National Park Service
U.S. Department of the Interior

SOUTHEAST UTAH GROUP:
Arches National Park, Canyonlands National Park,
Hovenweep National Monument and Natural Bridges National Monument.

Exotic Plant Management Plan
February 2009

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List of Abbreviations

ACHP	Advisory Council of Historic Properties
AEF	Assessment of Effect
APHIS	Animal and Plant Health Inspection Service
ARCH	Arches National Park
ATV	All Terrain Vehicle
BLM	Bureau of Land Management
BMP	Best Management Practice
CANY	Canyonlands National Park
CE	Categorical Exclusion
DOI	Department of Interior
ESA	Endangered Species Act
EPMP	Exotic Plant Management Plan
EPMT	Exotic Plant Management Team
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
HOVE	Hovenweep National Monument
IPM	Integrated Pest Management
I & M	Inventory and Monitoring Program
MSDS	Material Safety Data Sheet
NABR	Natural Bridges National Monument
NEPA	National Environmental Policy Act
NHPA	National Historical Protection Act
NPS	National Park Service
SEUG	Southeast Utah Group
SHPO	State Historic Preservation Office
USACE	U. S. Army Corps of Engineers
USEPA	U. S. Environmental Protection Agency
USFWS	U. S. Fish and Wildlife Service
USFS	U. S. Forest Service

Definitions
Several terms are defined to facilitate understanding of this EPMP EA/AEF:

Native Plant – 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 (NPS 2006). A goal of the NPS is to perpetuate native plants and animals as part of the natural ecosystem.

Exotic Plant – 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 exotic species did not evolve in concert with the species native to the place, it is not a natural component of the natural ecosystem at that place (NPS 2006).

Invasive Exotic Plant - An aggressive exotic plant that is known to displace native plant species in otherwise intact native vegetation communities. Invasive exotic species are unwanted plants that are harmful or destructive to humans or other organisms. Not all

exotic plants are invasive. This plan addresses only those exotic plants that are determined to be invasive.

State Listed Noxious Weeds – Exotic plants prohibited or restricted by Utah state law. Many of the exotic plants known to occur in the SEUG parks fall into this category (please refer to Table 1-1 on page 10). Transporting seed or parts of these plants or allowing them to seed on one's property is prohibited.

Integrated Pest Management (IPM) - ***also referred to as Integrated Weed Management (IWM*****) -** 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 (NPS 2003).

IPM Control Techniques defined:

Biological: Deliberately introducing insects, mammals or pathogens to stress exotic plants.

Chemical: Applying herbicides according to label requirements to kill or severely stress exotic plants.

Cultural: Cultural control can have a variety of interpretations within IPM. Some managers define it as referring to actions taken that require change in human behavior or thought processes. This definition more closely describes this document's use of prevention strategy implementation and therefore is further expressed as Best Management Practices (BMPs) under prevention techniques. For purposes of this document, cultural control is defined as providing competition, stress, or control of exotic species through the use of prescriptive fire, or by establishing native, desirable vegetation through various means (e.g. restoration, re-vegetation, etc.).

Mechanical/Manual: Using your hands and/or mechanical or simple tools to uproot or remove the above ground portion of plants by mowing, digging, pulling, and cutting seed heads and plants.

Prevention: Preventing or reducing the likelihood of future weed infestation establishment.

Eradicate – Completely eliminating all weed plants, including live roots, rhizomes, and seeds. Eradicating a weed species within a management area is very difficult unless it is present in small populations or numbers.

Suppress – To reduce abundance of a weed species, typically as measured or estimated in terms of canopy cover or plants density.

Contain – To confine an infestation so it does not expand, but does not usually mean reducing the current infestation.

CHAPTER 1- PURPOSE AND NEED

1.1 INTRODUCTION

The goal of this plan is to develop an Exotic Plant Management Plan (EPMP) for the park units of the Southeast Utah Group (SEUG) to control exotic or non-native plants in the four park units that comprise the SEUG. See Figure 1 for location of these units within Utah and Colorado. These park units include:

1) Arches National Park (ARCH)
2) Canyonlands National Park (CANY)
3) Hovenweep National Monument (HOVE)
4) Natural Bridges National Monument (NABR)

The NPS has prepared this plan in compliance with the National Environmental Policy Act (NEPA), §106 of the National Historic Preservation Act and other relevant Federal and State laws to determine the most appropriate and safe methods for implementing an "integrated" treatment of noxious or exotic weeds. The intent of this project is to manage exotic plants to reduce their negative effects on native plant communities and other natural and cultural resources within these park units. This Southeast Utah Group Exotic Plant Management Plan and Environmental Assessment/ Assessment of Effect (EPMP/EA/AEF) was developed to reduce the negative environmental effects of exotic plants.

For the purposes of this document the term "weed" will refer to alien plants whose presence and/or introduction does or is likely to cause economic or environmental harm, or harm to human health (Executive Order 13112, 1999). Exotic plants are species that occur outside of their native ranges as a result of direct or indirect human actions. Exotic plants replace native plant communities, degrade wildlife habitats, and reduce the biological diversity of ecosystems.

This chapter describes the scope, purpose, and need for this project. A summary of the history of each park unit and associated exotic plant management issues is also provided. This chapter is organized into the following sections:

1.2 Purpose for Taking Action
1.3 Need for Taking Action
1.4 Background and History of Each Park Unit
1.5 Scoping

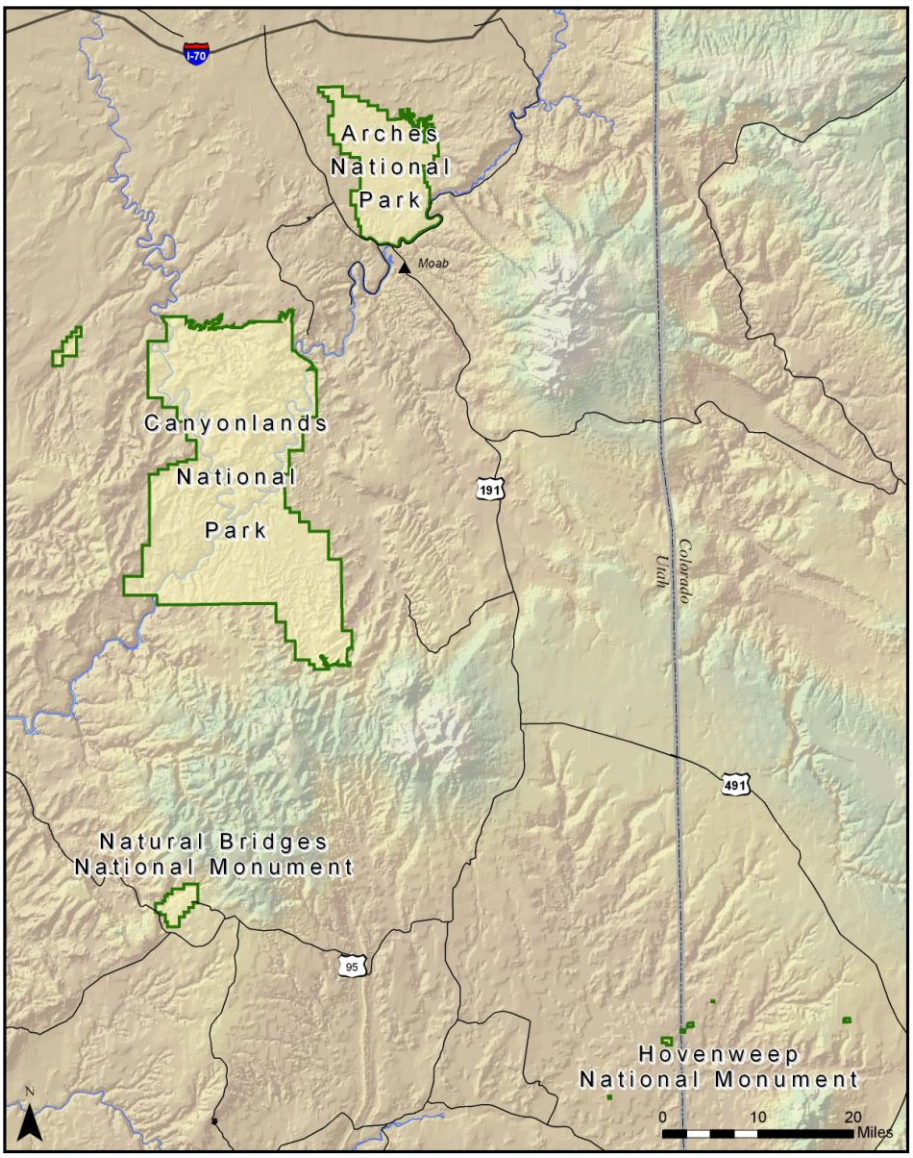

Figure 1. Location of the four park units of the Southeast Utah Group.

1.2 PURPOSE FOR TAKING ACTION

The purpose of this EPMP is to use an integrated approach to eradicate, contain, control, and prevent targeted weeds within the park units of the SEUG. The desired goal is to contain or control the spread of exotic species, and eradicate species that are the most exotic and pose the greatest threat to the biological diversity within SEUG park units, and prevent any new weeds from becoming established. The resulting pro-active management of these plants will promote the ecosystem health of the park's diverse native communities by maintaining and improving native forbs and grass species, increasing the regeneration of native cottonwoods and willows in riparian corridors, and ultimately preventing the loss of wildlife habitat and species diversity.

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

1. Restore native plant communities to reduce the need for ongoing exotic plant management.
2. Prevent unacceptable levels of exotic plant damage, using environmentally sound, cost effective management strategies that pose the least possible risk to people, park resources, and the environment.
3. Develop an EPMP that provides the necessary environmental compliance for exotic plant management treatments at the four SEUG park units.
4. Standardize exotic plant management at parks so their actions can be more effectively implemented by park managers and explained to the public.

1.3 NEED FOR TAKING ACTION

Under DO-12, "need" is described as an existing condition that should be changed, problems that should be remedied, decisions that should be made, and policies or mandates that should be implemented. Under this definition, the following needs have been identified for this project:

Existing conditions that should be changed:

- A comprehensive exotic plant management plan is needed to reduce the threat of exotic plants to these natural and cultural resources, including cultural landscapes, at the four park units of the SEUG.

Problems that should be remedied:

- An EPMP/EA/AEF is needed to achieve compliance with NEPA for future exotic plant management projects. Resource managers need access to more exotic plant management tools. This EPMP/EA/AEF will provide clearance for a number of treatment options, thus resource managers will be able to select and implement the most appropriate management approach in the future.

Decisions that should be made:

- A comprehensive evaluation of potential impacts associated with exotic plant management is needed to educate resource managers of the potential effects of various treatment methods. Resource managers also need standardized best management practices (BMPs) to mitigate potential impacts associated with management.
- Management activities need to be standardized among parks so that treatment methods can be more effectively implemented.

- A standardized decision-making process is needed so that management decisions can be easily communicated and justified to the public. A standardized process will also help park managers and their staff to educate the public about exotic plant management programs.

Policies or mandates that should be implemented:

- An EPMP/EA/AEF is needed to ensure that relevant policies and mandates are implemented.

1.3.1 Southeast Utah Group Needs

Controlling exotic plants in parks is one of the most serious cultural and natural resource protection challenges facing park managers. In the park units of the SEUG there are currently no planning documents that outline how to manage exotic plants or how to prioritize and plan control projects. Up to now, the SEUG park units have completed exotic plant surveys and mechanical control of some exotic plant species, but there has never been a comprehensive plan for vegetation management.

Out of the approximately 800 plant species found in the Southeast Utah Group parks, approximately 96 species are not native to this region. Experience in other parts of the country demonstrated that many exotic plants have the ability to eliminate all native plants within a given area in from 3-10 years (Sheley & Petroff 1999, Lesica & Shelley 1996, Tyser & Key 1988). Many exotic species can pose a serious threat to ecosystem diversity and have a high potential to harm native plants and wildlife, especially threatened, endangered and sensitive species.

Tamarisk, Russian olive, Russian thistle, the knapweeds, cheatgrass, and perennial pepperweed have established in many sectors of the SEUG park units and are of particular concern because of their aggressiveness and ability to eventually eliminate many other native plants. These exotic weeds often alter physical environmental conditions and/or natural disturbance regimes that allow the exotic plants to spread further and form exclusive monocultures. It has been documented that exotic weeds can alter the following environmental conditions: soil temperature, soil salinity, water availability, nutrient cycles, nutrient availability, native seed germination, infiltration and runoff of precipitation, and fire severity and frequency (DiTomaso 2000, Sheley & Petroff 1999, Belnap 1995).

Other common weeds of less environmental consequence in the SEUG include African mustard, tumbling mustard, the pigweeds, lambsquarters, halogeton, white sweet clover, yellow sweet clover, storksbill, crested wheatgrass, redtop, red brome, and bur buttercup. The effects of weed populations on native plants include a decline in ecosystem diversity and health, increases in bare soil resulting in declines in watershed condition, a decrease in the overall capacity of the land to support wild ungulates, and a reduction in the quality of habitat for many wildlife species that require native plants for either cover or food (Trammell & Butler 1995)

There have been 96 exotic plant species found within SEUG (Moran 2008); these can be found in Table 1-1. Twenty of these exotics are listed on the Utah and/or Colorado State Noxious Weed Lists (see Appendix B). It is mandated by law (Utah Noxious Weed Act of 1989 and Colorado Noxious Weed Act of 1996) that, if found, these noxious plants must be controlled due to their destructive capabilities towards human, animal and natural ecosystem health. Other than these twenty species, SEUG also considers a number of other exotics harmful to the natural diversity and integrity of SEUG resources.

Table 1-1. EXOTIC PLANT LIST OF SEUG AND THOSE PROPOSED FOR TREATMENT

Common Name	Scientific Name	Present in SEUG units	Proposed for Treatment
African mustard	*Malcolmia africana*	A,C,H,N	
Alfalfa	*Medicago sativa*	A,C,H	
Alyssum	*Alyssum alyssoides*	C	
Annual wheatgrass	*Eremopyrum triticeum*	A, C	
Asparagus	*Asparagus officinalis*	A,C,H	
Barbwire tumbleweed	*Salsola paulsenii*	C	
Black locust	*Robinia pseudoacacia*	A	
Blue mustard	*Chorispora tenella*	A,C	
Broadleaf plantain	*Plantago major*	A,C	
Buffalobur	*Solanum rostratum*	C	
Bulbous bluegrass	*Poa bulbosa*	C,N	
Bull thistle	*Cirsium vulgare*	A,C	
Bur buttercup	*Ranunculus testiculatus*	A,C,H,N	
Burdock	*Arctium minus*	A,C,H	
Canada bluegrass	*Poa compressa*	N	
Canada thistle	*Cirsium arvense*	C,H,N	
Carolina poplar	*Populus x canadensis*	A,C	
Cheatgrass	*Bromus tectorum*	A,C,H,N	
Chicory	*Cichorium intybus*	H	
Chufa flat-sedge	*Cyprus esculentus*	A	
Clasping pepperweed	*Lepidium perfoliatum*	A, C, H	
Common catalpa	*Catalpa bignonioides*	A	
Common cocklebur	*Xanthium strumarium var. canadense*	A,C,H,N	**X**
Common dandelion	*Taraxacum officinale*	A, C, H, N	
Common horehound	*Marrubium vulgare*	A,C,H,N	**X**
Crested wheatgrass	*Agropyron cristatum*	A,C,H,N	**X**
Cultivated rye	*Secale cereale*	A	
Curly dock	*Rumex crispus*	A, H	
Dalmatian toadflax, broad-leaved	*Linaria dalmatica*	A, H	
Desert wheatgrass	*Agropyron desertorum*	A	
Diffuse knapweed	*Centaurea diffusa*	C	**X**
English plantain	*Plantago lanceolata*	A	
European wintercress	*Barbarea vulgaris*	C	
Field bindweed	*Convolvulus arvensis*	A,C,H,N	**X**
Falseflax	*Camelina microcarpa*	H	
Five-hook smotherweed	*Bassia hyssopifolia*	A,C,N	
Flixweed	*Descurainia sophia*	A,C,H	
Garden orach	*Atriplex hortensis*	H	
Giant ragweed	*Ambrosia trifida*	H	

Common Name	Scientific Name	Present in SEUG units	Proposed for Treatment
Halogeton	*Halogeton glomeratus*	A,C,H	
Houndstongue	*Cynoglossum officinale*	A	
Intermediate wheatgrass	*Elymus hispidus*	C	
Japanese brome	*Bromus japonica*	C,H,N	
Johnson grass	*Sorghum halepense*	C	
Kentucky bluegrass	*Poa pratensis*	A	
Knotweed	*Polygonum aviculare*	N	
Lambsquarter	*Chenopodium album* var. *album*	A,C,N	
Licorice	*Glycyrrhiza glabra*	C	
London mustard	*Sisymbrium irio*	N	
Musk mustard	*Chorispora tenella*	A,H	
Musk thistle	*Carduus nutans*	C	
Oats	*Avena fatua*	H,N	
Orchard grass	*Dactylis glomerata*	A,N	
Peach	*Prunus persica*	C	
Perennial pepperweed	*Lepidium latifolium*	A, C	**X**
Pitseed goosefoot	*Chenopodium album* var.*berlandieri*	A, H	
Prickly Lettuce	*Lactuca serriola*	A,C,H,N	
Puncturvine/Goathead	*Tribulus terrestris*	A,C,H,N	**X**
Purple amaranth	*Amaranthus cruentus*	H	
Purple loosestrife	*Lythrum salicaria L.*	A	**X**
Purslane	*Portulaca oleracea*	A,C	
Rabbit barley	*Hordeum murinum*	A,C	
Rabbitfoot grass	*Polypogon monspeliensis*	A,C,N	
Red brome	*Bromus rubens*	C,H,N	
Red mulberry	*Morus rubra*	A	
Redroot pigweed	*Amaranthus retroflexus*	N	
Redtop	*Agrostis stolonifera*	A,C,H,N	
Ripgut brome	*Bromus diandrus*	A,C	**X**
Russian knapweed	*Centaurea repens*	A,C,H	**X**
Russian olive	*Elaeagnus angustifolia*	A,C	**X**
Russian thistle	*Salsola tragus*	A,C,H,N	**X**
Saltcedar/Tamarisk	*Tamarix chinensis*	A,C,H,N	**X**
Siberian elm	*Ulmus pumila*	A, C	**X**
Smooth brome	*Bromus inermis*	C,H,N	
Spiny sow-thistle	*Sonchus asper*	A,C,H,N	
Spotted knapweed	*Centaurea maculosa*	A	
Storksbill	*Erodium cicutarium*	A,C,H,N	
Summer-kochia	*Bassia scoparia*	A,C	
Tall wheatgrass	*Elymus elongates*	C	
Timothy	*Phleum pratense*	A,C,N	
Tumble pigweed	*Amaranthus albus*	A,C,H,N	
Tumbling mustard	*Sisymbrium altissimum*	A,C,H,N	
Tumbling orach	*Atriplex rosea*	C	
Umbrella mallow	*Malva neglecta*	C,H	
Water bent	*Polypogon semiverticillatus*	C,N	
Water speedwell	*Veronica anagallis-aquatica*	A,N	
Watercress	*Nasturtium officinale*	A, N	
Wheat	*Triticum aestivum*	A	

Common Name	Scientific Name	Present in SEUG units	Proposed for Treatment
White mulberry	*Morus alba*	A,C	
White poplar	*Populus alba*	A,C,N	
White sweet clover	*Melilotus albus*	A,C,H,N	**X**
Willowweed	*Polygonum lapathifolium*	A	
Winged pigweed	*Cycloloma atriplicifolia*	A, C	
Woolly mullein	*Verbascum thapsus*	A, C, H	
Yellow salsify	*Tragopogon dubius*	A,C,H,N	**X**
Yellow sweet clover	*Melilotus officinalis*	A,C,H,N	**X**

SEUG units: Arches National Park=**A**, Canyonlands National Park=**C**, Hovenweep National Monument=**H**, Natural Bridges National Monument=**N**

Twenty-one exotic weeds found in the SEUG parks, which may also be listed as a state noxious weed, have been targeted for control. A summary of each species can be found in Appendix C for habitats and treatment methods:

1. **Canada thistle** *(Cirsium arvense)*
2. **Common horehound** (*Marrubium vulgare*)
3. **Common cocklebur** (*Xanthium strumarium* var. *canadense*)*
4. **Crested wheatgrass** (*Agropyron cristatum)*
5. **Diffuse knapweed** (*Centaurea diffusa)*
6. **Field bindweed** (*Convolvulus arvensis)*
7. **Halogeton** *(Halogeton glomeratus)*
8. **Musk thistle** (*Carduus nutans)*
9. **Perennial pepperweed** (*Lepidium latifolium*)
10. **Puncturevine** (*Tribulus terrestris*)
11. **Purple loosestrife** (*Lythrum salicaria)*
12. **Ripgut brome** *(Bromus diandrus)*
13. **Russian knapweed** (*Centaurea repens*)
14. **Russian olive** (*Elaeagnus angustifolia*)
15. **Russian thistle** (*Salsola tragus)*
16. **Siberian elm** (*Ulmus pumila*)
17. **White sweet clover** (*Melilotus albus)*
18. **Tamarisk** (*Tamarix chinensis*)
19. **Tumble mustard (***Sisymbrium altissimum)*
20. **Yellow salsify** (*Tragopogon dubius*)
21. **Yellow sweet clover** *(Melilotus officinalis)*

* Native to N. America but invasive to SEUG

1.4 BACKGROUND AND HISTORY OF EACH PARK UNIT

The following sections provide a brief description, history, and describe the purpose of each SEUG park unit, followed by a summary of exotic plant management at each of the parks. Exotic plant management issues and current control strategies for each park unit are also described. Figure 1 shows the location of each park unit in the SEUG area. Tables 1-2 through 1-4 displays current exotic plants in each park, exotic plant management priorities at each park unit and herbicides are that are currently used for

control. With regards to the Green and Colorado River corridors, many non-native plant species are found and some areas are profoundly populated with exotics, but until more thorough mapping of these plants can be completed, priority sites will be burn areas and areas heavily used by visitors. Other species may become management priorities in the future. A summary of each exotic species discussed in this document is provided in Appendix C.

1.4.1 Arches National Park (ARCH)

Size
76,519 acres (30,979 hectares)

Park History and Purpose of ARCH
Arches National Monument was established by Presidential Proclamation No. 1875 on April 12, 1929. The monument was specifically set aside due to its outstanding and unusual geologic features. The proclamation states that the monument was established "to protect extraordinary examples of wind erosion in the form of gigantic arches, natural bridges, "windows", spires, balanced rocks and other unique wind-worn sand-stone formations, the preservation of which is desirable because of their education and scenic value". Geologic research has since established that water is the primary agent of erosion involved, although wind does play a role.

In 1938 the monument was enlarged to include a number of historic and prehistoric cultural sites. Later boundary adjustments were made on November 15, 1938; July 26, 1960; January 21, 1969; November 12, 1971. In 1971 the designation for Arches was changed from a National Monument to a National Park and the acreage was also increased to 73,379 acres (29,708 hectares). In 1999, the Lost Spring section was added to the park, which increased the total area by 3,100 acres to 76,519 acres.

Location
Arches National Park is located in southeast Utah along and north of the Colorado River in Grand County, see Figure 3. The park is five miles (8.3 kilometers) north of Moab, Utah, 100 miles (166.7 kilometers) west of Grand Junction, Colorado, and 240 miles (400 kilometers) southeast of Salt Lake City, Utah. The park is readily accessible by major travel routes such as Interstate I-70 located 20 miles (33.3 kilometers) north of the park headquarters; Utah Highway 191 runs from Interstate I-70 south to Moab and accesses the park entrance road.

The area surrounding the park (Grand County) is sparsely populated with a density of two people per square mile (0.8 people per square kilometer). Tourism is currently the most important economic activity.

Elevation
The elevation within the park ranges from approximately 4,000 feet in the canyons to 5,200 on the rims.

General Description

Arches National Park has the largest concentration of natural stone arches in the world. Examples of developing, complete, and collapsed arches are all evident within the 114 square miles of the park. Several arches are particularly noted for their outstanding size and erosional history. Landscape Arch is probably the longest natural stone arch in the world. Delicate Arch, a freestanding arch carved from what was once a freestanding fin, is internationally recognized.

The park is 16 miles (26.7 kilometers) from north to south and 8 miles (13.3 kilometers) from east to west. There are a total of 76,519 acres (30,979 hectares) of land within the legislative boundaries of the park. The topography of the area is diverse, ranging from open flats to steep-walled cliffs. The area has been greatly affected by geologic activity associated with the salt intrusions of the Paradox formation and the landscape has been carved by the effects of wind and water and preserved by the arid climate and lack of earthquake activity. This has produced a landscape dominated by red sandstone formations such as arches, fins, balanced rocks, mesas, canyons and spires. Major topographic features of Arches National Park are Courthouse Wash, Courthouse Towers, The Windows Section, Salt Valley, Klondike Bluffs, Devil's Garden and the Fiery Furnace. Some of the more famous geologic structures in the park are Landscape Arch, Delicate Arch, Tower Arch, the Marching Men, Skyline Arch, the Three Gossips, the Three Penguins, the Windows, the Parade of Elephants, Balanced Rock and the Great Wall. There are more than 2,000 catalogued arches within the park that have a span greater than three feet.

Arches National Park is largely covered by exposed bedrock, weakly developed soils and sand dunes. The park was established because of its unique geologic features, in particular the massive, spectacular natural rock arches formed in the Entrada Sandstone. The geology of Arches National Park is largely determined by the collapsed salt anticline in Salt Valley and to a lesser extent by the collapsed Moab and Cache Valley anticlines. There are ten major sedimentary formations exposed in the park ranging in age from the Pennsylvanian Paradox Formation to the Cretaceous Mancos Shale. In stratigraphic order, formations include Paradox, Honaker Trail, Cutler Group, Moenkopi, Chinle, Wingate Sandstone, Kayenta, Navajo Sandstone, Entrada, Morrison, Cedar Mountain, Dakota Sandstone and Mancos Shale. The Paradox Formation of salt and gypsum evaporates is a highly plastic formation which has formed the salt anticlinal structures in the park, which collapsed when ground water eroded the salt. The Navajo and Entrada Sandstones crop out over most of the park's surface, with the Entrada forming the majority of the outstanding geologic features. The cliff-forming Wingate Formation exposed along the Colorado River forms the south boundary of the park. Together with the associated Kayenta, Chinle and Moenkopi formations, it forms impressive eight hundred foot cliffs.

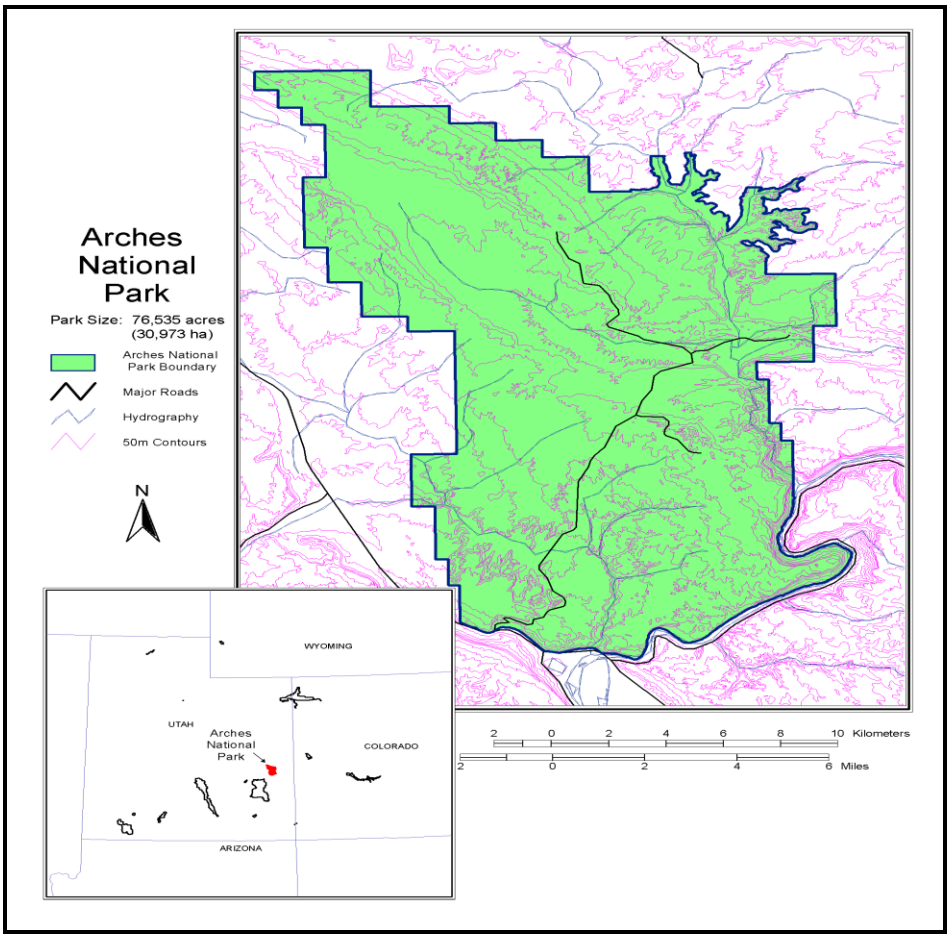

Figure 2. Map and Location of Arches National Park.

Several areas of pictographs and petroglyphs are found within the park. Two archeological surveys have been made in the park and approximately 239 sites have been documented. The Courthouse Wash Rock Art Panel is listed on the National Register of Historic Places. The panel represents the easternmost known occurrence of the Barrier Canyon Style.

Physical remains of early ranching and mining pursuits, as well as traces of pioneer routes, exist within the park.

Climate

The climate of Arches National Park is arid. It is characterized by hot, dry summers and cool to cold winters. From 1980 to 2007, the average annual precipitation of the area is 8.87 inches. Mean annual temperature is 56 degrees Fahrenheit (13.3 degrees Celsius) and the extreme temperatures are -16 degrees Fahrenheit (-26.7 degrees Celsius) and 112 degrees Fahrenheit (44.4 degrees Celsius) (Brough et al. 1987). Potential evapotranspiration exceeds precipitation, making effective soil moisture a critical environmental factor. Rainfall generally falls every month of the year, with monthly

rainfall averaged since 1980 ranging from .41 inches in June to 1.28 inches in October. Snow falls generally between November and March (WRCC 2008).

1.4.2 Canyonlands National Park (CANY)

Size
337,370 acres (136,587 hectares)

History and Purpose of CANY
Efforts to turn Utah's canyon country into a national park began about 1935 when Secretary of the Interior Harold Ickes proposed setting aside 7,000 square miles of southeast Utah as Escalante National Monument. This effort was doomed by opposition from state commercial interests and the demands of World War II (Smith 1991), but with the rise of the conservation movement in the 1960s, Senator Frank Moss, Secretary of the Interior Stewart Udall and locals such as Bates Wilson and Kent Frost took up the battle to preserve the "still untouched" canyon country near the confluence of the Green and Colorado Rivers. Their efforts resulted in congress and President Lyndon B. Johnson setting aside Canyonlands National Park on September 12, 1964. As stated in Public Law 88-590, Canyonlands was established "...to preserve an area in the State of Utah possessing superlative scenic, scientific, and archeological features for the inspiration, benefit, and use of the public...". This is the overriding legal mandate which guides the resource management program of the park today.

Location
Canyonlands National Park is located in southeast Utah along the Colorado and Green Rivers in Grand, Garfield, San Juan and Wayne Counties, see Figure 2. The park is southwest of Moab, Utah, 100 miles (166.7 kilometers) west of Grand Junction, Colorado, and 240 miles (400 kilometers) southeast of Salt Lake City, Utah. Parts of the park are readily accessible by major travel routes such as Interstate I-70 and Utah Highway 191.

The area surrounding the park is sparsely populated with a density of approximately two people per square mile (0.8 people per square kilometer). Tourism is currently the most important economic activity.

Elevation
The elevation within the park ranges from approximately 3,750 feet on the Colorado River south of Cataract Canyon to 7,180 feet above Big Pocket in the Needles District.

General Description
Canyonlands National Park has been expanded since it was originally established in 1964 to its present size of 337,370 acres centered around the confluence of the Green and Colorado Rivers. The rivers divide the park into three geographical districts: the Island in the Sky District is the triangle of land between the two rivers, the Needles District lies east of the Colorado River and the Maze District lies to the west of the Colorado and

Green Rivers. The Horseshoe Canyon Detached Unit is managed as part of the Maze District. In addition, the Green and Colorado River corridors are managed as a separate River District of the park. In summary, the park is divided into the Island in the Sky, Maze, Needles and River districts.

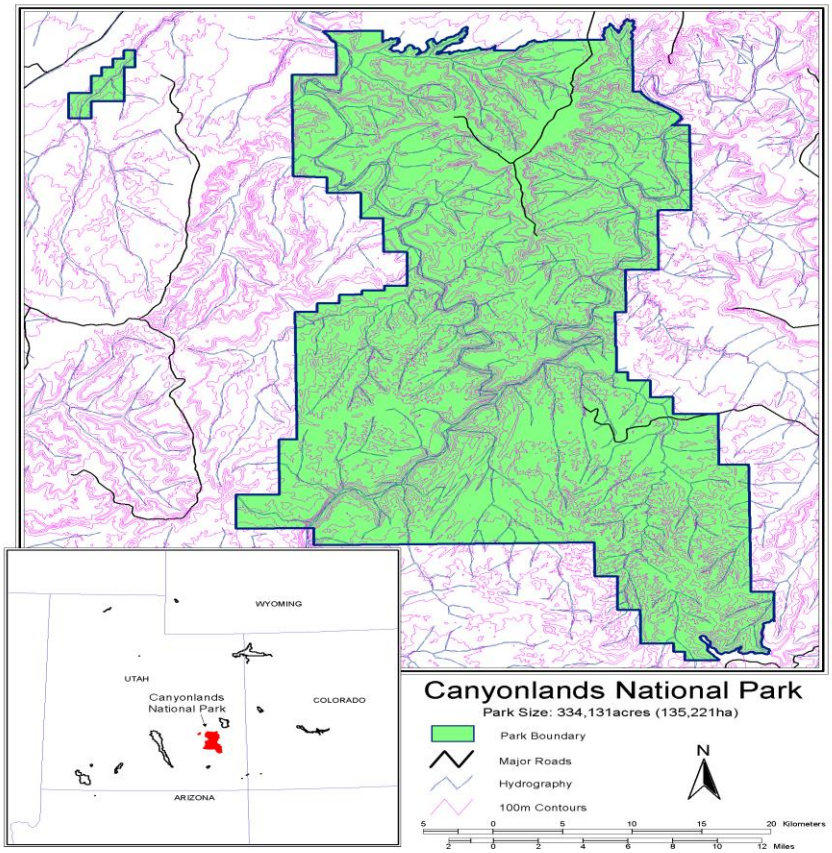

Figure 3. Map and Location of Canyonlands National Park

From prehistoric Native Americans searching for chert outcrops, through the geological investigations of John Wesley Powell and other turn-of-the-century explorers, to uranium miners of the 1950s, the geologic resources of Canyonlands have been of major interest and importance. As a result of these explorers, miners and recreationists, geological publications on the park are widely available (Baars and Molenaar 1971; Huntoon, Billingsley and Breed 1982; Mutschler 1969) and the geological resources of the park are well-known.

For park visitors, probably the two most important geological features of the park are the uniquely banded red and white sandstone of the Cedar Mesa Formation (exposed in the Needles and Maze Districts) and the White Rim Sandstone exposed in the Island in the Sky District.

The incredible features of the park are the remote mesas, buttes, and deep canyons cut by the Green and Colorado Rivers and their tributaries. The park's name, Canyonlands, is derived from the geology term "Canyon Lands", which is defined as the province south of the Uinta Basin and between the High Plateaus on the west and the Rocky Mountains to the east. As explained by Stokes (1988), the park lies at the rugged and remote heart of the Canyon Lands section of the Colorado Plateau physiographic province in southeast Utah. The park is characterized by sedimentary rock, which has been deformed by anticlines, synclines and monoclines. Uplift of the Colorado Plateau and concurrent water erosion have produced the extensive, deep canyon systems which are the defining features of the park and of the physiographic section (Lammers 1991).

There are five major sedimentary formations exposed in the park ranging in age from the Pennsylvanian Paradox Formation to the Jurassic Navajo Sandstone. In stratigraphic order, formations include Paradox, Honaker Trail, Cutler Group, Moenkopi, Chinle, Wingate Sandstone, Kayenta, and Navajo Sandstone. The Paradox Formation of salt and gypsum evaporates is a highly plastic formation which has formed the salt anticlinal structures and grabens in the park, which collapsed when ground water eroded the salt.

Climate
The climate of Canyonlands National Park is arid. It is characterized by hot, dry summers and cool to cold winters. Temperatures in the park vary with altitude and latitude (Brough et al. 1987). In the Needles District at an elevation of 5,040 feet the average maximum temperature is 68.30 F, the average minimum is 37.80 F. The average annual precipitation is 8.62 inches.

In the Island in the Sky at an elevation of 5,930 feet the average maximum temperature is 64.10 F, and the average minimum temperature was 42.20 F. Temperatures can reach as high as 1100 F and as low as -160 F. The normal annual precipitation is 9.27 inches.

Potential evapotranspiration exceeds precipitation, making effective soil moisture a critical environmental factor. Precipitation peaks occur in March and August. Snow falls between November and March.

1.4.3 Hovenweep National Monument (HOVE)

Size
784.3 acres (317.5 hectares)

Park History and Purpose of HOVE
Hovenweep National Monument was first established by Warren G Harding in 1923 by Presidential Proclamation 1654 (42 Statute 2299). The Proclamation states in part, “Whereas, there are in southwestern Colorado and southeastern Utah four groups of ruins, including prehistoric structures, the majority of which belong to unique types not found in other National Monument’s, and show the finest prehistoric masonry in the United States; and …. It appears that the public good will be promoted by preserving

these prehistoric remains as a National Monument with as much land as may be necessary for the proper protection thereof, … that there is hereby preserved, subject to prior valid claims and set apart as a National Monument to be known as Hovenweep National Monument …"

Subsequent Presidential Proclamations 2924, April 29, 1951; 2998, November 20, 1952, 3132, April 6, 1956; and Public Land Order 2604, February 5, 1962, added other areas and adjusted the boundaries of the monument. Given the proclamations listed above and the Organic Act of August 25, 1916 (Public Law 235, 39 Stat. 535) the National Park Service's mandate is to preserve and protect the cultural and natural resources associated with the six ruin groups, and to assist visitors in understanding the life and culture of the prehistoric inhabitants and their adaptation to the environment.

The resource values at HOVE consist of significant cultural resources and their associated pristine natural settings. The Cajon, Square Tower, Holly, Hackberry/Horseshoe, and Cutthroat units contain clusters of Ancestral Puebloans pueblos and towers situated near permanent springs at canyon-head locations on Cajon Mesa. These canyon rim towers and villages are the best preserved and protected, most visually striking, and accessible examples of 13the century Ancestral Puebloan architecture and community locations within the San Juan River Basin. Other archeological sites representative of paleo–Indian, archaic, and early Puebloan occupation are also found here. These five units are significant because of the large number of structures possessing a high degree of physical and locational integrity. In addition, the towers are noteworthy because of their many stylistic variations.

The Goodman Point unit consists of an immense pueblo in the Montezuma Valley, being excavated for the first time over just the last few years. These remains reflect its position as a regional center for the Mesa Verde Ancestral Puebloans, and it is the one of the best preserved sites in the West. It is the first archeological site set aside by the federal government, on September 13, 1889, and represents one of the largest 13th century villages in the San Juan Basin. These villages contain elements of public architecture such as great kivas, plazas, reservoirs, enclosing walls, etc.

Hovenweep also contains some of the best examples in the nation of ancient astronomical calendars that mark important seasonal events using architecture, rock art, and sunlight.

Location

Hovenweep National Monument contains six distinct units situated in the Four Corners area, see Figure 5. The Square Tower and Cajon units are located in San Juan County, Utah. The Goodman Point, Hackberry/Horseshoe, Holly, and Cutthroat units are located in Montezuma County, Colorado.

Elevation

The elevation within the monument varies from 5,200 feet at the Cajon unit to 6,760 at the Goodman point unit.

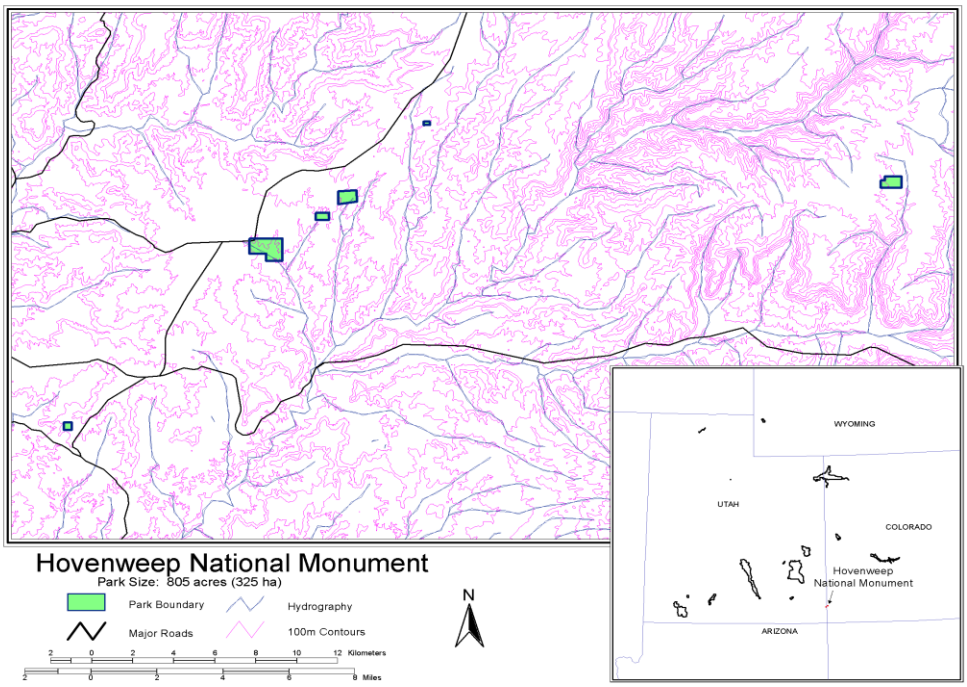

Figure 4. Location of Hovenweep National Monument.

General Description

The natural environment at Hovenweep is characterized by rugged topography, with small canyons divided by narrow mesa tops. The primary geologic formation is Cretaceous age Dakota Sandstone. Shallow to deep aeolian soils are found on the mesa tops, with shallow colluvium on the canyon slopes, and shallow to deep alluvium in the canyon bottoms. While permanent water sources are limited, a few springs and seeps located in the canyon-heads produce water year-round. Residual water trapped in potholes or flowing in washes after rains or snow melt is seasonally available. Five of Hovenweep's six units are on Cajon Mesa, which covers approximately 500 square miles on the Colorado-Utah border near Four Corners. Although the topography is fairly uniform, variations in rainfall, soil type, and plant associations occur through minor elevation and drainage pattern differences. The northern half of the mesa is higher, cooler, and wetter supporting a pinyon-juniper forest. This part of the mesa is the most productive today growing dry land pinto beans, winter wheat, and alfalfa. Most of Hovenweep's units are in the juniper-sage and sage areas in the mid-section of the mesa.

Climate

The climate in this high desert environment is dry, with an average of 12 inches of precipitation per year. Temperatures range from winter lows of –10 to 0 degrees F to summer highs averaging 100 to 105 degrees F, with a mean annual temperature of 52 degrees F.

1.4.4 Natural Bridges National Monument (NABR)

Size
7,445.49 acres (3010.3 hectares)

Park History and Purpose of NABR
Established in 1908, Natural Bridges National Monument is Utah's oldest National Park area. A total of 120 acres were originally set aside around each of the three bridges based on President Theodore Roosevelt's original Proclamation No. 804, April 16, 1908, 35 Statute 2183. The main purpose for the monument was stated by President Roosevelt as follows:

> "Whereas, a number of natural bridges situated in southeastern Utah having heights more lofty and spans far greater than any heretofore known to exist, are of the greatest scientific interest, and it appears that the public interests will be promoted by reserving these extraordinary examples of stream erosion with as much land as may be necessary for the proper protection thereof..."

Later, the monument was enlarged to encompass 2,420 acres containing the three natural bridges, prehistoric structures, and cave springs, as stated in President William H. Taft's Proclamation No. 881, September 25, 1909, 36 Statute 2502:

> "...at the time this monument was created nothing was known of the location and character of the prehistoric ruins in the vicinity of the bridges, nor of the location of the bridges and prehistoric cave springs, also hereby reserved..."

The same area was resurveyed, and set aside by President Woodrow Wilson's Proclamation No. 1323, February 11, 1916, 39 Statute 1764:

> "...whose purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

In August of 1962, President John F. Kennedy's Proclamation No. 320 withdrew 320 acres of land around Snow Flat Spring Cave and Cigarette Spring Cave from the monument since these caves: "...no longer contain features of archeological value and are not needed for the proper care, management, protection, interpretation, and preservation of the monument." In this proclamation, he expanded the size of the monument, reiterated the public and scientific communities' interest in the preservation and protection of the bridges and prehistoric sites, and he set forth the main management objectives for the monument.

Location
The monument is located in San Juan County, Utah, 120 miles (200 kilometers) south of Moab, Utah (Figure 4). The area is accessible via Utah Highway 95 which connects Blanding, Utah with Hanksville, Utah. Blanding, Utah (population 3,100) is the nearest population center, located 40 miles (65 kilometers) east of the monument. The surrounding area (San Juan County) is sparsely populated, with a density of less than 1.5 people per square mile (0.6 people per square kilometer). The area surrounding the monument has never been settled by Anglos and has been used only for extensive livestock grazing and minor mining activities.

Elevation
The elevation within the monument varies from approximately 5,700 feet in the canyons to 6,400 on the rims.

General Description
Nowhere else are three such extraordinary natural bridges found in such close proximity to one another. These three bridges show three different stages of development from youth (Kachina), to maturity (Sipapu), to old age (Owachomo). Together with the canyons in which they formed, these three bridges are excellent examples of the result of an entrenched meander stream system.

The monument was also created because of its well-preserved Ancestral Puebloan standing architecture. While archaeologists now recognize that these structural sites are common throughout the region, the presences of the well-preserved structural sites, as well as a range of archaeological sites from archaic through historic times make the monument highly significant.

A high desert riparian environment combined with a year-round supply of standing water (the result of numerous seeps) creates a unique biological climate where relict species (Douglas fir) maintain a foothold and where moist alcoves shelter hanging garden communities. It is here that rare plants (such as the Kachina daisy) find refuge, and other water-loving flora thrives in riparian corridors that also provide food, shelter, and travel paths for wildlife. The monument provides a breeding ground for peregrine falcons, is home to at least 15 species of bats, and has extensive public lands surrounding it that are candidates for Wilderness designation.

Pristine air quality ensures extensive vistas and combined with the absence of artificial light provides outstanding opportunities to view night skies. The absence of human-generated sound leaves the visitor to confront the natural silence that is the hallmark of canyon country.

The monument was also established to preserve outstanding Ancestral Puebloan cultural remains located throughout the monument. The cultural resources of Natural Bridges are outstanding and the monument provides the opportunity, found in few other places, to study the interaction among indigenous cultural groups. There are numerous sites with religious and historical significance to Native Americans.

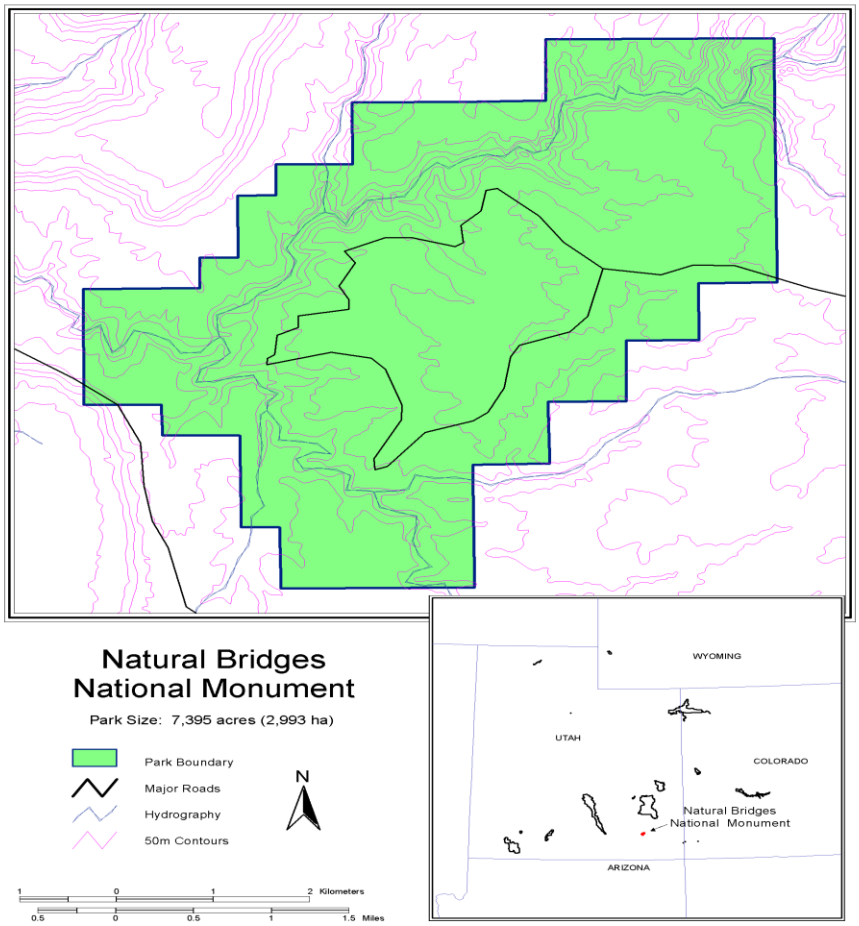

Figure 5. Map and Location of Natural Bridges National Monument.

The monument preserves one of the few locations of a very rare plant, the kachina daisy (*Erigeron kachinensis*). Natural Bridges contains an outstanding example of an ephemeral desert stream. The ecological processes and biological diversity of this area are found in few other places.

The monument contains two major canyons, White and Armstrong, which are deeply incised into the Cedar Mesa sandstone. The vegetation of the area is predominately pinyon-juniper woodland, a vegetation type common to most of southeast Utah at elevations of approximately 4,000 to 8,000 feet (1220-2440 meters). Riparian vegetation occupies the surface water drainages and small pockets of Douglas fir and associated mesic vegetation grow in sheltered areas along the canyon rims. The fauna of the monument is typical of the Cedar Mesa area of southeastern Utah. Large mammals commonly seen are mule deer, coyote and desert cottontail. Conspicuous birds are the common raven, turkey vulture, red-tailed hawk and scrub jay. A variety of lizards can be seen during the warmer months, and the monument is home to both prairie rattlesnakes and midget faded rattlesnakes.

Table 1-2. A SUMMARY OF THE 2003 INVASIVE NON-NATIVE PLANT INVENTORY REPORT

Park	Park Unit Acreage	Total Acreage Inventoried	Number of Exotic Species Targeted	Infested Acreage by Exotic Species
ARCH	76,519	8,166	11	748
CANY	337,598	25,160.9	14	774.5
HOVE	784.3	966*	11	16.87
NABR	7,636	2,070	6	2.45

*inventoried entire monument as well as some additional surrounding areas

For more site specific data and information, the complete Invasive Non-Native Plant Inventory reports for each park unit are located online at:

http://science.nature.nps.gov/im/units/ncpn/Inventory_Reports.cfm

SEUG staff used the same inventory methods in 2006 to inventory additional areas in Arches National Park (Moran 2007). They also began an effort to inventory the riparian zone along the Green River in 2008 (data pending).

Table 1-3. SUMMARY OF CURRENT EXOTIC PLANT MANAGEMENT PRIORITIES

ARCHES	CANYONLANDS	HOVENWEEP	NATURAL BRIDGES
VC Complex: *Puncturevine, Russian thistle*	Salt Creek-near gate: *Tamarisk*	Square Tower: *Tamarisk*	Entrance Area: *Common horehound*
Willow Springs: *Tamarisk*	NEEDLES Main Park Road: *Crested Wheatgrass*	Goodman Point: *Canada thistle, Musk thistle*	Entrance Road to the Monument: *Tumble mustard*
Courthouse Wash: *Tamarisk, Siberian Elm, Russian olive*	Upheaval Bottom: *Tamarisk*	Hackberry: *Tamarisk*	Armstrong Canyon Bottom: *Tamarisk*
Salt Valley Wash: *Tamarisk, Russian knapweed*	East side of Green River (park boundary to Queen Anne Bottom): *Russian Knapweed*		White Canyon Bottom: *Crested wheatgrass*
Winter Camp Wash: *Tamarisk*	ISKY Entrance Road: *Crested wheatgrass, Intermediate Wheatgrass*		
Wolfe Ranch: *Tamarisk, Russian*	Green River Overlook: *Halogeton*		

ARCHES	CANYONLANDS	HOVENWEEP	NATURAL BRIDGES
knapweed			
Upper Salt Wash: *Tamarisk* *Russian knapweed*	Willow Flat Area: *Halogeten*		
Lost Spring Canyon: *Tamarisk*	Aztec Butte: *Diffuse knapweed*		
Cottonwood Canyon: *Russian knapweed, Yellow sweetclover*	Anderson Bottom: *Russian knapweed*		
Cordova Canyon: *Russian knapweed, Yellow sweetclover*	Tuxedo Bottom: *Russian knapweed*		
Fish Seep Draw: *Tamarisk*	Turks Head Bottom: *Perennial pepperweed*		
Park Main Roadside (south of Courthouse Wash): *Puncturevine*	Green River Corridor Sites: >50 scattered *Russian olives.*		
	Spanish Bottom: *Russian knapweed, Perennial pepperweed, Puncturevine.*		
	Squaw Flat Campground: *Crested wheatgrass* *Puncturevine, Field Bindweed* *Creasted Wheatgrass*		

Table 1-4. SUMMARY OF HERBICIDES CURRENTLY BEING USED BY SEUG PARKS

Active Ingredient	Trade Names	Target Plants	Parks Currently using Product
Triclopyr amine	Garlon 4, Remedy, Tahoe 4E	Woody plants and broadleaf plants.	CANY, ARCH, NABR, HOVE
Glyphosate	Rodeo	Grasses, herbaceous plants, some broadleaf trees and shrubs.	CANY, ARCH, NABR, HOVE
Clopyrolid	Transline	Annual and perennial broadleaf herbs.	CANY, ARCH, NABR, HOVE
Imazapyr	Habitat	Annual and perennial grass, broadleaved weeds, brush, vines and deciduous trees.	CANY, ARCH, NABR, HOVE
Picloram	Tordon	Broadleaf herbs, vines, and woody plants.	CANY, ARCH, NABR, HOVE

All herbicides used by parks are registered by the U.S. Environmental Protection Agency. Parks also obtain approval from either the Regional or National IPM Coordinator before using an herbicide.

1.5 SCOPING

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

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

The scope of this EPMP is to develop a long-term management plan that will reduce the impacts of (or threats from) exotic plants to native plant communities and other natural and cultural resources, including cultural landscapes, at the four park units located in the SEUG. Because this project involves multiple parks, the approach is to develop a general plan that provides resource managers with multiple treatment options for exotic plant management. Resource managers can select the most appropriate treatment option or combination of treatments included in the EPMP to minimize potential impacts and maximize overall management success.

This plan covers activities to manage exotic plants within the SEUG park unit boundaries on NPS. Park unit boundaries are park boundaries that have been legislated by Congress. No exotic plant management activities will be conducted by the NPS in areas located outside of SEUG park unit boundaries under this EPMP. In summary, exotic plant management activities must occur within park unit boundaries and must involve NPS resources to be within the scope of this EPMP. Exotic plant management in areas located outside of SEUG park unit boundaries is beyond the scope of this EPMP.

Only plants defined as "exotic plants" will be managed under this EPMP. "Native plants" will **not** be managed under this EPMP. Native plants are defined as those species that "have occurred or now occur as a result of natural processes on lands designated as units of the national park system" (NPS 2006:44). For this project, exotic plants are defined as:

> *"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 non-native, alien, or exotic species. Since 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"* (NPS 2006:44).

Each plant species that meets this definition is subject to management under this EPMP. However, not all plants defined as "exotic plants" will necessarily be managed. Under NPS policy (NPS 2006:47, Section 4.4.4.), an exotic plant must also meet several criteria to be managed:

> *"All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed - up to and including eradication - if (1) control is prudent and feasible and (2) the exotic species:*
>
> - Interferes with natural processes and the perpetuation of natural features, native species or natural habitats; or
> - Disrupts the genetic integrity of native species; or
> - Disrupts the accurate presentation of a cultural landscape; or
> - Damages cultural resources; or
> - Significantly hampers the management of a park or adjacent lands; or
> - Poses a public health threat as advised by the U.S. Public Health Service (which includes the Centers for Disease Control and the NPS Public Health Program); or
> - Creates a hazard to public safety."

Only exotic plants that meet the above NPS definition and criteria will be managed under this EPMP.

For species that meet these criteria, management priorities will be assigned to each exotic plant. Exotic plants will then be managed according to relative management priority. In accordance with NPS policy, relative management priorities will be determined as follows (NPS 2006: 47, Section 4.4.4.2):

> *"Higher priority will be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controlled. Lower priority will be given to exotic*

species that have almost no impact on park resources or that probably cannot be successfully controlled."

CHAPTER 2- INTERGRATED PEST MANAGEMENT PLAN

Integrated Pest Management (IPM) is a decision-making process that supports the NPS mission by coordinating knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, using environmentally sound, cost-effective management strategies that pose the least possible risk to people, park resources, and the environment. This process helps the resource manager determine whether the treatment is necessary and appropriate, where treatment should be administered, when treatment should be applied, and what strategies should be used for immediate and long-term results. IPM is done on a case-by-case basis, so that treatment strategies are tailored to local conditions. Each exotic plant's natural history is also evaluated before developing treatment strategies. The goal of IPM for this project is therefore to manage exotic plants and the environment to balance costs, benefits, public health, and environmental quality (McCrea and DiSalvo 2001:394).

IPM employs multiple integrated management practices rather than a single solution, wherever technically and economically feasible. An integrated approach is often more effective than a single type of treatment. Integrated management practices that will be included under the preferred alternative include:

- Compliance with Regulatory Measures
- Education Programs
- Collaboration Measures
- Planning
- Treatment Methods
    1) Cultural Treatments
    2) Manual/Mechanical Treatments
    3) Biological Treatments
    4) Chemical Treatments
    5) Prescribed Fire Treatments
- Monitoring and Record Keeping

Individual treatments or combinations of these treatments will be implemented, as appropriate, to control exotic plants in the SEUG parks. Each of these treatments is discussed in additional detail in the following sections.

2.1 COMPLIANCE WITH REGULATORY MEASURES

Because of the multi-park nature of this project, the plan includes a broad analysis of potential impacts of various treatments on environmental resources. For future exotic plant management activities, parks will use the decision making tool "Confirm Compliance of Treatment Method with and Existing NEPA Document" in Appendix A to document NEPA compliance through this EPMP.

In the future, resource managers could also prepare exotic plant management plans to address specific exotic plant management issues. Park-specific plans containing actions that are consistent with those evaluated in this EPMP will document compliance with NEPA through this EPMP using a memo to file. Park-specific plans containing exotic plant management treatments or having associated potential impacts that have not been considered in this EPMP will require additional compliance with NEPA.

The plan will help resource managers confirm compliance with regulatory measures using the Decision-making Tool. Applicable NPS policies and guidelines have been built into this tool. Through using this process and through collaboration with NPS Regional IPM and NEPA Coordinators, resource managers will be able to confirm that their proposed treatments meet the necessary NPS and NEPA environmental compliance requirements for protection.

2.2 EDUCATION PROGRAMS

One of the objectives of the EPMP is to standardize exotic plant management at the four SEUG park units so each park's actions can be more effectively implemented and explained to the public. Education programs are a cost-effective exotic plant management strategy. Education of staff at each park and the public will help create an understanding of exotic plant management and promote acceptance of needed actions. Development of the EPMP is an initial step in the education process because it provides a consistent approach for exotic plant management planning and decision-making. This plan also identifies educational programs that will be implemented by parks under the preferred alternative.

A variety of education programs will be implemented. These programs may include:

- Internal Training and Awareness
- Visitor Awareness and Public Education

Internal training and awareness programs will be developed at each park. These programs will be used to educate park employees and volunteers on exotic plant identification and exotic plant management programs. Through an effective education program, park staff will come to recognize potential exotic plant problems, allowing resource managers to take action before problems develop. Park staff that is informed about the objective of the exotic plant management program will also be more likely to support it. These programs may include training on how to identify exotic plants that are known to occur within the park and exotic plants of concern that have not yet been located within the park, but that could occur within the park in the future. During this training, employees and volunteers will be provided with a NPS point of contact for reporting the locations of new exotic plants or new infestations that are observed within the park. Training will also include an overview of the SEUG EPMP to help staff and volunteers understand the decision-making process, what treatments are being used at that park and the justification for their use, and sensitive resource considerations. Other internal education programs will include:

- Incorporate exotic plant management information at all levels of NPS training, including planning/design, management, construction, interpretation, maintenance, law enforcement, and resource management
- Use established media (electronic media, publications, permits, and contracts) to educate NPS staff and commercial users about exotic plant management issues
- Interpret and communicate the results of the latest research on exotic plants to resource managers, interpreters, maintenance personnel, and others.

Visitor awareness and public education programs may also be developed. Park visitors and others concerned with management activities at any of the SEUG parks will be advised of IPM practices included in the EPMP and the benefits of implementing these approaches to address specific exotic plant management issues. Parks may develop a variety of avenues to educate the public, including education programs, exhibits, and public outreach programs. These programs will be used to educate the public on:

- Exotic plant management planning
- Exotic plant management priorities within the park
- The potential threat of these plants to park resources
- Methods for preventing the introduction of exotic plants into the park
- Treatment methods used within the park to control exotic plants, and why these treatments were selected.

These programs will also include publication of press releases using local media and articles in park newsletters, bulletins, and on park websites. In the case of large-scale treatments, parks will provide information to park staff, residents of surrounding areas, and park visitors. In the case of highly visible projects, formal interpretive programs or materials will be developed and press releases or briefings prepared. Some parks may also organize volunteer efforts to provide the public with “hands-on” opportunities to become involved in exotic plant management. Programs may also be developed for local schools to educate students on the threat and management of exotic plants. Specific public awareness activities may also include:

- Create and disseminate, through all available local outlets, educational materials that increase awareness of, understanding of, and support for the full range of exotic plant management activities.
- Participate in or create local area field days and other types of meetings to highlight the exotic plant management plan or current exotic plant management projects.
- Encourage public support through volunteer exotic plant management projects and activities.

2.3 COLLABORATION MEASURES

Collaboration of exotic plant management activities with other entities is a key component of IPM. Collaboration will be an ongoing process that will build consensus with interested parties (including adjacent landowners), decision makers, technical experts, and the general public. Several types of collaboration will be conducted, including:

- Collaboration between the park, the general public, and neighboring landowners
- Collaboration between NPS resource managers and exotic plant management experts
- Collaboration between parks
- Collaboration with local, state, and federal officials involved in exotic plant management

Each park will collaborate with the general public to disseminate consistent information about current and proposed exotic plant management activities. Parks will also collaborate with neighboring landowners to disseminate information on the importance of and methods for managing exotic plants on their properties. To encourage collaboration, parks may conduct periodic exotic plant management meetings. These meetings could be used to inform the public of current and proposed management activities and exotic plant issues within the park. These meetings will be an opportunity for landowners to learn how they can help prevent the introduction of exotic plants into the park. These meetings will also provide a forum for the public to express concerns regarding current and proposed exotic plant management activities.

Ongoing collaboration with exotic plant management experts both within and outside the NPS will also be conducted on a regular basis. This level of collaboration is needed to help NPS resource managers keep informed on the latest exotic plant management technologies available. Such collaboration will also be an opportunity for individuals to share and learn from their exotic plant management successes and challenges.

Establishment of management partnerships are also encouraged to foster relationships between the public, private landowners, conservation groups, and county weed superintendents.

Other collaboration activities may include:

- Work with universities, state and federal agencies, and private organizations to develop education programs and courses for resource managers and others responsible for managing exotic plants.
- Work with responsible agencies and the concerned public to incorporate exotic plant management techniques into herbicide applicator training courses.
- Participate in and conduct seminars or workshops on exotic plant management.
- Encourage NPS staff to join and participate in professional organizations or societies concerned with exotic plant management issues.
- Develop a model code of ethics concerning the use of plant materials through cooperative efforts with other concerned groups, industries, and agencies.
- Cooperate with other agencies to develop and disseminate educational materials (publications, posters, videos, and intranet) to the public, interested organizations, and agency employees.
- Work with the plant production industry to prepare educational materials that encourage the use of native plants and re-vegetation in landscaping.
- Develop collaborative groups that include multiple agencies and the public to assist with exotic plant management and to ensure that planning incorporates the concerns and issues of land managers and landowners with similar exotic plant management issues.

2.4 PLANNING

Resource managers will use the following Decision-making Tool, developed specifically for the EPMP, for exotic plant management planning. In using this tool, resource managers at each park will follow a standard decision-making process to identify exotic plants, determine exotic plant management priorities, identify and evaluate the efficacy and environmental effects of the proposed treatment, consider alternative treatments having less impacts, justify why a treatment was selected, and confirm compliance with applicable policies and regulations. Resource managers will also be able to use the results to explain to the public how each of these factors was accounted for in selecting treatment methods. Figure 6 provides an overview of the decision-making process and Appendix A includes the complete Decision-making Tool developed for the EPMP.

The Decision-making Tool includes a series of five decision trees. These decision trees include:

- Identify Exotic Plants and Justify Management Needs
- Guidance for Setting Management Priorities
- Optimum Tool Analysis for Treatment Options
- Justify and Confirm Compliance of Chemical and Biological Treatments (with applicable policies and regulations)
- Confirm Compliance of Proposed Treatment Method with NEPA

2.4.1 Identify Exotic Plants That Meet Action Thresholds

This decision tool is used to establish exotic plant management objectives and to identify exotic plants that meet at least one of the action thresholds. As part of initial exotic plant management planning, the resource manager will establish exotic plant management objectives. A management objective is a desired state of the system that the resource manager wants to achieve. Management objectives can be stated as general objectives or as specified numerical targets. Management objectives should, however, be measurable since they will be used to evaluate the effectiveness of various exotic plant management treatments. The general management objective for this project is to prevent unacceptable levels of exotic plant damage, using environmentally sound, cost-effective management strategies that pose the least possible risk to people, park resources, and the environment.

Resource managers will also establish specific exotic plant management objectives for their park. These management objectives will be developed based on NPS policy, resource management objectives for the park, the size of the park, and the extent and type of exotic plant infestations within the park. If the extent and distribution of exotic plants are not known, additional data collection such as mapping may be required before management objectives can be established. Additionally, mapping must be repeated at some interval in order to catch new early infestations. The interval will vary depending on the area; park roadsides, for example, might be monitored most frequently, if they are the most likely location for new infestations. Some examples of past exotic plant management objectives established by parks include:

- Maintain native vegetation surrounding developed areas in its historic state.

- Treat 1-5 acres of exotic plants per year.
- Return vegetation to historic site conditions.
- Lessen the economic impact of priority exotic plants by eradicating small stands and containing, then controlling, larger stands.
- Identify and control occurrences of exotic plants by containing large populations and reducing or eliminating small populations.

Figure 6. SOUTEAST UTAH GROUP EXOTIC PLANT MANAGEMENT PLAN DECISION-MAKING TOOL OVERVIEW

Identify Exotic Plants that Meet Action Thresholds
Establish management objectives. Identify exotic plants present within the park. Then, identify those exotic plants whose management meets action thresholds.

↓

Guidance for Setting Management Priorities
Use guidance to set exotic plant management priorities based on their potential impact on park resources and potential for control.

↓

Optimum Tool Analysis for Treatment Options
Identify proposed treatment options for each priority exotic plant. For each proposed treatment option, evaluate whether alternative treatment options with fewer potential impacts could be used.

↓

Confirm Compliance of Chemical and Biological Control Treatments with Applicable Regulations
If chemical or biological treatments are selected, confirm their use is compliant with applicable regulations and policies.

↓

Confirm Compliance of Treatment Method with an Existing NEPA Document
Prior to implementing the selected treatment, confirm that the selected treatment method has the necessary compliance with NEPA.

Management objectives developed by each park should be specific so that the overall effectiveness of the exotic plant management program can be evaluated. Resource managers should also revise management objectives on a regular basis to address the ever-changing exotic plant management issues within their park.

Once management objectives are established, plant species lists for the park will be reviewed to identify exotic plants. Those plants that occupy or could occupy parklands directly or indirectly

as the result of deliberate or accidental human activities are considered "exotic." Any plants that do not meet this definition are not exotic plants and will not be managed under the EPMP.

In housing developments and cultural landscapes, exotic plants should also be evaluated to determine their cultural and/or historical significance and ethnographic value. Both cultivated and non-cultivated species may be historically appropriate or important ethnographic resources. Examples of exotic plants that meet or are managed for an identified park purpose:

- Historic cultivars - varieties of domestic, ornamental, or crop plants that may be genetically or morphologically distinct from common contemporary varieties, present in historic districts during periods of significance, and have been used historically.
- Introductions by indigenous peoples - plant species introduced or cultivated by indigenous peoples prior to the time of European settlement. These species occur because of human intervention, but have long histories on site.

Exotic plants within the boundaries of housing developments and cultural landscapes that do not pose a significant threat or nuisance to natural areas are exempt from management efforts under the EPMP. These plants will be managed in accordance with NPS and park resource management guidelines. Exotic plants that pose a threat or nuisance to resources will be further evaluated to determine whether management is prudent and feasible and whether their management is a priority.

NPS policy (NPS 2006) further restricts management to only those exotic plants whose management is prudent and feasible. The exotic plant must currently, or have the potential to, meet at least one of the following criteria: interfere with natural processes, disrupt the genetic integrity of native species, disrupt the accurate presentation of cultural landscapes, damage cultural resources, hamper the management of park or adjacent lands, pose a health hazard, or create a hazard to public safety. These criteria have been adopted as general "action thresholds" for this project. An action threshold is the point at which approved exotic plant management treatments are implemented because of current or potential levels of intolerable impacts to environmental resources. Determining whether an exotic plant meets an action threshold will be determined on a case-by-case basis, at the discretion of each park resource manager.

2.4.2 Guidance for Setting Management Priorities

This decision tool assists the resource manager in determining management priorities based on potential impacts to park resources and the potential for controlling the exotic plant. Exotic plants that are listed as county, state, or federal noxious weeds are considered a general management priority. Relative management priorities for each exotic plant (including noxious weeds) can be determined using either a quantitative or qualitative process. The NPS has developed a planning resource called the Alien Plant Ranking System to quantitatively determine exotic plant management priorities. However, some resource managers may not have enough information, data, or resources to use the Alien Plant Ranking System. To address this potential need, a qualitative system is also provided in this decision tool to allow resource managers to qualitatively determine exotic plant management priorities. Resource managers can use the Alien Plant Ranking System to sort exotic plants within a park according to the plant's current level of impact and its innate ability to become a pest. This information is then weighed against the

perceived feasibility or ease of control. The Alien Plant Ranking System also helps the resource manager identify those species that are not presently a serious threat but have the potential to become a threat and, thus, should be monitored closely or managed aggressively before they become established. The potential cost of delaying any action is also considered in this analysis. The Alien Plant Ranking System can be downloaded at:

http://www.usgs.nau.edu/SWEPIC/aprs/downloads.html.

The qualitative ranking system was adapted from the *Handbook for Ranking Exotic Plants for Management and Control* (Hiebert and Stubbendieck 1993). Using this system, exotic plant management priorities are determined using four criteria:

- Current extent and distribution of exotic plant populations within the park
- Current and potential impacts of the exotic plant on environmental resources within the park
- Current and potential difficulty to control the exotic plant
- Value of habitat or resource being affected

The results of either the qualitative or quantitative rankings are used to determine relative management priorities. In accordance with NPS management policies (NPS 2006), highest priority is to manage disruptive exotic plants that have, or potentially have, a substantial impact on park resources, and can reasonably be expected to be controlled. Disruptive species typically have one or more of the following characteristics:

- Have community level or ecosystem level effects and significantly alter natural processes such as: fire regimes, nutrient cycling; hydrology, or successional patterns;
- Alter species composition and reduce populations of native species;
- Alter genetic variability through hybridization with native species;
- Affect localized resources, such as archaeological or scenic qualities.

Lower priority is given to innocuous exotic plants that have almost no impact on park resources or that probably cannot be successfully controlled. Innocuous species do not significantly harm park resources and are therefore usually a lower management priority. Most innocuous species do not invade native ecosystems without human-caused disturbance, and their populations generally do not expand within the park. Some innocuous species may invade native ecosystems, but do not displace native species to a significant extent. Whether a species is disruptive or innocuous depends on a number of factors, including the exotic plant's life history, environmental conditions, and the health of native ecosystems. An exotic plant may be disruptive in native ecosystems that are highly disturbed, but may be innocuous in a healthy native ecosystem. The ranking system allows the resource manager to account for each species' life history, environmental conditions, and the health of native ecosystems within their park when determining relative exotic plant management priorities.

Morse et al. (2004) have developed a system called *An Exotic Species Assessment Protocol: Evaluating Non-native Plants for their Impact on Biodiversity*. This tool could be used by parks to identify priority exotic plants on a more regional scale. NatureServe, in cooperation with TNC

and the NPS, developed the Exotic Species Assessment Protocol as a tool for assessing, categorizing, and listing non-native exotic vascular plants according to their impact on native species and natural biodiversity in a large geographic area such as a nation, state, province, or ecological region. The protocol is designed to make the process of assessing and listing exotic plants objective and systematic, and to incorporate scientific documentation of the information used to determine each species' rank.

Priority treatment areas of each park unit were determined using the first two steps of the decision making tool process. These sites are targeted for control over the next 10 years approximately and the maps of each park unit with treatment areas are in Appendix F.

2.4.3 Optimum Tool Analysis for Treatment Options

The Optimum Tool Analysis for Treatment Options decision tool is used to identify a proposed treatment option and to assess whether there are alternative cost-effective treatment options available that will result in lower impacts. The optimum tool analysis process is based on the concept of Minimum Requirement Decision Guide that is used by the NPS to evaluate activities in Wilderness areas. An optimum tool is a use or activity, determined to be necessary to accomplish an essential task, which makes use of the least intrusive treatment, agent, or application method that will achieve the management objective. This is not necessarily the same as the term "primitive tool," which refers to the actual equipment or treatment method that makes use of the simplest available technology (i.e., hand tools). In contrast to the primitive tool concept, the optimum tool analysis also considers whether the treatment is cost-effective. At the beginning of this decision tool, the resource manager identifies a proposed treatment option that is feasible given potential costs, available resources, potential impacts and effectiveness, and applicable regulations and policies. The next step is to consider whether there are any other treatment options, treatment agents, or application methods available that will result in lower impacts when compared to the proposed treatment option given potential costs, available resources, impacts, and effectiveness. If there are no other feasible options available, the resource manager selects the proposed treatment. However, if the resource manager identifies an alternative treatment that has lower impacts and that is feasible, the alternative treatment option is selected.

Once a treatment method is selected, its compliance with NPS policies and NEPA is confirmed. Two separate decision trees are used to confirm compliance. If chemical or biological control treatments are selected, their compliance with applicable regulations and policies is confirmed. Compliance with NEPA is also confirmed. These two steps are accomplished using separate decision trees. If compliant, the resource manager then determines whether there are any sensitive resources located within the treatment area that could be affected by the proposed treatment. Examples of sensitive resources include threatened, endangered, or traditional use plants; historic structures with limestone grout, raptor nests, and cave resources. If sensitive resources are identified, the locations of these resources and appropriate buffer areas are delineated so they can be avoided. Once sensitive resources have been delineated, the selected treatment along with BMPs to mitigate potential impacts can be implemented.

Treated areas are then monitored to determine whether management objectives established during the initial planning stages were met. If management objectives were met, the resource

manager documents the results of monitoring. The resource manager should, however, continue to consider other treatment options as they become available to identify other alternatives that might have even lower impacts.

If management objectives are not met, the selected treatment may be modified, or alternative treatments may be considered through adaptive management. The NPS must use adaptive management to fully comply with 40 CFR, which requires a monitoring and enforcement program to be adopted, where applicable, for any mitigation activity. Adaptive management [516 Departmental Manual (DM) 4.16] is a system of management practices based on clearly identified outcomes; monitoring to determine if management actions are meeting outcomes; and if not, facilitating management changes that will best ensure that outcomes are met or by reevaluating outcomes. Adaptive management recognizes that knowledge about natural resource systems is sometimes uncertain and is the preferred method of management in these cases.

2.4.4 Confirm Compliance for Chemicals and Biological Control Agents

If chemicals or biological control agents will be used, the resource manager must confirm that these treatments are justified and compliant with NPS policies using this decision tool. According to the NPS Management Policies (2006:48), a designated IPM specialist must first determine that the use of a chemical or biological control agent is necessary. In addition, all other treatment options considered must be either not acceptable or not feasible. If the use of chemical or biological control agents has not been determined necessary, or if there are other treatment options that are acceptable or feasible, the resource manager returns to the Optimum Tool Analysis to consider these treatments further.

Chemicals

In accordance with NPS-77 (NPS 1991), only those herbicides that are registered by the USEPA can be used. Herbicides must also be used in accordance with product labels. Some herbicides have use restrictions that prohibit their use under certain conditions. Herbicides having use restrictions will only be used for sites that meet the conditions specified on the product label. If the herbicide is registered, and if there are no existing site conditions that will restrict its use, the next step is to submit a herbicide use request to the Regional and/or National IPM Coordinator. In general, herbicide use proposals from parks are submitted to the Regional IPM Coordinator, who is responsible for soliciting input from the National IPM Coordinator for cases where the Regional Coordinator does not have approval authority. Herbicide use requests that involve any of the following actions must be approved by a National IPM Coordinator (NPS 1991):

- Aquatic applications or situations in which the applied herbicide could reasonably be expected to get into waters or wetlands;
- Applications that may affect rare, threatened, or endangered species or associated critical habitat;
- The use of restricted-use herbicides as defined by the USEPA;
- Treatment areas are equal to or larger than four sections of land.

Director’s Order-77-7 (DO 77-7) (in preparation) requires herbicide use request approval by a National IPM Coordinator for aerial application of herbicides. DO 77-7 also require approval by a National IPM Coordinator for application of 400 contiguous acres. This differs from current

NPS-77 requirements, which requires National IPM Coordinator review of any treatments equal to or larger than four sections of land. Although the size limit of four acres proposed under DO-77 has not been finalized, it is being used by the NPS as the acreage above which approval from the National IPM Coordinator is required.

The Regional IPM Coordinator may approve other herbicide use requests that do not fall into these categories.

Once the herbicide use request has been approved, the resource manager may then purchase herbicides. However, according to NPS policy, no herbicides may be purchased unless they will be used within one year from the date of purchase (NPS 2006:48).

Biological Control Agents
Only biological control agents that have been approved by APHIS for release will be used. If a biological control agent has not been approved by APHIS, resource managers must consider other treatments using the Optimum Tool Analysis in Appendix A. APHIS undergoes an extensive review process prior to approving any biological control agents for release in the U.S. The next step is to submit a biological control agent use request to the Regional IPM Coordinator. Once the biological control use request has been approved by the National IPM Coordinator, the resource manager can then identify a procurement source for the biological control agents. If biological control agents will be obtained from another state, a permit must be obtained from APHIS. Transportation and handling of biological control agents will comply with any conditions specified in this permit.

2.4.5 Confirm Compliance of Proposed Treatment Method with NEPA

This decision tool is used to confirm that the selected treatment method complies with NEPA. The resource manager will use an Environmental Screening Form to confirm that the selected treatment method has been considered in the EPMP or under another current and up-to-date environmental document. The resource manager will ask the following questions for each proposed exotic plant management treatment:

- Is the selected treatment included in the EPMP or another approved plan and accompanying NEPA document?
- Are the potential selected treatment impacts consistent with the EPMP or the other NEPA document?
- Is the EPMP or other NEPA document accurate and up-to-date?

Park-specific plans that include exotic plant management treatments and associated potential impacts considered in this EPMP may not require additional compliance with NEPA. However, resource managers are encouraged to consult regularly with a Regional NEPA Compliance Specialist to confirm that the EPMP or other existing documents have adequately addressed any NEPA requirements prior to implementing proposed treatments in the future. If the selected treatment(s) complies with the EPMP or other NEPA document, resource managers should document this compliance using a memo to file (see Appendix A decision making tool “Confirm Compliance of Treatment Method with an Existing NEPA Document”).

If the proposed treatment method has not been addressed in the EPMP or in another NEPA document, or if the document is out-of-date, preparation of a new NEPA document will be required to comply with NEPA. For example, new treatment methods other than cultural, mechanical, biological, chemical, and prescribed fire may become available that were not available at the time this document was prepared. Preparation of additional NEPA documentation may also be required in cases where the proposed treatment could not be covered using a CE.

Park-specific plans containing exotic plant management treatments or having associated potential impacts that have not been considered in this EPMP will also require additional compliance with NEPA. Regardless of whether an independent plan is developed, any exotic plant management action and associated impacts not covered under this EPMP will require additional compliance with NEPA (see Appendix A decision tool "Confirm Compliance of Treatment Method with an Existing NEPA Document").

In addition to NEPA, other federal, state, and local laws may also have information requirements that overlap with NEPA. The compliance review should also confirm that proposed treatment has addressed these other requirements. Some of these additional requirements, as identified in DO-12, include:

1. ESA - Section 7 requires that a federal agency consult with the USFWS or the National Marine Fisheries Service on any action that may affect endangered, species, threatened species, or candidate species, or that may result in adverse modification of critical habitat.

2. E.O. 11988 and 11990, Floodplain Management and Wetland Protection – These executive orders direct NPS to avoid, to the extent possible, the long- and short-term adverse impacts associated with modifying or occupying floodplains and wetlands. They also require NPS to avoid direct or indirect support of floodplain or wetland development whenever there is a practical alternative.

3. National Historic Preservation Act (NHPA) §106 - §106 of NHPA requires federal agencies to consider the effects of their proposals on historic properties, and to provide state historic preservation officers, tribal historic preservation officers, and, as necessary, the Advisory Council on Historic Preservation a reasonable opportunity to review and comment on these actions.

4. E.O. 12898, Environmental Justice in Minority and Low-Income Populations - This executive order directs federal agencies to assess whether their actions have disproportionately high and adverse human health or environmental effects on minority and low income populations.

5. Secretarial Order 3175 and Environmental Compliance Memoranda (ECM) 95-2 – These memoranda require bureaus to explicitly address environmental impacts of their preferred alternatives on Indian Trust Resources in any environmental document.

These requirements have been addressed in the preparation of this document.

2.5 TREATMENT METHODS

The following treatment methods are proposed to manage exotic plants. These treatments include:

- Cultural
- Manual/Mechanical
- Biological Control
- Chemical
- Prescribed Fire

Each of these treatments is discussed in the following sections.

2.5.1 Cultural Treatments

Cultural treatments are practices that promote the growth of desirable plants and reduce the opportunities for exotic plants to grow. Cultural treatment methods involve manipulating treatment areas to present exotic plants with effective native competitors. Examples of cultural treatments that may be implemented under the preferred alternative include:

- Prevention
- Reseeding and Planting
- Irrigation

Prevention

Preventing establishment is an economical way to manage exotic plants. Under the preferred alternative, the following prevention actions will be implemented:

- Any feed, forage, mulch, fill, gravel, and other like materials brought into a park should be certified free of exotic plant seed ("certified weed-free"). Certified weed-free hay is often smooth brome, crested wheat grass, and alfalfa, which are not native to this country. While certified weed-free hay may include exotics, it may be the best option available. However, parks will encourage the use of hay composed only of native forage. Weed-free hay that does not include exotic plants should be readily available.
- Sources of "clean fill" (weed-free) will be used, where available, if construction fill will be obtained from within parks. If not feasible, fill not designated as "clean fill" may be used but should be closely monitored for exotic plant growth. Construction equipment will otherwise avoid exotic plant infestations, to the extent feasible.
- Brush horses and pack animals thoroughly and have their hooves cleaned before entering a park.
- Feed horses and pack animals only food that is "certified weed free" starting 96 hours before entering a park.
- Any seed or plant materials used for restoration efforts within a park should be "certified weed-free".

- Require inspections and cleaning of contractors' and fire fighters' equipment, vehicles, and materials to prevent importation of nonnative plant seed or materials into a park.
- Require commercial users that disturb established vegetation to provide bonds that are retained until sites are returned to a specified condition.
- Develop BMPs to limit the amount and impact of ground-disturbing activities.
- Train park staff and volunteers on how to identify priority exotic plants. Park employees and volunteers should report any observations of exotic plants to the resource manager immediately. A phone number for the point of contact will be provided to staff and volunteers.
- Develop information for the public and park staff on exotic plants. This information may include signs, interpretive displays, brochures, and programs.

Reseeding and Planting

Reseeding is used to encourage the re-establishment of native plants and to prevent the establishment of exotic plants. Native shrubs or trees can also be replanted after exotic shrubs and trees are removed to help restore habitat structure. Unless native plants are reestablished, the removal of one exotic plant may result in the establishment of another undesirable exotic plant. Reseeding will not be required in areas where native plant diversity is good within and surrounding treated infestations of exotics.

Any planned in-park development or disturbance activities should be required to include sufficient time for plant salvage to be completed prior to disturbance. Any areas that are disturbed will be reseeded as soon as possible to facilitate the reestablishment of native plants. Restoration may also be necessary in dense infestation areas that no longer support native species or where viability of native species seed banks has been exhausted. Following treatment and removal of exotic plants, these areas will be reseeded using native plant materials. Any materials used in re-vegetation (including mulch and organic fertilizers) will be free of non-native plant seeds or materials. In addition, locally grown, native plant materials will be used where possible. All plant materials used will be "certified weed-free."

Irrigation

Irrigation may be used on a limited basis to help native vegetation become established during dry periods. However, no surface water depletions or accretions related to irrigation will occur. Because much of the SEUG area has been in a drought over the last several years, any projects that involve planting native shrubs or trees should also consider whether there will be adequate water to facilitate vegetation establishment. If drought conditions are forecasted, resource managers should delay the purchase and planting of shrubs to avoid the need for irrigation. Resource managers should also confirm that there is water available for irrigation should the need arise.

2.5.2 Manual and Mechanical Treatments

Manual and mechanical treatments will continue. Mechanical treatments will continue to involve the use of tools to remove or physically damage exotic plants. Examples of mechanical treatments include using hand cutting (shovels and clippers), pulling tools (such as weed wrenches™), and power tools. Any manual and mechanical methods will be highly selective for individual plants. Both manual and mechanical treatments could be used to treat individual plants

or specific treatment areas. Manual or mechanical treatments may need to be performed several times during a season and are often used in concert with other treatment methods. For example, manual or mechanical treatments may be followed by application of herbicides or prescribed fire to treat re-sprouts and new seedlings.

Mechanical treatments remove aboveground biomass and deplete nutrient reserves that are stored in root or rhizome systems. Once nutrient reserves are depleted, exotic plants become more susceptible to subsequent chemical or fire treatments. Following biomass removal, chemicals are often applied directly to the stumps to prevent suckering.

Activities with minimal surface disturbance, such as no-till drill seeding, might be used to reseed riparian and wetland areas in the future. Any activities that could disturb wetlands or waters of the U.S. will require separate consultation with the USACE to determine if a permit is needed.

2.5.3 Biological Control

Biological control relies on the use of other biological organisms to maintain pest populations below the action thresholds. In some cases, such as when native insects and herbivores are not maintaining exotic plants at acceptable levels, releases of biological control agents may be necessary. Release of biological control agents adhere to the following BMPs:

- Biological control agents should be released in each climatic zone that is occupied by the host so that the natural enemy has a chance to develop in all areas where the host occurs.
- The number of biological control agents released should account for the size and density of the treatment area and the number of agents required to maintain a viable biological control agent population.
- More than one release in an area may be necessary for successful establishment.
- Releases should be synchronized with the time period when the host is present.
- Biological control agents should be released at times of the day when they will not disperse from the treatment area.
- Surveys for biological control agents should be completed several times during the season to monitor biological control agents.

In this plan, insects will be the primary biological control agent that will be used. SEUG parks who currently do not use these biological control agents could consider using them. Biological control agents that are proposed for use in this plan are summarized in Table 2-1.

Only biological control agents that have been approved by APHIS for release on federal lands in Utah and/or Colorado could be used. When considering the use of a new biological control agent, the resource management specialist will confirm that its use is necessary and that all other treatment options are either not acceptable or not feasible. In making this determination, resource managers are also encouraged to contact specialists at APHIS who have studied the biological control agent. The resource manager should confirm that use of the selected biological control agent is appropriate for their site, that it has the potential to be effective, and that populations will be viable. Taking these extra steps will help to ensure that the most appropriate and cost-effective biological control agent is selected.

Before a biological control agent is released, the resource manager will receive approval from the National IPM Coordinator to release the agent. If biological control agents will be obtained from another state, a permit, which has been reviewed by the State Entomologist, must also be obtained from APHIS. The transport, handling, and release of biological control agents will be in accordance with all permit conditions. Parks will use a standardized form to report annual releases of biological control agents to the Regional IPM Coordinators.

The release of tamarisk leaf beetles (*Diorhabda elongata deserticola*) is not currently permitted by APHIS in Utah. Therefore, if future activities include use of this biological control methodology, formal Section 7 consultation will need to be reinitiated.

Table 2-1. SUMMARY OF BIOLOGICAL CONTROL AGENTS

Targeted Plants	Biological Control Agent		Habitat	Mode of Action	Impact on Host
	Common Name	Scientific Name			
Tamarisk	Tamarisk Leaf Beetle	*Diorhabda elongata deserticola*	This beetle may not be able to establish where floods or permanent above-ground water do not permit pupation or over wintering.	Both adults and larvae feed on the foliage of tamarisk.	Beetle causes death of more plant tissue than it consumes. Damages tamarisk foliage by scraping tissue off leaves, causing twigs beyond this damage to turn yellow and eventually fall off.
Goathead/ Puncturevine	Puncturevine Seed Weevil	*Microlarinus lareynii*	Hot and dry conditions and only on puncturevine plants	Adults over winter in plant debris. Adults lay eggs in the immature burr or flower bud and the larvae feed on and destroy the seeds before they pupate and emerge as adults	This feeding prevents many seeds from germinating and severely impacts the plants.
	Puncturevine Stem Weevil	*Microlarinus lypriformis*	Hot and dry conditions and only on puncturevine plants	Adults over winter in plant debris and lay eggs in the undersides of stems, branches, and the root crown. The larvae tunnel in the pith where they feed and pupate.	Damage to the stems from both external adult feeding and internal larval activity shortens stem lengthening and ultimately delays or prevents the development of flowers and, subsequently, seeds.
Field Bindweed	Bindweed Gall Mite	*Aceria malherba*	Cultivated fields, roadsides, waste places. Grows best on moist fertile soils. Tolerates poor, dry, gravelly soils, but seldom grows in wet soils.	Mites cause galls to form on the leaves and stems of bindweed; During the winter these mites feed on root buds.	Feeding results in stunting of the plant, reduced flowering, and some reduction in the amount of bindweed.
	Field Bindweed Moth	*Tyta luctuos*	Cultivated fields, roadsides, waste places. Grows best on moist fertile soils. Tolerates poor, dry, gravelly soils, but seldom grows in wet soils.	Larvae feed on both leaves and flower buds.	Heavily defoliated plants may die or produce fewer shoots the following year.
Purple Loosestrife	Loosestrife Beetle	*Hylobius transversovittatus*	Sites without prolonged flooding are favored for weevil development.	Larvae live in the roots while adults feed on foliage.	Small roots can be destroyed within two years if infested by several larvae. Larger roots may die after several consecutive years of infestation.
	Golden loosestrife beetle	*Galerucella pusilla*	Readily establishes in infested areas that do not remain	Adults and larvae feed on buds and foliage.	Defoliates purple loosestrife so completely that plants are often

Targeted Plants	Biological Control Agent		Habitat	Mode of Action	Impact on Host
	Common Name	Scientific Name			
			flooded.		killed.
	Black-margined loosestrife beetle	*Galerucella calmariensis*	Continuously flooded habitats are not suitable for beetle survival.	Adults and larvae feed on buds and foliage.	Stunts plants and reduces seed production. Heavily defoliated plants may die or produce fewer shoots the following year.
Canada Thistle	Canada thistle stem-boring weevil	*Ceutorhynchus litura*	Favorable conditions include disturbed areas where Canada thistle is dense, and where plant is not stressed by grazing, flooding, mowing, or herbicides.	Adults feed on leaf and stem tissue. Larvae feed on stem and crown of the plant.	Departing larvae create an emergence hole below the soil surface, which provides access for small insects, other arthropods, nematodes, and pathogens.
Spotted Knapweed, diffuse knapweed	Blunt knapweed flower weevil	*Larinus obtusus*	More moist areas than *L. minutus* (see below)	One or two larvae destroy most of the developing seeds in the head.	Seed production is reduced.
	Lesser knapweed flower weevil	*Larinus minutus*	Hot and dry areas	Larvae feed on seeds, adults feed on rosette leaves.	Reduces seed production. Single larva can destroy an entire knapweed seedhead.
	Knapweed root weevil	*Cyphocleonus achates*	Prefers well-drained soils that lack dense vegetation other than knapweed.	Larvae mine and gall the central vascular tissue of the roots.	Newly hatched larvae mine into the root cortex. Feeding by older larvae causes damage to roots.
	Sulfer knapweed moth, yellow knapweed root moth	*Agapeta zoegana*	Favorable habitats are moderately humid and temperate and have an arid subcontinental climate.	Larvae damage their host plant by mining the roots.	Small plants are often killed by the feeding of the young larvae, larger plants will not flower.

2.5.4 Chemical Treatments

Chemical treatments involve applying herbicides as prescribed by their labels, using a variety of application methods. Herbicides are most effective for treating pure stands of a single exotic plant species in areas where desirable plants are scarce or absent. Herbicides can also be used to treat small patches of exotic plants where hand pulling or cutting is not feasible (Colorado Natural Areas Program (CNAP 2000).

Herbicides will be applied a number of different ways. In most instances brushes or portable sprayers will be used, other possible methods include All-Terrain Vehicles (ATVs) equipped with sprayers, and aerial application (helicopter and fixed wing). Portable spot or wick applicators can be used to apply an herbicide directly onto a target plant. Power sprayers are portable, pressurized sprayers that can be used to treat small application areas. ATVs or helicopters can be equipped with either a boom or boomless applicator to rapidly treat large areas. A boom applicator is a long horizontal tube that is equipped with multiple spray heads. A boomless sprayer is designed to provide a full left to right hand spray pattern from a centrally mounted nozzle. An ATV can be mounted with two nozzles directly behind the ATV that can spray 15 feet in each direction. The boom is carried above the exotic plants, while spraying the herbicide. Spray mechanisms are equipped with flow regulators that control application rates. In the SEUG, a common application method for treating trees and shrubs is the "cut stump method." The tree or shrub is cut near the base of the trunk, and herbicides are sprayed or painted directly onto the cut stump.

Aerial application of herbicides will only be conducted for sites that meet one of the following criteria:

- The infestation covers a large area and will be most effectively treated from the air. There is no acre limit for using aerial application, however aerial application sites are typically over 20 acres and have fairly dense exotic plant coverage.

- The infestation covers a small area but can be successfully treated using a microfoil boom or similar apparatus that allows for a limited band of spray. A microfoil boom can be used to spray widths as small as 12 feet, effectively treating small infestations. Microfoil booms are designed specifically to minimize herbicide drift.

- The infestation is very remote and treatment using other application methods will require an inordinate amount of time for crews to arrive and apply ground treatment.

- The infestation is located on rough, steep terrain that prevents ground application and is too dangerous for employees on foot.

The use of herbicides will be considered only after alternative manual/mechanical, cultural, or biological control treatment methods have been ruled out using the Optimum Tool Analysis. Under some circumstances, herbicides may be the only feasible option for treating an exotic plant. Herbicides selected for treatment will be known to be effective on the target exotic plant and known to have a minimal effect on the environment. To minimize potential environmental effects, herbicides will be selected based on the presence of non-target plants (including

sensitive, traditional use plants), soil texture, depth and distance to water, and environmental conditions.

Resource managers may use the Relative Aquifer Vulnerability Evaluation (RAVE) system to assess the potential risk for ground water contamination resulting from the use of herbicides. Use of the RAVE model or other appropriate model is encouraged in areas where leaching to ground water is possible. RAVE is a numeric scoring system that is relatively simple to use, and allows resource managers to quantitatively evaluate the potential for an herbicide to contaminate ground water. The RAVE system can also be used for insecticides, fungicides, and rodenticides. However, only herbicides will be used in SEUG parks.

The RAVE system includes a model that addresses irrigation systems developed by Montana State University (MSU 1990) and one that addresses natural precipitation systems developed by the Forest Service (USDA Forest Service 1992). Both models are included as tools in Appendix G. The original RAVE system, titled "RAVE: Relative Aquifer Vulnerability Evaluation," was developed by the MSU Extension Service (MSU 1990). This system was developed for farming situations that use irrigation. Under the EPMP/EA/AEF, the original RAVE system could be used for situations where parks irrigate areas that are also chemically treated. The Forest Service has modified this original RAVE system so it can also be used for non-irrigated areas that only receive natural precipitation. This version of the RAVE system is titled RAVE: Relative Aquifer Vulnerability Evaluation (as adapted from Montana Department of Agriculture and Environmental Management Division) (USDA Forest Service 1992). This version of RAVE will be used by parks for those areas that only receive natural precipitation and do not receive supplemental irrigation. Appendix G also includes a supplemental table to be used with either RAVE system. This table, developed by Gerald McCrea (Regional IPM Coordinator for the Intermountain Region) provides additional information on herbicides that will be used under the preferred alternative.

To determine the potential for ground water contamination, the RAVE system considers several factors: irrigation practice, depth to ground water, distance to surface water, percent organic matter, herbicide application frequency, herbicide application method, herbicide leachability, and topographic position. Values are assigned to each of these factors and then totaled. The total value is then compared to a "scorecard interpretation scale" to determine the potential for ground water contamination by an individual herbicide. Higher scores indicate a higher vulnerability of ground water to herbicide application. If an herbicide is determined to have a high potential for ground water contamination, an alternative herbicide or alternative application method is selected and results are compared. The alternative that has the lowest potential for ground water contamination and that has an acceptable score is then selected. Approval by the Regional IPM Coordinator is also required. In some cases, herbicide soil mobility data are available which has enabled the establishment of herbicide-specific buffer zones. In such cases, these data could be used instead of the RAVE model, as it is based on research data rather than modeling.

Only those herbicides that have been registered by the US EPA will be used under the preferred alternative. When considering the use of a chemical treatment, the resource management specialist will confirm that its use is necessary and that all other treatment options are either not

acceptable or not feasible. The resource manager should also confirm that use of the selected herbicide is appropriate for the site and that it has the potential to be effective on the target species. Taking these extra steps will help to ensure that the most appropriate and cost-effective herbicide is selected.

Herbicides are classified according to their mode of action, which is determined by the active ingredients. Active ingredients that may be used under the preferred alternative are summarized in Table 2-4. Common trade names are provided in parentheses after the active ingredient. This is not a comprehensive list of trade names, and under the EPMP, any registered herbicide trade name that contain the active ingredients listed in Table 2-2 may be used. Herbicides containing active ingredients that are not listed on Table 2-2 may also be used under the EPMP. However, the use of any herbicide must meet all conditions outlined in this document and must also be approved by the Regional or National IPM Coordinator.

An adjuvant is a substance added to an herbicide to aid its action, but has no herbicide action by itself. Some herbicides require the addition of an adjuvant to work effectively. Surfactants are adjuvants used in conjunction with herbicides to increase absorption. A surfactant is a surface active ingredient that lowers surface tension of the solvent in which it is dissolved or the tension between two immiscible liquids. Safety procedures and MSDS's must be kept on site for all adjuvants used under the EPMP.

Table 2-2. SUMMARY OF ACTIVE INGREDIENTS FOR HERBICIDES

Active Ingredients	Registered Use	Target Plants	Mode of Action	Method of Application
Aminopyralid (Milestone)	General Use	Annual, biennial and perennial broadleaf weeds and woody plants.	Translocates throughout the entire plant and accumulating in meristematic tissues, including the roots. It disrupts plant growth metabolic pathways affecting the growth process of the plant.	Aerial spraying, spraying from a truck, backpack or handheld sprayer, foliar spray, spot treatments.
Clopyralid (Curtail, Transline, Reclaim, Lontrel, Redeem)	General Use	Annual and perennial broadleaf herbs, especially knapweeds, thistles, and other members of the sunflower, legume, and knotweed families	Absorbed by the leaves and roots of the exotic plant and moves rapidly through the plant. It affects plant cell respiration and growth.	Aerial spraying, spraying from ground equipment.
Glyphosate Products (Roundup Pro, Roundup Ultra, Rodeo, GlyPro, Accord, Glyphomax, Touchdown)	General Use	Grasses, herbaceous plants including deep rooted perennial exotic plants, brush, some broadleaf trees and shrubs, and some conifers. Does not control all broadleaf woody plants.	Absorbed by leaves and rapidly moves through the plant. It acts by preventing the plant from producing an essential amino acid. This reduces the production of protein in the plant, and inhibits plant growth.	Aerial spraying, spraying from a truck, backpack or handheld sprayer, wipe application, frill treatment, cut stump treatment.
Imazapic	General Use	Annual and perennial	Inhibits the production of	Aerial spraying,

Active Ingredients	Registered Use	Target Plants	Mode of Action	Method of Application
(Plateau, Cadre, Plateau Eco-Paks)		broadleaves and grasses	some amino acids, which are necessary for protein synthesis and growth.	spraying from ground equipment or a handgun sprayer.
Imazapyr (Arsenal, Habitat)	General Use	Annual and perennial grass, broad-leaved weeds, brush, vines, and deciduous trees.	Absorbed by leaves and roots, moves rapidly through plants. Disrupts photosynthesis and interferes with cell growth and DNA synthesis.	Ground or aerial foliage spray, basal bark and stem treatment, cut stump treatment, tree injection.
Picloram (Tordon, Grazon PC, Tordon K, Tordon 22K)	Restricted Use*	Broadleaf herbs, vines, and woody plants (especially leafy spurge).	Absorbed through plant roots, leaves and bark. It moves both up and down within the plant, and accumulates in new growth. It acts by interfering with the plant's ability to make proteins and nucleic acids.	Broadcast or spot treatment as foliar (leaf) or soil spray, basal spot treatment, tree injection, frill treatment, stump treatment, basal bark treatment, low volume dormant stem spray, by air as broadcast or low volume dormant spray.
Triclopyr (Garlon products)	General Use	Woody plants and broadleaf plants.	Disturbs plant growth. It is absorbed by green bark, leaves and roots and moves throughout the plant. Accumulates in the meristem (growth region) of the plant.	Ground or aerial foliage spray, basal bark and stem treatment, cut surface treatment, tree injection.

* All formulations that may be broadcast on soil or foliage are classified as “restricted use” herbicides. Sale and use of these herbicides are limited to licensed herbicide applicators or their employees, and only for uses covered by the applicator's certification. The restricted use classification is due to picloram’s mobility in water, combined with the extreme sensitivity of many important crop plants to damage.

Each herbicide varies in terms of its chemical and biological behavior in the environment. Factors that affect herbicide behavior in the environment include herbicide properties, soil characteristics, and climatic conditions. Factors that influence the behavior of herbicides in the environment are summarized below. This summary is based on information provided by Miller and Westra (1998) in “*Colorado State University Fact Sheet: Herbicide Behavior in Soils*”.
Acid or base strength - refers to whether a herbicide has basic, acidic, or non-ionizable properties. This factor determines the ability of a herbicide to exist in soil water or be retained onto soil solids. In general, herbicides whose pH is close to the pH of soil are strongly retained and are not subject to runoff, erosion, and/or leaching. In contrast, herbicides whose pH is not close to that of the soil are less strongly retained and are subject to runoff, erosion, and/or leaching. These herbicides are also more available for plant uptake than those herbicides that are strongly retained onto soil solids.

- Water solubility - refers to how readily an herbicide dissolves in water and determines the extent to which an herbicide is in the solution (water) phase or the solid phase. An herbicide that is water soluble generally is not retained by soil.

- Volatility - refers to the tendency of an herbicide molecule to become a vapor. Herbicides with high vapor pressures are likely to escape from the soil and volatilize in the atmosphere.

- Soil retention - is an index of the binding capacity of the herbicide molecule to soil organic matter and clay. In general, herbicides with high soil retention are strongly bound to soil and are not subject to leaching. Those not exhibiting high soil retention are not strongly bound and are subject to leaching.

- Soil persistence - refers the longevity of a herbicide molecule, typically expressed in terms of a half-life, as determined under normal conditions in the region where the herbicide will be used.

These factors influence the environmental fate and effects of an herbicide, including its residual soil activity, persistence, volatilization, water solubility, and potential for leaching into ground water. Table 2-3 summarizes potential environmental fate and effects of herbicides that may be used.

Once an herbicide has been selected, the resource manager will submit an herbicide use request using the Intranet-based IPM System. In general, the Regional IPM Coordinator will be responsible for reviewing and approving proposed herbicide uses. However, review and approval from a National IPM Coordinator will be required for herbicide uses that involve: aquatic applications or situations in which the applied herbicide could reasonably be expected to get into waters or wetlands; herbicide uses that may affect rare, threatened, or endangered species or associated critical habitat; herbicide use involving aerial application; herbicide use on 400 or more contiguous acres, use of a restricted-use herbicide as defined by the USEPA will be used. The only restricted use herbicide currently being used by parks is picloram. All formulations that contain picloram and that may be broadcast on soil or foliage are classified as “Restricted Use” herbicides. Sale and use of these herbicides are limited to licensed herbicide applicators or their employees, and only for uses covered by the applicator's certification. A National IPM Coordinator must approve the use of picloram prior to its purchase and use.

Table 2-3. HERBICIDES AND THEIR ENVIRONMENTAL FATE AND EFFECTS.

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatilization and Potential By-Products from Burning	Solu-bility	Potential for Leaching	Surface Waters	Toxicity
Aminopyralid (Milestone)	Half-life can range from 32-533 days with a typical time of 103 days.	Soil microorgisms and sunlight break down aminopyralid	No information is available on potential by-products from burning.	Not available	Moderate potential to leach through soils and contaminate groundwater.	Reduced run-off potential because of its low use rate. Surface water breakdown in less than 24 hours.	**Soil microorganisms-** no information is available. **Plants-** Contact with non-target plants may injure or kill plants especially leguminous trees. **Aquatic animals-**Practically non-toxic to slightly toxic to aquatic invertebrates. Practically non-toxic to fish. **Terrestrial animals-** Practically non-toxic to mammals and birds **Human health-**EPA toxicity level IV. Classified as "not likely" to be carcinogenic to humans.
Clopyralid (Curtail, Transline, Reclaim, Lontrel, Redeem)	May be present in anaerobic soils or soils with low microorganisms. Half-life is 15-287 days.	Active in soil, is usually absorbed from soil by plants. Soil microorganisms break down Clopyralid.	Does not evaporate easily. No information is available on potential by-products from burning.	Highly soluble in water.	Because clopyralid is highly soluble in water, does not absorb to soil particles, and is not readily decomposed in soils, it 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, there is potential for surface waters to be contaminated if clopyralid is applied directly to bodies of water or wetlands.	**Soil microorganisms** - no information is available. **Plants** - contact with non-target plants may injure or kill plants. **Aquatic animals** - low toxicity to fish and aquatic invertebrate animals. Clopyralid does not bio-accumulate in fat tissues. **Terrestrial animals** - low toxicity to birds and mammals. Not toxic to bees. **Human Health-** EPA Toxicity level IV. This herbicide is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. No reports of acute poisoning in humans have been found. Clopyralid can cause severe eye damage, so properly fitted goggles are mandatory for applicators.
Glyphosate Products (Roundup Pro, Roundup Ultra, Rodeo, GlyPro, Accord, Glyphomax, Touchdown)	Half-life can range from 3 to 130 days. Soil micro-organisms break down glyphosate. Surfactant in Roundup has a half-life of less than 1 week.	Generally not active in soil. It is not usually absorbed from the soil by plants.	Does not evaporate easily. Major products from burning treated vegetation include phosphorus pentoxide, acetonitrile, carbon dioxide, and water. None of these com-pounds is known to be a health threat at levels that will be found in a vegetation	Dis-solves easily in water.	The potential for leaching is low. Glyphosate and the surfactant in Roundup are strongly absorbed by soil particles. Half-life for glyphosate in water ranges from 35 to 65 days. The surfactant half-life ranges from 3 to 4 weeks.	Very low concentrations of glyphosate have been observed in surface water following heavy rains, up to 3 weeks after application.	**Soil microorganisms** - Glyphosate and the surfactant have no known effects on soil microorganisms. **Plants** - Contact with non-target plants may injure or kill plants. **Aquatic animals** - Glyphosate is no more than slightly toxic to fish, and practically non-toxic to aquatic invertebrate animals. It does not bio-accumulate in fish. The Accord and Rodeo formulations are practically nontoxic to freshwater fish and aquatic invertebrate animals. The Roundup formulation is moderately to slightly toxic to freshwater fish and aquatic invertebrate animals.

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatilization and Potential By-Products from Burning	Solu-bility	Potential for Leaching	Surface Waters	Toxicity
			fire.				**Terrestrial animals** - Glyphosate is practically nontoxic to birds and mammals. It is practically non-toxic to bees. **Human Health**- EPA Toxicity level IV. Glyphosate is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. Most reports impacts to humans have involved skin or eye irritation while mixing and loading.
Imazapic (Plateau, Cadre, Plateau Eco-Paks)	Half-life can range from 120- 140 days. It binds weakly to moderately with most soil types. Adsorption increases with decreasing soil pH and increase-ing clay and organic matter.	Moderately persistent.	Does not volatilize from the soil surface and photolytic break down 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 1 or 2 days. Has limited horizontal mobility (6 to 12 inches; up to 18 in sandy soils).	Is rapidly degraded by sunlight in aqueous solution, but is not registered for use in aquatic systems.	**Soil microorganisms** - no information is 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 bio-accumulate in animals, and is rapidly excreted in urine and feces. **Human Health**- EPA Toxicity level IV. Imazapic is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. If ingested, imazapic is rapidly excreted in the urine and feces and does not bioaccumulate.
Imazapyr (Arsenal, Habitat)	May be broken down by exposure to sun-light. Soil micro-organisms contribute to breakdown of imazapyr.	Imazapyr can remain active in soil for 6 months to 2 years.	Does not evaporate easily.	Soluble in water.	Imazapyr has a low potential for leaching to ground water.	Imazapyr may move from treated areas to streams. Most movement of imazapyr was found in runoff from storms. Use of a stream-side management zone can significantly reduce the amount of off-site movement in stream-flow. Half-life in water is about 4 days.	**Soil microorganisms** - has very little effect on soil microorganisms. **Plants** - non-toxic to conifers, but is toxic to many other non-target plants. **Aquatic animals** - Imazapyr and its formulations are low in toxicity to invertebrates and practically non-toxic to fish. Imazapyr is not expected to build up in aquatic animals. **Terrestrial animals** - practically non-toxic to mammals and birds. It is of low toxicity to bees. Imazapyr is rapidly excreted by animals. **Human Health**- EPA Toxicity level III. Triclopyr does not cause birth defects or cancer, and has little or no effect on fertility or reproduction. The exposure levels a person could receive from routine operations are below the levels shown to cause harmful effects in laboratory studies. If ingested, imazapyr is rapidly excreted in the urine and feces and does not bioaccumulate.
Picloram (Tordon, Grazon	Long-term build up of picloram in	Picloram can stay active in soil for a	Does not evaporate easily. Burning	Dissolves readily in	Picloram can leach into ground water under	Picloram can be carried by surface	**Soil microorganisms** - Picloram has very low toxicity to soil microorganisms at up to 1,000

Active Ingredient	Persistence in Soil	Residual Soil Activity	Volatilization and Potential By-Products from Burning	Solu-bility	Potential for Leaching	Surface Waters	Toxicity
PC, Tordon K, Tordon 22K)	soil generally does not occur. Sun-light and micro-organisms in the soil break down picloram. Alkaline condi-tions, fine tex-tured clays, and low densities of plant roots can increase the persistence of picloram.	moderately long time, depending on soil, soil moisture, and temperature. It may exist at levels that are toxic to plants more than a year after application.	destroys more than 95% of picloram residue.	water.	certain conditions. Picloram leaches more easily in soils that have low organic content or are very sandy. Picloram movement is greatest for soils with low organic matter, alkaline soils, and soils that are highly permeable. Where the water table is very low, picloram may leach into ground water. Picloram should not be applied to any surface that will allow for direct pollution of ground water.	run-off water. To prevent water pol-lution, picloram spray drift or runoff should not be allowed to fall onto banks or bottoms of irrigation ditches, or water intended for drinking or house-hold use. Picloram should not be directly applied to wetlands.	parts per million (ppm). **Plants** - Picloram is highly toxic to many non-target plants. Most grasses are resistant to picloram. **Aquatic animals** - Picloram is moderately to slightly toxic to freshwater fish, and slightly toxic to aquatic invertebrate animals. It does not bio-accumulate in fish. The formulated product is generally less toxic than picloram. **Terrestrial anima**ls - Picloram is almost non-toxic to birds. It is relatively non-toxic to bees. Picloram is low in toxicity to mammals, and animals excrete picloram in urine unchanged. **Human Health**- EPA Toxicity level III. Exposure is primarily through inhalation and dermal sensitization. The exposure levels a person could receive from routine operations are below the levels shown to cause harmful effects in laboratory studies.
Triclopyr (Garlon products)	Microorganisms degrade triclopyr rapidly. The average half-life in soil is 46 days.	Triclopyr is active in soil and is absorbed by plant roots.	Very low potential for volatilization. No information is currently avail-able on potential for byproducts from burning of treated vegetation.	Moderate to low.	The potential for leaching 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. The 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 to soil microorganisms. **Plants** - Triclopyr is toxic to many plants. Even very small amounts may injure some plants. **Aquatic animals** - Triclopyr is low in toxicity to fish. The ester form of triclopyr, found in Garlon 4, is more toxic, but in normal conditions, it rapidly breaks down to a less toxic form. Does not bio-accumulate in fish. Triclopyr is slightly toxic to practically non-toxic to aquatic invertebrates. **Terrestrial animals** - Triclopyr is slightly toxic to mammals. In mammals, most triclopyr is excreted, unchanged, in urine. Triclopyr and its formulations have very low toxicity to birds. Triclopyr is non-toxic to bees. **Human Health**- EPA Toxicity level III. Triclopyr does not cause birth defects or cancer, and has little or no effect on fertility or reproduction. The exposure levels a person could receive from routine operations are below the levels shown to cause harmful effects in laboratory studies.

2.5.5 Prescribed Fire Treatments

SEUG does not include prescribed fire by itself as a management tool to control exotic plants according to the Fire Management Plan. The plan provides guidance to allow individual burns to be used for disposal of vegetative debris that is infeasible to dispose of by other means. Brush piles that accumulate from cutting of exotic plants such as tamarisk (*Tamarix chinensis*) and Russian thistle (*Salsola tragus*) will continue to be burned. Heat treatments of individual or small populations of emerging plants, particularly puncturevine (*Tribulus terrestris*) and Russian thistle (*Salsola tragus*) will also continue.

2.6 MONITORING AND RECORD KEEPING

Detailed and accurate record keeping and monitoring is a fundamental component of IPM. Record keeping will be used to provide a historical record of activities and also to provide information that can be used to justify future exotic plant management activities. Monitoring will be used to determine whether exotic plant management activities are effective in meeting management objectives.

The effects of the biological control agent the Tamarisk Leaf Beetle are not well known. They have been released outside the parks but are quickly spreading throughout ARCH and CANY. In fiscal year 2009, funding has been provided to assist with monitoring the beetle's effects on tamarisk and the effects of the dead tamarisk on the environment in general. In some areas monitoring may be more site-specific, like monitoring the large dense tamarisk populations along the river ways. Once these large populations are thinned due to the help of the beetle, what is the potential for other exotics to proliferate in these newly opened riverside areas? It will also be imperative for resource managers to keep in contact with other local agencies that are using biocontrol agents and learn of their results as well.

When biocontrol agents are released in the parks, annual reports will be prepared that summarize the type and number of biological control agents released using the Biological Control Agent Release Form. Biological control reports will be submitted to the Regional IPM Coordinator by March 15 of each year. Biological control reports may also be submitted using an Intranet-Based System once it is developed.

When recording herbicide use, SEUG will use the web-based Pesticide Use Proposal System (PUPS). PUPS is a historical database of the SEUG's control actions and include the amounts of products applied and actual areas treated in the SEUG. Herbicide use in the field will be recorded using the Herbicide Data Form. Information recorded on herbicide use forms will include the following:

- Date and time of application
- Name, location, and estimated area of treatment site
- Brand name of the material or materials used, including formulation

- US EPA registration number of materials used
- The mix rate of material used
- The amount of material used
- Name and license number of herbicide applicator
- General weather conditions, including wind speed

Annual herbicide use reports will be submitted electronically using PUPS. Herbicide use reports must be entered into this system by March 15 of each year.

2.7 BEST MANAGEMENT PRACTICES

To minimize the potential impacts from personnel and equipment, the following general BMPs (mitigation measures) will be implemented.

General

- Equipment will use existing roads and trails to the maximum extent practical.
- Herbicides will be applied primarily by backpack sprayers and hand sprayers, and of specific criteria warrant, boom sprayers on ATV's and aircraft may be used.
- Herbicides will be applied according to application rates specified on the product label.
- Hand tools will be primarily used and only where hand tools are not feasible, chainsaws may be used.
- Equipment used for exotic plant management will be washed prior to entering a park to reduce the potential for accidentally introducing exotic plants from another area.
- Use of equipment in high visibility areas will be avoided to the extent feasible.
- The number of vehicle and equipment passes off-road (only on a case by case basis) will be minimized to the extent possible.
- NPS policy requires that only herbicides that are expected to be used in a 1-year period can be purchased at one time. Therefore, herbicides will not be stored for periods greater than one year. Herbicide efficacy is lost over time.

Air Quality

- Reduced application rates of herbicides will be used wherever possible. Reduced application rates are often more effective than higher application rates because translocation is enhanced prior to loss of physiologic function. Higher rates may burn off leaves and reduce translocation.
- Herbicide application will account for meteorological factors such as wind speed, wind direction, inversions, humidity, and precipitation in relation to the presence of sensitive resources near the treatment area and direction provided on labels. Herbicides will only be applied when meteorological conditions at the treatment site allow for complete and even coverage and will prevent drifting of spray onto non-target sensitive resources or areas used by humans.

- Herbicides will be applied only during periods of suitable meteorological conditions. Loss of spray from a treated area increases during high winds or low humidity. Herbicides should also not be applied during periods of dead calm (this could indicate an inversion) or when wind velocity and direction pose a risk of spray drift.
- Herbicides will be applied using coarse sprays to minimize the potential for drift. Avoid combinations of pressure and nozzle type that will result in fine particles (mist). Add thickeners if the product label permits.

Soils

- Vehicles used for control will avoid wetland areas with standing water or saturated soils, to the extent practical and will be operated to minimize disturbance to soils.
- Personnel and equipment will avoid areas having sensitive biological soil crusts, especially those including colored lichen, or areas that are prone to erosion.
- Off-road vehicles will not be operated where there are well-developed soil crusts, especially where there are mature soil crusts including colored (yellow, white, red, green, brown or blue) soil lichens.
- Damage to soils will be minimized by using existing access routes, when possible, avoiding sensitive biological soil crusts, especially those including colored lichens.
- Type of mowing equipment will be selected based on the patch size, density of the target species, and terrain and condition of biological soil crusts. Large, dense patches are suitable for vehicle-drawn mowing equipment, while small, dispersed patches are more suitable for control with hand-held equipment, such as a weed-whip.
- Hand raking will be used in smaller-scale sites if there are potential impacts to desirable vegetation or soil crusts.
- Where soil destabilization is not desired, the full removal of root systems will not be employed.
- Herbicides with longer persistence will be applied at lower concentrations and with less frequency to limit the potential for accumulation of herbicides in soils.

Native Vegetation

- Exotic plant management activities will only be used where necessary to promote the reestablishment of native plant communities.
- All mowing activities will be timed so that they are performed before there is a danger of contributing to the spread of viable seed.
- Cut plant material will be removed from the site if it may prevent establishment/growth of desirable vegetation and appropriately transported and disposed of in a way so that no propagules are spread. If plant material can or must be left, it will be piled or scattered in a way that it does not re-root or interfere with desirable vegetation.

- Re-vegetation will be implemented as quickly as possible to large areas of bare soil to reduce the danger of erosion caused by any loss of vegetative cover. Small areas that are adjacent to healthy native vegetation will be allowed to recover naturally, whenever possible.
- Selection of restoration species will be limited to native species that exist naturally in the region to prevent the accidental introduction of new exotic species. To minimize genetic contamination, propagules will be collected or propagated from the closest sites possible, as long as the collection site remains healthy and resilient to future disturbance. The benefits of local propagule collection must be weighed against the need for prompt re-vegetation. In many cases it may be more important to prevent establishment of non-desirable species and stabilize soils than to wait for sufficient seed to be collected locally.
- To limit the potential for equipment to spread exotic plant seeds, treatments should be completed before seed becomes viable.
- Planning will be utilized to assure that appropriate seed is available at the necessary time, and local collections will be prioritized based on available information concerning each species' genetic site-specificity.
- Parks will identify traditional use plants based on consultation with tribes. Traditional use plants are plants used or held sacred by Native American Tribes for medicinal, ceremonial, religious, or other cultural purposes.
- NPS staff will receive training on identification of traditional use plants and will avoid treating non-target plants to the extent feasible.
- Mechanical methods such as tilling will not be used in areas where traditional use plants are known to occur or have the potential to occur.
- Herbicides will be selected and BMPs will be implemented to maximize the effectiveness of the treatment on the target exotic plant and to minimize the potential effects on non-target plants.
- Herbicides will be applied as near to the target plant as possible.
- Herbicides will be applied at the appropriate time based on the herbicide's mode of action. Poor timing of application can reduce the effectiveness of herbicides and can increase the impact on non-target plants.

Water Resources (including wetlands and floodplains)

- If drought conditions are forecasted, resource managers should delay the purchase and planting of shrubs to avoid the need for irrigation. Resource managers should also confirm that there is water available for irrigation should the need arise.
- Vehicles are only permitted on established roads and will not be driven up or down stream channels. The number of vehicles will also be minimized to the extent possible.
- Applications of herbicides will be avoided during periods and in areas where seasonal precipitation or excess irrigation water is likely to wash residual herbicides into waterways.
- Only herbicides that are registered for use in or near water will be used in those areas. Only those herbicides that have a low potential toxicity, such as

glyphosate (Roundup Pro and Rodeo) will be used within areas near surface waters or in areas with a high leaching potential. Glyphosate is strongly adsorbed into soil, with little potential for leaching to ground water. Microbes in the soil readily and completely degrade it even in low temperatures. It tends to adhere to sediments when released to water and does not accumulate in aquatic life (Forest Service 2004).

- Herbicides with high soil retention will be used in areas where there is potential to affect surface water or ground water resources.
- As needed to protect the efficacy of the herbicide, water will be buffered, depending on hardness, pH, and other factors.
- Highly water-soluble herbicides will not be used in areas where there is potential to affect surface water or ground water resources.
- Herbicides with high volatility will not be used to treat areas located adjacent to sensitive areas because of the potential for unwanted movement of herbicides to these areas.
- In areas where there is the potential to affect surface water or ground water resources, herbicide pH and soil pH will be considered to select the herbicide with the lowest leaching potential.

Wilderness

- The Minimum Requirement Decision Guide (Appendix H) will be used to determine whether the action is first necessary, then determines the alternatives (equipment, device, force, or practice) for how to accomplish the action that will achieve both Wilderness and resource objectives.
- Unavoidable impacts, such as vehicle tracks from ATVs, will be mitigated immediately after IPM activities are completed.
- SEUG will disseminate information to the public and staff on various control projects as to how and why particularly loud techniques, such as ATVs and aircraft, are necessary to accomplish project goals.

Cultural Resources

- Prior to treatments, the cultural resource manager or assigned staff will brief all weed management staff about issues regarding working around cultural resource sites.
- An annual work plan will be developed that identifies proposed treatment areas that have already been surveyed for cultural resources and where appropriate §106 compliance has been completed.
- Proposed treatment areas that have not been surveyed for cultural resources will be avoided until a survey and SHPO consultation and §106 compliance has been completed or see next bullet for only treatment option.
- In unsurveyed areas and only if feasible, handcutting of exotic vegetation and applying a basal chemical to exotic vegetation with a portable sprayer will be permitted. Portable spraying allows for treatment of individual plants and the spray can be directed within an inch of the target plant. Exotic vegetation will then be cut into manageable sizes and left. No ground disturbance will be permitted. No dragging material and building brush piles will be permitted.

- Surface disturbing activities, such as digging, pulling, tilling or use of heavy equipment, will not be allowed with the boundary of identified and eligible historic properties. Only handcutting of exotic vegetation with a portable basal chemical application will be permitted. Portable spraying allows for treatment of individual plants and the spray can be directed within an inch of the target plant. Exotic vegetation will be cut into manageable sizes and left. No ground disturbance will be permitted. No dragging material and building brush piles will be permitted.
- An archeological monitor must be present when treating areas within the boundaries of eligible cultural resource sites.
- In the event that previously unknown cultural resources are encountered during manual or mechanical treatments, work will stop immediately and will not continue until the site can be evaluated by the park resource staff and appropriate §106 compliance has been completed.
- Use of herbicides within the boundaries of identified and eligible cultural resource sites will be prohibited.
- If portable spraying is used to apply herbicides, establish a 10 foot no-spray zone around cultural resources for treatments involving application of herbicides. Portable spraying allows for treatment of individual plants and the spray can be directed within an inch of the target plant. Care will be given when applying herbicides to limit drift.
- If boom treatments are used on ATVs or aircraft to apply herbicides, a 100 foot no- spray zone around cultural resources will be established. GPS units within aircraft can guarantee this precision when additional BMPs are followed regarding herbicide treatments (low wind conditions, etc.).
- Vehicle traffic, including ATV's, will be limited to existing paved and four wheeled drive roads to protect vulnerable cultural resources.
- To further reduce impacts by weed management on cultural resources, crews will stay on trails, use slickrock and dry washes and work in small teams.
- Burn piles will not be constructed within 100 feet of eligible cultural resources.
- Parks will identify traditional use plant species based on consultation with Native American Tribes.
- NPS staff will receive training on identification of traditional use plants and will avoid treating non-target plants to the extent feasible.
- No manual/mechanical and chemical treatment will take place within 300 feet of identified (through Native American Tribal consultation) sacred springs and seeps.
- Biological control agents may be allowed within the Hackberry spring area.
- No work will be done within the upstream portion of the burn area without archeological staff present within the Tuxedo Bottom area in Canyonlands National Park.
- Within the Spanish Bottom area in Canyonlands National Park, no mechanical/manual or chemical treatment will be done in the talus area. Only mechanical/manual, chemical and biological treatments can be conducted

within the flats and along the river's edge. No cheatgrass will be removed from the archeological resources.

- Within the Upheaval Bottom area in Canyonlands National Park, no mechanical/manual or chemical treatment will be allowed without prior consultation with park cultural resource staff.
- Within the Anderson Bottom area in Canyonlands National Park, no mechanical/manual or chemical treatment will be allowed without prior consultation with park cultural resource staff.
- Parks will identify traditional use plant species based on consultation with tribes.NPS staff will receive training on identification of traditional use plants and will avoid treating non-target plants to the extent feasible.
- The spring in the Hackberry Unit in HOVE has been identified as a possible Traditional Cultural Site Property by Hopi Elders whom are among several of the monument's consulted Native American tribes. The following mitigation measures are required:
  - No manual/mechanical and chemical treatment will take place within 300 feet of the spring.
  - Biological control agents may be allowed in this area.
- Exotic plant treatments within Goodman Point Unit will require additional compliance:
  - The Cultural Resource Program Manager must be contacted at least 1 week before the commencement of work. The Program Manager will contact the researchers with the IPM schedule.
  - Specific target areas for exotic plant treatment must be identified on a 7.5 minute topographical map.
  - Depending on the areas targeted, it will be at the discretion of the Program Manager to decide whether archeological staff will need to be present during exotic plant treatment.
- The following Table 2-4 provides additional mitigation measures for cultural resources that may have adverse effects from IPM.

Table 2-4. ASSESSMENT OF EFFECT ON CULTURAL RESOURCES

Treatment Area	# of cultural sites potentially affected	Action/ Treatment	Effect*	Mitigation
ARCH				
Visitor Center Complex	1	Annual treatment of Russian thistle and puncturevine	NHPA	
Lower Courthouse Wash	3	Removal of Russian olive	NHPA	
Side Canyon to Courthouse Wash	0	Removal of Siberian elm and tamarisk	NHPA	
Middle Courthouse Wash	0	Removal of tamarisk and Russian olive	NHPA	
Sevenmile Wash	0	Removal of tamarisk	NHPA	
Winter Camp Wash	0	Removal of tamarisk	NHPA	

Treatment Area	# of cultural sites potentially affected	Action/ Treatment	Effect*	Mitigation
Middle Salt Wash	2	Removal of Russian knapweed	NHPA	
Wolfe Ranch	0	Removal of tamarisk	NHPA	
Colorado River Corridor	0	Removal of Russian knapweed	NHPA	
Salt Spring	0	Removal of Russian knapweed	NHPA	
Herdina Park/Willow Flat	0	Removal of tamarisk	NHPA	
Middle Salt Valley Wash	1	Removal of tamarisk	NAE	Archeological monitor during activity.
Salt Valley Road	0	Removal of horehound mint	NHPA	
Cordova Canyon/Upper Salt Wash	0	Russian knapweed	NHPA	
Fish Seep Draw	0	Removal of tamarisk	NHPA	
Park Roadside	2	Removal of puncturevine	NHPA	
CANY				
Syncline Loop Trail	2	Removal of tamarisk	NHPA	
Lathrop Canyon	4	Removal of tamarisk	NAE	No work within the lithic scatter site.
Horseshoe Canyon	5	Removal of tamarisk	NHPA	
Green River Corridor	0	Removal of Russian knapweed	NHPA	
Tuxedo Bottom	2	Removal of tamarisk	NAE	No work on upper portion of burn area without an archeological monitor.
Upheaval Bottom	1	Removal of tamarisk	NAE	No treatment will be allowed without prior contact with archeological staff.
Anderson Bottom	1	Removal of Russian knapweed	NAE	No treatment will be allowed without prior contact with archeological staff.
Queen Anne Bottom	1	Removal of Russian knapweed	NHPA	
Turks Head Bottom	0	Removal of perennial pepperweed	NHPA	
Willow Flat Area	3	Removal of halgeton and diffuse knapweed along road.	NHPA	
Spanish Bottom Fire	4	Treatment of burn area to control cheatgrass, perennial pepperweed, Russian knapweed and tamarisk.	NAE	No work in talus areas. No removal of cheatgrass within archeological sites.
Middle Salt Creek	1	Protecting cottonwoods by removal of tamarisk	NHPA	

Treatment Area	# of cultural sites potentially affected	Action/ Treatment	Effect*	Mitigation
Squaw Flat Campground	4	Removal of crested wheatgrass.	NHPA	
Peek-a-boo	0	Removal of ripgut brome	NHPA	
HOVE				
Goodman Point Unit	All sites	Removal of Canada thistle	NAE	No work allowed in Unit without prior discussion with archeologist. Additional NEPA compliance required.
Hackberry/ Horseshoe Unit	2	Removal of tamarisk	NAE	Avoid any manual, mechanical and chemical treatment methods within 300 ft of Hackberry Spring.
NABR				
Armstrong Canyon	4	Removal of tamarisk	NHPA	
Entrance Road	0	Control tumble mustard	NHPA	
Sewage Pond	0	Removal of reeds	NHPA	
White Canyon Bottom	0	Removal of crested wheatgrass	NHPA	

* NHPA- No Historic Properties Affected; NAE-No Adverse Effect; AE-Adverse Effect

Visitor Use and Experience

- Exotic plant management activities will be timed to coincide with low visitor use periods.
- Visitor access will be restricted from some areas during the burning of brush piles and chemical applications.
- SEUG will disseminate information to the public and staff on various control projects as to how and why particularly loud techniques, such as ATV's and aircraft are necessary to accomplish project goals.

Human Health and Safety

- Safety protocols for storing, mixing, transporting, handling spills, and disposing of unused herbicides and containers are included in Appendix E and will be followed at all times. Plans for emergency spills are also included in Appendix E.
- All SEUG employees, volunteers and contractors will be advised and required to follow the safety plan in Appendix E.
- Use of appropriate personal protective equipment PPE will be used when implementing control techniques.
- All SOP's will be reviewed and followed prior to implementation.
- All herbicide labels will be followed to ensure that proper application is used in a safe manner.
- A Job Hazard Analysis for herbicide application will be reviewed prior to implementation.

- Signs will be posted to inform visitors of chemically treated areas. Chemically treated areas will be temporarily closed off to visitors. All federal, state, and local regulations regarding herbicide use will be followed at all times.
- All product labels will be read and followed by herbicide applicators. It is a violation of federal law to use an herbicide in a manner that is inconsistent with its label.
- Herbicide applicators will obtain any certifications or licenses required by the state and/or county.
- All concessionaires will comply with the EPMP/EA/AEF and NPS policy when applying herbicides. Concessionaires will comply with guidance document, *"Understanding the National Park Service's Integrated Pest Management Program"* (NPS 2003).

2.7.1 Committed Conservation Measures for Threatened, Endangered, and Species of Concern

A number of conservation measures have been developed to mitigate potential impacts to threatened and endangered species. Although candidate species are not afforded any protection under the ESA, efforts will be made to avoid or minimize potential impacts to these species as well.

- Field personnel will be trained to recognize and avoid threatened, endangered, and candidate species in their travel routes.
- Prior to implementation of mechanical controls, areas that are potential habitat for listed wildlife species will be surveyed. If listed species are found in the vicinity of the treatment area, treatments will be limited to ones that are unobtrusive or to times of year when the listed species are not present or less affected by disturbance.
- Selection of restoration species will be limited to native species that exist naturally in the region, or non-native species that are known to not spread, to prevent the accidental introduction of new exotic plants that will endanger listed plant or wildlife values.
- Larger equipment associated with restoration, such as seed drills, seedbed preparation equipment or harrowing equipment will not be used in the vicinity of listed plant species unless there is a direct benefit to the listed species.
- Restoration activities will be timed so that negligible disturbance to listed wildlife occurs.
- Herbicide use will be avoided in the vicinity of listed plant species.
- All restrictions outlined on herbicide labels will be followed.
- Chemical controls will be used in the vicinity of listed wildlife or their habitat when other weed management techniques might cause undue disturbance to listed wildlife or their habitat or are deemed infeasible.
- Herbicides that are of low toxicity to wildlife and/or that will degrade before wildlife are likely to encounter them will be used and will be applied in a manner that uses the least amount, but still remains effective and that best protects habitat for listed species.

- Ground-based equipment, including backpack sprayers and spray units on trucks will be used in low-wind conditions.
- If portable spraying is used to apply herbicides, establish a 5 foot no- spray zone around T & E species for treatments involving application of herbicides. Portable spraying allows for treatment of individual plants and the spray can be directed within an inch of the target plant.
- In the event that an area infested by one of the target species provides habitat for a listed species, weed management activities will be implemented in such a way that any potential adverse impacts to that species are negligible. If certain times of the year are less likely to cause disturbance than others, then for all treatments this will be implemented. If a critical feature (such as a snag or den) is within the treatment area, then for all treatments it will be maintained. Also, if a target species provides critical habitat for a listed species, such as nesting sites or a food source, then for all treatments it will be controlled in phases, so that native vegetation can be reestablished that will provide equivalent requirements and habitat is maintained.
- Burning of brush piles will not be conducted in T&E species' habitat during active periods. Project specific brush piles will be designed to prioritize the protection of habitat for T&E species.
- Treatments will be chosen as selectively as possible to minimize impacts to native species. "Broad brush" treatments (such as indiscriminately using ATVs or aerial sprayers for chemical treatments, or mechanical treatments such as mowing) will mostly be used for large, dense infestations of exotic plants. In contrast, individual exotic plants or smaller infestations interspersed with native plants will be treated using precise methods. These methods will allow for treatments of smaller areas or individual plants, while limiting the potential impact on non-target native species.
- ATVs will be used on a limited basis in areas where T&E species are known to occur or have the potential to occur and only along established roads.
- If boom treatments are used (on ATVs or aircraft) to apply herbicides, a 50-foot no-spray zone will be established around listed plants. GPS units within aircraft can guarantee this precision when additional BMP's are followed regarding herbicide treatments.
- Only bio-controls that are deemed host-specific by APHIS and other associated federal agencies using the best available science and monitoring techniques will approved for release in the parks, should they match the park's need for management of a particular species.
- When possible, all tamarisk treatments will occur outside the breeding bird period to protect migratory bird species.

Species-specific measures are described below. Some exotic plant management activities may be necessary within buffer zones established for each species. Any activities that could result in take, as defined by the ESA, will be coordinated with the appropriate USFWS Field Office before any actions are taken.

Mexican spotted owl (*Strix occidentalis mexicana*)

- Treatment areas will be evaluated for Mexican spotted owl nesting and roosting habitats prior to conducting exotic plant management activities. Suitable nesting or roosting habitat is any forested mountain, shady or steep canyon with mature trees that create high closed canopies.
- A disturbance-free buffer area will be maintained around any active Mexican spotted owl nests. If a disturbance-free buffer zone is not feasible, then activity should be conducted outside of the period from April through October to protect nesting and fledgling birds.
- Clearing of live or dead trees greater than 12 inches in diameter at breast height (DBH) along canyons will be avoided to the extent possible to help preserve potential Mexican spotted owl roosting or nesting habitat.

Southwestern willow flycatcher (*Empidonaz traillii extimus*)

- Treatment areas could be evaluated for southwestern willow flycatcher nesting and roosting habitats prior to conducting any exotic plant management activities. Southwest willow flycatcher surveys according to the FWS approved protocol will be completed in any suitable habitats prior to habitat treatments. Suitable nesting/roosting habitat is any dense stand of cottonwood, willows, tamarisk or Russian olive in association with rivers, streams, or any significant body of water, or areas of saturated soils. (See page 11 of the Final Recovery Plan for Southwestern Willow Flycatcher for a detailed list of tree and shrub species used by nesting southwestern willow flycatcher (USFWS 2002).)
- A disturbance-free buffer area of a minimum 300 feet could be maintained around any active southwestern willow flycatcher nests year round and no treatments will occur during the nesting season. Instead the NPS will coordinate with the FWS and UDWR to develop a revegetation and restoration plan for the areas within 300 feet of identified nests. Larger buffers will be considered if the activity includes high noise levels or long-term disturbances.
- Removal of tamarisk on a broad scale (10-200 acres) will only be conducted after a wildfire. Wildfires, which are infrequent within the parks, have the potential to naturally destroy southwestern willow flycatcher habitat. Typically, treatment (cut stump and chemical application to stump or basal spray to new sprouts) of tamarisk is conducted on a smaller scale (less than 2 acres) and is site-specific.
- There will be no clear cutting of large areas (i.e. greater than 2 acres) of exotic species.
- Release of the tamarisk leaf beetle, will not be permitted in the parks until it is approved by APHIS in Utah. If and when the leaf beetle will be approved, formal Section 7 consultation will have to be reinitiated.
- Only willows, cottonwoods and other native vegetation species will be used to reseed and/or replant treated areas.

California condor (*Gymnogypus californianus*)

- Treatment areas will be evaluated for California condor nesting and roosting habitats prior to conducting exotic plant management activities. Suitable nesting/roosting habitat is rocky and brushy areas with cliffs or standing snags available for nest sites near important foraging grounds. A disturbance-free buffer area will be maintained around any active California condor nests. If a disturbance-free buffer zone is not feasible, then activity should be conducted outside of the period from early February through early May to protect nesting and fledgling birds.

Yellow-billed cuckoo (*Coccyzus americanus occidentalis*)

- Treatment areas could be evaluated for yellow billed cuckoo nesting and roosting habitats prior to conducting exotic plant management activities. Suitable nesting/roosting habitat is any dense stand of cottonwood, willows, tamarisk or Russian olive in association with rivers, streams, or any significant body of water.
- A disturbance-free buffer area of a minimum 100 foot buffer area will be maintained around any active yellow billed cuckoo nests. If a disturbance-free buffer zone is not feasible, then activity will be conducted outside of the period from early May through mid September to protect nesting and fledgling birds.
- When possible, all tamarisk treatments will occur outside the breeding period to protect this migratory species.
- Removal of tamarisk on a broad scale (10 to 200 acres) will only be conducted after a wildfire. Wildfires are usually infrequent. Typically, treatment (cut stump and apply chemical to stump or basal treatment to new sprouts) of tamarisk is on a smaller scale (less than 2 acres) and site-specific.
- There will be no clear cutting of large areas (i.e. greater than 2 acres) of exotic species.
- Release of the tamarisk leaf beetle, will not be permitted in the parks until it is approved by APHIS in Utah. If and when the leaf beetle will be approved, formal Section 7 consultation will have to be reinitiated.
- Only willows, cottonwoods and other native vegetation species will be used to reseed and/or replant treated areas.

Black-footed ferret (*Mustela nigripes*)

- Black-footed ferrets are not known to occur within any of the four park units of the SEUG. In the unlikely event that black-footed ferrets are located, the USFWS will be consulted and no disturbance will be allowed within prairie dog colonies inhabited by black-footed ferrets.
- Because some white-tailed prairie dog colonies may provide habitat for future black-footed ferret reintroduction, a number of management practices will be implemented to minimize potential impacts to white-tailed prairie dogs. These practices include:

  *Physical disturbance to prairie dog towns or complexes will be avoided wherever possible.

*The use of mechanical treatments such as tilling will not be used in prairie dog colonies.
*The use of herbicides in prairie dog colonies will only be considered if no other alternatives are feasible.
*Only those herbicides that have a low potential toxicity, such as glyphosate will be used within prairie dog colonies. Glyphosate is strongly adsorbed into soil, with little potential for leaching to ground water. Microbes in the soil readily and completely degrade it even in low temperatures. It tends to adhere to sediments when released to water and does not accumulate in aquatic life (USFS 2004).
*Herbicides that do not readily break down in soil will not be used in prairie dog colonies.
* To avoid physically disturbing prairie dog towns, no mechanical vehicles or maintenance equipment will be used.

Endangered Fish: Bonytail chub *(Gila elegans)*, Humpback chub *(Gila cypha)*, Colorado pikeminnow *(Ptychocheilus lucius)* and Razorback sucker *(Xyrauchen texanus)*

- Treatment areas will be evaluated for these endangered fish prior to conducting exotic plant management activities along the rivers.
- A fifty foot disturbance-free buffer area from the water will be maintained.
- The Rodeo herbicide (glyphosate) will be applied to exotic vegetation as it is not known to be toxic to fish.

Jones cycladenia *(Cycladenia humillis)*

- Prior to implementation of mechanical controls, areas that are potential habitat for *Cycladenia humillis* will be surveyed. If they are found in the vicinity of the treatment area, treatments will be limited to ones that are unobtrusive or to times of year when the listed species are not present or less affected by disturbance.
- NPS staff responsible for exotic plant management at Arches National Park will receive training on how to identify the Jones cyclandenia plant and its potential habitat. If populations of the Jones cyclandenia plant are identified, conservation measures developed for threatened and endangered plants will be implemented (see below).

Threatened, Endangered, and Sensitive Plants

- If portable spraying is used to apply herbicides, establish a 5- foot no- spray zone around threatened or endangered plants for treatments involving application of herbicides. Portable spraying allows for treatment of individual plants and the spray can be directed within an inch of the target plant.
- If boom treatments are used (ATVs or aircraft) to apply herbicides, establish a 50- foot no- spray zone around threatened and endangered plants.
- Tilling will not be used in areas where threatened, endangered, and sensitive plants are known to occur or have the potential to occur.

- ATVs and off- road vehicle traffic will not be used in areas where threatened, endangered, and sensitive plants are known to occur.
- Herbicides will be applied in accordance with herbicide labels.
- Herbicide applicators will receive training on identification of threatened, endangered, and sensitive plants. If these plants are identified in the field, treatments will be halted until the aforementioned buffer areas are established.

Species of Concern

- Parks will identify state species of concern based on lists developed by each state and federal agency. State species of concern include state endangered, state threatened, state candidate, or state species of concern, or species of special concern and are not part of a federal designation of threatened or endangered species made by the USFWS.
- NPS staff will receive training on identification of state species of concern and will avoid treating these species to the extent feasible.
- Mechanical methods such as tilling will not be used in areas where state species of concern are known to occur or have the potential to occur.
- Herbicides will be applied in accordance with herbicide labels.

CHAPTER 3-CONSUTATION AND COORDINATION

This section summarizes agencies contacted during preparation of this document. A list of reviewers and preparers is also provided.

3.1 EXTERNAL SCOPING

External (public) scoping was conducted to inform various agencies and the public about the proposal to implement exotic plant management at Southeast Utah Group parks and to generate input on the preparation of this EPMP.

External scoping was initiated with the distribution of a scoping letter to inform the public of the proposal to implement exotic plant management, and to generate input on the preparation of this EPMP. The scoping letter from SEUG dated June 25, 2008 was mailed to 37 addresses. Addressees included: various federal and state agencies, affiliated Native American tribes, and local and state governments.

Information on the EPMP was also posted on NPS Planning, Environment, and Public Comment website (PEPC) at http://parkplanning.nps.gov/. The public was given 30 days to comment on the project during the scoping period. No comments were received from the internet postings or mailings. Addressees included:

Federal Agencies
Bureau of Land Management
US Fish and Wildlife Service

In accordance with the ESA, Section 7 consultation with the USFWS concerning impacts to threatened and endangered species was initiated during the initial drafting of this EPMP. Letters initiating informal consultation and requesting a list of federal threatened and endangered species were sent to Colorado and Utah Service Offices on June 25, 2008. Response to the informal consultation letters was received from the Utah USFWS office on July 30 and the Colorado USFWS office on September 17 respectively. The US Fish and Wildlife Mountain Prairie Region was consulted via the internet (USFWS 2008b) to generate a list of threatened, endangered and candidate species for Grand and San Juan Counties in Utah. The Colorado USFWS submitted a list of threatened, endangered and candidate species for Montezuma County, however, they determined that there are no threatened and endangered species within HOVE and therefore only the Utah USFWS will have the lead on our determinations.

State Agencies
Colorado State Historic Preservation Office
Utah State Historic Preservation Office
Dead Horse State Park in Utah

County Agencies
Grand County Weed Board
Montezuma County Weed Board
San Juan County Board of Commissioners

List of Consulted Native American Tribes and Pueblos
Hopi Tribal Council
Jemez Pueblo
Jucarilla Apache Nation
Laguna Pueblo
Navajo Nation
Pueblo of Acoma
Pueblo of Cochiti
Pueblo of Isleta
Pueblo of Nambe
Pueblo of Picuris
Pueblo of Pojoaque
Pueblo of San Clara
Pueblo of San Ildefonso
Pueblo of Santo Domingo
Pueblo of Taos
Pueblo of Tesuque
Pueblo of Zuni
San Felipe Pueblo
San Juan Pueblo
Sandia Pueblo
Santa Ana Pueblo
Southern Ute Tribe
Ute Indian Tribe
Ute Mountain Tribe
Ysleta Del Sur Pueblo
Zia Pueblo

3.2 INTERNAL SCOPING

Internal scoping was conducted by an interdisciplinary team of professionals from the Southeast Utah Group. Interdisciplinary team members met on April 3, 2008 to discuss the purpose and need for the project; various alternatives; potential environmental impacts; past, present and reasonable foreseeable projects that may have cumulative effects and possible mitigation measures. The team also gathered background information and discussed public outreach for the project. Over the course of the project, team members have conducted individual meetings to evaluate the proposed plan and discussed the impact analyses associated with this assessment. The results of multiple meetings are documented in this EPMP EA/AEF.

3.3 ENVIRONMENTAL ASSESSMENT REVIEW

The EPMP EA/AEF will be released for public review in February 2009. To inform the public of the availability of the EPMP EA/AEF, NPS will publish and distribute a letter or press release to various agencies, tribes, and members of the public on the SEUG's mailing list, as well as place an ad in the local newspapers. Copies of the EPMP EA/AEF will be provided to interested individuals upon request. Copies of the document will also be available for review at each park's visitor center and on the internet at http://parkplanning.nps.gov.

The EPMP EA/AEF is subject to a 30-day public comment period ending March 6, 2009. During this time the public is encouraged to post comments online at http://parkplanning.nps.gov/ or mail comments to Superintendent; Southeast Utah Group; 2282 West Resource Blvd, Moab, UT, 84532. Following the close of the comment period, all public comments will be reviewed and analyzed prior to the release of a decision document. NPS will issue responses to substantive comments received during the public comment period, and will make appropriate changes to the EPMP EA/AEF as needed.

3.4 LIST OF PREPARERS

Preparers (developed EPMP EA/AEF content):

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Appendix A

Southeast Utah Group
Exotic Plant Management Plan
Decision- Making Tree Overview

Identify Exotic Plants that Meet Action Thresholds

Establish management objectives. Identify exotic plants present within park unit. Then, identify those exotic plants whose management meets action thresholds.

↓

Guidance for Setting Management Priorities

Use guidance to set exotic plant management priorities based on their potential impact on park resources and potential for control.

↓

Confirm Compliance of Treatment Method with an Existing NEPA Document

Prior to implementing the selected treatment, confirm that the selected treatment method has the necessary compliance with NEPA.

↓

Optimum Tool Analysis for Treatment Options

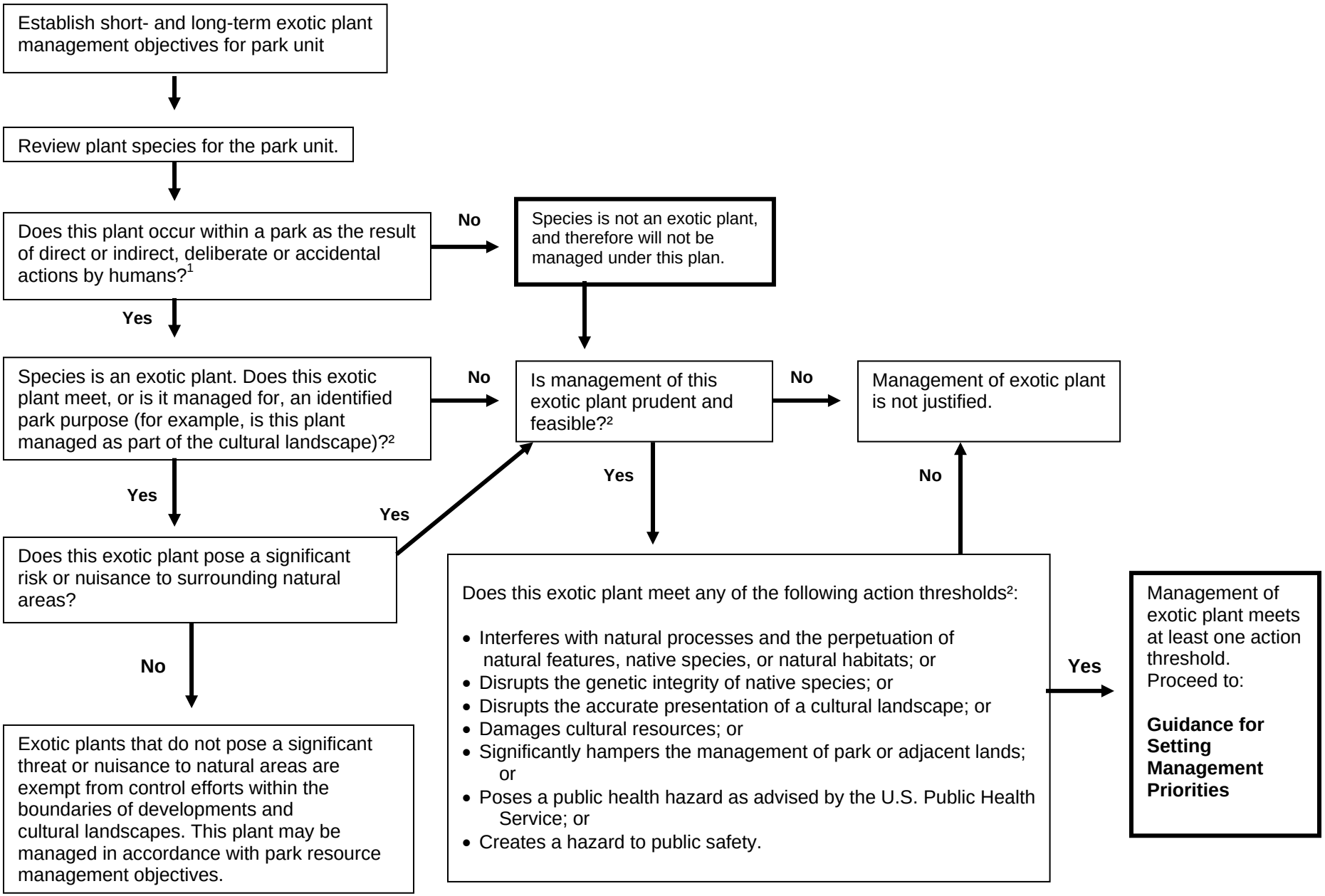
Identify proposed treatment options for each priority exotic plant. For each proposed treatment option, evaluate whether alternative treatment options with fewer potential impacts could be used.

↓

Confirm Compliance of Chemical and Biological Control Treatments with Applicable Regulations

If chemical or biological treatments are selected, confirm that their use is compliant with applicable regulations and policies.

Identify Exotic Plants that Meet Action Thresholds



Guidance for Setting Management Priorities

Is the exotic plant included on a federal, state, or county noxious weed list?

No → Determine relative management priorities. Are there available data and resources to use a quantitative ranking system?

Yes → Use Alien Plant Ranking System or other suitable system to quantitatively determine relative exotic plant management priorities.

Yes ↓ Exotic plants on a federal, state, or county noxious weed list are a management priority.

No ↓ Qualitatively determine relative exotic plant management priorities using the four decision trees provided below.[3]

Through cooperative relationships, are there known exotic plants present near the park, but not within the park?

Yes → *Cooperate with local landowners, county extension agents, and state agencies to prevent introduction into park.*

No ↓ Determine priorities based on current extent (distribution) of exotic plant populations within the park unit.

Is exotic plant present as a small or new population or outlier of larger infestations?

→ *First priority – eliminate small infestations.*

No ↓ Is exotic plant present in a large infestation(s) that continues to expand?

Yes → *Second priority – prevent large infestation from expanding.*

No ↓ Is exotic plant present in large infestation(s) that is not expanding?

Yes → *Third priority- contain, reduce, or eliminate large populations.*

Determine priorities based on current and potential impacts of the exotic plant.

Prioritize according to the following criteria:
1. Alters ecosystem processes.
2. Out competes native species.
3. Does not out compete natives, but:
- Prevents recruitment/ regeneration
- Reduces/eliminates resources.
- Provides resources to non- native animals.
4. May overtake or exclude natives following disturbance.

Determine priorities based on difficulty to control the exotic plant.

Prioritize according to the following criteria:
1. Likely to be controlled and replaced with native species.
2. Likely to be controlled, but not replaced with native species.
3. Difficult to control and potential impact from control on park resources.
4. Unlikely to be controlled.

Determine priorities based on value of habitats and areas of infestations.

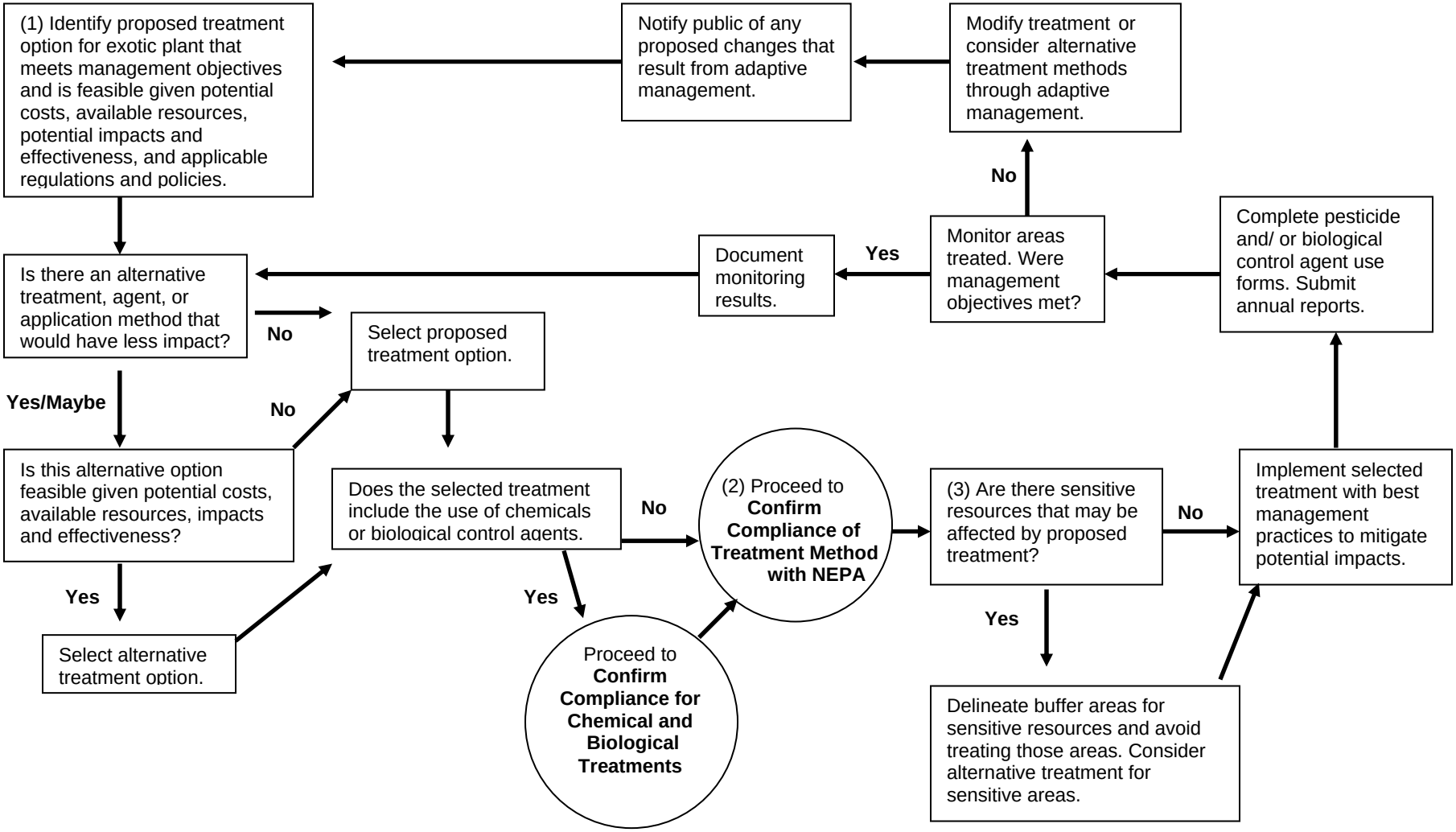
Prioritize according to the following criteria:
1. Infestation occurs in high quality/ high value habitat or resource areas.
2. Infestation occurs in less valued areas.

Italics – characteristics of a disruptive exotic plant. Highest priority is to manage disruptive exotic pla otentially have, a substantial impact on park resources, an be expected to be controlled. [2]

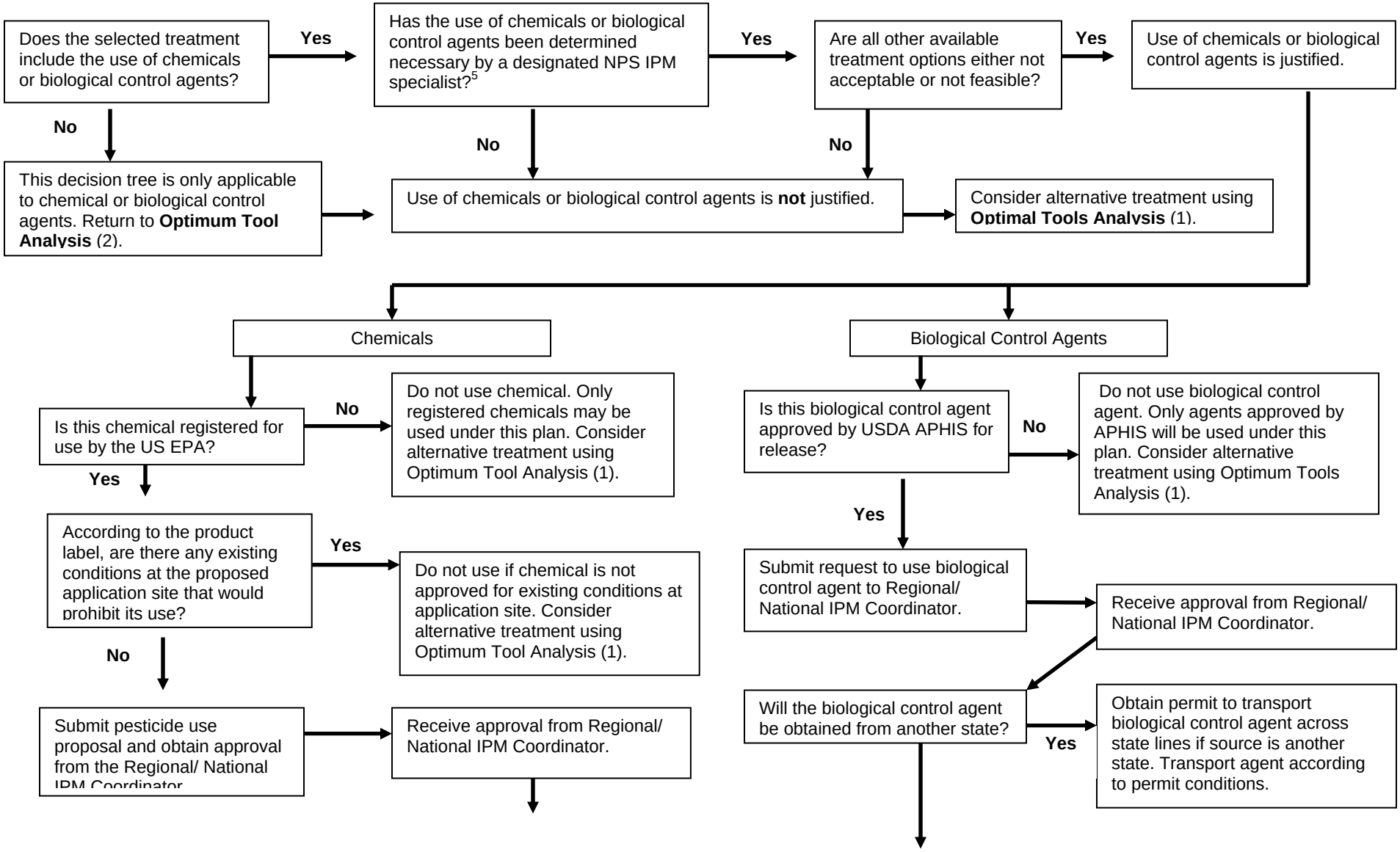
Lower priority will be given to plants that have almost no impact on park resources or ccessfully controlled. [2]

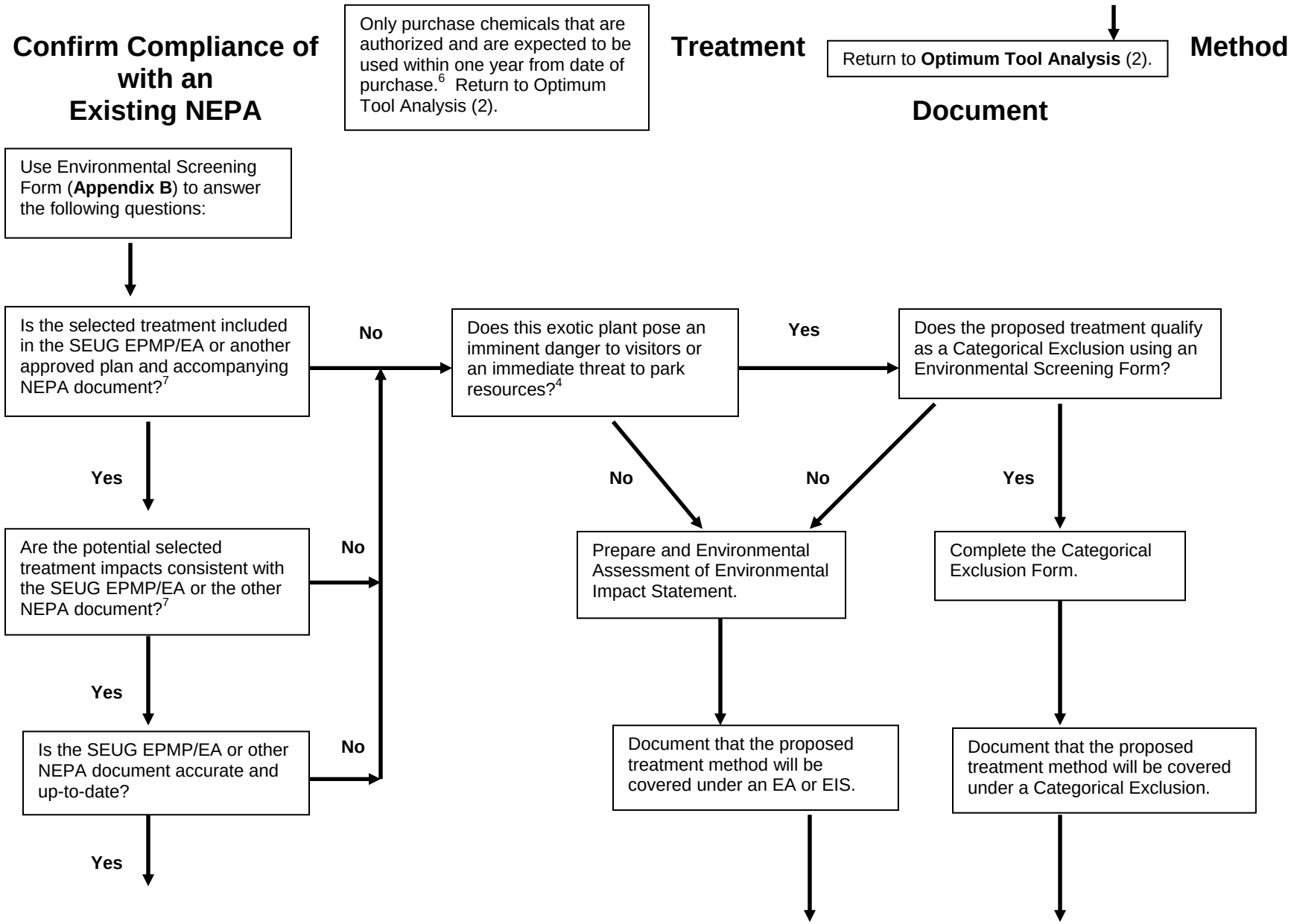
Proceed to **Optimum Tool Analysis** (1).

Optimum Tool Analysis for Treatment



Confirm Compliance of Chemical and Biological Control Treatments with Applicable Regulations




Confirm Compliance of with an Existing NEPA
Only purchase chemicals that are authorized and are expected to be used within one year from date of purchase.6 Return to Optimum Tool Analysis (2).
Treatment
Return to Optimum Tool Analysis (2).
Method
Document
Use Environmental Screening Form (Appendix B) to answer the following questions:
Is the selected treatment included in the SEUG EPMP/EA or another approved plan and accompanying NEPA document?7
No
Does this exotic plant pose an imminent danger to visitors or an immediate threat to park resources?4
Yes
Does the proposed treatment qualify as a Categorical Exclusion using an Environmental Screening Form?
Yes
No
No
Yes
Are the potential selected treatment impacts consistent with the SEUG EPMP/EA or the other NEPA document?7
No
Prepare and Environmental Assessment of Environmental Impact Statement.
Complete the Categorical Exclusion Form.
Yes
Is the SEUG EPMP/EA or other NEPA document accurate and up-to-date?
No
Document that the proposed treatment method will be covered under an EA or EIS.
Document that the proposed treatment method will be covered under a Categorical Exclusion.
Yes

Document in a Memo to File that the selected treatment complies with the SEUG EPMP/EA or other NEPA document.

Return to **Optimum Tool Analysis** (3).

Footnotes

1 National Park Service. 2006. Management Policies. Section 4.4.1.3.
2 National Park Service. Management Policies. 2006. Section 4.4.4.2.
3 Adapted from the Site Weed Management Plan for Middle Niobrara Weed Awareness Group, Middle Niobrara River Valley, Nebraska 2003- 2005 (Faulkenberry 2003) and Handbook for Ranking Exotic Plants for Management and Control (Hiebert and Stubbendieck 1993)
4 National Park Service. 2001. Director's Order #12. Conservation Planning, Environmental Impact Analysis, and Decision Making.
5 National Park Service. 2006. Management Policies. Section 4.4.5.3.
6 National Park Service. 2006. Management Policies. Section 4.4.5.5.
7 Adapted from Midwest Region and Intermountain Region Environmental Screening Forms.

Appendix B

Utah and Colorado State Noxious Weed List

Common Name	Scientific Name
Absinth wormwood†	*Artemisia absinthium*
African rue†	*Peganum harmala*
Bermudagrass	*Cynodon dactylon*
Black henbane	*Hyoscyamus niger*
Black nightshade	*Solanum nigrum*
Blue mustard	*Chorispora tenella*
Bouncingbet†	*Saponaria officinalis*
Bull thistle	***Cirsium vulgare***
Camelthorn†	*Alhagi pseudalhagi*
Canada thistle*	***Cirsium arvense***
Chicory	***Cichorium intybus***
Chinese clematis	*Clematis orientalis*
Chufa flat-sedge	***Cyperus esculentus***
Coast tarweed†	*Madia sativa*
Common burdock	***Arctium minus***
Common crupina†	*Crupina vulgarus*
Common groundsel	*Senecio vulgarus*
Common mullein	***Verbascum thapsus***
Common St. Johnswort	*Hypericum perforatum*
Common Tansy	*Tanacetum vulgare*
Common teasel†	*Dipsacus fullonum*
Cypress spurge	*Euphorbia cyparissias*
Dalmatian toadflax, broad-leaved*	***Linaria dalmatica***
Dalmatian toadflax, narrow-leaved*	*L. genistifolia*
Dame's rocket	*Hesperis matronalis*
Diffuse knapweed*	***Centaurea diffusa***
Downy brome	*Bromus tectorum*
Dyers woad†	*Isatis tinctoria L*
Eurasian watermilfoil†	*Myriophyllum spicatum*
Field bindweed*	***Convolvulus arvensis***
Flixweed	***Descurainia sophia***
Giant salvinia†	*Salvinia molesta*
Green foxtail	*Setaria viridis*
Hairy nightshade	*Solanum sarrachoides*
Halogeton	***Halogeton glomeratus***
Hoary cress*	*Cardaria draba*
Houndstongue	*Cynoglossum officinale*
Hydrilla†	*Hydrilla hydrilla*
Johnson grass	***Sorghum halepense***
Kochia	***Bassia scoparia***
Leafy spurge*	*Euphorbia esula*
Mayweed chamomile	*Anthemis cotula*
Meadow knapweed†	*Centaurea pratensis*
Mediterranean sage†	*Salvia aethiopis*
Medusahead rye†	*Taeniatherum caput-medusae*
Moth mullein†	*Verbascum blattaria*
Musk thistle*	***Carduus mutans***

Common Name	Scientific Name
Myrtle spurge†	*Euphorbia myrsinites*
Orange hawkweed†	*Hieracium aurantiacum*
Oxeye daisy	*Chrysanthemum leucanthemum*
Perennial pepperweed	***Lepidium latifolium***
Perennial sorghum	*Sorghum halepense L & Sorghum almum*
Perennial sowthistle	*Sonchus arvensis*
Plumeless thistle	*Carduus acanthoides*
Poison hemlock	*Conium maculatum*
Puncturvine	***Tribulus terrestris***
Purple loosestrife	***Lythrum salicaria L.***
Quackgrass	*Agropyron repens*
Rush skeletonweed†	*Chondrilla juncea*
Russian knapweed*	***Centaurea repens***
Russian olive	***Elaegnus angustifolia***
Russian thistle	***Salsola tragus***
Saltcedar/Tamarisk	***Tamarix chinensis***
Scentless chamomile	*Anthemis arvensis*
Scotch thistle	*Onopordum acanthium*
Sericea lespedeza†	*Lespedeza cuneata*
Shepherdspurse	*Capsell bursa-pastoris*
Spotted knapweed	***Centaurea maculosa***
Spurred anoda	*Anoda cristata*
Squarrose knapweed†	*Centaurea squarrosa*
Storksbill	*Erodium cicutarium*
Sulfur cinquefoil†	*Potentilla recta*
Swainsonpea	*Sphaerophysa salsula*
Tansy ragwort	*Senecio jacobaea*
Velvetleaf	*Abutilon theophrasti*
Venice mallow†	*Hibiscus trionum*
Wild caraway	*Carum carvi*
Wild mustard	*Brassica kaber*
Wild oats	*Avena fatua*
Wild proso millet	*Panicum miliaceum*
Yellow foxtail	*Setaria glauca*
Yellow starthistle†	*Centaurea solstitialis*
Yellow toadflax	*Linaria vulgaris*

Bold species-Current exotics found in the SEUG units.

* - Weeds marked with an asterisk (*) are recognized as the top ten prioritized weed species for the State of Colorado. After analysis of a statewide survey of counties, these species are acknowledged to be the most widespread and to cause the greatest economic impact in the State of Colorado. These species shall be considered by each local advisory board and local governing body in the development, adoption and enforcement of their noxious weed list and noxious weed management plan.

† - Weeds marked with a cross (†) may not be present or are not yet widespread or causing great economic impact within the State of Colorado. However, counties and local advisory boards are encouraged to contain and eradicate these species before they proliferate and significantly impact the economic and environmental values of the lands of the State.

Appendix C

Summaries of Southeast Utah Group Exotic Plants of Concern

Canada thistle (*Cirsium arvense*)

Canada thistle is an herbaceous perennial with erect stems 1½-4 feet tall, prickly leaves and an extensive creeping rootstock. Stems are branched, often slightly hairy, and ridged. Leaves are lance-shaped, irregularly lobed with spiny, toothed margins and are borne singly and alternately along the stem. Rose-purple, lavender, or sometimes white flower heads appear from June through October, generally, and occur in rounded, umbrella-shaped clusters.

Canada thistle grows in barrens, glades, meadows, prairies, fields, pastures, and waste places. It does best in disturbed upland areas but also invades wet areas with fluctuating water levels such as stream bank sedge meadows and wet prairies.

As it establishes itself in an area, Canada thistle crowds out and replaces native plants, changes the structure and species composition of natural plant communities and reduces plant and animal diversity. This highly invasive thistle prevents the coexistence of other plant species through shading, competition for soil resources and possibly through the release of chemical toxins poisonous to other plants.

http://www.nps.gov/plants/ALIEN/fact/ciar1.htm

Treatment Methods: Manual and mechanical treatments prior to seed set or application of a systemic herbicide such as glyphosate. Rhizomatous-herbicide treatment only.

Common cocklebur (*Xanthium strumarium v. canadense*)

Common cocklebur is a coarse bushy annual with stout, usually red-spotted stems, 2 to 3 feet high, reproducing by seed. The large rough glandular green leaves are long stalked and triangular, somewhat lobed, about 2 to 14 inches long, and 1 to 8 inches broad. The short flowering branches arise from the leaf axils along the main stems. The inconspicuous male flowers are grouped into several to many round clusters at the top, with the conspicuous brown female burs at the base. The football shaped burs, 1/2 to 1 inch or more long, enclose 2 female flowers, and are covered by about 400 stiff, glandular-hairy spines, 1/8 to 1/4 inch long, ending in a hook. The male flowers drop off quickly, but the burs persist, with the 2 blackish achenes. The 2 seeds inside, about 1/2 inch long, remain fertile for many years.

Common cocklebur grows in moist flooded soil of roadsides, cultivated fields, pastures, and flats throughout the state, particularly troublesome in wet years around water holes flowering June to October. The vicious burs form-tangled clots in the manes, tails, or wool of animals, often resulting in a lower value of the wool.

The seeds and the seedling plants of cockleburs are particularly poisonous to hogs; however, sheep, cattle, horses, and chickens have also been poisoned by eating the seedlings. The seeds are rarely eaten; the seedlings contain the poisonous principle that decreases rapidly as the seedling plant grows.

http://www.uapress.arizona.edu/online.bks/weeds/cocklbur.htm

***Treatment Methods*:** Mechanical removal. Herbicidal treatment with Plateau, Transline, or Rodeo.

Common horehound (*Marrubium vulgare*)

Horehound is a bushy spreading plant that grows to 75cm in height. The base of the stems is woody. The leaves are grey-green, hairy and crinkled in appearance. Fairly insignificant white flowers arranged in rings around the upper part of the stems. Flowers die off leaving a spiny burr. Each burr contains 4 small brown or black seeds.

Horehound was sold in Tasmanian nurseries as a garden or medicinal herb from as early as 1845. The plant now spreads when the burrs attach themselves to passing animals in fur and wool and on to peoples clothing. It is spread by water along drainage lines and creeks. It is drought tolerant and is able to quickly increase its range when hot dry conditions limit the growth of other plants. It does best in alkaline soils.

Horehound is very bitter. Grazing animals tend to concentrate on other plants in the paddock cutting down the competition and leaving Horehound to spread. If animals are forced to eat Horehound, their meat has a strong offensive smell and flavor. The most significant effect of the weed is that the burrs attach themselves strongly to wool and are difficult to remove. The sale price of the wool will then be down graded. Because the plant is drought tolerant, it can use the occasional drought to suddenly increase its range.

http://weeds.tassie.net.au//txts/horehound.html

Treatments Methods: Mechanical removal. Herbicide treatment with Plateau.

Crested wheatgrass (*Agropyron cristatum*)

Long-lived, moderately coarse perennial bunchgrass, 2 to 3 feet tall with a bright green, curing to straw color. Leaves are flat, 6 to 10 inches long. Seed heads are l 1/2 to 2 1/2 inch-long spikes, borne singly on the ends of the stalks. The name refers to the flat inflorescence that somewhat resembles a head of wheat. The grass was often seeded after big Sagebrush (*Artemisia tridentata*) control measures.

http://ag.arizona.edu/pubs/natresources/az97105/crested_wheatgrass.html

Treatments Methods: Mechanical removal.

Diffuse knapweed (*Centaurea diffusa)*

Diffuse knapweed (*Centaurea diffusa*) is a biennial or, occasionally, an annual or short-lived perennial. It reproduces and spreads from seed. The plant develops a single shoot (stem), 1 to 2 feet tall, which is branched toward the top. Rosette and lower shoot leaves are finely divided. Leaves become smaller toward the top of the shoot and have smooth margins.
Many solitary flowering heads occur on shoot tips. They are about 1/8 inch in diameter and 1/2 to 2/3 inch long. Flowers usually are white but may be purplish. Involucre bracts are divided like teeth on a comb and tipped with a slender spine that makes them sharp to the touch.
Diffuse knapweed is native to degraded noncropland (waste places) and seashores from southern Europe to north-central Ukraine. It generally is found on dry, light, porous soils in Europe. Diffuse knapweed appears to occupy similar areas in the United States. Diffuse knapweed will not tolerate flooding or shade and thrives in the semiarid west (generally in 9- to 16-inch precipitation zones). Environmental disturbance (e.g., overgrazed pastures or rangeland, roadsides, rights-of-way, gravel piles, etc.) promotes its invasion.

http://www.ext.colostate.edu/pubs/natres/03110.html

Treatments Methods: Small patches treated by pulling and foliar spray with Transline (Clopyralid) with water carrier and a surfactant. Also, occasional late season use of Tordon (Picloram) with a water carrier and a surfactant.

Field bindweed (*Convolvulus arvensis*)

Field bindweed, *Convolvulus arvensis,* is a native of Eurasia and was first documented in California in 1884 when it was collected in San Diego. By the first quarter of the twentieth century, field bindweed was proclaimed the worst weed in California and many of the western states. Seed most likely arrived in the United States as a contaminant in farm and garden seeds. However, because of its flowers and climbing nature, some seed were probably planted as ornamentals, either as a ground cover or hanging basket. Field bindweed has been given many names including perennial morning-glory, creeping jenny, and corn-bind.

Mature field bindweed plants have arrowhead-shaped leaves that can be between 0.5 to 2 inches long, depending on environmental conditions. Mature leaves at the base of the stem are larger than the young leaves at the stem terminal. The flowers are trumpet shaped, white to pink in color, and 1 to 1.5 inches in width. Field bindweed is a prostrate plant unless it climbs on an object for support. It is often found growing on upright plants, such as shrubs or grape vines, with its stems and leaves throughout the plant and the flowers exposed to the light. Under warm moist conditions, leaves are larger and vines more robust than under drought conditions. The root system has both deep vertical and shallow horizontal lateral roots. The vertical roots can reach depths of 20 feet or more. However, 70% of the total mass of the root structure occupies the top 2 feet of soil. Most of these lateral roots are no deeper than 1 foot. Experiments on bindweed have shown that its root and rhizome growth can reach 2.5 to 5 tons per acre.

http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7462.html

Treatments Methods: Foliar spray with Transline (Clopyralid) with water carrier and a surfactant. Foliar spray with Rodeo (Glyphosate) with water carrier and a surfactant. Occasional late season use of Tordon (Picloram) with water carrier and a surfactant.
Bio-control: Bindweed Gall Mite *(Aceria malherbae),* Field Bindweed Moth *(Tyta luctuosa)*

Halogeton *(Halogeton glomeratus)*

Halogeton is an annual herbaceous plant, typically six to twelve inches tall, with short, fleshy, sausage-like leaves less than half an inch long. One of its most distinctive features is the conspicuous, soft, slender spine at the bluntly rounded tip of each leaf. Plants are often bluish green in spring and early summer, turning yellow, salmon, pink, purplish, or even reddish by late summer or early fall. Stems often turn pink or red while leaves are still blue-green. Plants can resemble Russian thistle in early stages of growth, but are distinguished easily by the unique leaf tips and the presence of tiny, cotton-like hairs in the leaf axils.

Halogeton is found mainly on disturbed arid sites in saltgrass, salt desert shrub, mixed desert shrub, or pinyon-juniper plant communities. Annual weeds typically associated with halogeton include cheat grass (*Bromus tectorum*) and Russian thistle (*Salsola tragus*). It is especially common along roadsides, on the edges of alkaline flats, in livestock bedding or feeding areas, in abandoned dryland farms and townsites, and around desert watering sites.

Treatment Methods: Manual/mechanical methods. Foliar spray with Rodeo (Glyphosate), Transline, or Plateau with water carrier and a surfactant.

Musk thistle *(Carduus nutans)*

Musk thistle is a biannual plant, typically are 5-7 feet high with a long, fleshy taproot. Leaves of both rosettes and bolted plants are deeply segmented and dark green with a light green midrib.

Each lobe has three to five points that end in a white or yellowish spine. Seedlings emerge only as a single leaf and grow into rosettes that can reach over 2 feet in diameter. It has deep reddish purple flowers that are large (up to 3 inches in diameter) and attractive. Blooming starts with the terminal head at the top of the plant about the first week in June and progresses to the lower branches over six to eight weeks. Musk thistle is a prolific seed producer and individual terminal heads can have as many as 1,500 seeds each a little over 1/8 inch long. Seed germination may run as high as 95% shortly after dissemination and most germinate in the first year, some will remain viable for more than 10 years in the soil.

Musk thistle is mainly found in pastures, rangeland, roadway ditches and wasteland. These areas that are not tilled or treated with herbicides can develop into a serious infestation. In pasture and rangelands thistles compete for the moisture, sunlight and nutrients needed to produce forage for livestock. On roadways and wastelands musk thistle does not provide sufficient protection from soil erosion, crowds out desirable vegetation, is unsightly, hinders movement of people and wildlife and produces seed that infests surrounding areas.

Treatment Methods: Mechanical removal. Herbicide treatment with Transline.

Perennial pepperweed (*Lepidium latifolium*)

Perennial pepperweed or tall whitetop is a member of the Mustard family. It was introduced from either southern Europe or western Asia. It is a deep-rooted perennial plant with an extensive, vigorous creeping root system that reproduces by seed rootstalks. Perennial pepperweed is similar to whitetop, however, it is taller. Perennial pepperweed stands 3 to 5 feet high with a heavy, sometimes woody, crown. The lower leaves are oblong with toothed margins. The upper leaves do not clasp the stem as whitetop. Flowers are white. Perennial pepperweed can be found in pastures, riparian areas, roadsides, and waste places.

http://www.cwma.org/perr_pepperwood.html

Treatments Methods:

Foliar spray with Transline (Clopyralid) with water carrier and a surfactant. Foliar spray with Habitat (Imazapr) with water carrier and a surfactant.

Puncturevine (*Tribulus terrestris*)

Puncturevine is a member of the Caltrop family and is an introduced annual that reproduces by seeds. It is a prostrate, mat forming plant with trailing stems, each 1 to 6 feet long and hairy. The leaves are opposite, pinnate, one to two inches long with four to eight pairs of leaflets. The yellow flowers are 1/4 to 1/2 inches wide with five petals. The fruit is a hard, spiny bud that at maturity breaks into five tack-like sections.

Puncturevine, also known as goathead, grows in pastures, cultivated fields, and waste places. The burs may injure livestock and are the bane of bicyclists.

http://www.cwma.org/puncturevine.html

Treatments Methods: Some mechanical removal and some heat treatment.
Bio-control: Puncturevine Seed Weevil *(Microlarinus lareynii,),* Puncturevine Stem Weevil *(Microlarinus lypriformis)*

Purple loosestrife (*Lythrum salicaria*)

Purple loosestrife is a tall, erect, perennial herb that grows to nearly 2 m tall when present in the most favorable wetland habitats. Plants tend to be covered with short hairs, at least in the upper part. A number of varieties have been recognized on the basis of the species' variability in the amount and distribution of hairs on the stem and leaves and differences in leaf shape. Its

relatively stout and firm stems bear stalkless, opposite or whorled leaves that are generally lance-shaped but may be more oblong or relatively narrow and linear. The bases of the blades tend to be rounded or somewhat heart-shaped. Leaves vary in length from 3-10 cm. Those at the base of the flower spikes and within the spikes are commonly much reduced in size and tend to be attached alternately. In mid-summer, plants are very showy because each has several to many spikes of densely clustered, nearly stalkless, rose to red-purple flowers. In large plants, many flowering branches may be present giving the plant a bushy appearance.

Purple loosestrife is an herbaceous perennial that reproduces sexually by seed and vegetatively through the formation of adventitious shoots and through the rooting of buried and cut stems. Cultivated varieties formerly thought to be sterile are now known to produce fertile seeds when cross-pollinated by wild plants. The plant's widespread occurrence is due, in part, to the attractiveness of its showy flowering spikes in mid summer that make it a desirable addition to perennial gardens and, as well, to its prolific seed production. It has been estimated that a large robust plant could produce up to 2.7 million seeds. Seeds survive for a number of years within the soil seed bank. Disruption of the soil by mechanical removal of plants for control purposes results in buried seeds being brought to the surface. Seeds germinate over a wide range of environmental conditions.

The flowers of purple loosestrife are trimorphic, meaning that there are three forms of flowers present in the species, with only one type being present on a particular plant. Flowers may have short styles, medium styles or long styles. Each flower with a particular style length also has stigmatic papillae of a particular length suited to the germination of small, medium or large pollen grains. Each flower type also has two sets of stamens of different lengths that hold the anthers away from the stigmatic surface to minimize transfer of pollen within a flower.

http://infoweb.magi.com/~ehaber/factpurp.html

Treatments Methods: Small patches treated by pulling and foliar spray with Rodeo (Glyphosate) with water carrier and a surfactant.
Bio-control: Leaf Beetles *(Galerucella* spp.)

Ripgut brome (*Bromus diandrus*)

Ripgut brome, also known as great brome, is a brome grass which is native to the Mediterranean but has been introduced to much of the rest of the world. It has naturalized in some areas and is considered a troublesome noxious weed in others. It does best in areas with a Mediterranean climate, such as California and parts of southern Australia, but it is quite tolerant of many climates. The adult plant is one to three feet in height with hairy, rough leaves about a centimeter wide. It has a tubular sheath on the seedling which distinguishes it from most other grass seedlings. Soft hairs cover the blades and sheaths. The membranous ligule is long, whitish, and jagged. No auricles present. Open panicles resemble oats. Large spikelets have awns that are 1 to 2 inches (2.5 - 5 cm) long, distinguishing it from another common bromegrass, soft brome, which has much shorter awns. The floret parts have tiny, rough teeth that are injurious to livestock and pets. This is one of several grass species known to pet owners as "foxtails". To distinguish from wild oat, dig down and check for seed coat.

It is in flower from May to June. The flowers are hermaphrodite (have both male and female organs) and are pollinated by Wind, Cleistogomy (self-pollinating without flowers ever opening). The plant is self-fertile. The plant prefers light (sandy), medium (loamy) and heavy (clay) soils, requires well-drained soil and can grow in nutritionally poor soil. The plant prefers acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It requires dry or moist soil and can tolerate drought. The plant can tolerate strong winds but not maritime exposure.

http://plants.usda.gov/java/profile?symbol=BRDI3

Treatments Methods: Pulling and removal of entire plant from area. Herbicidal treatment with Plateau.

Russian knapweed (*Centaurea repens*)

Russian knapweed (*Acroptilon repens*) is a creeping, herbaceous perennial of foreign origin that reproduces from seed and vegetative root buds. Shoots, or stems, are erect, 18 to 36 inches tall, with many branches. Lower leaves are 2 to 4 inches long and deeply lobed. Upper leaves are smaller, generally with smooth margins, but can be slightly lobed. Shoots and leaves are covered with dense gray hairs. The solitary, urn-shaped flower heads occur on shoot tips and generally are 1/4 to 1/2 inch in diameter with smooth papery bracts. Flowers can be pink, lavender or white. Russian knapweed has vertical and horizontal roots that have a brown to black, scaly appearance, especially apparent near the crown. The weed forms dense, single species stands over time due to competition and allelopathy (biochemicals it produces that inhibit the growth of other plants).

Russian knapweed emerges in early spring, bolts in May to June (elevation dependent) and flowers through the summer into fall. It produces seeds sparingly, approximately 50 to 500 per shoot. Seeds are viable for two to three years in soil. Its primary method of reproduction is from vegetative propagation, with seed of secondary importance. Roots from a recently established plant expand rapidly and may cover up to 12 square yards in two growing seasons.
Russian knapweed is native to southern Ukraine, southeast Russia, Iran, Kazakhstan and Mongolia. It grows on clay, sandy or rocky prairies and sunny meadows; on saline soils; or clay, rocky or sandy shores of lakes and rivers; and on rocky and clay slopes of hills and bottomlands. It is a weed of cultivated land, dry pastures and degraded non-cropland (waste places) in its native land. Russian knapweed grows in most western states.

http://www.ext.colostate.edu/pubs/natres/03111.html

Treatments Methods: Foliar spray with Transline (Clopyralid) with water carrier and a surfactant. Some previous use of Rodeo (Glyphosate) with water carrier and a surfactant. Occasional late season use of Tordon (Picloram) with water carrier and a surfactant.

Russian olive (*Elaeagnus angustifolia*)

The species is widely grown as an ornamental in North America because of its silvery-gray foliage. It is still being actively promoted as a suitable windbreak species, as living snow fences, for erosion control and as a food source, particularly in the form of the edible fruits, for birds and other wildlife. Plants are well adapted to open sunny locations, tolerate most soil types and are hardy in zones 2 to 7. Russian olive is known to be salt-tolerant. It is also promoted as a preferred species for sandy, alkaline and well-drained soils. In the western US, where Russian olive has become most widely naturalized, it occurs commonly along floodplains, stream channels, riverbanks, marshes and irrigation ditches.

Russian olive begins flowering when plants are between 3 to 5 years old. Flowering occurs from May through June, with fruits maturing from August to October. Fruits remain on the plant throughout the winter, if they are not eaten by birds. The pulpy, sweet fruits are eaten by a variety of birds and small mammals. Ingested seeds are readily dispersed by birds. In the western states, seeds are commonly deposited along river courses where shrubs and trees are localized and provide perches for birds.

Seeds remain viable for up to three years. Once established, plants thrive over a broad range of soil textures and moisture levels from heavy clay soils with groundwater to within about .5 m of the surface to light, sandy, well-drained soils. Plants can withstand flooding and silting and are also drought resistant. They grow best in deep sandy or loamy soils with pH>6 and with low levels of salt and alkali. Russian olive, however, is also tolerant to elevated levels of salt. The

species also tolerates temperature ranges from -45° C to +46° C and ranges from sea level to mountainous sites to at least about 2500 m. This exotic grows rapidly, as much as 1.8 m per year, and readily competes with other species, especially in riparian habitats. It is somewhat shade tolerant and, once established in disturbed sites being colonized, can persist through the various seral stages to become the dominant species replacing native cottonwoods and willows in western drainage systems.

In addition to sexual reproduction and the setting of abundant seeds and seedlings, Russian-olive also propagates itself vegetatively by sprouts from adventitious buds formed on the root crowns and by root suckers. Burned areas are readily re-colonized through the production of root crown sprouts and offsite seed sources.

http://infoweb.magi.com/~ehaber/factoliv.html

Treatments Methods: Cut stump treatment, stem is cut and stump is sprayed with a 1:4 mixture of Garlon 4 and JLB oil. Occasional direct spraying of small stems with the Garlon 4 mixture.

Russian thistle (*Salsola tragus*)

Russian thistle, also known as tumbleweed, is in the goosefoot family (Chenopodiaceae). Its scientific name is *Salsola tragus,* but it also has been known as *S. iberica, S. kali,* and *S. australis.* It is a summer annual native to southeastern Russia and western Siberia and was first introduced into the United States in 1873 by Russian immigrants as a contaminant in flax seed in South Dakota. After its introduction, it spread by contaminated seed, threshing crews, railroad cars (especially livestock cars), and by its windblown pattern of seed dissemination. In 1895 Russian thistle moved to the Pacific Coast in contaminated railroad cars that transported cattle to Lancaster in California's Antelope Valley. Today it is common throughout the western United States and is particularly well adapted to California's climate of winter rainfall and summer drought.

Russian thistle is primarily a weed in sites where the soil has been disturbed, such as along highways. It is also prevalent in vacant lots and other non-crop areas, in field and vegetable crops, and in poorly tended landscapes. It is rarely a problem in well-managed gardens or turfgrass. Russian thistle is a bushy summer annual with numerous slender ascending stems that become quite woody at maturity. Stems vary from 8 to 36 inches in length and usually have reddish to purplish stripes. Seedlings have very finely dissected leaves that almost look like pine needles. Leaves of young plants are fleshy, dark green, narrow, and about 1 inch in length. Young plants are suitable for livestock forage and are sometimes grazed. As the plant matures in July to October the older leaves are short and stiff with a sharp-pointed tip. The single, inconspicuous flowers lack petals and are borne in most leaf axils above a pair of small spine-tipped bracts. The bracts and spiny leaves prevent predation by herbivores as the plant nears maturity. The overall shape of the plant becomes oval to round and may attain a diameter of 18 inches to 6 feet at maturity. After the plant dries, the base of the stem becomes brittle and breaks off at soil level in fall and early winter. These round, thorny plants are capable of dispersing seed for miles as they tumble along in the wind.

In late fall and early winter, this troublesome pest becomes conspicuous as it breaks from the soil and is blown across highways and fields. Although Russian thistle, or tumbleweed, conjures up images of the old west, it can be a serious weed pest. In agricultural areas, Russian thistle can reduce yield and quality of numerous crops, particularly alfalfa and small grains. It depletes soil moisture, interferes with tillage operations, and serves as a shelter or food source to many insects, vertebrate pests, and crop diseases. Russian thistle can also threaten native plant ecosystems. Large plants can reduce highway safety by obstructing views along right-of-ways and causing drivers to swerve their cars in an attempt to avoid colliding with windblown plants. In many areas, plants accumulate along tree rows and fence lines, posing a serious fire hazard that necessitates hours of manual labor for cleanup and disposal. It has been reported that prairie

wildfires can spread rapidly when ignited balls of burning Russian thistle blow through grasslands. Russian thistle is a major problem along the California aqueduct where it can interfere with water delivery and pumping systems. Many people are sensitive to Russian thistle and exhibit skin rashes and allergic reactions after exposure to the plant. A slight scratch or abrasion from the plant may result in itching or reddened patches of skin. The windblown pollen of Russian thistle can cause an allergic reaction in people during summer.

The Russian thistle seed is a naked, coiled embryo [22K] that begins to uncoil when it is exposed to the proper temperature (52° to 90°F) and moisture conditions. As it uncoils, the taproot extends into the soil within about 12 hours, making the germination period quite rapid and giving Russian thistle a decided advantage under limited moisture conditions. A minimum amount of moisture, lasting only a few hours, will allow germination and root growth to deeper, subsurface moisture. Russian thistle normally will not germinate successfully in firm soil: the soil in the site must be loose. Likely sites for germination include vacant lots, abandoned gardens and agricultural fields, roadsides, fence lines—any open site with loosened soil. Germination normally occurs in late winter or early spring when the seed can take advantage of winter moisture. Seed viability is rapidly lost in soil. Over 90% of the seed either germinate or decay in the soil during the first year. Russian thistle is extremely drought tolerant. The taproot can extend several feet into the soil to reach subsurface moisture. Early leaves are linear and fleshy, much like pine needles, but as the plant matures, later leaves are short and spiny and much more capable of conserving moisture. Russian thistle normally matures in late summer. An abscission layer forms in the stem near the soil surface that allows the shoot to break off from the taproot in fall and early winter. The seed is spread when mature plants are blown along by the wind. A large Russian thistle plant may produce more than 200,000 seed. In spring, months after their dissemination, it is possible to trace the paths of tumbleweeds across plowed fields by the green trails of germinating Russian thistle seedlings.

Russian thistle can tolerate alkaline soil conditions. It is very competitive when moisture is a limiting factor to the growth of other vegetation, when soils are disturbed, or when competing vegetation is suppressed by overgrazing or poor crop establishment. If moisture is not limiting, Russian thistle is less competitive with other species. Seedlings of Russian thistle are suppressed when other plants become established first and shade out the sunlight.

http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7486.html

Treatments Methods: Mechanical removal, heat treatment and foliar treatment with a 1:4 mixture of Garlon 4 and JLB oil or foliar treatment with Rodeo (Glyphosate) with water carrier and a surfactant.

Siberian elm (*Ulmus pumila*)

Siberian elm is a fast-growing, small to medium-sized tree with an open, round crown of slender, spreading branches. It generally measures 50-70 feet (15-21 meters) tall with a spread equal to three-fourths its height. Its rough bark is gray or brown and shallowly furrowed at maturity. Both the small, blunt buds and slender, smooth twigs are nearly hairless. This elm is distinguished by its small, elliptic, smooth, singly-toothed leaves, that reach lengths of approximately 0.8-2.6 inches (2-7 cm). Blades of the alternate, simple leaves are short-pointed at the tip and tapering or rounded at the asymmetrical base. The short-petioled leaves are dark green and smooth above, paler and nearly hairless beneath, and yellow in autumn. Foliage is slightly pubescent when young, and firm at maturity. Flowers are greenish, lack petals, and occur in small drooping clusters of 2-5. The winged fruit of this hardy tree is a 1-seeded, smooth, circular or rather obovate samara that is 0.4-0.6 inch (10-15 mm) wide and hangs in clusters.
Siberian elm is native to northern China, eastern Siberia, Manchuria, and Korea, and was introduced to the U.S. in the 1860's. It is the hardiest of all elms and does well even in areas with cold winters and long periods of summer droughts. Often planted in recent decades because of its fast growth, it is now established at least from Minnesota south to Arkansas and west to Utah.

Because this elm tolerates a variety of conditions, such as poor soils and low moisture, it is found in dry regions, along roadsides, in pastures, in grasslands, as well as in moist soils along streams. It invades dry and mesic prairies, including sand prairies.

The tree flowers in spring before leaves begin to unfold. The samaras follow quickly and are disseminated by wind, allowing the species to form thickets of hundreds of seedlings in bare ground. Seeds germinate readily and seedlings grow rapidly. If there is a nearby seed source, the tree can invade and, in a few years, dominate prairie areas, particularly if they have been subjected to past disturbance.

http://www.inhs.uiuc.edu/edu/VMG/sibelm.html

Treatments Methods: Cut stump treatment, stem is cut and stump is sprayed with a 1:4 mixture of Garlon 4 and JLB oil. Occasional direct spraying of small stems with the Garlon 4, Remedy, or Tahoe 4E mixture. Cut stump treatment with Remedy (Triclopyr), Garlon 4, or Tahoe 4E with water carrier and a surfactant.

Sweet clovers (*Melilotus albus* and *Melilotus officinalis*)

Annual forms of white sweet clover exist, but the plant is primarily biennial. First-year plants are comprised entirely of vegetative growth (usually a single stem) and over winter as buds on the caudex. Second-year plants have a strongly developed taproot that may exceed 50 inches (120 cm) in depth, and 1 to 10 upright or ascending flowering stems from 3 to 8.5 feet in height. The inflorescence is a raceme with 40 to 80 white flowers. The fruit is a one-seeded pod.

White sweet clover is a good seed producer. Seed production estimates of 14,000 to 350,000 seeds per plant have been reported. Large plants growing in the open in Ontario produced between 200,000 and 350,000 seeds each. The fruits are shed in the fall, and are dispersed by gravity, strong winds, and water. The seeds float, and thus rain wash and stream flow may be an important means of dispersal. A large percentage of the seeds have a hard seed coat and can remain viable in the soil for more than 20 years. Natural scarification occurs through fluctuating freezing and thawing temperatures or by heat from a fire. New seedlings are found almost any month during the growing season, but only spring-emerged seedlings survive the winter. Vegetative reproduction does not occur naturally. If second-year plants are cut, new growth must come from buds on the stems rather than the caudex.

White sweet clover is shade intolerant and grows in a wide variety of open habitats but is most common along roads and railways, and in prairies, arid rangelands, fields, and waste places. Its associates are too numerous to list, but it often grows with yellow sweet clover (Melilotus officinalis) in the West. It is not tolerant of continuous flooding but occasionally grows on open, gravelly riverbanks that experience brief spring flooding. White sweet clover grows on a wide range of soil types and textures from clay to dune sand and river gravels. It is most commonly found on calcareous soils. It grows poorly on acid soils. It requires sufficient moisture for establishment but is thereafter very drought tolerant. White sweet clover is an early colonizer of disturbed sites. It is common on strip-mined lands in the central and eastern United States.

http://www.fs.fed.us/database/feis/plants/forb/melalb/all.html

Treatments Methods: Small patches treated by pulling and foliar spray with Rodeo (Glyphosate), Transline or Plateau with water carrier and a surfactant. Heat treatment for larger areas.

Tamarisk (*Tamarix chinensis)*

Tamarisk (a.k.a. salt cedar) is one of the most invasive, natural community altering, shrub-trees in the southwestern United States. Estimates of the tamarisk invasion in the southwest include over

600,000 ha of riparian habitats dominated by this species. One need only look to the Colorado River to see the potential that tamarisk has as an alien invader into natural ecosystems. Tamarisk is a superior competitor in the wetland ecosystems of the southwest, and we have helped it further by damming and increasing the salinity of those systems. Each tamarisk produces 500,000 wind-dispersed seeds per year. Once established, tamarisk acts as a facultative halophyte, tolerating salt concentrations up to 15,000 ppm, and secreting salt at 41,000 ppm, which is deposited on the soil surface. In addition to increased soil salinity, tamarisk increases fire frequency within the riparian habitats it dominates. The high levels of dead leaves and branches produced by the fast growing tamarisk provide ample fuels for wildfires. After the fires, tamarisk sprouts vigorously, while native riparian trees and shrubs generally do not. The result over time, as a result of both increased soil salinity and fire frequency is a riparian community dominated by tamarisk. Along with the invasive adaptations tamarisk possesses, human alteration of hydrologic regimes (i.e. dams) along streams and rivers has reduced the natural flood processes that willows and cottonwoods thrive under, and that flush out salts accumulating at the soil surface, giving tamarisk one more advantage.

http://www.caleppc.org/symposia/96symposium/barrows.html

Treatments Methods: Cut stump treatment, stem is cut and stump is sprayed with a 1:4 mixture of Garlon 4 and JLB oil. Occasional direct spraying of small stems with the Garlon 4 mixture.
Bio-control: Chinese Leaf Beetle (*Diorhabda elongate deserticola)*

Tumble mustard *(Sisymbrium altissimum)*
Tumble mustard is a winter annual or annual. The stems are simple below, much branched above having a bushy appearance. It grows 2 to 5 feet tall. Leaves are alternate and of 2 types; lower leaves are coarse and divided into broad lobes or leaflets. Upper leaves are much reduced and finer with narrow lobes or segments. Flowers are small, pale yellow, in racemes. Fruit is a slender 2-valved capsule 2 to 4 inches long. The seeds are small, numerous, yellow to brown and oblong.

It is a native of Europe, but is widely scattered throughout the United States. It is common in small grains, rangeland, waste areas, and along roadsides. This species often breaks off at soil level at maturity and scatters seeds as it tumbles in the wind.

Treatment Methods: Heat treatment. Herbicidal treatment with Transline.
Bio-Contol: Musk thistle head weevil (*Rhinocyllus conicus*), musk thistle rosette weevil (*Trichosirocalus horridus*), and musk thistle tortoise beetle (*Cassida rubiginosa*).

Yellow salsify (*Tragopogon dubius*)
Yellow salsify is an introduced biennial or an annual herb with milky sap. The stems are leafy, often branched and reach 30-100 cm tall. The stem is markedly swollen just below the heads. The alternate leaves clasp the stem at the base and are long, narrow, smooth-margined, and taper from the base to the tip. The solitary heads are composed of pale yellow ray flowers only with the involucre large (2.5-4 cm long) and cone-shaped in bud. Yellow salsify is common in relatively dry waste places such as railroad embankments, roadsides, and fields at low elevations.

http://www.ups.edu/faculty/kirkpatrick/field_botany/family_pages/Asteraceae/tragopogon_dubius.htm

Treatments Methods: Mechanical control. Herbicide treatment with Transline.

Appendix E

Safety Plan

HERBICIDE SAFETY AND SPILL PLAN

The following information will be reviewed by all workers who handle herbicides. The terms “pesticides” and “herbicides” are used interchangeable.

- All personnel who handle herbicides will obtain a Pesticide Applicators License from the Department of Agriculture through the State of Utah.

- All potential herbicides to be used in the park are described in the Exotic Plant Management Plan and Environmental Assessment. Before those herbicides are used in the park, yearly approval will be obtained from the NPS Regional IPM coordinator through the NPS Pesticide Use Proposal System (PUPS).

- All personnel will be familiar with and strictly adhere to the best management practices described in the Exotic Plant Management Plan.

- Safety equipment will be carried by all employees in the field (first aid kits, PPE). Communication equipment (cell phone and/or radio), herbicide labels, and MSDS will be carried by a minimum of one person in each field crew.

Herbicide Purchase

NPS 77 allows NPS personnel to purchase the amount of herbicide authorized for use during the year of approval. Larger amounts can be purchased only when the smallest amount available for purchase is larger than the amount necessary for the project. If an approved herbicide is unavailable, any substitutions with different active ingredients will require approval through the same herbicide use request and approval process.

Herbicide Storage

Herbicide storage facilities must be locked, fireproof, and ventilated; proper warning signs must be posted. Herbicides must be stored separately from all other substances, and the directions provided on the labeling must be followed. In addition, each type of herbicide must be stored on separate shelves. Any structure used for storage of herbicides should be posted, and copies of labels, material safety data sheets (MSDSs), and inventories should be kept in a locked container outside the storage facility.

Information and Equipment

A copy of the Labels and Material Safety Data sheets for herbicides being used will be available at all times during project operations. All personnel involved in the handling of herbicides will review and be familiar with relevant Material Safety Data Sheets.

Required Personal Protective Equipment (PPE) will be worn at all times when herbicides are being mixed and applied. Label requirements for specific herbicides

will be followed. Applicators and handlers must wear the PPE required by the labels of each herbicide being applied.

An emergency spill kit, with directions for use, will be available when herbicides are being mixed, transported and applied. Employees will be trained in the use of the spill kit prior to initiation of operations. The spill kit will contain the following equipment:

- Shovel
- Broom
- Absorbent material
- Large plastic garbage bags
- Safety goggles
- Rubber gloves

Procedures for Mixing, Loading and Disposing of Chemicals
The following procedures will apply to all herbicide applications:

1. Mixing of herbicides will occur at least 100 feet from well heads or surface water
2. Dilution water will be added to the spray container prior to addition of the spray concentrate.
3. Hoses used to add dilution water to spray containers will be equipped with a device to prevent back-siphoning, or a minimum 2-inch air gap.
4. Only those quantities of herbicides needed for one day's use will be mixed.
5. Those workers mixing chemicals will wear personal protective equipment required by the label.
6. Empty containers will be triple rinsed. Rinsate will be added to the spray mix or disposed of at the application site at rates that do not exceed those on the label.
7. Unused herbicides will be stored in a herbicide storage cabinet in accordance with herbicide storage instructions provided by the manufacturer and in accordance with Utah Department of Agriculture.
8. Empty and rinsed herbicide containers will be punctured and disposed of according to label directions.

Procedures for Herbicide Spill Containment
In the event of a spill, immediately notify the project supervisor. Identify the nature of the incident and extent of the spill, including the product name(s) and chemical registration number(s).

Remove any injured or contaminated person to a safe place. Remove contaminated clothing and follow MSDS guidelines for emergency first aid procedures following exposure. Obtain medical help for any injured employee.

Minor Spills (Less than 1 gallon of herbicide formulation or less than 10 gallons of herbicide mixture).
Areas where chemicals are spilled will be roped off or flagged to warn people and restrict entry. Qualified personnel will always be present on the site to confine the spill and warn of danger until it is cleaned up. The spill will be confined with earthen or sand dikes if the chemical starts to spread. The spill will be soaked up with absorbent material such as sawdust, soil, or clay. Contaminated material will be shoveled into a leak proof container for disposal and labeled. Contaminated material will be disposed

of using the same method as for herbicides. The spill area will not be hosed down. Emergency phone numbers will be carried by the herbicide applicators.

Major Spills (More than one gallon of herbicide formulation or more than 10 gallons of herbicide mixture).

Areas where chemicals are spilled will be roped off or flagged to warn people and restrict entry. Qualified personnel will always be present on the site to confine the spill and warn of danger until it is cleaned up. The spill will be confined with earthen or sand dikes if the chemical starts to spread. The spill will be soaked up with absorbent material such as sawdust, soil, or clay.

The local fire department and State herbicide authorities will be notified. Follow their instructions for further action. Whenever possible, someone familiar with the situation will remain at the site until help arrives. Emergency phone numbers will be carried by the herbicide applicators.

Decontaminate the soil by removing it to a depth of at least 2 inches below the contaminated zone and place in clearly labeled leak proof containers for disposal.

Reporting

The following list is a guide for the information regarding spills that should be reported. Incidents should be reported even if there is doubt as to whether the spill is an emergency or whether someone else has reported it. Emergency phone numbers will be carried by the herbicide applicators.

Date:
Time of Release:
Time Discovered:
Time Reported:
Duration of Release:
Location: (State, county, route, milepost)
Chemical name:
Chemical identification number:
Chemical data:
Known health risks:
Precautions to be taken:
Cause and source of release:
Estimated quantity (gallons) released:
Quantity (gallons) which has reached water:
Name of affected watercourse:
Number and type of injuries:
Potential future threats to environment or health:
Your name:
Telephone numbers:
Address:

GENERAL HEALTH AND SAFETY/ HAZARD REDUCTION PLAN

It is essential that safety be a part of every employee's job. Because of the varied terrain, elevation, variable and often severe weather, number of visitors, and a variety of work performed, employees and visitors face a myriad of potential natural and manmade hazards. Everyone needs to exercise caution on and off duty to ensure that this year will be a safe and enjoyable one. Remember: THERE IS NO JOB OR TASK WHICH IS SO IMPORTANT THAT REQUIRED TIME AND RESOURCES CANNOT BE DEDICATED SO THAT IT MAY BE PERFORMED SAFELY.

In the event of an injury, immediately notify the supervisor or crew leader and seek medical attention if needed. The required forms related to workplace injuries will be carried in the field at all times by at least one member of the field crew (typically the crew leader). In the packet with the forms will be directions to nearest medical facilities, emergency notification phone numbers, radio call numbers, and procedures to follow in case of emergency. All crew members will be provided a basic first aid kit and this will be carried at all times in the field.

Job hazard analyses have been developed for all aspects of exotic plant control work (hand-pulling, chainsaw operations, herbicide application). In addition, general environmental safety guidelines have been developed. These documents are available on the park network.

The following are some of the typical hazards employees can expect to encounter at the Southeast Utah Group parks and the actions to eliminate the hazard:

Hazard	Actions to Eliminate the Hazard
Exposure to Herbicide	The only restricted- use herbicide that may be used is picloram (Tordon). Picloram is relatively non- hazardous to humans. This chemical may cause moderate eye irritation. A complete first aid kit will be on the work site and it includes eyewash. If the chemical gets in your eyes, alert your crew leader, then flush thoroughly with eyewash or drinking water and call a physician if irritation persists. Prolonged or frequent repeated skin contact with the chemical may cause allergic skin reactions in some individuals. Other herbicides that may be used include: Garlon 4, Arsenal, 2,4- D, Plateau, Curtail, Redeem R&P, Transline, Telar, Roundup and Rodeo. All herbicide labels and MSDS sheets will be located in each spray vehicle. Wear all personal protective gear required by the product label: long sleeved shirt and long pants (you provide), waterproof gloves (provided by park), shoes and socks (you provide). If you dispense herbicide from the mix tank into your backpack you must also wear a face shield with goggles and respirator or full- face respirator. You may wear additional gear. The park will provide chemical- resistant coveralls (tyvek), chemical- resistant overshoes, rubber gloves, respirators, and safety glasses/goggles. When using a chemical, wash hands before eating, drinking, chewing

Hazard	Actions to Eliminate the Hazard
	gum, using tobacco, or using the toilet. Remove clothing immediately if herbicide gets inside. Remove personal protective equipment immediately after handling. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing. Clothing that may have been exposed to herbicide should be laundered separately from other clothing using detergent and hot water.
Backpacking and Lifting	Use proper lifting techniques, such as keep back straight, lift with your legs and lift straight. Don't try to lift too much weight. Ask for assistance with heavy/cumbersome objects. Watch hands and feet when lifting and lowering objects. Be cognizant of your back when engaged in any of these type activities. Warm up to minimize chance of pulled/strained muscles.
Slipping and Falling in Holes	Wear proper hiking or work boots with slip resistant soles. Keep an eye on the terrain being traversed. Be cognizant of uneven terrain and avoid holes.
Heat Emergencies:	Heat emergencies (particularly dehydration) are our biggest problem for both visitors and employees. Heat emergencies are serious and potentially fatal conditions typically brought on by exposure to heat combined with dehydration. Early symptoms include headaches, nausea, muscle spasms, and fatigue. More advanced cases (heat exhaustion to heat stroke) include symptoms of cool moist skin, dilated pupils, fever, dark urine, dry hot and red skin, confusion or irrational behavior, unconsciousness. Always wear sunscreen, a hat, and lightweight clothes, drink plenty of water (in summer at least one quart per hour for light to moderate activity), and eat snacks or drink an electrolyte solution to replace electrolytes lost during sweating. If you are thirsty, you are already dehydrated and need to increase your fluid consumption. Alcohol and sodas are diuretics, so avoid them when working outdoors in the heat.
Blisters	Be prepared. Before you head out on a long walk, take along a blister kit to be ready to cover up any hot spots or treat any blisters. Wear proper fitting hiking or work boots with moisture wicking socks. Wear proper fitting leather gloves when working with hand tools or pulling weeds. If a blister develops clean area with soap and water and keep area free from dirt and sweat. Place antibiotic ointment on blister and cover with sterile bandage. Change bandage every day.
Biohazards	Wear gloves when dealing with any kind of biohazard. Wash hands and other affected skin promptly with soap and water after removal of gloves and other PPE. Flush mucous membranes with water immediately or as soon as feasible following contact with blood or other potentially infectious materials.

Hazard	Actions to Eliminate the Hazard
	Do not bend, shear, break, or remove contaminated needles or other contaminated sharps. Recapping is authorized only when no feasible alternative (that is, approved sharps container) is available to prevent needle sticks. Accomplish recapping by using hemostats or equivalent device. Perform all tasks and procedures involving blood or other potentially infectious materials in such a manner as to minimize splashing, spraying, and generation of droplets, mist, or vapors of these substances. Do not perform mouth pipetting or suctioning of blood or other potentially infectious materials. Such practices are prohibited; no exceptions. When performing First Aid, CPR or other life-saving activities wear all the PPE and equipment provided by the NPS at the site of the activity. If, and when, the PPE is not available take all precautions to protect everyone to the greatest extent available.
Chainsaw Operations	Wear proper PPE- Chaps, hardhat, gloves, leather boots, eye protection, ear plugs. Wear long pants and long sleeved shirt. Never work alone under any circumstances. Have a radio with you also. Starting- Place saw on firm level surface with bar and chain in clear area. Never straddle guidebar or lean across saw. To start, hold saw down firmly with left hand holding down on the handlebar, place left knee snugly against engine and tip of right foot in trigger guard handle. Briskly pull starter rope with right hand. Never drop start. Cutting- Use caution, be alert for kickback, know exactly where the bar and tip are at all times, never cut limbs, logs, or brush simultaneously. Cut away from body and stand to the side of cut while bucking. Keep balanced. Throttle up to full speed before allowing chain to cut. Do not cut at half throttle as clutch will slip and burn. Use the proper saw for job with proper bar length and proper chain. Refueling-Stop saw before refueling. Refuel on bare ground or other noncombustible surface, remove spilled fuel off saw, never start saw within 10 ft. of refueling area. Use clearly labeled and safety approved fuel mixture and bar oil containers. Have first aid kit accessible.
ATV Use	Adhere to standard and safe operating procedures. Personal Protective Equipment required: ANSI approved crash helmet, safety goggles, gloves, lace-up/non-skid boots, long pants, and long sleeved shirt. All employees identified as ATV operators will have successfully completed an ATV Safety Institute (ASI) certification class and have in possession a certificate of qualification. A review of safe ATV operating procedures will be conducted prior to

Hazard	Actions to Eliminate the Hazard
	projects requiring the use of ATVs, including the appropriate JHA. A pre-ride inspection shall be performed checking tires and wheels, controls and cables, lights and electrics (ignition switch, engine stop switch), oil and fuel, drive shaft, chain, and chassis. Doing warm up exercises will help prevent muscle strain and injury. When refueling, allow machine to cool, avoid spills, refer to MSDS. Watch for low limbs, holes, large rocks, etc. Slow down when in rough terrain; avoid traversing side slopes that are steep, slippery or very bumpy. Going straight up or down slope is safest when possible. Use body weight to balance the ATV. If a tip-over seems likely, turn front wheels downhill if the terrain allows. If not, and shifting weight uphill does not help; quickly dismount to the uphill |side avoiding the hot areas of the ATV (engine, exhaust, etc.) When approaching unknown terrain, slow to a speed that will allow for a complete stop within the limit of your visibility. In extremely rough terrain, dismount and scout travel route on foot. Always use parking brake when ATV is riderless. Follow the principles of "Light on the Land" and "Tread Lightly." Loads shall be securely tied down to racks properly fastened to ATV. Ensure that the load does not exceed the design capability of racks and manufacturers weight limits. The center of gravity shall be as low as possible and weight shall be evenly distributed between front and rear axles. Loads can affect handling and performance. Extra caution is essential to safe operation. Ensure that loads do not interfere with operation of ATV and the rider's ability to dismount in an emergency. Avoid working alone, carry a radio if possible.

Heat Emergencies

There are three types of heat emergencies you may be required to treat.

Heat Stroke

This is the most serious type of heat emergency. It is LIFE-THREATENING and requires IMMEDIATE and AGGRESSIVE treatment!

Heat stroke occurs when the body's heat regulating mechanism fails. The body temperature rises so high that brain damage --and death-- may result unless the body is cooled quickly.

Signs and Symptoms

The victim's skin is HOT, RED and usually DRY. Pupils are very small. The body temperature is VERY HIGH, sometimes as high as 105 degrees.

First Aid

Remember, Heat Stroke is a life-threatening emergency and requires prompt action! Summon professional help. Get the victim into a cool place.

COOL THE VICTIM AS QUICKLY AS POSSIBLE IN ANY MANNER POSSIBLE!

Place the victim into a bathtub of cool water, wrap in wet sheets, place in an air conditioned room.

Do not give victim anything by mouth. Treat for shock.

Heat Exhaustion

Heat exhaustion is less dangerous than heat stroke. It is caused by fluid loss which in turn causes blood flow to decrease in vital organs, resulting in a form of shock.

Signs and Symptoms

COOL, PALE AND MOIST skin, heavy sweating, dilated pupils (wide), headache, nausea, dizziness and vomiting. Body temperature will be near normal.

First Aid

Get the victim out of the heat and into a cool place. Place in the shock position, lying on the back with feet raised. Remove or loosen clothing. Cool by fanning or applying cold packs or wet towels or sheets. If conscious, give water to drink every 15 minutes.

IMPORTANT: WHILE HEAT EXHAUSTION IS NOT A LIFE- THREATENING EMERGENCY LIKE HEAT STROKE, IT CAN PROGRESS TO HEAT STROKE IF LEFT UNTREATED!

Heat Cramps

Heat cramps are muscular pain and spasms due to heavy exertion. They usually involve the abdominal muscles or legs. It is generally thought this condition is caused by loss of water and salt through sweating.

First Aid

Get the victim to a cool place. If they can tolerate it, give one-half glass of water every 15 minutes. Heat cramps can usually be avoided by increasing fluid intake when active in hot weather.

Other Safety Concerns When Working in the Field

Lightning

Afternoon thunderstorms are frequent in the summer monsoon season. When thunderstorms approach, avoid mountain tops, exposed areas, tall or lone trees, ponds or puddles. If lightning is nearby, refrain from transmitting on portable radios. If caught in the open when lightning is imminent, squat with hands on knees, keep your head low and wait for the storm to pass. If carrying a metal frame backpack, remove it and place it away from you. Lightning has caused several injuries and deaths in the SEUG area and should not be taken lightly.

West Nile Virus
The West Nile virus (WNV) is transmitted to people by bites from infected mosquitoes. The virus is maintained in the bird-mosquito-bird cycle. Mosquitoes are infected by feeding on a bird with virus in its blood. Humans are infected when an infected mosquito bites them. Person-to-person transmission does not occur. The virus is relatively new to Arizona, but has the potential to be prevalent whenever mosquitoes are abundant. At the lower elevations this can be from March to November, or longer.

Most people who are infected with the virus do not become ill and have no symptoms. For persons who do become ill, the time between the mosquito bite and the onset of symptoms ranges from 5-15 days. Two types of disease occur in humans: (1) viral fever syndrome, and (2) encephalitis, an inflammation of the brain. Symptoms of the viral fever syndrome include fever, headache, and malaise. These symptoms persist for 2-7 days. Encephalitis is very rare. Symptoms include a sudden onset of high fever and a headache, and they may progress to stiff neck, disorientation, tremors, and coma. There is not specific treatment for this virus except supportive care.
To decrease exposure to mosquitoes and the West Nile virus:

- Limit outside activity around dawn and dusk when the mosquitoes feed.
- Wear protective clothing such as lightweight long pants and long sleeve shirts when outside.
- Apply insect repellant to exposed skin when outside. Repellents with DEET are the most effective.
- Make sure that doors and windows have tight-fitting screens. Repair or replace screens that have tears or holes in them.
- Drain all standing water on property, no matter how small an amount.
- Remove items that could collect water such as old tires, buckets, empty cans, and food and beverage containers.

Hantavirus
Hantavirus Pulmonary Syndrome (HPS) is a disease caused by a virus that is carried by rodents, particularly the deer mouse. Hantavirus is present in the saliva, urine and feces of infected mice. People are infected by breathing in the virus during direct contact with rodents or from disturbing dust and feces from mice nests or surfaces contaminated with mice droppings or urine.

There have been many cases of HPS reported in both Utah and Colorado and the consequences of HPS can be severe; approximately half of the people who develop HPS die.

Spiders (Brown Recluse and Black Widow)
Two venomous spiders are found here, the brown recluse and the black widow. Both types of spiders have bitten employees and volunteers in past years. Please use caution when entering dark spaces in or under buildings. Little-used out buildings (like sheds) are likely hiding places.

- The brown recluse spider is typically a dark brown to almost black spider with a characteristic violin-shaped mark on the spider's back. The bite from this spider causes a stinging sensation followed by intense pain. Within 24 to 36 hours, the victim may experience fever, chills, nausea, weakness, and joint

pain. The venom kills the affected tissue, which sloughs off and exposes the underlying tissue. Healing can take 8 weeks or longer.

- Red "hourglass" markings on the lower abdomen of a shiny black body distinguish the black widow spider. These spiders spin tangled webs of coarse silk in dark places. The bite may or may not be painful. Afterward, red swelling and possible numbness may be evident in the bite area. Some people are allergic to spider venom and those victims will experience additional muscle-related symptoms (cramps, tremors, etc).

If you have been bitten by a brown recluse or a black widow spider, it is recommended that you seek medical attention.

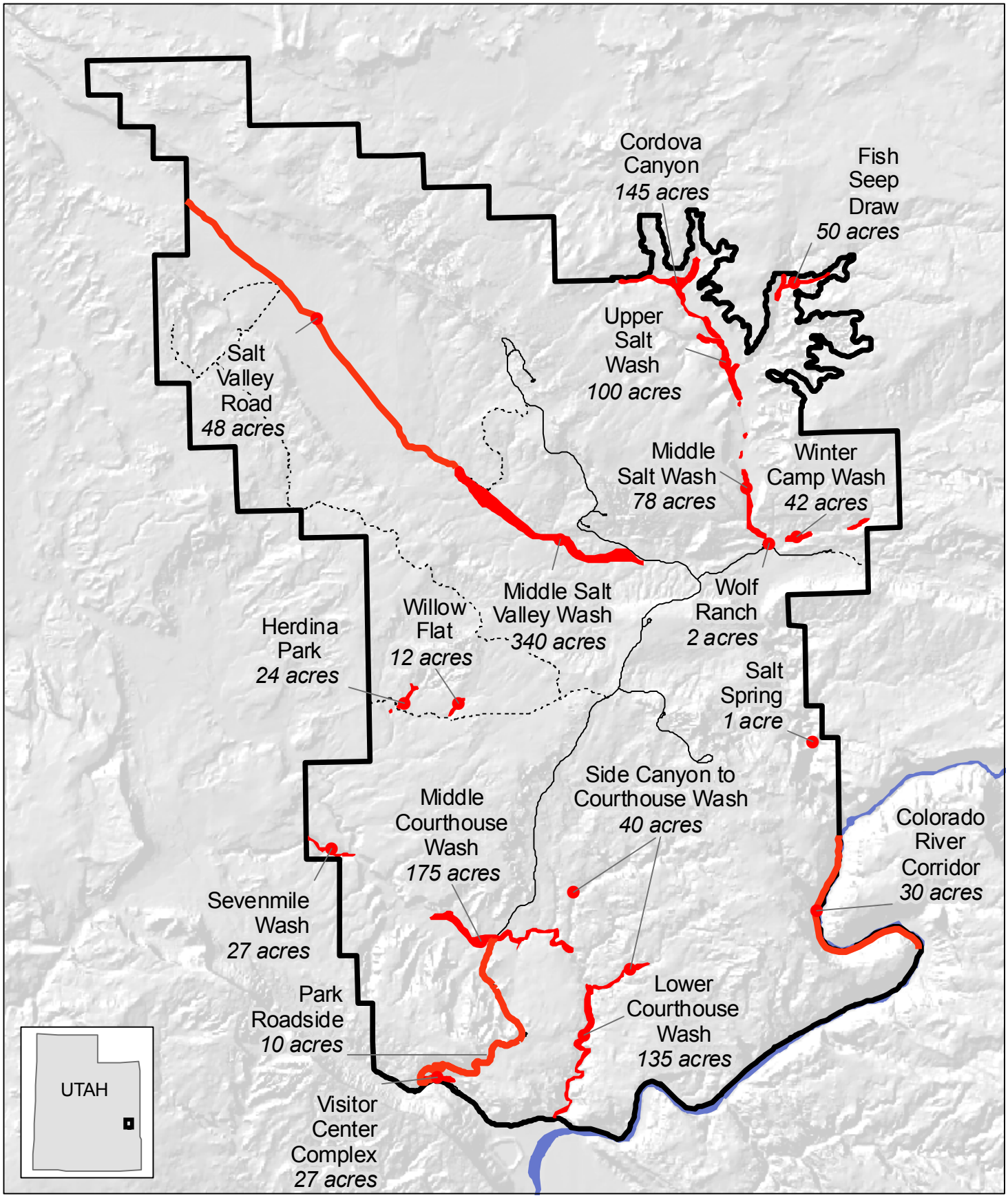
Scorpions
Scorpions are very common on the Northern Colorado Plateau desert. Scorpions are active at night; during the day they hide under stones and tree bark, in rock and wood piles, and in masonry cracks. Use caution when moving rocks, logs, etc. Don’t put your hands or feet where you can’t see. Shake out boots and shoes before putting them on. Scorpion stings are painful, but are rarely dangerous (except bark scorpions). People who are sensitive to insect stings may be more likely to have a reaction to scorpion stings.

Rattlesnakes
The parks in the SEUG have one species of rattlesnake, the midget-faded rattlesnake. Like the name implies, the rattlesnakes have a rattle at the end of the tail. Don’t count on getting a warning rattle every time you encounter a rattlesnake. Even if a snake feels threatened by your presence, it may not rattle. Snakes generally want to be left alone and prefer to stay hidden and avoid confrontation.

A rattlesnake will generally bite for one of two reasons: to inject venom into its prey, or in self defense. Most rattlesnake bites to humans are because the rattlesnake felt threatened by the human’s actions. However, occasionally the victim did not intentionally provoke the snake into biting. In about 25% of all rattlesnake bite cases, the snake does not inject venom. To reduce your chances of being bitten by a snake, follow these simple guidelines. Do not harass or attempt to kill snakes. If you see a snake, stay at least 4 feet away from it. Do not put your hands or feet where you can't see. Wear boots and loose fitting pants while hiking and carry a flashlight after dark.

If you are bitten by a snake, seek emergency medical treatment immediately. Do NOT attempt to treat a snake bite yourself. Many of the treatments cause more damage than the snakebite itself (never make incisions, use ice, or electricity).

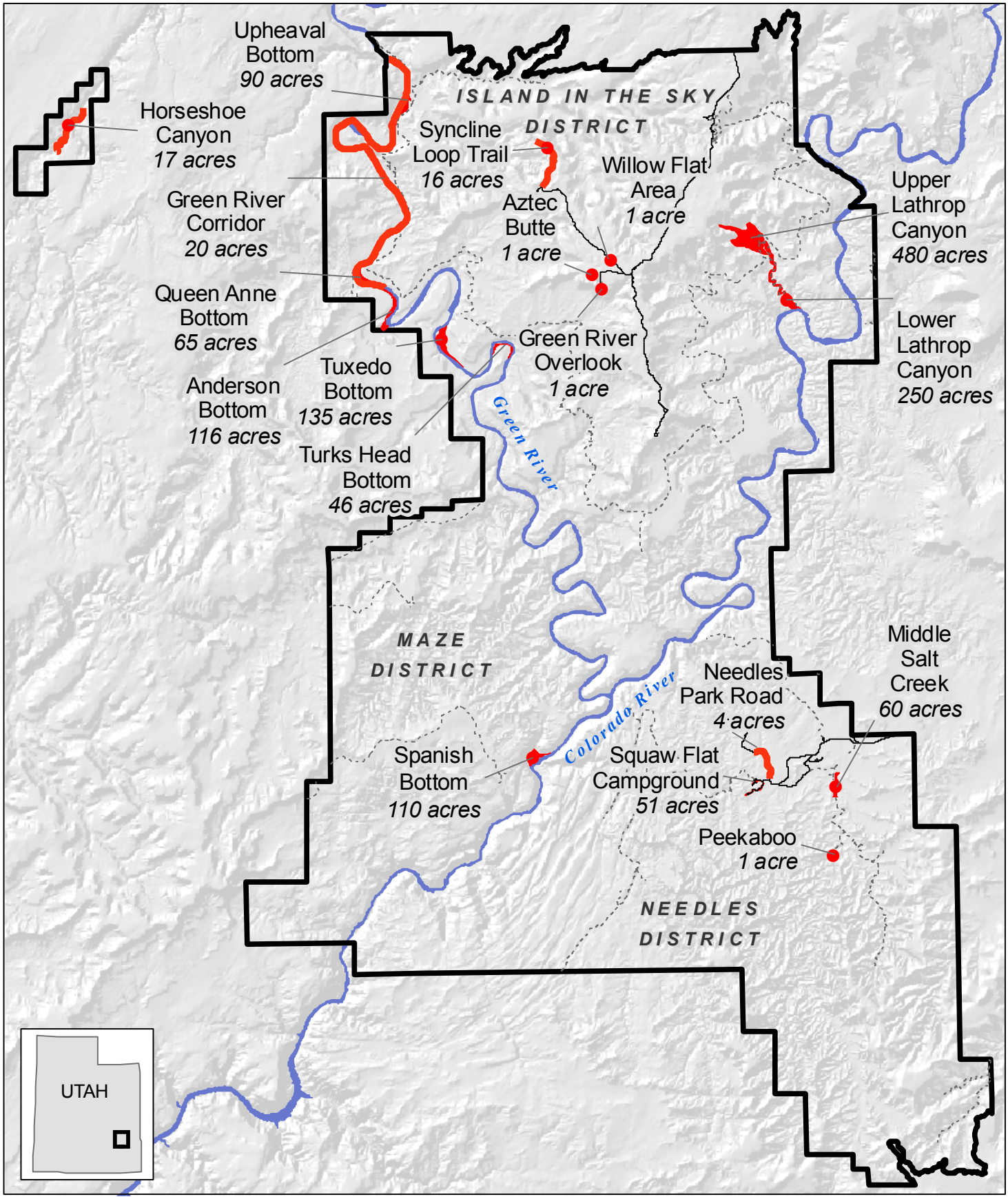
Appendix F. Proposed Treatment Areas of Non-Native Plant Species
Arches National Park



● Proposed Treatment Areas **1,285 acres*

*Acreage values are approximate

Appendix F. Proposed Treatment Areas of Non-Native Plant Species
Canyonlands National Park

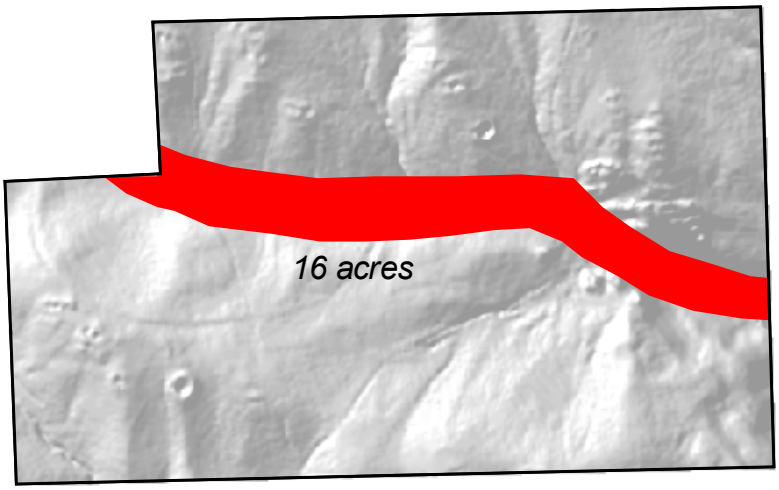


● Proposed Treatment Areas *1,465 acres**

*Acreage values are approximate

Appendix F. Proposed Treatment Areas of Non-Native Plant Species
Hovenweep National Monument

Hackberry Unit

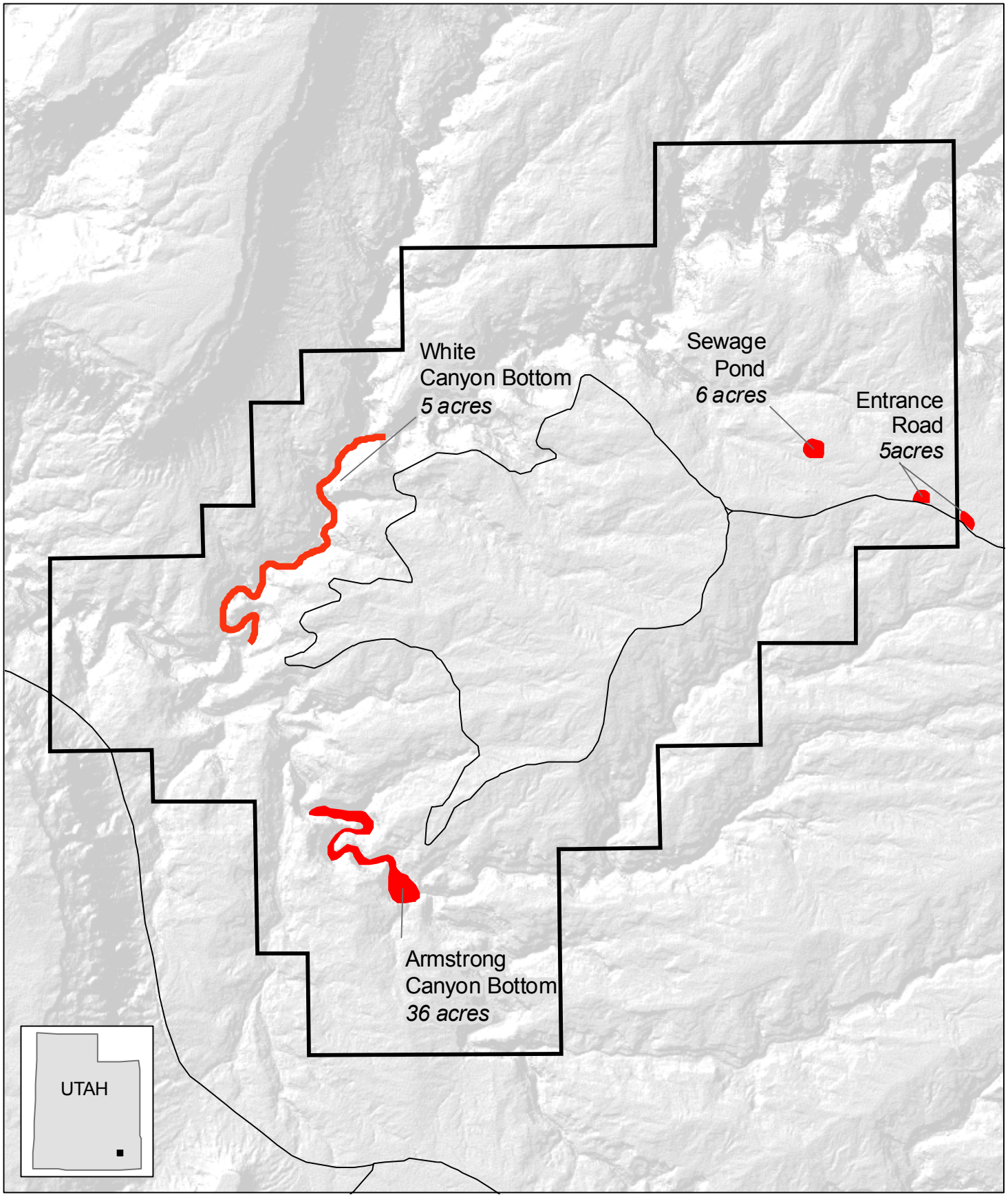


Goodman Point Unit

● Proposed Treatment Areas **32 acres*

*Acreage values are approximate

Appendix F. Proposed Treatment Areas of Non-Native Plant Species
Natural Bridges National Monument



● Proposed Treatment Areas **52 acres*

*acreage values are approximate

Appendix G
RAVE Model

RAVE: Relative Aquifer Vulnerability Evaluation

An on- farm scoring system to evaluate aquifer vulnerability to pesticide contamination; 2nd Ed.

Introduction
Pesticide applicators of today are faced with growing concern over the potential for pesticide contamination of ground water. Over 50% of all Montanan's and 95% of the agricultural community consume ground water as their source of drinking water. Protecting this fragile resource from pesticide contamination is imperative, because some pesticides may be harmful to humans at very low concentrations and clean- up of ground water is extremely difficult. Pesticide residues in ground water may also adversely affect sensitive crops and wildlife.

To help farmers and pesticide applicators reduce the potential for contaminating ground water with pesticides, an aquifer vulnerability scoring system; RAVE: Relative Aquifer Vulnerability Evaluation has been developed. This numeric scoring system helps individuals evaluate pesticide selection for on- site ground water contamination potential. RAVE is designed only as a guidance system and does not replace the need for safe and judicious pesticide application required in all situations.

In most cases pesticide contamination of ground water can be avoided by using common sense and following label instructions. However, some areas are particularly vulnerable to pesticide contamination and thus require special consideration prior to making an application. The use of this score card may indicate whether an alternative pesticide should be used within a given area or if the area is not suited to pesticide applications.

Several major factors in a particular area determine the relative vulnerability of ground water to pesticide contamination. Nine of these factors have been incorporated into the RAVE score card and are defined below. A Value for most of these factors can be determined by a simple on- site inspection. If a value for a particular factor is not known, contact the appropriate agency for assistance. A listing of agency contacts is provided below. Pesticide leaching potential is based on the soil persistence and mobility of a pesticide. A list of leaching potentials for some commonly used pesticides is given on pages 3- 4.

Factor Definitions

Irrigation Practice: A rating based on whether a field is flood, sprinkler or non- irrigated.

Depth to Ground Water: The distance, in vertical feet, below the soil surface to the water table.

Distance to Surface Water: The distance, in feet, from the field boundary to the nearest flowing or stationary surface water.

Percent Organic Matter: The relative amount of decayed plant residue in the soil (see soil test results, county soil survey or consult the SCS). This may be estimated by soil color; darker soil generally indicates higher organic matter (most Montana soils are < 3 %).

Pesticide Application Frequency: The number of times the particular pesticide is applied during one growing season.

Pesticide Application Method: A rating based on whether the pesticide is applied above or below ground.

Pesticide Leachability: A relative ranking of the potential for a pesticide to move downward in soil and ultimately contaminate ground water based upon the persistence, sorptive potential and solubility of the pesticide.

Topographic Position: Physical surroundings of the field to which the pesticide application is to be made. Flood plain = within a river or lake valley, Alluvial Bench = lands immediately above a river or lake valley, Foot Hills = rolling up- lands near mountains, Upland Plains = high plains not immediately affected by open water or mountains.

Sources of Information

Soils Information: (1) USDA- SCS soil survey, district offices in most county seats; (2) Montana State University (MSU) Extension Service in most county seats, State Soil Specialist in Bozeman (994- 4601); (3) MSU Department of Plant, Soil and Environmental Sciences (994- 4601).

Ground Water Information: (1) Montana Bureau of Mines and Geology in Butte (496- 4155), in Billings (657- 2938); (2) United States Geological Survey in Helena (449- 5225); (3) Montana Department of Health and Environmental Sciences, Water Quality Division (444- 2406); (4) Montana Department of Natural Resources and Conservation, Water Resource Division (444- 6601).

Pesticide Information: (1) Montana Department of Agriculture, Agricultural Sciences Division. Headquarters: Helena (444- 5400), Regional offices: Billings (652- 3615), Bozeman (587- 9067), Great Falls (761- 0926), Glasgow (228- 9510), Missoula (329- 1340); (2) MSU Extension Service offices in most county seats, Pesticide Specialist in Bozeman (994- 3518); (3) US EPA Montana Office in Helena 457- 2690).

Directions for Use of the RAVE Score Card

The RAVE score card can be completed in a matter of minutes. On a separate sheet of paper write down the appropriate value for each of the nine factors listed on the score card. For example; at a sprinkler irrigated site the "Irrigation Practice Factor" would be assigned a value of 7. Once all of the factors have been assigned a value, total all values. This total

should then be compared to the Score Card Interpretation Scale to determine the relative vulnerability of ground water to contamination by an individual pesticide. Higher scores indicate higher vulnerability of ground water to pesticide contamination. If a high score is received, select an alternative pesticide and compare the results.

Score Card Interpretation Scale

30 — 60 — 100

Low Concern — High Concern

THE RAVE SCORE CARD

DEPTH TO GROUND WATER:		
*2-10 ft	20	
10- 25 ft	12	
25-50 ft	5	
> 50 ft	0	_____

DISTANCE TO SURFACE WATER:		
1-100 ft	5	
100- 500 ft	3	
> 500 ft	2	_____

TOPOGRAPHIC POSITION:		
Floodplain	15	
Alluvial bench	10	
Rolling foothill	5	
Upland plain	2	_____

SOIL TEXTURE:		
Gravelly	15	
Sandy	15	
Loamy	10	
Clayey	5	_____

PERCENT SOIL ORGANIC MATTER:		
0- 1%	5	
**1- 3%	3	
> 3%	2	_____

IRRIGATION PRACTICE:		
Flood irrigated	10	
Sprinkler irrigated	7	
Non- irrigated	2	_____

PESTICIDE APPLICATION FREQUENCY:		
> 1/year	5	
1/year	2	_____

PESTICIDE APPLICATION METHOD:		
Soil applied	5	
Foliar applied	2	_____

PESTICIDE LEACHING INDEX:		
***High	20	
Moderate	10	
Low	5	_____

Total ALL Rankings for the field and pesticide in question here:

* If water table < 2 feet deep, applications should probably not be made
** If unknown, use this value
*** See Table 1 for pesticide leaching index

Interpretation of RAVE Scores

The RAVE score card rates aquifer vulnerability on a scale of 30 to 100 for individual application sites and pesticides. Higher values indicate high vulnerability of ground water to contamination by the pesticide used in the evaluation. Those values greater than or equal to 65 indicate a potential for ground water contamination. In such instances alternative pesticides should be sought which have a lower leaching potential. Scores of 80 or greater indicate that pesticide applications should not be made at this location unless an alternative product greatly reduces the score. Scores between 45 and 64 indicate a moderate to low potential for ground water contamination and scores less than 45 indicate a low potential for ground water contamination by the pesticide in question. Even in such cases, careful use of pesticides and following label instructions is imperative to protect ground water.

Table 1. Commonly used pesticides, an example trade name and relative pesticide leaching potentials. Chemicals bolded have been found in ground water in Montana (Adapted from McBride et al., 1989.)

Pesticide	Leachability
Insecticides	
acephate (Orthene)	low
aldicarb (Temik)	high
aldrin	low
azinphos-methyl (Guthion)	low
carbaryl (Sevin)	low
carbofuran (Furadan)	high
chlorpyrifos (Lorsban)	low
diazinon	low
dimethoate (Cygon)	med
disulfoton (Di- Syston)	low
endosulfan (Thiodan)	low
esfenvalerate (Asana XL)	low
fenvalerate (Pydrin)	low
fonofos (Dyfonate)	med
lindane	med
malathion (Cythion)	low
methamidophos (Monitor)	high
methidathion (Supracide)	med
methomyl (Lannate, Nudrin)	med
methyl parathion (Penncap-M)	low
parathion	low
permethrin (Ambush, Pounce)	low
phorate (Thimet, Rampart)	med
terbufos (Counter)	low
tralomethrin (Scout- Xtra)	low
trichlorfon (Dylox, Proxol)	high
vitavax (Lindane & Thiram)	med
Fungicides	
Benalaxyl	low
benomyl (Benlate, Tersan 1991)	low
captan	low
chlorothalonil (Bravo, Daconil)	low
copper hydroxide (Kocide, Champion)	low
mancozeb (Dithane, Manzate, Penncozeb)	low
maneb	low
metalaxyl (Ridomil)	high
PCNB (Terraclor)	low
propiconazole (Tilt)	med
sulfur (Magnetic 6, Thiolux)	low
thiophanate methyl (Topsin M)	low
thiram	low
triadimefon (Bayleton)	med
triforine	low

Pesticide	Leachability
Herbicides	
acifluorin (Blazer)	low
acrolein (Magnacide H)	high
alachlor (Lasso EC)	med
ametryn	med
amitrole (Amitrole T)	med
atrazine (AAtrex)	high
benefin (Balan)	low
bentazon (Basagran)	med
bromacil (Hyvar)	high
bromoxynil (Butricil)	low
butylate (Sutan+)	low
chloramben (Amiben)	high
chlorsulfuron (Glean)	high
clopyralid (Stinger, Curtail)	high
cyanazine (Bladex)	med
cycloate (Ro- Neet)	med
dalapon	high
desmedipham (Betanex)	low
dicamba (Banvel)	high
diclofop (Hoelon)	low
difenzoquat (Avenge)	low
diuron (Karmex)	med
endothall (Des- I- Cate, Herbicide 273)	low
EPTC (Eptam, Eradicane)	med
ethalfluralin (Sonalan)	low
ethofumesate (Nortron)	high
fenoxaprop (Whip)	low
fenoxaprop- P- ethyl (Cheyenne, Puma)	low
fluazifop- P- butyl (Fusilade 2000)	low
Fosamine Ammonium (Krenite)	low
Glufosinate ammonium (Finale)	low
glyphosate (Roundup)	low
hexazinone (Velpar)	high
imazamethabenz-methyl (Assert)	high
imazapic (Plateau)	high
imazapyr (Arsenal)	high
MCPA	high
MCPA amine (Weedar)	high
MPCA ester	low
MCPA ester (Curtail M)	high
MCPP	high
metolachlor (Dual)	med
metribuzin (Sencor, Lexone)	high
metsulfuron methyl (Ally)	high
MSMA (Daconate)	low
oryzalin (Surflan)	low

Modified RAVE Model

USERS GUIDE

for the

VEGETATION MANAGEMENT RISK ASSESSMENT

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RAVE: Relative Aquifer Vulnerability Evaluation
(as adapted from Montana Department of Agriculture,
Environmental Management Division)

INTRODUCTION

To help pesticide applicators reduce the potential for contaminating groundwater with pesticides, an aquifer vulnerability scoring system--Relative Aquifer Vulnerability Evaluation (RAVE)--was developed by the Montana Department of Agriculture. This numeric scoring system helps individuals evaluate pesticide selection for on-site groundwater contamination potential. RAVE is designed only as a guidance system and does not replace the need for safe and judicious pesticide application in all situations.

In many cases pesticide contamination of groundwater can be avoided by using common sense and following label instructions. However, some areas are particularly vulnerable to pesticide contamination and require special consideration prior to making an application. The use of this score card may indicate whether an alternative pesticide should be used within a given area or if the area is not suited to pesticide applications.

Several major factors determine the relative vulnerability of groundwater in a particular area to pesticide contamination. Nine of these factors have been incorporated into the enclosed RAVE score card and are defined below. A value for most of these factors can be determined by a simple on-site inspection. If a value for a particular factor is not known, then the appropriate agency should be contacted. A listing of agency contacts is provided. Pesticide leaching potential is based on the persistence and mobility of a pesticide in the soil. A list of leaching and surface runoff potentials for herbicides used in vegetation management is given on the attached table.

FACTOR DEFINITIONS

Depth to Groundwater: Distance in vertical feet below the soil surface to the water table.

Soil Texture: Soils predominantly gravel, sand, loam, or clay.

Percent Organic Matter: The relative amount of decayed plant residue in the soil may be estimated by soil color; darker soil generally indicates higher organic matter (most National Forest soils are less than 3 percent).

Topographic Position: Physical surroundings of the field where the pesticide application is to be made. Flood Plain = within a river or lake valley; Alluvial Bench = lands immediately above a river or lake valley; Foot Hills = rolling uplands near mountains; Upland Plains = high plains not immediately affected by open water or mountains.

Distance to Surface Water: Distance in feet from treatment boundary to the nearest flowing or stationary surface water.

Annual Precipitation: Over 60" annual precipitation, 30-60" annual precipitation, less than 30" annual precipitation on the treatment site.

Pesticide Application Frequency: Number of times the particular pesticide is applied during one growing season.

Pesticide Application Method: Whether the pesticide is applied above or below ground.

Pesticide Leachability: A relative ranking of the potential for a pesticide to move downward in soil and ultimately contaminate groundwater. The ranking is based upon the persistence and mobility of the pesticide.

DIRECTION FOR USE OF THE RAVE SCORE CARD

The RAVE score card can be completed in a matter of minutes. On a separate sheet of paper, write down the appropriate value for each of the nine factors listed on the score card. Once all of the factors have been assigned a value, the values should be totaled.

THE RAVE SCORE CARD

Depth to Groundwater:
*2-10 ft. 20
10-25 ft. 12
25-50 ft. 5
> 50 ft. 0 ___

Soil Texture:
Gravelly 15
Sandy 15
Loamy 10
Clayey 5 ___

Percent Soil Organic Matter:
0-1% 5
**1-3% 3
>3% 2 ___

Topographic Position:
Flood Plain 15
Alluvial Bench 10
Rolling Foothill 5
Upland Plain 2 ___

Distance to Surface Water:
0-100 ft. 5
100-500 ft. 3
> 500 ft. 2 ___

Annual Precipitation:
> 60" 5
30-60" 2
<30" 0 ___

Pesticide Application Frequency:
> 1/year 5
1/year 2
< 1/year 1 ___

Pesticide Application Method:
Soil Applied 5
Foliar Applied 2 ___

***Pesticide Leaching Potential:**
Large 20
Medium 10
Small 5 ___

Total all Rankings for the Site and Pesticide in Question here: _____ = RAVE Score.

* If the watertable is less than 2 feet deep, then applications should probably not be made.
** If unknown, use this value.
*** See attached Table (Herbicides and their Properties) for the leaching potential for the pesticide in question.

INTERPRETATION OF RAVE SCORES

Higher numbers indicate high vulnerability of groundwater to contamination by the herbicide used in the evaluation. RAVE scores greater than or equal to 65 indicate a potential for groundwater contamination. In such instances, alternative pesticides should be sought which have a lower leaching potential. Score of 80 or greater indicate that pesticide applications should not be made at this location with the proposed product. Scores between 45 and 65 indicate a moderate to low potential for groundwater contamination and scores less that 45 indicate a low potential for groundwater contamination by the pesticide in question. Even in such cases, it is imperative to use pesticides carefully with strict adherence to label instructions to protect groundwater.

Note: Some products such as the sulfonylurea's are used in very small quantities. In cases where less than 1/2 pound AI per acre is applied, it would be reasonable to reduce the final RAVE score by 2-5 points.

HERBICIDES AND THEIR PROPERTIES

Common Name Herbicide	Trade Name Name	Solubility In Water PPM	Soil Sorption Index Koc	Half Life in Soil Days	Surface Runoff Potential	Leaching Potential
AMITROLE	Amizole, Weedazol	280,000	100	14	Medium	Medium
ATRAZINE	Atrazine, AAtrex	33	100	60	Medium	Large
BROMACIL	Hyvar X	815	32	90	Medium	Large
CHLORSULFURON	Glean, Telar	300 (pH-5) 28,000 (pH-7)	f(pH)	30-Acid Soil 30+ -Alkaline	Small	Large
CLOPYRALID	Stinger, Curtail	Very Soluble	~~1.4~~ 6.0 (AVG) (RANGES TO 60)	20	Small	Large
2,4-D (ESTER)	Several Names	900	~~1,000~~ E 100 (ESTIMATED)	10	Medium	Small
2,4-D (AMINE)	Several Names	890	20	10	Small	Medium
DICAMBA	Banvel	4,500	2	14	Small	Large
DICHLOBENIL	Casoron	25	224	30	Medium	Medium
DIURON	Karmex, Diuron	42	480	60	Large	Medium
GLYPHOSATE	Roundup	12,000	24,000	30	Large	Small
HEXAZINONE	Velpar	33,000	54	60	Small	Large
IMAZAPYR	Arsenal, Chopper	15,000	5 E	90	Small	Large
MEFLUIDIDE	Embark 2-S	566,000	--	2	Medium	Small
METSULFURON METHYL	Escort	.109 mg/ml	f(pH)	120	Medium	Large
PICLORAM	Tordon 22K	430	16	90	Small	Large
PROMETON	Pramitol	750	300	120	Large	Large

- - Continued - -

Common Name Herbicide	Trade Name Name	Solubility In Water PPM	Soil Sorption Index Koc	Half Life in Soil Days	Surface Runoff Potential	Leaching Potential
SIMAZINE	Princep, Simazine	3.5	138	75	Medium	Large
SULFOMETURON	Oust	10 (pH-5) 5,300 (pH-7)	f(pH) f(pH)	60 60	Medium Large	Medium Large
TEBUTHIURON	Spike	2,300	80	360	Small	Large
TRICLOPYR	Garlon 4, Turflon	430	780	46	Large	Medium
TRIFLURALIN	Treflan	0.3	7,000	60	Large	Small

SOURCE: Wyoming Weed Control Series, No. 1, Herbicides and Their Properties and Applications, College of Agriculture. B-442.1, University of Wyoming, Laramie, Wyoming.

Utah Weed Control Handbook, 1991, Cooperative Extension Service, EC 301, Utah State University Logan, Utah.

DEFINITIONS

COMMON NAME - Refers to an active ingredient without naming a specific product.

TRADE NAME - Typical name or names by which the ingredient is marketed.

SOLUBILITY IN WATER - This is the solubility of the pure active ingredient, not the formulated product. A large number means highly soluable. A small number means low solubility. Generally, herbicides with solubilities of 1 PPM or less will tend to stay near the soil surface and be washed off in sediment.

SOIL SORPTION INDEX - The Koc measures the tendency of the herbicide to be strongly attached, by chemical or physical bonds, to soil particle surfaces. The higher Koc values (1000) have a stronger attachment to soil and a lesser tendency for the herbicide to move except with sediment movement. "E" = Estimate value w/probable error values of 3X to 5X for Koc.

HALF-LIFE IN SOIL - The time required for herbicides in soils to be degraded so their concentration decrease by one-half. Herbicide degredation can be described fairly accurately by assuming that each successive elapsed half-life will decrease the herbicide concentration by half. A period of two half-lives will reduce a soil concentration to one-fourth the initial amount. The numbers given should only be used as relative indicators of persistence. These half-lives are for herbicides in the interior of the soil and generally refer to chemical or microbiological degradation. Herbicides deposited on the surface or deposited on plant or crop litter surfaces, which remain there generally show half-lives of only a few days or less under these conditions.

RUNOFF POTENTIAL - A large rating means the herbicide has a high tendency to move with sediment in runoff. A small rating means the herbicide has a low potential.

LEACHING POTENTIAL - This indicates the tendency of an herbicide to move in solution with water and leach below the root zone into deep perculation. A rating of large means the chemical has a high potential for leaching.

Supplemental Table
Herbicides and their Properties
(for use with RAVE Scorecard)

Common Name	Trade Name	Solubility in Water (ppm)	Soil Sorption Index (Koc)	Half Life in Soil (days)	Surface Runoff (Loss) Potential	Leaching Potential
Chlorsulfuron	Telar	300 (pH 5) 28,000 (pH7)	40 @ pH 7 (average)	30 for acid soil 30+ for alkaline soil	Small	Large
Clopyralid	Curtail, Transline, Stinger, Reclaim, Lontrel	1,000 (acid) 300,000 (salt)	1.4	20	Small	Large
2,4-D (amine)	2,4-D, Aqua-Kleen, Barrage, Weedone	890	20	10	Small	Medium
2,4-D (ester)		900	100 (estimated)	10	Medium	Small
Glyphosate	Roundup Pro, Roundup Ultra, Rodeo, GlyPro, Accord, Glyphomax, Touchdown	12,000	24,000	30	Large	Small
Imazapic	Plateau, Cadre, Plateau Eco-Paks	2,200	10-267 (depends on soil type)	31-410 (176.25 average)	Small	Medium
Metsulfuron methyl	Escort	548 @ pH 5 2,790 @ pH 7 213,000 @ pH 9	37 @ pH 7	120	Medium	Large
Picloram	Tordon, Grazon PC, Tordon K, Tordon 22	430	16 - average for the K salt (17-160 range)	90	Small	Large
Quinclorac	Paramount	64	13-54	18-176	Variable, depends on soil type	Medium
Triclopyr	Garlon products	430	780	46	Large	Medium

Source: McCrea, J. 2001. Supplemental Table for RAVE.

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Appendix H
Minimum Requirement Decision Guide

Process Outline

Step 1: Determine if any administrative action is *necessary*

First, describe the situation that may prompt action and describe why it is a problem or issue.

Then, answer the following questions to determine if administrative action is necessary in wilderness:

A. Options Outside of Wilderness - Is action necessary within wilderness?

B. Valid Existing Rights or Special Provision of Wilderness Legislation - Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of the Section 4(c) prohibited uses?

C. Requirements of Other Legislation - (ESA, ARPA, NHPA, Dam Safety Act, Clean Air Act, etc.) - Is action necessary to meet the requirements of other laws?

D. Other Guidance - Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other federal agencies?

E. Wilderness Character - Is action necessary to preserve one or more of the qualities of wilderness character including: ***untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation***, or unique components that reflect the character of this wilderness area?

F. Public Purposes of Wilderness - Is action necessary to support one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Step 1 Conclusion: Is Administrative Action Necessary?
If action is necessary, proceed to Step 2 to determine the minimum activity which least impacts the wilderness resource and character.

Step 2: Determine the *minimum* activity

A. Description of Alternative Action - For each alternative, describe what methods and techniques will be used, when the action will take place, where the action will take place and what mitigation measures are necessary.

Alternatives considered should include one with the use of the suggested prohibited equipment or facilities, one with none of the Section 4 (c) prohibitions, and, if possible one with a mix of prohibited and non-prohibited uses. Alternatives should be "feasible" and creative.

B. **Alternative Comparison -** For each alternative, describe effects based on:

- Wilderness Character

-Untrammeled
-Undeveloped
-Natural
-Outstanding Opportunities for Solitude or a Primitive and Unconfined Type of Recreation
-Other unique components that reflect the character of this wilderness

- Heritage and Cultural Resources
- Maintaining Traditional Skills
- Special Provisions
- Economics and Time constraints
- Additional wilderness-specific criteria

- Safety of personnel, visitors, and contractors

➢ Include mitigation (timing, location, frequency, design standards, etc.)

Step 2 Decision: What is the Minimum Activity?

➢ Identify the selected alternative.
➢ Describe the rationale for selecting this alternative, based on law and policy criteria. Include documentation of Safety criterion, if appropriate**.**
➢ Describe any monitoring and reporting requirements.

Approvals and NEPA analysis - Follow agency guidelines.

Reporting – Follow agency requirements

Appendix I

Maps of Cultural Sites within Proposed Treatment Areas

SENSITIVE INFORMATION
FOR INTERNAL USE ONLY

Appendix J

Cultural Site Mitigation Lists for Each Park

SENSITIVE INFORMATION
FOR INTERNAL USE ONLY