.

There are few historic records of razorback suckers in Grand and Marble Canyons, possibly due to lack of historic sampling in these inaccessible whitewater canyons (Minckley et al., 1991). In the Lower Basin, this species remains in the Colorado River from Grand Canyon to near the Mexican border. Small numbers occur in Lake Mead and Grand Canyon where individuals are found sporadically downstream on the mainstem river and associated impoundments and canals (United States Fish and Wildlife Service & United States Department of the Interior, 1998). With the exception of the large population remaining at Lake Mohave, these populations are very small and recruitment is virtually non-existent (United States Fish and Wildlife Service & United States Department of the Interior, 1994). Current populations consist primarily of old fish believed to be nearing maximum life expectancy (Minckley et al., 1991).

Relict leopard frog – Candidate – The relict leopard frog (a USFWS candidate for listing as endangered or threatened, and an Arizona wildlife species of special concern) was considered extinct until small populations were located in 1991. This species persists in Nevada near the Overton Arm of Lake Mead and in Black Canyon below Hoover Dam (United States Fish and Wildlife Service & Interior, 2002). Potential habitat in the form of small streams, springs, and spring-fed wetlands between 1,214 and 2,494 feet exists in the area of analysis. In 1987 a researcher found a decomposed leopard frog specimen in a Lower Gorge tributary, identified as a relict leopard frog. In 2004, a leopard frog survey conducted by park biologists discovered a population of leopard frog tadpoles in a small pool up a side canyon in Lower Gorge (Ward, 2009). Initially thought to be relict leopard frog tadpoles, genetic analysis recently completed determined them more closely related to the lowland leopard frog (*Rana yavapaiensis*) than to the relict leopard frog. The NPS is continuing surveys to determine GRCA relict leopard frog status. There are no known populations of relict leopard frog in the park at this time. One leopard frog specimen, presumed to be *Rana onca*, has been documented on the Hualapai Reservation by tribal biologists, but genetic analysis has not been performed.

Mohave desert tortoise – Threatened – The Mojave population is a Federally threatened species and an Arizona species of special concern that inhabits Grand Canyon's north side and west end. Critical Mojave tortoise habitat was designated in 1994 and includes areas adjacent to GRCA in Lake Mead National Recreation Area. In May 2004, in the Whitmore area on the river's north side, biologists from

Lake Mead National Recreational Area and Grand Canyon National Park discovered desert tortoise scat and a burrow that was thought to belong to the Mojave tortoise (Ward, 2008). In late August 2004, the University of Reno confirmed the scat collected from the area belongs to the Mojave population of the desert tortoise.

Sentry Milk-Vetch – Endangered – Sentry Milk-vetch was listed as a threatened candidate species (Category 1) in 1980 due to its declining status caused by visitor trampling and habitat degradation. Sentry milk-vetch is the park's only Federally listed endangered plant species. It is a small, mat-forming, herbaceous perennial plant with a thick taproot. Its short creeping stems have compound leaves. Whitish or pale purple flowers appear late-April to early-May, with seed set in late-May to June. Seeds are small and not wind or rodent dispersed, but instead fall in the plant mat; therefore, the population does not spread and remains isolated. Plants occur in crevices and depressions with shallow, well-drained soils or porous limestone pavement in the pinyon-juniper woodland along the canyon's edge. The underlying limestone bedrock stores water and is critical to the growth and development of seeds (Crawford, 2006). This species is endemic to Grand Canyon National Park and occurs at approximately 6,100 feet. This species is found only on limestone outcrops on South Rim of Grand Canyon.

Brady Pincushion Cactus – Endangered – The Brady pincushion cactus was listed as endangered in 1979. It was first discovered in 1958 and has shown a marked reduction in plant number since that time. It is a small semiglobose cactus with yellow flowers and typically a single stem. This species is endemic to a small geographical area in Coconino County, and occurs on benches and terraces of the Colorado Plateau near the Marble Canyon area in northern Arizona. Its habitat includes Kaibab limestone chips overlying soil derived from Moenkopi shale and sandstone outcrops at elevations between 3,861 and 4,488 feet in the Great Basin Desert Scrub biotic community (Brown, 1994). Plants are found in exposed, sunny situations (United States Fish and Wildlife Service & United States Department of the Interior, 1985). Distribution is reasonably well-documented; it has not been recorded in GRCA, but does occur near its boundaries in the Marble Canyon area.

Fickeisen Plains Cactus – Candidate – This species has been a candidate for listing since 1975. In April 2007, species information was reviewed, and the USFWS concluded this species is warranted for listing throughout all of its range and should continue to be considered a candidate. The Fickeisen plains cactus is found on canyon margins and well-drained hills in deserts and grasslands at elevations between 4,298 and 5,446 feet. Monitoring data suggests numbers are declining, and one factor contributing to decline is continuing drought (United States Fish and Wildlife Service & United States Department of the Interior, 2007). This species is not known to occur in GRCA, but populations are known from the Marble Canyon area near the park boundary.

Other Species of Special Concern / Non-Federally Listed Species:

Flannelmouth Sucker – The flannelmouth sucker (a Grand Canyon National Park species of concern) is found in the Colorado River mainstem throughout Glen Canyon National Recreation Area, Grand Canyon National Park, and in most tributaries including the Paria River, the Little Colorado River, Bright Angel Creek, Kanab Creek, Shinumo Creek, and Havasu Creek (Valdez et al., 1998).

Tributaries and confluence areas have generally had higher densities of this species than the mainstem and are the most likely sites for successful reproduction (Valdez & Ryel, 1995). Spawning occurs March through July and has been reported from the Paria River, the Little Colorado River, and Shinumo, Bright Angel, Kanab, Havasu, Spencer, and Surprise Canyon Creeks (Arizona Department of Game and Fish, 2001a; Valdez et al., 1998). Mainstem spawning has also been documented in the tailwaters of Glen Canyon Dam (apparently unsuccessful because of cold water temperatures) and in western Grand Canyon (Arizona Department of Game and Fish, 1996; McKinney, 1999). The canyon population of flannelmouth suckers has never been formally estimated but is considered to be relatively stable (Valdez et al., 1998).

Northern Leopard Frog – The northern leopard frog (listed as an Arizona wildlife species of special concern, and a species in jeopardy by the Navajo Nation) occurs in northeastern and north-central Arizona in and near permanent water with rooted aquatic vegetation, generally at elevations from about 2,640 to 9,155 feet (Arizona Department of Game and Fish, 2002b). These frogs use springs, streams, and ponds, as well as moist habitat in grasslands, brush lands, woodlands, and forests. Breeding takes place March through May, eggs are deposited on submerged vegetation in shallow water, and tadpoles transform to frogs June through August (Miller, 1982). Leopard frogs (either adults or tadpoles) were historically observed at one locality along the river in the canyon and in several tributaries. One extant population is known to occur along the river in Glen Canyon a few miles upstream of the park boundary (Spence, 1996). A survey to determine the status of northern leopard frog populations in the river corridor is currently being conducted by the NPS.

American Peregrine Falcon – The American peregrine falcon was listed as endangered in 1970; however, recovery efforts were successful, and the species was removed from the list in 1999. It is now considered an Arizona species of special concern. To ensure the peregrine falcon's recovery in Grand Canyon, the park treated the species as endangered until 2004. Currently, over 100 pairs nest in the park from Lees Ferry to Lake Mead and a monitoring program is in place (Ward, 2000). Peregrines use areas with high massive cliffs, preferably near water, where bird concentrations (food source) are relatively high.

Allen's Lappet-browed Bat – Allen's lappet-browed bat (a Grand Canyon National Park species of concern) is found in Mexico, Arizona, and New Mexico (Arizona Department of Game and Fish, 2001b). In Arizona, the bat occupies mountainous regions at higher elevations. Typical habitat includes ponderosa pine, pinyon/juniper, and riparian areas with sycamore, cottonwood, and willow. Individuals have also been observed in Mojave desert scrub and white fir. Boulder piles, cliffs, rocky outcrops, and lava flows also tend to be associated with their preferred habitat. Day roosts include rock shelters, caves, mines, and trees.

Northern Goshawk – The northern goshawk (Federal species of concern and an Arizona wildlife species of special concern) is found in coniferous forests in northern, north-central, and eastern Arizona (Arizona Department of Game and Fish, 2003a) and in pine-oak habitats in isolated mountain ranges in southeastern Arizona. Threats to goshawk populations include historic timber management and habitat threats from wildfire. The northern goshawk generally nests in stands of mature trees with dense canopy. In the Southwest, goshawks most frequently

occupy three forest types: ponderosa pine, mixed-conifer, and Englemann spruce-subalpine fir. As of 2007, 18 northern goshawk territories are identified in North Rim forests, and four territories in South Rim forests.

Greater Western Mastiff Bat – The greater western mastiff bat (a Grand Canyon National Park species of concern) has been observed year-round in most Arizona counties, including Coconino and Mohave (Arizona Department of Game and Fish, 2002a) and has been recorded in the park. These bats prefer narrow, rocky canyon walls with many crevices in lower and upper Sonoran desert scrub habitat. They crowd into tight, deep crevices and are able to crawl through small passageways to reach the roosting site.

Mexican Long-tongued Bat – The Mexican long-tongued bat is an Arizona wildlife species of special concern and is the only phyllostomid species found in the park. It lives in caves and mines in the park and is primarily nectarivorous and fugivorous (Arizona Department of Game and Fish, 2006). Mexican long-tongued bats do not enter torpor in winter, so warm geothermally heated roosts are important for their survival. Only three occurrences of this species are known in GRCA (Ward, 2009).

Pale Townsend's Big-eared Bat – The pale Townsend's big-eared bat (a Grand Canyon National Park species of concern) is found in Arizona from the vicinity of the Grand Canyon to the southeastern portion of state (Arizona Department of Game and Fish, 2003b). Habitat types used by this bat include desert scrub, oak woodland, oak/pine forests, pinyon/juniper forests, and coniferous forests. Caves are a preferred location for day roosts in summer and hibernation in winter. This species is sensitive to disturbance and often abandons maternity colonies as a result of human activity. A gate designed to keep out human visitors but allow entry by bats was installed in 1997, and the cave is once again home to a maternity colony of this species.

Pocketed Free-tailed Bat – The pocketed free-tailed bat is a Grand Canyon National Park species of special concern. The pocket for which it is named consists of a membrane that extends the length of the femur (Arizona Department of Game and Fish, 2003f). Arizona is the northern limit of its range, and it has been found from Lake Mead to below the Mogollon Rim. It was first collected in GRCA in 2002 near RM 209. It prefers caves and crevices along rocky cliffs and lives in colonies of less than 100 individuals.

Southwestern Myotis Bat – The southwestern myotis is a small brown bat that inhabits Arizona and New Mexico, and is predominantly found in southern parts of these states. It is a Grand Canyon species of special concern because it was caught only once along the Colorado River in the park. It primarily lives in ponderosa pine forests, oak woodlands, pinyon-juniper, chaparral and mesquite, but roosts in riparian habitat adjacent to water. It relies on cliff-face crevices for hibernation, and makes maternity roosts in cavities of living and dead Gambel oak and under the bark of ponderosa pine snags.

The spotted bat (an Arizona wildlife species of special concern) is found in central western North America, from Canada to Mexico (Arizona Department of Game and Fish, 2003c). Multiple populations have been found throughout Arizona, with a fairly large one near the Utah-Arizona border. In Arizona, this species has mostly

been collected from dry, rough desert scrub, although a few have been documented in ponderosa pine forest. They roost in small cracks in rocky cliffs. Spotted bats have been collected from canyon rim to river in localized areas of the park (Ward, 2009).

Western Red Bat – The western red bat (an Arizona wildlife species of special concern) ranges from southern Canada to South America where it migrates during winter (Arizona Department of Game and Fish, 2003d). It resides in Arizona from April through September and is found primarily in riparian and woodland habitats. Roosting sites are located in foliage of trees and shrubs. Fewer than 100 individuals have been sighted throughout the state. It is dispersed throughout the river corridor and has been observed and collected at various locations from Bright Angel Creek to Diamond Creek (Ward, 2009).

Long-legged Myotis – The long-legged myotis bat (a Grand Canyon National Park species of concern) ranges from southeastern Alaska and western Canada to central Mexico (Arizona Department of Game and Fish, 2003e). Its preferred habitat type is coniferous forests but riparian and desert habitats are occasionally used. Typical roosting sites include abandoned buildings, cliff crevices, and behind exfoliating tree bark. Caves are used for hibernating in winter. Long-legged myotis have been collected along river corridor and canyon plateau regions of the park (Ward, 2009).

Desert Bighorn Sheep – Preferred habitat for desert bighorn sheep (classified by the Navajo Nation as potentially in jeopardy in the future) is rough, rocky, sparsely vegetated land, characterized by steep slopes, canyons, and washes. They tend to stay within a few miles of perennial water, but also use ephemeral pools and moisture from succulent plants (Hoffmeister, 1986). Breeding occurs July through September peaking in August. Lambing typically occurs in February; once lambing commences, bighorn move to lower elevations. Bighorn are commonly seen on rocky cliffs along the river. In a 2002 NPS-sponsored survey, approximately 100 to 120 sheep were counted from the river (National Park Service, 2003b). Little is known about the population status of desert bighorn sheep in the park.

APPENDIX H Minimum Requirement Analysis

INTRODUCTION

No portion of Grand Canyon National Park has been designated as wilderness. Nevertheless, *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 continue, “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 its Final Wilderness Recommendation/1993 Update, the NPS identified most of the Colorado River corridor as potential wilderness.

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 exotic plant management throughout the park. 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.

GRCA MINIMUM REQUIREMENT ANALYSIS

Exotic Plant Management in Grand Canyon National Park

PART A: Is this action necessary to manage the area as wilderness?

DESCRIPTION OF PROPOSED ACTION: Treat exotic plants using integrated pest management techniques including survey, coordination with park staff and adjacent land owners, education of park staff and visitors, manual, cultural, and chemical treatment of plants throughout the park, 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 Grand Canyon National Park 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 Chapter 1 – Management and Planning History and Appendix A for applicable laws and policy.

3. Describe Options Outside of proposed wilderness. Can this action be accomplished outside GRCA wilderness?

☐ **Yes** ☒ **No** **Explain:** Exotic plant surveys and treatment is necessary throughout the entire park; therefore, the proposed action cannot be completed outside GRCA's proposed wilderness.

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): See Chapter 3, Wilderness Character section

Undeveloped (Wilderness has minimal evidence of modern human occupation or modification): See Chapter 3, Wilderness Character section

Natural (Wilderness ecological systems are substantially free from the effects of human use, e.g. visitation and/or management activities): See Chapter 3, Wilderness Character section

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): See Chapter 3, Wilderness Character section

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 not hinder the recreation, scenic, scientific, education, conservation or historical use of proposed wilderness in Grand Canyon. Exotic plant management in itself is a form of conservation of native plant species and supports native ecosystems. As such, the proposed action would enhance and support public purposes through the removal of nonnative species. Additionally, the plan identifies 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 exotic plant management is an appropriate use in the park. Additionally, NPS policies and laws support the action to manage exotic plant species in the park. Removal of nonnative species and restoration of native species are necessary to the management of recommended wilderness within the park.