

**INVASIVE EXOTIC PLANT MANAGEMENT PLAN
and
ENVIRONMENTAL ASSESSMENT
Rocky Mountain National Park**



Yellow Toadflax in Horseshoe Park

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Rocky Mountain National Park

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Invasive Exotic Plant Management Plan and Environmental Assessment

Rocky Mountain National Park

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Abstract:

National Parks represent complex communities of native plants and animals. The ecological balance within these communities is currently threatened by the invasion of exotic plants. Controlling invasive exotic plants is a serious challenge facing National Park Service (NPS) managers, who are charged with the protection of natural and cultural resources. Over one hundred species of exotic plants occur in Rocky Mountain National Park (RMNP). Of these, 35 species are of particular concern because they are aggressive and invasive and have the potential to displace native vegetation. RMNP proposes a proactive approach to manage exotic plant infestations, including mechanical, cultural, chemical, and biological control techniques. Of the 35 invasive exotic species identified for control, herbicides will likely be used on only 15 of those species. Citizens and environmental organizations have expressed concern over chemical control (use of synthetic herbicides), which prompted the Park to develop a new Invasive Exotic Plant Management Plan and Environmental Assessment (EA) to replace the Plan and EA released for public review in February 2000. This Plan and EA addresses those concerns and examines alternatives for controlling invasive exotic herbaceous plants and grasses, including lower risk techniques such as scalding exotic plants with hot water (steam), and using biodegradable natural chemicals that are acceptable herbicides used by organic farmers. If synthetic herbicides are used, the park would use the least toxic effective herbicide only after making a good faith effort to control invasive exotics using other control techniques.

List of Abbreviations

ATV	All Terrain Vehicle
BLM	Bureau of Land Management
CDOT	Colorado Department of Transportation
CDOW	Colorado Division of Wildlife
CE	Categorical Exclusion
CNAP	Colorado Natural Areas Program
CNHP	Colorado Natural Heritage Program
DBG	Denver Botanical Gardens
DWLOC	Drinking Water Level of Comparison
EA	Environmental Assessment
ESA	Endangered Species Act
FWS	U.S. Fish and Wildlife Service
HTP	Human Toxicity Potential
IEMP	Invasive Exotic Management Plan
IPM	Integrated Pest Management

MCS	Multiple Chemical Sensitive
MSDS	Material Safety Data Sheet
NEPA	National Environmental Policy Act
NPS	National Park Service
NRCS	Natural Resources Conservation Service, U.S. Department of Agriculture
PPE	Personal Protective Equipment
RMNP	Rocky Mountain National Park
USDA	United States Department of Agriculture
USFS	United States Forest Service

Definitions

Several terms are defined to facilitate understanding of this Plan and EA:

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 2001). 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 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 2001)

Invasive Exotic Plant - An aggressive plant that is known to displace native plant species. Invasive exotic species are unwanted plants which are harmful or destructive to man or other organisms (Holmes, 1979; Webster).

State Listed Noxious Weeds – Invasive exotic plants prohibited or restricted by Colorado Law. Many of the invasive exotic plants known to occur in RMNP fall into this category (please refer to Table 1 on page 3). Transporting seed or parts of these plants, or allowing them to seed on one’s property is prohibited. RMNP does propose to control a few invasive exotic plants that are not State Listed Noxious Weeds because they pose a threat to the park’s natural resources.

Integrated Pest Management (IPM) - A decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment (NPS, 2001).

Proposed Integrated Pest Management Control Techniques:

Mechanical: Using tools to remove plants by mowing, digging, and cutting seed heads and plants.

Cultural: Providing competition, stress, or control of exotic species by planting native vegetation or burning exotic plants.

Chemical: Using synthetic herbicides to kill or severely stress invasive exotic plants.

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

Low Risk Methods: Using hot water (steam) to scald exotic plants, or using natural chemicals that may contain biodegradable soap, acetic acid, sugar compounds, or plant proteins.

INVASIVE EXOTIC PLANT MANAGEMENT PLAN And ENVIRONMENTAL ASSESSMENT

Rocky Mountain National Park, Colorado

Summary

The National Park Service (NPS) is examining ways to manage and control exotic plant infestations in Rocky Mountain National Park (RMNP). Thirty-five species of invasive, exotic herbaceous plants and grasses are of concern to park managers (please refer to Table 1 on page 3). These invasive species, occurring on an estimated 427 acres of park land, displace natural vegetation and consequently affect the long-term health of native plant and animal communities. Of the 427 infested acres, 65.25 acres would be managed using the full range of IPM techniques, including the use of synthetic herbicides.

RMNP released an Invasive Exotic Plant Management Plan (Plan) and Environmental Assessment (EA) for public review in February 2000. The Plan proposed using IPM techniques, including mechanical, cultural, synthetic herbicides, and biological controls to eradicate or reduce exotic plant species. It did not include using low risk methods such as hot water and natural chemicals that are acceptable herbicides used by organic farmers. Thirty-eight responses from citizens and environmental organizations were received. Concerns expressed by respondents focused on the use of synthetic herbicides and their potential effects on the environment and people. Additionally, some respondents wanted to be properly notified if, when, and where herbicides were to be used. To address these concerns RMNP has prepared this new Plan and EA. No synthetic herbicides have been used in the park for the last two years, and will not be used until a Plan has been approved.

This new plan and EA examines in detail two alternatives: the continuation of current management practices and the preferred alternative. The no action alternative was also evaluated but rejected from further consideration. The preferred alternative will have no adverse impact on geology and topography; threatened, endangered, candidate species or species of special concern; natural lightscapes; archeological resources, cultural landscapes, historic structures, and museum collections; prime and unique farmlands; ethnographic resources; socioeconomic of the park and nearby communities; or environmental justice. There would be short-term negligible to minor adverse impacts to soils and native vegetation; aquatic, wetland and riparian communities; natural soundscapes; wildlife; recommended wilderness; air quality; human health and safety; park operations; and visitor use. Weed management activities will be an inconvenience and will intrude on some visitor's park experience. These impacts will be adverse, short-term, localized and minor. There would be long-term beneficial effects to soils and native vegetation; threatened, endangered, candidate species or rare species; aquatic, wetland and riparian communities; park operations; and visitor use.

RMNP proposes a proactive approach to managing invasive exotic plants. If left unchecked, invasive exotic plants could spread to unmanageable levels and cause long-term harm to the park's natural and cultural resources. This Plan provides the blueprint for managing exotic plants, while fulfilling the NPS mandate of protecting and preserving natural resources and the human environment. The Plan's primary objectives are to eradicate, significantly reduce, or contain populations of thirty-five species of invasive exotic plants in the park, and to aggressively eradicate any new invasive exotics that may invade the park in the future. To accomplish this, the Plan calls for the following actions:

Proposed Actions

- **Action 1** - Inventory and monitor invasive exotic plants in RMNP.
- **Action 2** - Prioritize exotic plants to be controlled.
- **Action 3** - Identify control techniques most appropriate for each species.
- **Action 4** - Apply the most appropriate control technique for each species.
- **Action 5** - Monitor effectiveness of control efforts.
- **Action 6** - Prevent new infestations by monitoring invasive exotic plant pathways.
- **Action 7** - Inform the public about RMNP exotic plants and control methods.
- **Action 8** - Work with adjacent landowners and local, county, state and federal agencies.

The eradication or control of invasive exotic plants requires an Environmental Assessment (EA) to evaluate the impacts of alternatives on the park's natural, cultural, and human resources. There are many different ways to control invasive exotic plant species, including digging, mowing and cutting plants, use of prescribed fire, herbicides (both natural and synthetic), hot water (steam), insects. The effectiveness and environmental consequences of these techniques, including taking no action, are examined in this Plan and EA. The alternatives being considered are:

ALTERNATIVE 1 – CONTINUATION OF CURRENT MANAGEMENT PRACTICES: MECHANICAL, CULTURAL, LOW RISK METHODS INCLUDING NATURAL BIODEGRADABLE HERBICIDES, AND BIOLOGICAL CONTROL (NO SYNTHETIC HERBICIDE CONTROL).

RMNP is currently using these techniques to control invasive exotic plant infestations within the park. These activities are Categorically Excluded from compliance with NEPA. If this alternative is selected, RMNP will continue to conduct invasive exotic plant control work within the park as it has for the past two years, without the use of synthetic herbicides.

This alternative affords less long-term protection of the Park's natural resources than the preferred alternative. Some species like leafy spurge, yellow toadflax, and field bindweed cannot be effectively controlled without synthetic herbicides. There would be a moderate risk of losing native flora and fauna due to ineffective eradication of some invasive exotic plant species.

ALTERNATIVE 2 – PREFERRED ALTERNATIVE: MECHANICAL, CULTURAL, LOW RISK METHODS INCLUDING NATURAL HERBICIDES, BIOLOGICAL AND SYNTHETIC HERBICIDE CONTROL.

The preferred alternative would implement the full range of IPM techniques – mechanical, cultural, natural and synthetic chemicals, biological, and low risk methods– to eradicate or to prevent/reduce further infestations. The control technique(s) would be selected based on minimizing environmental effects, cost effectiveness, and with the utmost attention to safety. Only the least toxic effective synthetic herbicides would be used as a last resort after making a good faith effort to control invasive exotics using other techniques.

The Preferred Alternative provides park managers with the broadest range of “tools” to manage invasive exotic plants, and can provide the greatest long-term protection to natural resources and native biodiversity.

ALTERNATIVE 3 - NO INVASIVE EXOTIC PLANT MANAGEMENT OR CONTROL.

Without management or control, invasive exotic plants would continue to harm the Park’s natural resources, displacing native vegetation and wildlife. While a “No Action” alternative must be included in an EA, it does not meet the Park’s enabling legislation to protect natural resources, the NPS Organic Act (1916), or the Federal Noxious Weed Act (1974).

This Plan and EA analyzes the alternatives for invasive exotic plant management in RMNP and their impacts on natural, cultural and human resources. It has been prepared in compliance with the National Environmental Protection Act (NEPA) of 1969 and regulations developed by the Council on Environmental Quality (40 CFR 1508.9).

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CHAPTER 1 PURPOSE FOR THE PLAN

Because of the complexity of this management plan and EA, the purpose and need for the plan have been divided into two chapters. Chapter 1 describes the purpose for the plan and Chapter 2 the need for the plan and the proposed actions that would be implemented if the plan were adopted.

Introduction

Congress established Rocky Mountain National Park on January 26, 1915. The park's enabling legislation states, "...said area is dedicated and set apart as a public park for the benefit and enjoyment of people of the United States...with regulations being primarily aimed at the freest use of the said park for recreation purposes by the public and for the preservation of the natural conditions and scenic beauties..." (38 Stat. 798). The significance of RMNP lies in displaying, preserving and making available for public use and enjoyment, some of the finest examples of the spectacular physiographic, biologic, and scenic features typifying the southern Rocky Mountains. These natural and historic resources are even more significant because of their proximity to Colorado's Front Range metropolitan areas. Minimizing impacts to the natural environment, but yet still providing recreational opportunities for the public is consistent with the park's enabling legislation.

NPS superintendents are expected to vigorously apply existing legislation, executive orders, and NPS regulatory standards in managing exotic plants (Please refer to *Compliance with State and Federal Regulations* on Page 19). The most fundamental provisions are found in the NPS Organic Act of 1916 (16 USC Section 1) and the Redwood Act amendment to the 1970 General Authorities Act (16 USC Section 1a-1). Specifically, NPS Director's Order #12, amended in January 2000, directs national park units to develop individual Exotic Plant Management plans in compliance with the National Environmental Policy Act (NEPA).

Location and Access

RMNP, located in north central Colorado, encompasses 265,780 acres. The park lies within Larimer, Boulder, and Grand Counties and is bordered by the towns of Estes Park, Allenspark, and Glenhaven on the east and Grand Lake on the west. The park is surrounded by state, local, private, and federally owned lands. About 62% of the park borders national forest land, of which 70% is managed as wilderness.

The park is easily accessible from the Denver metropolitan area, 65 miles to the southeast. Interstates 25, 70 and 76, which converge in Denver, provide access for visitors coming from all regions of the United States. Local thoroughfares accessing the park include State Highways 7, 34, and 36. RMNP's proximity to populous Front Range communities has resulted in steadily increasing visitation. RMNP receives nearly 3.5 million visitors annually, roughly equal to Yellowstone's visitation, though it is about one-eighth the size of the country's first national park.

Invasive Exotic Plants in RMNP

Controlling exotic plant infestations is one of the most serious challenges facing RMNP managers, who are charged with the protection of natural and cultural resources.

Invasive exotic plants are infesting RMNP at an alarming rate. Of over one hundred exotic herbaceous plants and grasses occurring in the park, 35 species have been identified as a threat to the park's natural resources (please refer to Table 1 on page 3). An estimated 427 acres below 8,500 feet elevation are affected by these 35 species (please refer to Figures 1 through 6 on pages 6 through 11 for maps of the proposed treatment areas and current locations of invasive exotic plants within the park).

The dots that are shown on Figures 2 through 6 represent existing invasive exotic plant infestations that are being considered for natural and synthetic herbicide treatments. Herbicide treatment would continue until the infestations can be brought below specified threshold levels, which is anticipated to take between three to five years. The dots are generic and represent one of the 15 invasive exotic species identified for control using herbicides. Each treatment area surrounding the dots represents areas of the park infested with invasive exotic plants that are to be controlled using all of the various IPM techniques. Table 2, on pages 12 - 14, identifies the invasive exotic species that are present and will be controlled within each treatment area. Control work will not be done on park inholdings, which are privately owned. Species listed in Table 2 that will be controlled using herbicides have been identified with an asterisk. Other species will be controlled using IPM techniques other than herbicides.

Although, 427 acres represents less than 1% of the landmass within the park, 17 % of the park's landmass (45,044 acres) is believed to be at high or medium risk of infestation (please refer to Table 3 on page 15). Even the alpine tundra (11,500 feet elevation and above) – an outstanding feature of Rocky Mountain National Park – is now considered at medium risk of infestation. Previously, high altitude was believed to be a natural barrier for exotic plant infestations. It is primarily due to the park's proactive approach in controlling invasive exotics that more acres have not become infested (i.e. controlling plants before they become a serious problem).

Exotic plants near park boundaries threaten to infest neighboring lands and communities. Conversely, where neighboring landowners are not controlling exotic plants, these invasive species can spread into the park. RMNP must work closely with local citizens, organizations, communities, neighboring counties, the state, and adjacent federal landowners to achieve common goals of managing invasive exotic plants. If action is not taken, invasive exotic plants will displace native vegetation and wildlife habitat will be lost. In addition, biological diversity, soils, aquatic systems, and rare, threatened, and endangered species could be affected. Visitor enjoyment of park resources may also be diminished if exotic plants are not controlled.

Natural Resource Integrity and Biodiversity – When exotic plant species displace or inhibit the growth of native vegetation in RMNP, there are long-term changes to plant communities. Natural habitat and diversity of flora and fauna are diminished:

- **Wildlife Habitat** – Exotic plants are undesirable –and in some cases, poisonous food for wildlife. For example, in Moraine Park, which is critical elk winter and calving range, 20% of the plant composition is exotic. This elk habitat could be lost if some exotic plants continue to spread.
- **Wildflowers** – Some exotic plants inhibit the growth of native wildflowers – a major attraction for park visitors – reducing the aesthetic qualities of the landscape. Native insects that rely on wildflowers are also affected.
- **Soil Erosion** – When native vegetation is displaced by exotics, the amount of bare ground increases, which consequently increases soil erosion.
- **Cultural Resources** – Exotic plants may alter the integrity of historic or cultural landscapes.
- **Public Health** – Some exotic plant species contain toxins that can be harmful to humans after prolonged exposure. For example, leafy spurge, spotted knapweed and diffuse knapweed contain toxins that can affect people with sensitive skin.
- **Neighbor Relations** – As exotic plant species cross the park boundary (by either moving into or out of the park) relationships between the park and neighboring landowners can be strained.

Table 1 - Invasive Exotic Plants of Colorado

INVASIVE EXOTIC SPECIES	PRESENT IN THE PARK	'95-'96 RISK ASSESSMENT SPECIES OF CONCERN	PROPOSED FOR CONTROL	STATE NOXIOUS WEED LIST
African rue (<i>Peganum harmala</i>)				■
Baby's breath (<i>Gypsophila paniculata</i>)	■	■	■	
Black henbane (<i>Hyoscyamus niger</i>)				■
Black knapweed (<i>Centaurea nigra</i>)				■
Black nightshade (<i>Solanum nigrum</i>)				■
Blue mustard (<i>Chorispora tenella</i>)				■
Bouncingbet (<i>Saponaria officinalis</i>)	□		■	■
Bull thistle (<i>Cirsium vulgare</i>)	■	■	■	■
Camelthorn (<i>Alhagi pseudalhagi</i>)				■
Canada thistle (<i>Cirsium arvense</i>)	■	■	■	■
Cheatgrass (<i>Bromus tectorum</i>)	■	■	■ (limited)	
Chicory (<i>Cichorium intybus</i>)				■
Chinese clematis (<i>Clematis orientalis</i>)				■
Coast tarweed (<i>Madia sativa</i>)				■
Common burdock (<i>Arctium minus</i>)	■		■	■
Common groundsel (<i>Senecio vulgaris</i>)				■
Common mullien (<i>Verbascum thapsus</i>)	■		■	■
Common St. Johnswort (<i>Hypericum perforatum</i>)	□	■	■	■
Common tansy (<i>Tanacetum vulgare</i>)				■
Common teasel (<i>Dipsacus sylvestris</i>)				■
Curly dock (<i>Rumex crispus</i>)	■		■ (limited)	
Cypress spurge (<i>Euphorbia cyparissias</i>)				■
Dalmatian toadflax (<i>Linaria dalmatica</i>)	■	■	■	■
Dame's rocket (<i>Hesperis matronalis</i>)	□		■	■
Deptford pink (<i>Dianthus armeria L.</i>)	■		■	

INVASIVE EXOTIC SPECIES	PRESENT IN THE PARK	'95-'96 RISK ASSESSMENT SPECIES OF CONCERN	PROPOSED FOR CONTROL	STATE NOXIOUS WEED LIST
Diffuse knapweed (<i>Centaurea diffusa</i>)	■	■	■	■
Dyers woad (<i>Isatis tinctoria</i>)				■
Field bindweed (<i>Convolvulus arvensis</i>)	■	■	■	■
Flixweed (<i>Descurainia sophia</i>)				■
Green foxtail (<i>Setaria viridis</i>)				■
Hairy nightshade (<i>Solanum sarrachoides</i>)				■
Halogeton (<i>Halogeton glomeratus</i>)				■
Hoary alyssum (<i>Berteoa incana</i>)	■		■	
Hoary cress (<i>Cardaria draba</i>)				■
Houndstongue (<i>Cynoglossum officianale</i>)	■		■	■
Johnsongrass (<i>Sorghum halepense</i>)				■
Jointed goatgrass (<i>Aegilops cylindrica</i>)				■
Kentucky bluegrass (<i>Poa pratensis</i>)	■	■	■ (limited)	
Kochia (<i>Kochia scoparia</i>)				■
Leafy spurge (<i>Euphorbia esula</i>)	■	■	■	■
Longspine sandbur (<i>Cenchrus longispinus</i>)				■
Mayweed chamomile (<i>Anthemis cotula</i>)				■
Mediterranean sage (<i>Salvia aethiopsis</i>)				■
Musk thistle (<i>Carduus nutans</i>)	■	■	■	■
Myrtle spurge (<i>Euphorbia mysinites</i>)				■
Orange hawkweed (<i>Hieracium aurantiacum</i>)	■		■	■
Orchard grass (<i>Dactylis glomerata</i>)	■	■		
Oxeye daisy (<i>Chrysanthemum leucanthemum</i>)	■	■	■	■
Perennial pepperweed (<i>Lepidium latifolium</i>)				■
Plumeless thistle (<i>Carduus acanthoides</i>)				■
Poison hemlock (<i>Conium maculatum</i>)	■			■
Puncturevine (<i>Tribulus terrestris</i>)				■
Purple loosestrife (<i>Lythrum salicaria</i>)		■		■
Quackgrass (<i>Agropyron repens</i>)	■	■	■	■
Redstem filaree (<i>Erodium cicutarium</i>)				■
Red-top grass (<i>Agrostis gigantea</i>)	■		■ (limited)	
Reed canary grass (<i>Phalaris arundinaceae</i>)	■	■		
Rush skeletonweed (<i>Chondrilla juncea</i>)				■
Russian knapweed (<i>Centaurea repens</i>)				■
Russian thistle (<i>Salsola collina</i>)	■		■	■
Russian thistle (<i>Salsola iberica</i>)				■
Common Russian thistle (<i>Salsola australis</i>)	■		■	
Saltcedar (<i>Tamarix parviflora</i>)				■
Saltcedar (<i>Tamarix ramosissima</i>)				■
Scentless chamomile (<i>Matricaria perforata</i>)	■		■	■
Scotch thistle (<i>Onopordum acanthium</i>)				■
Scotch thistle (<i>Onopordum tauricum</i>)	□		■	■
Sheep fescue (<i>Festuca ovina</i>)	■		■ (limited)	
Smooth brome (<i>Bromus inermis</i>)	■	■	■	
Swamp sow-thistle (<i>Sonchus uliginosus</i>)	■	■		
Spotted knapweed (<i>Centaurea maculosa</i>)	■	■	■	■
Squarrose knapweed (<i>Centaurea virgata</i>)				■
Sulfur cinquefoil (<i>Potentilla recta</i>)	■		■	■

INVASIVE EXOTIC SPECIES	PRESENT IN THE PARK	'95-'96 RISK ASSESSMENT SPECIES OF CONCERN	PROPOSED FOR CONTROL	STATE NOXIOUS WEED LIST
Timothy (<i>Phleum pratense</i>)	■		■ (limited)	
Velvetleaf (<i>Abutilon theophrasti</i>)				■
White sweetclover (<i>Melilotus alba</i>)	■	■	■	
Wild caraway (<i>Carum carvi</i>)				■
Wild mustard (<i>Brassica kaber</i>)				■
Wild proso millet (<i>Panicum miliaceum</i>)				■
Yellow foxtail (<i>Setaria glauca</i>)				■
Yellow nutsedge (<i>Cyperus esculentus</i>)				■
Yellow starthistle (<i>Centaurea solstitialis</i>)				■
Yellow sweetclover (<i>Melilotus officianalis</i>)	■	■	■	
Yellow toadflax (<i>Linaria vulgaris</i>)	■	■	■	■

□ = Historic but currently eradicated from the park

Species listed in bold = Top ten prioritized weed species for the State of Colorado.

These ten species are acknowledged to be the most widespread and to cause the greatest economic impact in the state.

(limited) = Only a small percentage of the infestation will be controlled in the park, usually near the park boundary.

Figure 1 – Index of Treatment Areas

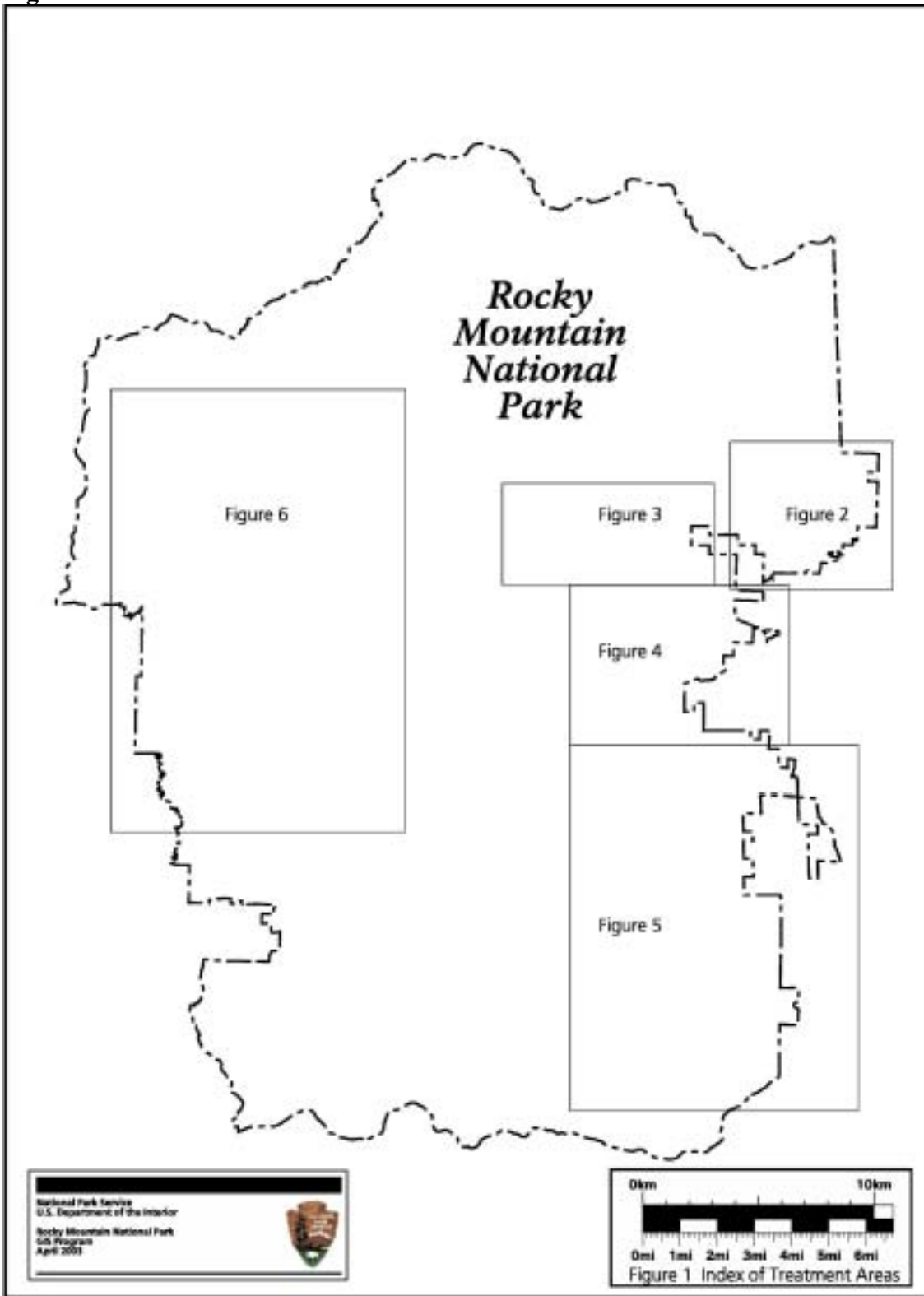


Figure 2 - Treatment Areas

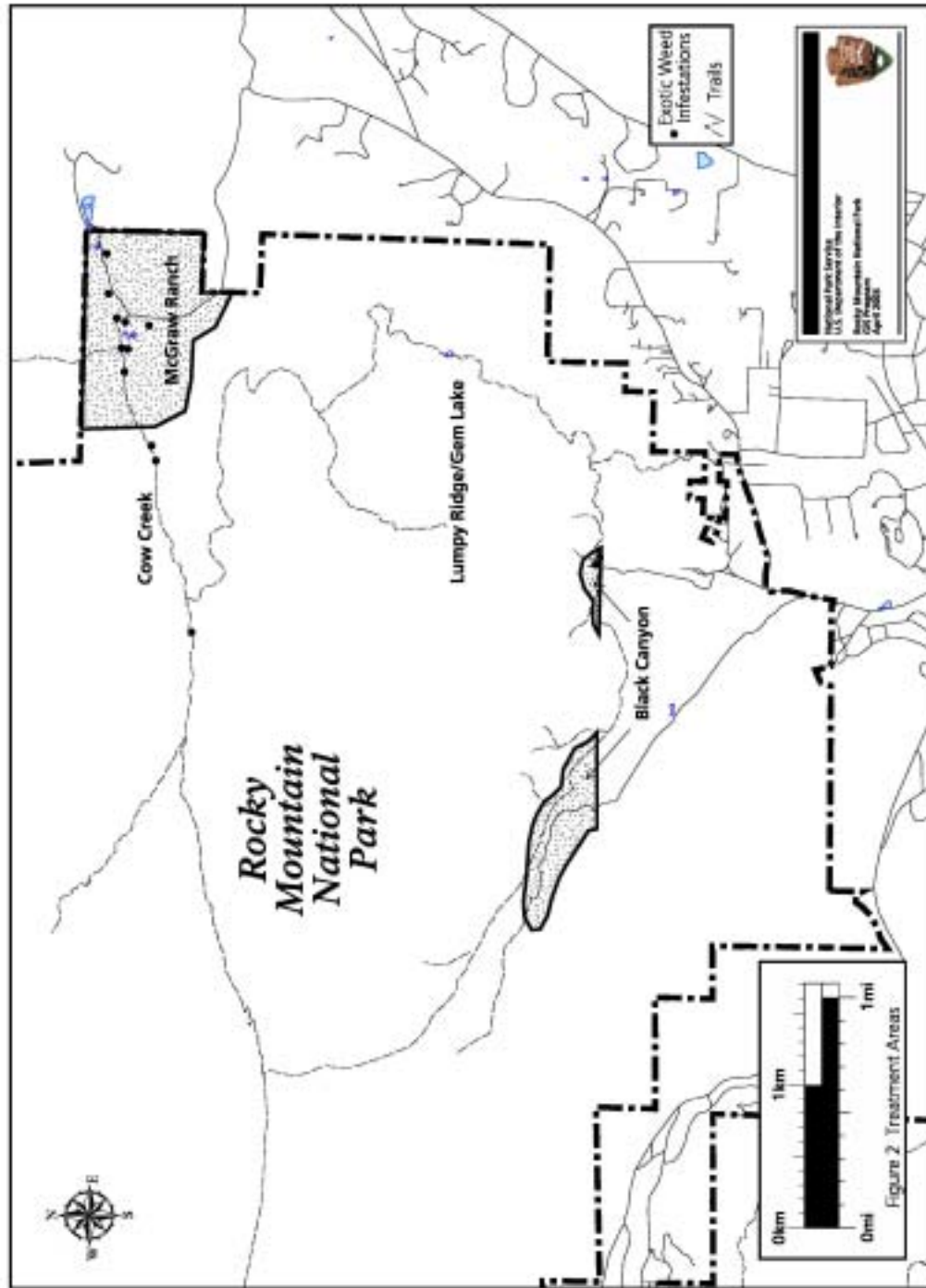


Figure 3 - Treatment Areas

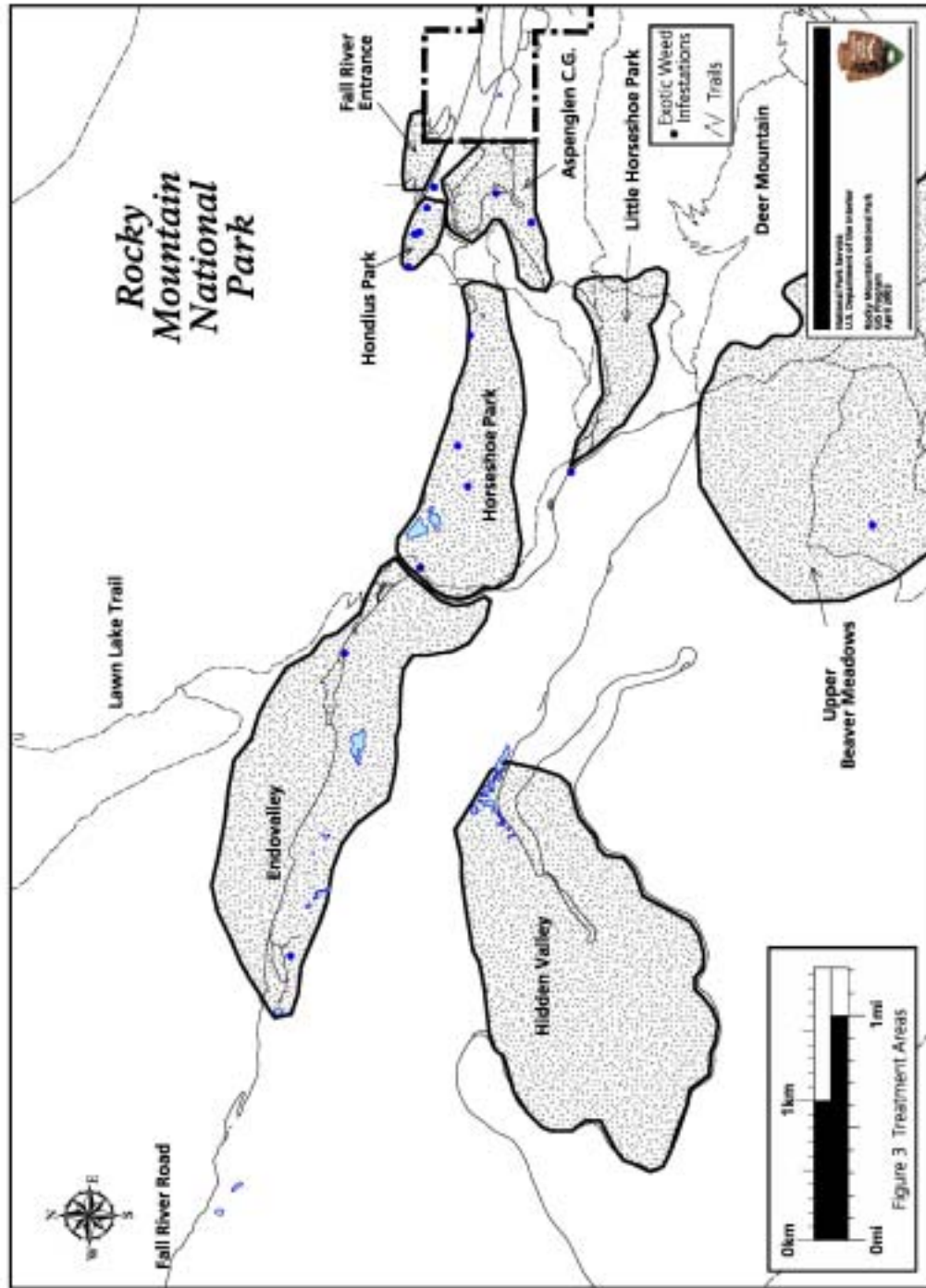


Figure 4 - Treatment Areas

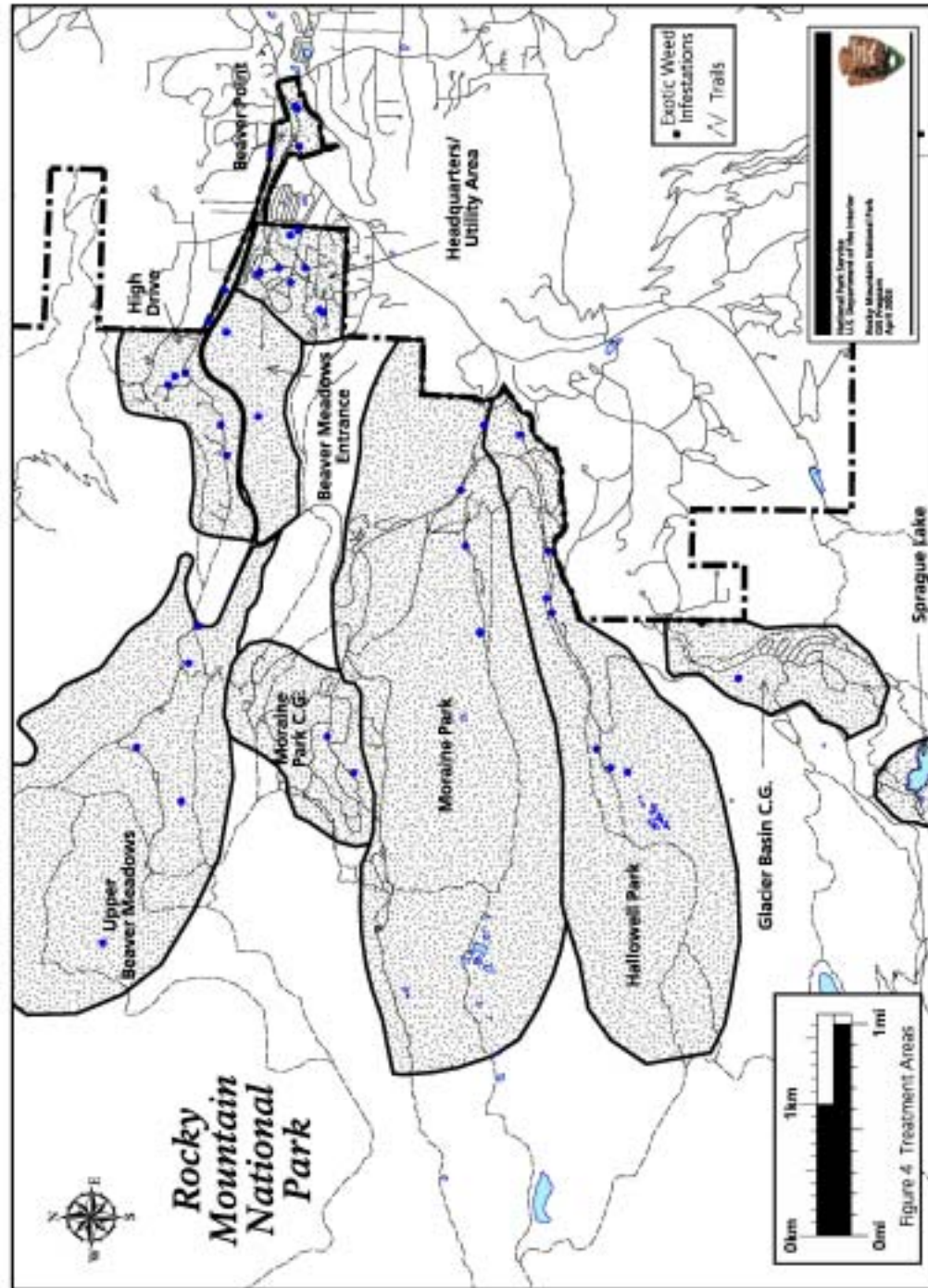


Figure 5 - Treatment Areas

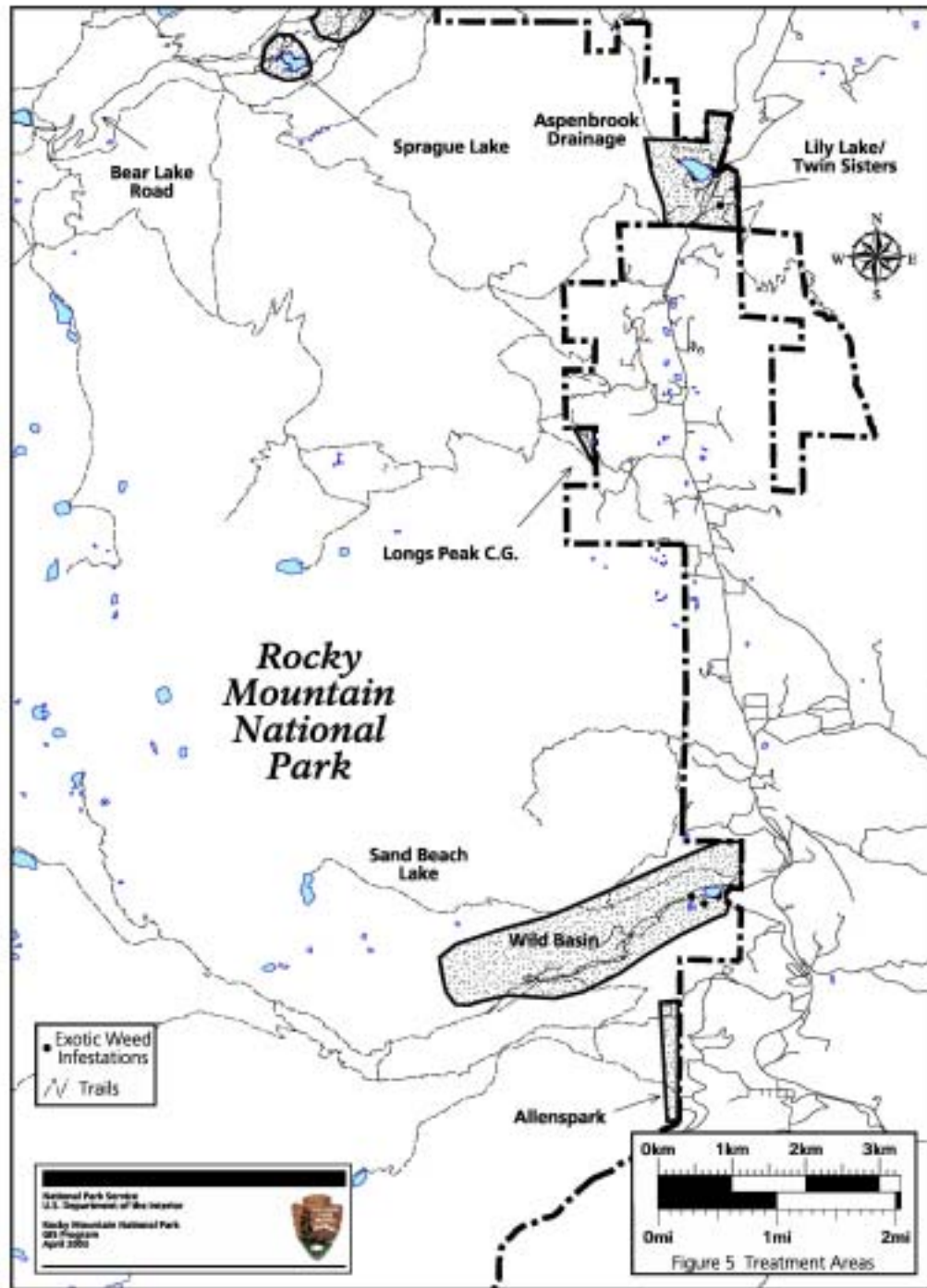


Figure 6 - Treatment Areas

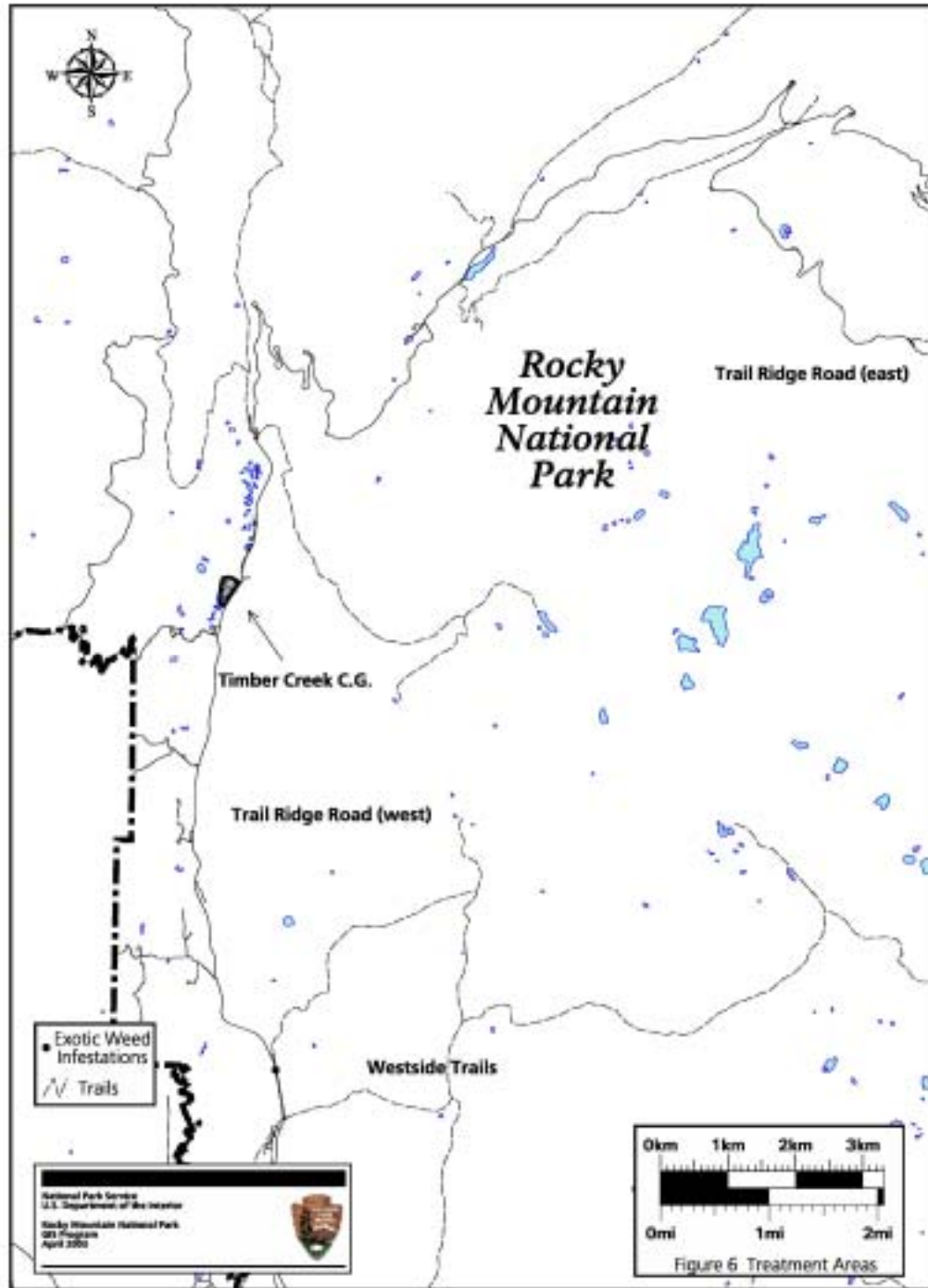


Table 2 - Exotic Plants by Treatment Area and Zone Designation

Allenspark Area (Natural Zone) –

Figure 5

Canada thistle
Musk thistle

Aspenbrook Drainage (Natural Zone) –

Figure 5

Dalmatian toadflax
Musk thistle

Aspenglen Campground (Developed Zone) – Figure 3

Canada thistle
Common burdock
Dalmatian toadflax
Field bindweed
Houndstongue
Musk thistle
Spotted knapweed
Wooly mullien
Yellow sweetclover
Yellow toadflax

Bear Lake Road (Developed Zone) –

Figures 4 & 5

Baby's breath
Canada thistle
Spotted knapweed
Wooly mullien
Yellow sweetclover
Yellow toadflax

Beaver Meadows Entrance (Developed Zone) – Figure 4

Canada thistle
Dalmatian toadflax
Diffuse knapweed
Field bindweed*
Musk thistle
Russian thistle
Wooly mullien
Yellow toadflax*

Beaver Point (Natural Zone) –

Figure 4

Baby's breath
Canada thistle*
Dalmatian toadflax
Diffuse knapweed
Field bindweed*
Wooly mullien
Yellow toadflax*

Black Canyon (Natural & Developed Zone) – Figure 2

Bull thistle
Canada thistle
Diffuse knapweed
Hoary alyssum
Houndstongue
Leafy spurge
Musk thistle
Spotted knapweed
Wooly mullien
Yellow toadflax

Cow Creek Drainage (Natural Zone) –

Figure 2

Canada thistle
Houndstongue
Leafy spurge*
Musk thistle
Wooly mullien

Deer Mountain (Natural Zone) –

Figure 3

Musk thistle

Endovalley (Developed & Natural Zones) – Figure 3

Canada thistle
Houndstongue
Leafy spurge
Musk thistle
Orange hawkweed
Wooly mullien
Yellow sweetclover
Yellow toadflax*

* Proposed for herbicide control

**Fall River Entrance (Developed Zone) –
Figure 3**

Leafy spurge*
Musk thistle

**Fall River Road (Developed Zone) –
Figure 3**

Canada thistle*
Leafy spurge*
Musk thistle
Yellow sweetclover
Yellow toadflax*

**Glacier Basin Campground (Developed
Zone) – Figure 4**

Canada thistle
Curly dock
Musk thistle
Russian thistle
Yellow toadflax

**Hallowell Park (Developed & Natural
Zone – Figure 4**

Canada thistle
Deptford pink
Musk thistle
Field bindweed
Sulfur cinquefoil
Yellow toadflax

**Headquarters/Utility Area (Historic
Zone) – Figure 4**

Canada thistle*
Dalmatian toadflax
Field bindweed*
Hoary alyssum
Houds toungue
Leafy spurge*
Musk thistle
Russian thistle
Wooly mullien
Yellow sweetclover
Yellow toadflax*

**Hidden Valley (Developed Zone) –
Figure 3**

Curly dock
Yellow toadflax

High Drive (Developed Zone) – Figure 4

Canada thistle

Dalmatian toadflax
Diffuse knapweed
Yellow toadflax

Hondius Park (Natural Zone) – Figure 3

Leafy spurge
Yellow toadflax
Canada thistle*
Musk thistle

**Horseshoe Park (Natural Zone) –
Figure 3**

Canada thistle
Leafy spurge*
Musk thistle
Yellow toadflax*

**Lawn Lake Trail (Natural Zone) –
Figure 3**

Canada thistle
Musk thistle

**Lily Lake/Twin Sisters (Developed Zone)
– Figure 5**

Canada thistle
Musk thistle
Yellow toadflax

**Little Horseshoe Park (Natural Zone) –
Figure 3**

Canada thistle
Musk thistle

**Lumpy Ridge/Gem Lake (Natural,
Developed & Historic Zone) – Figure 2**

Canada thistle
Field bindweed
Houndstongue
Musk thistle
Wooly mullien
Yellow toadflax

**McGraw Ranch (Developed Zone) –
Figure 2**

Canada thistle*
Houndstongue
Leafy spurge*
Musk thistle
Wooly mullien

* Proposed for herbicide control

Moraine Park (Natural & Developed Zone) – Figure 4

Bull thistle
Canada thistle
Dalmatian toadflax
Field bindweed*
Musk thistle
Sulfur cinquefoil*
Wooly mullien
Yellow toadflax*

Moraine Park Campground (Developed Zone) – Figure 4

Canada thistle
Curly dock
Diffuse knapweed
Field bindweed*

Houndstongue
Musk thistle
Spotted knapweed
Wooly mullien
Yellow toadflax

Sand Beach Lake (Natural Zone) – Figure 5

Curly dock
Musk thistle
Wooly mullien

Sprague Lake (Developed Zone) – Figure 4

Canada thistle
Musk thistle
Wooly mullien

Trail Ridge Road – East (Developed Zone) – Figure 6

Curly dock
Dalmatian toadflax
Yellow toadflax

Trail Ridge Road – West (Developed Zone) – Figure 6

Canada thistle
Curly dock
Oxeye daisy
Scentless chamomile
Yellow sweetclover
Yellow toadflax

Upper Beaver Meadows (Developed & Natural Zones) – Figure 4

Canada thistle
Field bindweed
Leafy spurge*
Musk thistle
Wooly mullien
Yellow toadflax

Westside Trails (Natural Zone) – Figure 6

Bull thistle
Canada thistle
Scentless chamomile

Wild Basin (Developed & Natural Zones) – Figure 5

Canada thistle
Curly dock
Diffuse knapweed
Musk thistle
Spotted knapweed
Wooly mullien
Yellow toadflax

* Proposed for herbicide control

Table 3 - List of different habitats, estimated acres and risk level for invasion by exotic plants within RMNP

Description	Acres	Percent Cover	Risk
Alpine Tundra	33,247	12.50	Medium
Aspen	1499	0.56	High*
Alpine Willows	4630	1.74	Low
Douglas Fir	4065	1.53	Low to Medium*
Dry Grasses	2009	0.76	High*
Dry Shrub	801	0.30	High*
Limber Pine	2687	1.01	Low
Lodgepole Pine	55,665	20.94	Medium*
Disturbed	136	0.05	High*
Rock	48,437	18.22	Low
Ponderosa Pine	9179	3.45	High*
Riparian Bog	345	0.13	Medium
Open Water	1149	0.43	Low
Riparian Meadows	4642	1.75	High*
Blue Spruce	188	0.07	Medium to High*
Riparian Willow	3338	1.26	High*
Snow/Permanent Ice	483	0.18	N/A
Spruce/Fir	93,265	35.09	Low to Medium*

* = Susceptible to invasive exotic plants if a disturbance occurs such as from fire, heavy ungulate grazing, construction causing vegetation and soil loss, or from social trails.

Background

Native plant communities in what is now RMNP have been evolving over thousands of years. Plant communities that are presently found in the park were established within the past 10,000 years as glaciers retreated. The first plants that are considered exotic to RMNP were introduced by early settlers in the mid-1850's, who planted exotic grasses as forage for domestic livestock. Building the infrastructure of the park, such as roads, trails, campgrounds, visitor centers, and picnic areas further contributed to the establishment of exotic plant species as seeds were carried in and transported on machinery, in gravel, or contaminated seed mixes. Over the years, park development activities have imported contaminated topsoil, exotic seeds, and sod. Visitors, too, have unknowingly introduced and transported seeds on vehicles, horses, hiking boots, and by other means.

People, machinery, vehicles, livestock, wildlife, wind, and water have all contributed to the establishment and spread of exotic plant species.

RMNP began controlling exotic plant species based on two management concerns: 1) maintenance of native plant ecosystems; and 2) perpetuation of a good neighbor policy. Exotic plant species near park boundaries were spreading onto adjacent public lands and communities.

Exotic plant control in RMNP began in 1960. Efforts focused on eradication of Canada thistle and leafy spurge using synthetic herbicides. By 1999, control efforts had expanded to include removal of musk thistle, yellow and dalmatian toadflax, diffuse and spotted knapweed, leafy spurge, bull thistle, scotch thistle, common burdock,

houndstongue, hoary alyssum, orange hawkweed, and woolly mullein. The full range of IPM techniques was used, including pulling, digging, mowing, spraying with synthetic herbicides, replanting native vegetation, and release of biocontrol insects.

Overall, herbicide use in the park has been limited. During the past ten years, less than 20 acres have been treated with herbicides. Some areas have been treated with herbicides more than once, but only 20 acres have received one or more chemical applications. Chemical applications were focused on the eradication of leafy spurge, Canada thistle, orange hawkweed and diffuse and spotted knapweed.

In addition to digging, cutting, mowing, and using herbicides, other techniques have been attempted. Biological techniques have been used with limited success. Goats were introduced into the Cow Creek area of RMNP in 1989 to control leafy spurge with initial success until the goats threatened the health of nearby native bighorn sheep herds. That effort was abandoned after one year. Insects have been used for biological control in the park including an inadvertent introduction of an exotic insect that is currently threatening two species of native thistle (Louda et al. 1997, 1998). Approved insect releases to control leafy spurge occurred in 2001 and 2002. In the 1990's, revegetation of disturbed areas using native plants became a significant part of management efforts to reduce exotic plant infestations in the park (McLendon and Redente, 1994).

In February of 2000, the NPS developed an Invasive Exotic Plant Management Plan and EA to guide park managers in controlling and/or reducing further infestations of exotic plants in RMNP. The Plan called for a proactive approach in managing exotic plant species, using the full range of IPM techniques. During the public review period for the Plan and EA, thirty-eight responses were received. Some respondents expressed concern about the potential environmental and safety effects of herbicides as a method to control exotic plants. Due to these concerns, the Plan was not approved and park staff began to develop a new Plan to better quantify the effects of exotic plant control measures on the park's natural, cultural, and human resources. Synthetic herbicides have not been used in the park since 2000.

The Commissioner of Agriculture for the State of Colorado wrote a letter to the park Superintendent dated October 15, 2002 (please refer to Appendix I on page 142) expressing concern about the length of time it has taken for the park to complete an Exotic Plant Management Plan. The Commissioner stated that the park's failure to complete an EA for weed management was hindering the implementation of an effective weed management program. The Commissioner urged the park to complete an Exotic Plant Management Plan and EA by April 1, 2003.

New research conducted in the park and on-the-ground surveys continue to provide information to park managers on the ecological characteristics of exotic plant and grass species, the extent of their infestations, and the most effective measures to control and eradicate them (Wolf 2000, Azdeh 2001, Stohlgren et.al. 1996, 1997a,b,c, 1999, Chong 2002, Kalkan et.al. 2000, RMNP Resources Management Division Annual Reports 2000, 2001, and 2002). The results have been evaluated and integrated into exotic plant management in the park.

Three management zones were identified in the 1976 Park Master Plan: Natural, Historic, and Developed. Any action called for in this Plan will be consistent with activities allowed within each of the zones.

Issue and Impact Topics

RMNP has worked closely with universities, U.S.G.S. Biological Resources Division, exotic plant management experts, adjacent landowners, Colorado Coalition for Alternatives to Pesticides, and local communities to identify issues, concerns, and solutions to invasive exotic plant management in RMNP. Additionally, an Invasive Exotic Plant Management Plan and EA was released in February of 2000 to solicit public input on a wide range of topics related to exotic plant eradication and control. A summary of the issues that are considered in detail in this Plan and EA are listed below.

Soils and Native Vegetation

How will using a full range of IPM techniques to control invasive exotic plants affect soil resources in the park? How will the use of herbicides (natural and synthetic) and lower risk techniques, such as scalding with hot water (steam) affect native vegetation? For example, will treating leafy spurge with herbicides denude areas of native broad-leaf plants and warm-season grasses? Will insects released on invasive exotic species, such as knapweed and leafy spurge, adversely affect closely related native species? How will the various IPM techniques affect rare plants in Rocky Mountain National Park?

Aquatic, Wetland and Riparian Communities

Will the use of herbicides contaminate ground and/or surface water in areas of treatment? Will fish, boreal toads and aquatic populations be placed at risk? Will the use of herbicides contaminate wetland soils or affect flora or fauna in areas of treatment?

Natural Soundscape

Will exotic plant control activities create noise impacts to the natural soundscapes?

Endangered, Threatened and Rare Species

Will exotic plant control activities, including the use of herbicides, have an impact on endangered, threatened or rare plant and animal species?

Wildlife

Does the presence of invasive exotic weeds have an impact on wildlife? Will exotic plant control activities, including the use of herbicides, impact wildlife?

Wilderness

Are there restrictions on the types of exotic plant management techniques that can be used within recommended wilderness areas of the park? Will exotic plant management activities affect wilderness?

Air Quality

Will the use of herbicides or other control techniques affect air quality?

Cultural Resources

Will mechanical control techniques impact sensitive archeological resources or historic structures?

Socioeconomics

What would be the economic impact if exotic plants continued to spread within the park? If park visitors are made aware that herbicides are proposed for use in the park, would it deter some people from visiting the park?

Visitor Experience

How would invasive exotic plant management activities affect the experience of park visitors?

Human Health and Safety (Herbicides)

How would chemical applications affect human health? What is the risk of exposure to carcinogens through respiratory, dermal or dietary routes (touching or eating berries with residues)? What is the human toxicity potential when chemicals are released into the air and water?

Impact Topics Dismissed from Further Analysis

Prime and Unique Farmland

In August, 1980, the Council on Environmental Quality (CEQ) directed that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resource Conservation Service as prime or unique. Prime or unique farmland is defined as soil which particularly produces general crops such as fruits, vegetables, and nuts. According to the Colorado Department of Agriculture, the soils comprising RMNP are used for wildlife habitat and are not considered to be prime or unique farmlands. Thus, the topic of prime and unique farmland will not be addressed as an impact topic.

Natural Lightscapes

Exotic plant control activities will have no impact on natural lightscapes since all work will occur during daylight hours. This impact topic is dismissed from further consideration.

Ethnographic Resources, Cultural Landscapes, Historic Structures and Museum Collections

Exotic plant control activities will have no impact on ethnographic resources, cultural landscapes, historic structures and museum collections.

Relationship to Other Plans

This Plan, which proposes using the full range of IPM techniques to manage invasive exotic plants, is consistent with the following park documents:

- Master Plan (1976)
- Land Protection Plan (1985/1991)

- Resources Management Plan (1998)
- Backcountry/Wilderness Management Plan (2001)
- Vegetation Restoration Management Plan (1994)

Compliance with State and Federal Regulations

The Plan is consistent with the following Acts, NPS Management Guidelines and Policies, and Executive Orders.

- Act of 1915, establishing Rocky Mountain National Park
- The National Park Service Organic Act of 1916
- The Redwood Act of 1978
- The Endangered Species Act
- The Wilderness Act of 1964
- National Environmental Policy Act of 1969
- National Park Service Management Policies
- Colorado Noxious Weed Act, 1996
- NPS-77 Natural Resources Management Guidelines
- Act of Administration, 1970
- Federal Noxious Weed Act of 1996
- Carlson-Foley Act of 1968
- Clean Water Act of 1972
- Executive Orders and Director's Orders
 - Federal Water Pollution Control Act and Executive Order 11990 Protection of Wetlands
 - Director's Order #77-1: Wetland Protection Order of 1998
 - Invasive Species Executive Order 13112 of 1999
 - Director's Order #55: Interpreting the National Park Service Organic Act

Decision Process

An EA analyzes the proposed action and alternatives and their impacts on the environment, cultural resources, and socioeconomics. This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and regulations of the Council on Environmental Quality (40 CFR 1508.9). The EA will be released to the public for a 30-day (minimum) comment period. The NPS will determine whether the environmental consequences of the proposed action requires preparation of an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI).

This EA evaluates three alternatives and the potential impacts that could result from implementing each of the alternatives. Chapter 2 describes the *Need for the Plan and the Proposed Actions*. Chapter 3 describes the *Alternatives*, including a “No Action” alternative. Chapter 4 discusses the *Affected Environment*, and Chapter 5 includes an analysis of the *Environmental Consequences* for each of the alternatives.

CHAPTER 2 NEED FOR THE PLAN AND PROPOSED ACTIONS

A Plan is needed to guide RMNP managers in containing, suppressing, or eradicating invasive exotic plant populations in RMNP.

Impacts of Invasive Exotic Plants

Today, exotic plants infest approximately 2.6 million acres in the national park system, reducing the natural diversity of these places (NPS, 2002). Invasive exotic plants are aggressive and competitive. They displace native vegetation by robbing moisture, nutrients and sunlight from surrounding plants. Exotic plants often establish themselves in disturbed areas, such as roads, trails, campgrounds, picnic areas, parking lots and construction sites. Once established, they spread into undisturbed areas. Overall, native habitat is lost and soil erosion increases, leading to long-term changes in plant communities and loss of biodiversity. In the state of Colorado, 82 invasive exotics have infested two million acres of private land and 4.3 million acres of public land and cost landowners \$100 million annually in lost productivity. Invasive exotic plants have displaced 10% of Colorado's 1,300 known native vascular plants (Eric Lane, personal communication).

Plan Goals

The goals of the Invasive Exotic Management Plan are to:

- Eradicate, significantly reduce, or contain populations of 35 invasive exotic plants.
- Prevent further infestations of existing and eradicated species, or new infestations of invasive exotic species that presently do not exist in the park.

RMNP proposes to be proactive versus reactive by stopping invasive exotic plants before they become a serious threat to the park's natural and cultural resources. When the use of synthetic herbicides is warranted, RMNP proposes to use the least toxic effective herbicide only as a last resort, and only after making a good faith effort to control invasive exotics by using other IPM techniques.

Plan's Proposed Actions

The Plan calls for eight proactive strategies to achieve the goal of eradication and/or reduction of invasive exotic species in RMNP. These actions are:

- **Action 1** - Inventory and monitor invasive exotic plants in RMNP.
- **Action 2** - Prioritize exotic plants to be controlled.
- **Action 3** - Identify control techniques most appropriate for each species.
- **Action 4** - Apply the most appropriate control technique for each species.
- **Action 5** - Monitor effectiveness of control efforts.
- **Action 6** - Prevent new infestations by monitoring invasive exotic plant pathways.
- **Action 7** - Inform the public about RMNP exotic plants and control methods.
- **Action 8** - Work with adjacent landowners and local, county, state and federal agencies.

These eight actions constitute the Invasive Exotic Plant Management Plan, and are discussed in detail below.

ACTION 1 – Inventory and monitor invasive exotic plants in RMNP

This action calls for the continuation of a rigorous inventory and monitoring program in RMNP. Information gathered from the inventory and monitoring program will be evaluated and integrated into the exotic plant management program in the park.

Tools: RMNP currently uses Global Positioning System (GPS) equipment to locate and Geographical Information System (GIS) software to map invasive exotic plants. Figures 1 through 6 on pages 6 - 11 were developed using the park's GPS and GIS capabilities. Maps of each treatment area showing specific locations of invasive exotic plants are maintained in the Division of Resources Management and Research. Remote sensing using satellite imagery to locate and map infestations, or spatial modeling (Kalkan et.al., 2000) may be used in the future.

Inventory and Monitoring: Park staff and volunteers conduct invasive exotic plant surveys every year, documenting species present and population size (RMNP Resources Management Division Annual Reports 2000, 2001, and 2002). These annual surveys include road shoulders and hiking trails in the park. If time allows, they survey backcountry areas and notify resource managers of any new infestations. Rangers are trained to identify invasive exotic plants and are instructed to report them to the Division of Resource Management and Research. Each District Ranger's "performance standards" call for the identification and control of invasive exotic plants within their district (Government Performance and Results Act).

Ongoing surveying and monitoring efforts include:

Stohlgren et. al. (1997a,b,c, 1999) established 181 permanent plots in various habitats in RMNP. Researchers report the occurrence of invasive exotic plants found within their plots (Chong 2002, Kalkan, 2000).

Denver Botanical Gardens (DBG): Since 1999, RMNP has contracted with DBG to survey and map the locations of 86 locations of rare plants in RMNP. Invasive exotic plants found in or near rare plant populations are reported to the Division of Resources Management and Research (DBG, 2000).

RMNP's Fire Effects Monitoring Program has established 69 fire effects plots. Staff is instructed to notify the Division of Resources Management and Research if any of the 35 invasive exotic plants are encountered, or if monitoring detects an increase or decrease in the number of exotic plants after a prescribed or wildland fire. In addition, the park is currently updating its vegetation map and in 2002 approximately 640 vegetation plots were established that documented exotic plants.

RMNP continues to monitor areas where exotic plants have been removed. Permanent plots are established at selected locations for more intensive sampling of vegetative cover and density to determine the effectiveness of control techniques (RMNP Resources Management Division Annual Report 2002). Plot protocols were borrowed from the NPS Fire Monitoring Handbook procedures and the USDA-USFS Field Guide for Invasive Plant Inventory, Monitoring and Mapping Protocol.

ACTION 2 – Prioritize exotic plants to be controlled.

RMNP prioritizes invasive exotic plants for control based on two management strategies: the **Risk Assessment** (Rutledge and McLendon, 1996) and **Management Zones** (RMNP Master Plan, 1976). RMNP also relies on new information as it becomes available about the invasive tendencies of species, and considers state or national priorities when setting park priorities.

Risk Assessment:

In 1995 and 1996, Rutledge and McLendon of Colorado State University conducted a risk assessment of 102 exotic plant species known to occur in RMNP. Due to an increase in inventory and monitoring of exotic plants since 1996, the current list of exotic plants known to occur in the park has expanded to 115. Park staff will continue to use the Rutledge and McLendon risk assessment methodology to establish priorities for exotic plant control.

The Rutledge and McLendon risk assessment evaluates exotic plants based on their ecological impact and their relative ease of control. Exotic plant species were assigned “urgency” scores, ranging from **high** (delayed action will result in significant effort required for control), to **medium** (delayed action will result in a moderate increase in the effort for control), to **low** (delayed action will result in little increase in effort required for control). High-ranking plants – those that have a potential ecological impact score of 24 in the Risk Assessment – will be the highest priority for control. (See Appendix A on page 117 for the *Summary of the Final Assessment of Exotic Plant Species of Concern*).

Management Zones:

Three management zones are defined for all park management activities: *natural*, *historic*, and *developed* (RMNP Final Master Plan, 1976). Priorities for controlling exotic plants are consistent with priorities established for each of these zones.

Natural Zone: This zone includes undeveloped areas of the park. Most of this area, (248,464 acres or 93% of the park) has been recommended as wilderness. An additional 2,917 acres is designated as part of the established Indian Peaks Wilderness. Within this zone, emphasis is on protection of natural resources and ecological processes. This zone has the highest priority for controlling invasive exotic plants. Access points (such as trailheads) and trails leading into wilderness become conduits for seed dispersal, and will be given high priority for control efforts.

Within the natural zone, there are three Research Natural Areas (RNA’s): Specimen Mountain, West Creek, and Paradise Park totaling 24,000 acres. Presently there are no known invasive exotic plants in these RNA’s. Invasive exotic plants found here will be given the highest priority for eradication.

Historic Zone. This zone includes the William Allen White Zone (5 structures on less than 3 acres), McGraw Ranch (11 structures on 10 acres), and the Holzwarth Historic District (12 structures on 75 acres). Invasive exotic plants

will be given high priority for eradication if their presence alters the integrity of an historic landscape. With the exception of invasive exotic plants, exotic plants that are an integral part of a cultural landscape within these historic zones will be managed and protected.

Developed Zone. This zone includes 768 acres of park land where development and intensive use substantially alter the natural environment. Established uses within the developed zone include campgrounds, park housing, visitor centers, utility areas, trailheads, and liveries. This zone is managed for administrative and recreation purposes and is frequently disturbed with construction and maintenance activities. The Developed Zone has the highest incidences of invasive exotics.

The developed zone provides an avenue for invasive exotic plants to expand into surrounding natural areas. Therefore, the developed zone will be given high priority for exotic plant management to prevent the spread of invasive exotic plants to undisturbed areas of the park.

In addition to the strategies of the Risk Assessment and Management Zones, other considerations are examined when establishing priorities for invasive exotic plant management:

- ***How does the plant affect the biodiversity of the park?***
Areas with significant native plant diversity often contain more invasive exotic species than areas that have less biodiversity. Consequently, areas with significant biodiversity are most susceptible to exotic plant infestation (Chong, 2002, Stohlgren et.al, 1997a,b,c,1999, Kalkan et.al., 2000). These areas, occurring predominantly in riparian, aspen, ponderosa pine, upland shrub, and dry grassland communities below 8500 feet, will be given high priority for control. For example, aspen communities have the highest native plant diversity in the park, but also are at the greatest risk of losing native biodiversity because of invasive exotic plants (Chong, 2002).
- ***Is the area susceptible to infestation?***
There is evidence to suggest that the structure and site conditions of plant communities have a significant influence on the capability of exotics to invade and establish colonies. As stated by McLendon 1996, Kalkan 2000 and Chong 2002, significant factors include:
 - habitat type
 - aspect
 - moisture
 - canopy coverage
 - soil
 - geology
 - competition
 - plant diversity

- ***What are the state and county priorities for weed control?***
There is a regional list of 90 exotic species considered invasive, which occur in at least one or more of the following states: Colorado, Wyoming, Utah, New Mexico, Nevada, Washington, Oregon, Kansas, South and North Dakota, and Montana. These states are working together to prevent invasive exotic plant infestations. These 90 invasive exotic plants should be controlled or eradicated if they appear in the park. In addition, Old (1993) developed a list of 60 plant species that are of concern within the state of Colorado (see Appendix J on page 143). Many of these species do not yet occur in the state. If these listed species show up in RMNP, high priority will be given to eradicate them.
- ***Is an invasive exotic plant within 1/2 mile of the park boundary and threatening to spread to adjacent lands?***
Invasive exotic plants that have the potential to spread to adjacent private or public land will be given a high priority for control.
- ***Is the invasive exotic species new to the park or a new infestation of an existing species?***
Exotic plants are much easier to control and less costly to eradicate when they are few in number. A high priority will be given to eradicating newly discovered infestations of invasive exotic plants.

In summary, high priority for control will be given to exotic plants that:

- Affect the biodiversity of park resources.
- Threaten rare plant species in the park.
- Occur within the natural zone or RNA's in the park.
- Occur in developed areas that are "hot spots" or pathways for infestations to spread.
- Threaten the integrity of an historic landscape.
- Are listed by the state and/or county as high priority for eradication or control.
- Occur within 1/2 mile of the park boundary and pose a threat to spread to neighboring lands.
- Are new infestations of new exotic plant species, having never occurred in the park before.
- Occur in areas where seed can be rapidly dispersed to other areas of the park.
- Occur at or above treeline (11,500 feet).
- Have an ecological impact greater than 24 in Rutledge & McLendon's Risk Assessment.

ACTION 3 – Identify control techniques that are most appropriate for each species.

Control techniques will be selected that achieve maximum effectiveness in eradication while minimizing risks to natural resources, cultural resources, and the human environment. They will be identified as appropriate for invasive exotic plant control if they possess the following characteristics:

Control Technique Characteristics:

- The control technique must be effective at killing the invasive exotic plant.
- The control technique poses little or no risk to native vegetation, wetlands, wildlife, or other natural resources.
- The control technique poses little or no risk to cultural resources.
- The control technique poses little or no risk to the human environment or to the safety of park visitors or park employees.
- The control technique must be cost-effective to implement.

These characteristics are described in further detail:

- **Effective at killing the exotic plant**

Five options are available to managers in controlling invasive exotic plants:

Mechanical - Using tools to remove exotic plants by digging, mowing, or cutting.

Cultural - providing competition, stress, or control of exotic species by planting native vegetation or using prescribed fire.

Chemical - Using synthetic herbicides to kill or severely stress invasive exotic plants.

Lower-risk methods – Using hot water to scald a plant or the use of natural herbicides that contain biodegradable soap, acetic acid, sugar compounds, or plant proteins in place of synthetic herbicides. However, some natural chemicals have health and safety risks, such as a low pH, that could be caustic to an applicator applying the chemical. Even these low risk products must be handled in a manner similar to synthetic chemicals and with appropriate personal protective equipment (PPE).

Biological - Using insects, mammals, or pathogens to stress exotic plants.

The process of evaluating which technique(s) is/are most appropriate for each species is known as Integrated Pest Management (IPM).

Techniques vary in effectiveness. In some cases, a combination of treatments is necessary to meet control or eradication goals. For example, Canada thistle is most effectively controlled when mechanical means (i.e., mowing) are followed by a chemical application (Laurie Dieter and George Beck, personnel communication). Leafy spurge may be most effectively treated with the herbicide Plateau in combination with a biocontrol, such as insects, or in combination with prescribed fire.

In all cases, the effectiveness of mechanical, cultural, biological, and low-risk methods will be evaluated before synthetic herbicide control is proposed. For example, RMNP initiated research on Canada thistle in 1993 to determine the factors controlling its distribution in the montane zone (McLendon, 1996). Recommendations from the research enabled the park to significantly reduce the amount of herbicides used to control this plant. Wolf (2000) provided recommendations on controlling white and yellow sweetclover, and determined that

herbicides are not necessary in controlling these two species because prescribed fire is effective at killing the plants. A prescribed fire to control yellow sweetclover along Trail Ridge Road shoulders from the Beaver Meadows Entrance to Deer Ridge Junction is being planned in 2003. Future burn plans will be developed for other areas within treatment areas where prescribed fire has been identified as one of the control techniques. New research that will start in 2003 will determine if biological control insects identified to control yellow toadflax could negatively impact closely related native wildflowers.

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

RMNP will continue to make a good faith effort to evaluate treatment options and ensure all environmental compliance standards are met. RMNP will review any new relevant scientific literature and references to ensure the control technique selected is biologically sound. Some recent research and monitoring pertinent to RMNP that addresses protecting natural resources:

- Recent research and monitoring using lower risk methods such as hot water and synthetic herbicides on several perennial plants have not been encouraging (George Beck and Carlie Ronca, personal communication). The methods appear to be effective on annuals and perhaps a few biennials, but most of RMNP's invasive species of concern are perennial with extensive rhizominous roots. After treatment with a lower risk technique these species quickly rebounded and continued to spread and set seed. Susan Wolf (personal communication) stated that Canada thistle is especially sensitive to corn and wheat gluten meal and this option will be further explored.
- Presently a research project is ongoing in RMNP that is evaluating ecosystem impacts resulting from the use of synthetic herbicides. The research will be completed in 2004 (Moore, 2001). Early data indicates that sites not treated with an herbicide support higher densities of soil arthropods than treated sites. Data from this research will be used to minimize impacts to natural resources from using synthetic herbicides.
- Recent research by Dr. Jorge Vivanco of Colorado State University isolated a herbicidal chemical called catechin minus. Catechin minus attacks the root cap and then moves into the root hairs. Lab tests show that it acts quickly, killing cells and moving from the bottom to the top of plants. Susceptible species include Dalmatian toadflax and diffuse knapweed. While the preliminary findings must be verified through additional research, they suggest that a new type of natural broadleaf herbicide may be available in the future, with the advantage of being a chemical naturally produced by some plant species.
- Recent research on the biological control species *Urophora cardui* (a gall fly) released on Canada thistle has some promising results. However, other research indicates the fly also negatively impacts native thistles. For this reason RMNP will not release this insect, though it is anticipated that this fly will eventually be found in the park due to releases occurring elsewhere in the state (George Beck and Savata Louda, personnel communication).

- **The technique poses little to no risks to humans.**

Some IPM techniques have the potential to harm humans. Injuries can occur with the use of weed whackers, scalding hot water and prescribed fire. Herbicides can impact human health, particularly for those with Multiple Chemical Sensitivity (MCS). RMNP would like to use both natural and synthetic herbicides on 15 invasive exotic plants in order to achieve effective control and to keep invasive exotic plant populations from spreading. RMNP proposes to use synthetic herbicides only as a last resort if other IPM techniques prove ineffective. The type of chemicals proposed for use and thresholds for chemical control have been established for the 15 invasive exotic plants (please refer to Appendix C on page 125). The goal of synthetic herbicide use is to reduce the invasive exotic species below the defined threshold. Once below the threshold, synthetic herbicides would not be used and RMNP would use other IPM techniques to control plants. The use of synthetic chemicals would only be warranted if the threshold is exceeded in the future.

Some species may require more than one application of herbicide. RMNP's preference is to only do one application of a synthetic herbicide in any one year versus multiple applications, but applications could occur once a year over several years until an invasive exotic is brought below the established threshold level. To improve the efficacy of an herbicide, other IPM techniques, such as mowing, may be used before the chemical is applied (Please see Table 4, below). Once herbicides have been applied and the invasive exotic plant species has been reduced below the threshold, it is anticipated that herbicides would not be needed for a period of five (5) years. Presently two of the 15 species are below the defined threshold level (Please see Appendix C on page 125 and Table 4, below). It is anticipated that nine additional species could be brought below the threshold level within two years if Alternative 2 was implemented, and the remaining four species could be brought below the threshold level in three to five years. None of the 15 invasive exotic species identified for synthetic herbicide control will be managed solely by the use of herbicides.

Despite the proposed use of natural and synthetic herbicides, almost all of RMNP will remain chemical free. By April 30 of each year, park personnel will identify locations in the park where herbicide application is warranted. Herbicide treatment will not be done outside of the identified locations. Based on this information, RMNP will identify trail segments, trailheads, picnic areas, parking lots and campsites that are located within or adjacent to the planned treatment areas. Areas treated with a herbicide will be posted at least two weeks before treatment occurs, and yellow signs will remain in place for three months afterwards. RMNP will also identify all campgrounds in the park that will remain chemical free for that year. This information will be made available to the public via the RMNP website and other print media.

Table 4 - Estimated Herbicide Treatment Schedule for 15 Invasive Exotic Plants

Species	Estimated Acres to be initially treated	Estimated Acres Year Two	Estimated Acres Year Three
Canada Thistle – based on 80% estimated efficacy of the herbicide	~16 acres	~3.2 acres	~0.64 acres
Cheatgrass –based on 100% estimated efficacy of the herbicide	<1.00	0	0
Common St. Johnswort	Eradicated	*	*
Dalmatian Toadflax – Based on 90% estimated efficacy of the herbicide	3.50	.35	.04
Diffuse Knapweed – Based on 95% estimated efficacy of the herbicide	1.65	.08	0
Field Bindweed – Based on 90% estimated efficacy of the herbicide	4.75	.50	.05
Houndstongue –Based on 95% estimated efficacy of the herbicide	2.50	.12	0
Leafy Spurge – Based on 95% estimated efficacy of the herbicide	13.75	.69	.03
Oxeye Daisy – based on 90% efficacy of the herbicide	1.00	.10	0
Orange Hawkweed	*	*	*
Quack grass – Based on 100% estimated efficacy of the herbicide	1.00	0	0
Smooth Brome – Based on 100% estimated efficacy of the herbicide	5.00	0	0
Spotted knapweed – Based on 95% estimated efficacy of the herbicide	<1.00	.05	0
Sulfur Cinquefoil – Based on 90% estimated efficacy of the herbicide	1.00	.1	0
Yellow Toadflax – Based on 85% estimated efficacy of the herbicide	12.75	1.91	.29
Total Acres	65.25	7.1	1.05

* Orange hawkweed and Common St. Johnswort are currently below the threshold level that would warrant chemical control.

- The technique poses little or no risk to cultural resources.**
 RMNP will identify a control technique that poses minimal or no impact to known cultural resources. Ground disturbing activities, such as digging plants or use of prescribed fire, would not be appropriate for exotic plant removal where cultural resources are present.
- The technique is cost effective to implement.**
 Cost is not the driving factor in selecting appropriate control techniques for exotic plant control, but would be considered. For example, based on 2002 figures, exotic plant control using all IPM techniques except natural and synthetic herbicides

required approximately 21 hours per acre at a cost of approximately \$268 per acre. Revegetation cost was \$11,000 per acre.

Under some circumstances, the cost of mechanical treatments can be significantly higher. For example, at Golden Gate National Recreation Area, \$80,000 was spent over five months to control invasive exotic plants on 89 acres (about \$900 per acre) (Bruce Badzik, personal communication).

Herbicide application by a certified chemical applicator using a tractor equipped with two ten foot booms requires about ½ hour per acre. Based on 1999 figures (the last year that herbicides were used in RMNP) the use of herbicides in the park costs approximately \$500 per acre. Using backpack sprayers would take a significantly longer time and may be more expensive per acre.

In 1999, RMNP spent over \$17,000 on invasive exotic plant management such as mechanical and cultural controls, mapping, and administrative work. Only \$3,000 was spent on herbicide application. For every \$1 spent on chemical control, about \$6 was expended on mechanical and cultural control. When large infestations are treated with herbicides, the initial treatment usually results in greater reduction in the number of plants than can be accomplished with other methods of control.

ACTION 4 – Apply the most appropriate control technique.

RMNP recommends specific actions for each of the 35 invasive exotic plants (See Appendix B on page 120). If it is determined that eradication is not feasible, the objective will be to suppress the exotic plant population below the threshold level, or conduct limited eradication or containment in sensitive areas of the park (NPS, 1991 and 2001). In the case of leafy spurge, the action level is reached when only one plant is found and an herbicide may be used. In the case of bouncing bet, the action level is reached when one plant is found, yet one plant does not warrant herbicide use since a single plant can be controlled by hand pulling or digging.

ACTION 5 – Monitor effectiveness of control efforts.

Monitoring is an essential strategy in evaluating control techniques. RMNP will continue to monitor the occurrence of invasive exotic plants and update the information annually.

RMNP will continue to monitor areas where invasive exotic plants are removed (Resources Management Division annual report, 2002). Temporary survey plots are already in place (please refer to the description of ongoing surveying and monitoring efforts on page 20), and new survey plots will be established in the future at selected locations. These survey plots will be used for intensive sampling of vegetative cover and density.

ACTION 6 – Prevent new infestations by monitoring exotic plant pathways.

Exotic plants establish themselves in developed areas and in biologically diverse habitats. The most heavily invaded sites in the park tend to have a small total area, but unique plant species (Kalkan 2000, Stohlgren 1999, Chong 2002). These “hot spots” of infestation provide avenues for invasive exotic plants to expand into other areas of the park. RMNP will closely monitor these areas, including road shoulders, campgrounds, trailheads, trails, and diverse habitats such as ponderosa pine, aspen and riparian areas below 9,000 feet elevation.

To prevent new infestations, RMNP will employ “Best Management Practices,” including:

- Using only barren fill and gravel in all park construction and maintenance activities.
- To the extent possible, construction and fire fighting equipment will be cleaned prior to entering the park to prevent the introduction of invasive exotic plant seeds.
- RMNP requires NPS stock and all liveries offering horseback rides into the park to feed their stock certified weed seed free hay. Private horse users are encouraged to feed their stock certified hay. Hay certified or not, is not allowed into the backcountry.

ACTION 7 – Inform the Public about exotic plants and control measures.

RMNP will increase efforts to inform the public about invasive exotic plants and control measures. A communication plan was developed (please see Appendix F on page 135). The communication plan is designed to:

- Inform the public about local, regional, and national issues regarding invasive exotic plants;
- Inform the public about invasive exotic plant control measures in RMNP, especially herbicide use;
- Inform individuals with Multiple Chemical Sensitivity (MCS) about upcoming invasive exotic plant control activities within the park that involve the use of chemicals; and,
- Encourage two-way communication between NPS and the public on matters regarding invasive exotic plant management in RMNP.
- Areas treated with a herbicide may be closed to the public for a period of time and yellow signs will be posted.

RMNP will use the following methods to inform the public about invasive exotic plant management activities:

Programs to Inform the Public

- **Visitor Centers** – Information on invasive exotic plants will be available at visitor centers through site bulletins, postings on bulletin boards, or through personal communication by rangers.
- **RMNP Information Office** – If a chemical, whether it is natural or synthetic, is proposed for use, the information on chemical application schedules, type of chemical and location will be available through this office by April 30 each year. The Information Office will also be notified when a prescribed fire is implemented to control invasive exotic plants.
- **RMNP District Rangers** – Information on chemical application schedules, type of chemical and location will be available to District Rangers by April 30 each year.
- **Interpretive Programs** – Interpretive talks and guided walks will be designed to communicate invasive exotic plant management concerns and controls in RMNP.
- **Environmental Outreach Programs** – RMNP will integrate invasive exotic plant management issues into current environmental education curriculum.
- **Press releases** – The park will notify local media about exotic plant control activities, dates, locations and treatment methods.
- **Park Newspaper** – The park newspaper will contain articles and updates about invasive exotic species management in RMNP.
- **Mail** – Specific information on chemical treatment locations, dates and treatment methods will be mailed to park inholders and adjacent landowners within ¼ mile of a treatment site on, or about, April 30 each year. The park will also develop a mailing list of other stakeholders who would like to be kept informed about exotic plant management activities at RMNP.
- **Internet** – Updated information about invasive exotic plant control locations, scheduled treatment dates, and treatment methods will be posted on RMNP’s web page.
- **Signs** – If chemicals are used, the treatment areas will be posted with conspicuous yellow signs. The signs would state the date of application and the chemical used. Signs would be posted two weeks prior to the chemical application date, and would remain in place three months following application.
- **Yearly Update** – Provide an opportunity for interested individuals to meet and discuss the effectiveness of all management tools and interchange of new techniques.

ACTION 8 – Work closely with adjacent landowners to achieve common goals of exotic plant management.

The spread of invasive exotic plants throughout Colorado, the American west, and the nation poses a serious environmental and economic threat to public land, ranchland, farmland and private property. RMNP has joined with other federal, state and local government agencies, homeowner associations, private landowners, and businesses to develop joint strategies for curbing this silent threat.

The park participates in the Colorado Weed Network – an informal network of federal, state, county, and city officials, and private citizens concerned about exotic plant infestations. Quarterly meetings provide opportunities to develop regional and local strategies and coordinate invasive exotic plant control efforts.

The Estes Valley Improvement Association (EVIA), a non-profit civic group, hosts many public meetings and weed pulling days to promote awareness of invasive exotic plants.

RMNP will continue to work with volunteers (local and others) in controlling invasive exotic plants by mechanical, cultural, or biological means. Volunteers have helped to reduce the number of acres infested with invasive exotics and to contain some problem plants to specific areas. Almost 800 hours of volunteer time was devoted to controlling invasive exotic plants in 2002.

RMNP will continue to exchange information with surrounding landowners in an effort to eradicate or reduce exotic plant populations along shared boundaries. Information is shared with the U.S. Forest Service, Bureau of Land Management, Bureau of Reclamation, United States Geological Survey (USGS), Colorado Department of Agriculture, Colorado Noxious Weed Management Team, County Weed Districts, Boulder County Open Space, and the towns of Estes Park and Grand Lake.

CHAPTER 3 ALTERNATIVES

This chapter describes the alternatives being considered to manage invasive exotic plants in RMNP. Criteria used in the selection of reasonable alternatives include:

- Potential for protecting the park's natural and cultural resources
- Effectiveness at eradicating or controlling exotic plant infestations
- Ability to ensure human safety

In addition to a No Action alternative, two alternatives were identified for detailed analysis. Both action alternatives involve the use of IPM techniques to eradicate and/or reduce exotic plant infestations in RMNP. The only difference between the two action alternatives is that one alternative does not include the use of synthetic herbicides. The No Action alternative provides a baseline against which the environmental effects of the other two alternatives can be compared.

Alternative 1 – Continuation of Current Management Practices: mechanical, cultural, low risk methods including natural biodegradable herbicides and biological control (no synthetic herbicide control).

RMNP is currently using these techniques to control invasive exotic plant infestations within the park. These activities are Categorically Excluded from compliance with the National Environmental Policy Act (NEPA). The categorical exclusions read as follows:

“Routine maintenance and repairs to non-historic structures, facilities, utilities, grounds and trails” (NPS Director's Order #12, §3.4.C(3)); and,

“Removal of individual members of a non-threatened/endangered species or populations of pests and exotic plants that pose an imminent danger to visitors or an immediate threat to park resources.” (NPS Director's Order #12, §3.4.E(3)).

If this alternative is selected, RMNP would continue to conduct invasive exotic plant control work within the park as it has for the past three years, without the use of synthetic herbicides.

Alternative 2 – Preferred Alternative: mechanical, cultural, low risk methods including natural herbicides, biological and synthetic herbicide control.

The preferred alternative is based on IPM recommendations for selected species, as outlined in the following documents:

- “An Assessment of Exotic Plant Species of Rocky Mountain National Park” (1996)
- The Nature Conservancy Weed Control Handbook (2001)
- Recommendations from a variety of experts, and other documents cited in this plan and EA.

RMNP proposes to implement the full range of IPM techniques. The park would use mechanical, cultural, low risk methods, biological, and natural and synthetic chemicals

to eradicate or reduce the numbers of 35 invasive exotic plants occurring in RMNP. Of the 35 invasive exotic species identified for control, herbicides will likely be used on only 15 of those species. Using the full range of IPM techniques would prevent unacceptable levels of invasive exotic plants using the most economical means while posing the least hazard to people, property, and the environment.

Alternatives Excluded From Further Consideration

Alternative 3 - No invasive exotic plant management or control.

This alternative was excluded from further consideration because it does not meet the requirements of the park's enabling legislation to protect natural resources, the NPS Organic Act, NPS policies, or the Federal and State Noxious Weed Acts. Although this alternative was considered, and is used for comparison with other alternatives, it is unacceptable.

Environmentally Preferred Alternative

The environmentally preferred alternative is determined by applying criteria suggested in the National Environmental Policy Act of 1969 (NEPA), with additional guidance provided by the Council of Environmental Quality (CEQ). The environmentally preferred alternative is the one "that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural and natural resources." As expressed in section 101 of NEPA, "it is the continuing responsibility of the Federal Government to:

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

The environmentally preferred alternative for managing invasive exotic plants in RMNP is based on these national environmental policy goals. A discussion of how each alternative relates to these goals follows:

Alternative 1 – Continuation of Current Management Practices. This alternative seeks to meet the environmental policy goals by using several IPM techniques to eradicate or control invasive exotic plants. Only natural biodegradable herbicides, usually used by organic farmers, would be used. Without the use of synthetic herbicides, certain invasive exotic plant species are likely to spread within the park. Some environmental

degradation would occur, which fails to meet one of the environmental policy goals. For example, in 1999 (the last year a synthetic herbicide was used in the park) leafy spurge infested about five acres. In 2002, after survey work was completed, it was determined that leafy spurge now infests 13.75 acres - a 175% increase in just two years, despite using mechanical and biocontrol techniques to manage this invasive species.

Alternative 2 – Preferred Alternative. This alternative seeks to meet the environmental policy goals by eradicating or controlling invasive exotic plants by using the full range of IPM techniques, including the use of synthetic herbicides. Control techniques would be tailored to the specific environment in which the invasive plants are found. This alternative proposes the use of the least toxic effective synthetic herbicide to control certain species of invasive exotic plants that have exceeded defined thresholds and are difficult to eradicate or control using mechanical, cultural, biological or other low-risk methods. To fully meet the environmental policy goals, synthetic herbicides would have to be used “without degradation, risk of health or safety, or other undesirable and unintended consequences.”

Summary

Table 5 provides a summary of the potential effects of the No Action alternative as compared to the potential effects of Alternatives 1 and 2. Chapter 4 provides a description of the affected environment, and Chapter 5 provides additional information on the potential impact of the two action alternatives on each resource.

Table 5 Comparative Summary of Environmental Impacts

Impact Topic	Alternative 1 – Continue Current Management Practices: mechanical, cultural, low risk methods including natural biodegradable herbicides, biological control (No synthetic herbicide control)	Alternative 2 – Preferred Alternative: mechanical, cultural, low risk methods including natural chemicals, biological and synthetic herbicide control	Alternative 3 – No Action: no invasive exotic plant management or control
Soils and Native Vegetation	Long-term beneficial effects to soil and vegetation would occur. There is a risk that some invasive exotic plants could expand into undisturbed habitat with a long-term minor to moderate adverse impact to soil and native plants.	Greatest long-term beneficial effect on soil and vegetation. This alternative poses the least long-term threat to native species due to exotic plant invasion. There would be some short-term localized minor impacts when natural or synthetic chemicals are applied, but native plants are expected to recover in the long-term.	This alternative was considered but rejected for further consideration due to expected long-term major impacts to soil and native vegetation caused by the spread of noxious weeds.

Impact Topic	Alternative 1 – Continue Current Management Practices: mechanical, cultural, low risk methods including natural biodegradable herbicides, biological control (No synthetic herbicide control)	Alternative 2 – Preferred Alternative: mechanical, cultural, low risk methods including natural chemicals, biological and synthetic herbicide control	Alternative 3 – No Action: no invasive exotic plant management or control
Natural Soundscape and Lightscape	There may be a slight increase in activities that may cause excessive or unnecessary unnatural sounds. Activities generating noise would include using gasoline-powered string trimmers or mowers, trucks, ATVs, or the presence of a large group of volunteers and/or park employees. There would be no light impacts.	Effects on natural quiet and sound would be the same as Alternative 1.	There would be no impact because no weed management activities would occur.
Aquatic, Wetland and Riparian Communities	Effects on wetlands and riparian communities would generally be beneficial.	The type of synthetic herbicides proposed for use, especially with implementation of the proposed mitigating measures, would minimize impacts in the short-term. The greatest long-term beneficial effects to aquatic, wetlands and riparian communities would occur.	Without control, noxious weeds would spread, resulting in long-term major impacts to wetland and riparian communities.
Endangered, Threatened and Rare Species	Effects to threatened or endangered and rare species would generally be beneficial. The species-level biological diversity of the park would be partially protected but not to the degree afforded by Alternative 2. The species-level biological diversity of the park may be slightly jeopardized in the long-term under this alternative.	Alternative 2 would provide more long-term protection than Alternative 1 to threatened, endangered, candidate species, and rare species. The species-level biological diversity of the park would be better protected under this alternative in the long-term when compared to Alternative 1.	Without control, noxious weeds would spread, resulting in long-term major impacts to the biological diversity of the park and endangered, threatened and rare species.

Impact Topic	Alternative 1 – Continue Current Management Practices: mechanical, cultural, low risk methods including natural biodegradable herbicides, biological control (No synthetic herbicide control)	Alternative 2 – Preferred Alternative: mechanical, cultural, low risk methods including natural chemicals, biological and synthetic herbicide control	Alternative 3 – No Action: no invasive exotic plant management or control
Park Wildlife	The integrity of existing native species would be enhanced. Some individual wildlife may be displaced from their habitat at certain times, but would be expected to return to the immediate area after perceived threats are no longer present. Overall, adverse impacts would be localized, short-term, and negligible to minor in intensity.	This alternative would have the greatest beneficial effect. The integrity of existing native species would be enhanced. As in Alternative 1, wildlife would be frightened or displaced at times when invasive exotics are being controlled. There will be some short-term impacts to herbaceous plants from using synthetic herbicides that will have a localized effect on forage available for some wildlife. With the removal of invasive exotic plants these areas are expected to recover. Overall, the impacts of this alternative on wildlife would be adverse, short-term, localized, and of minor intensity.	Without control, noxious weeds would spread, resulting in long-term major impacts to park wildlife.
Wilderness	The integrity of wilderness and its values would be enhanced.	This alternative would have the greatest beneficial impact to wilderness. The integrity of wilderness would be enhanced.	Without control, noxious weeds would spread, resulting in long-term impacts to wilderness.
Air Quality	There would be no significant change in air quality.	There would be no significant change in air quality.	There would be no impact to this resource.

Impact Topic	Alternative 1 – Continue Current Management Practices: mechanical, cultural, low risk methods including natural biodegradable herbicides, biological control (No synthetic herbicide control)	Alternative 2 – Preferred Alternative: mechanical, cultural, low risk methods including natural chemicals, biological and synthetic herbicide control	Alternative 3 – No Action: no invasive exotic plant management or control
Cultural Resources	Cultural resources would be protected under this alternative. Known archeological sites will be avoided and will not be impacted.	This alternative would result in better protection of cultural resources in the long-term. Known archeological sites will be avoided and will not be impacted.	Moderate impacts would occur to cultural resources if invasive exotic plants are not controlled.
Human Environment	A wide spectrum of visitors would continue to have multiple means of access to prime natural, cultural, scenic and recreational resources. There would be localized, short-term minor impacts to visitors due to the use of natural herbicides and recommended closure of treated areas for periods of time. No roads, trails or campgrounds would be closed under this alternative except during the application of natural chemicals, such as Burn Out.	A wide spectrum of visitors would continue to have multiple means of access to prime natural, cultural, scenic and recreational resources. Some visitors would experience short-term minor impacts due to the use of synthetic herbicides and recommended closure of treated areas for periods of time. Some visitors, such as those with Multiple Chemical Sensitivity, are likely to avoid the park after herbicides have been used. During and after herbicide application, portions of trails, parking lots, campgrounds and trailheads could be closed for a short period of time to protect human health. Closures would negatively impact some visitors.	Visitor experience would be negatively impacted if invasive exotic plants displace native vegetation and ultimately wildlife.

CHAPTER 4 AFFECTED ENVIRONMENT

Areas of the park that could be affected by exotic plant control are described. Future site-specific proposals following approval of this plan may require further surveys and environmental compliance.

Natural Resources

Topography, Geology and Soils

The park features an exceptionally scenic and ecologically typical portion of the Southern Rocky Mountains. The mountains were formed by a series of granitic batholiths intruded into precambrian micashists and pegmatities. The geology associated with the park is generally igneous and metamorphic rock and glacial till.

The Continental Divide bisects the park, dividing it into two distinct drainages. Steep cliffs and U-shaped valleys characterize the eastern slope. The eastern slope receives about 15 inches of precipitation annually, and is subject to high Chinook winds throughout the winter. On the western slope, mountains fall away more gradually to the Kawuneeche Valley. This side of the Continental Divide receives about 20 inches of precipitation annually, and typically receives more snow than the eastern slope in winter.

Nearly one-third of the park lies above treeline (above 11,500 feet in elevation). In the alpine tundra, precipitation falls as snow for about nine months of the year. Snow can occur any month of the year.

In 1998, an Order 2 soil survey was completed in the lower elevations of the park and an Order 3 soil survey was completed for other areas of the park (Natural Resources Conservation Service 1999). Most soil series in the park are classified in the cryic soil temperature regime. Data suggest that soils at high elevations and under spruce-fir forest meet the requirements of the isofrigid soil temperature class. Soil types generally include Cryochrepts, Cryoboralfs and Cryaquepts. The Cryochrept type is well drained with moderate permeability and slow runoff. Cryochrepts are generally in the glacial till areas and are deep to very deep. They may have large stones and boulders on the surface as well as in the profile. The erosion hazard is slight to moderate. The Cryoboralfs are moderately well drained with moderate permeability and moderate runoff. The erosion hazard is slight. The Cryaquepts are poorly to very poorly drained, with slow to moderate permeability and slow runoff. They are found in the wetter, flatter areas, such as the Kawuneeche Valley. Erosion is slight unless slopes are denuded of vegetation.

Vegetation

Due to the variation in elevation, climate, and soils, RMNP contains nine distinct vegetation types. These range from grass/shrub meadows at 7,800 feet to alpine tundra above 11,500 feet in elevation. Most forested communities are dominated by ponderosa pine, lodgepole pine, or spruce/fir trees.

Approximately 60% of the park is forested, 13% is located above treeline, 18% consists of exposed rock, and 9% is a mixture of other habitat types (please refer to Table 2 on page 12). Major vegetation types consist of ponderosa pine and grass/shrub habitat between 7,800 ft. to 8,500 ft., lodgepole pine between 8,500 ft. to 9,500 ft, spruce/fir between 9,500 ft. to 11,500 ft., and alpine tundra above 11,500 ft. The west side of the park is characterized by lodgepole pine and spruce/fir. The Kawuneeche Valley is the largest riparian meadow in the park and is about nine miles long and ½ mile wide. The valley is composed of marshes, bogs, ponds, and wet meadows dominated by sedges and willow.

There are approximately 1,000 known vascular plant species in RMNP. Of these, 115 are exotic. Thirty-five (35) species of exotic plants are of particular concern due to their ability to displace native vegetation, and their potential to adversely affect the long-term health of the ecosystem.

Human activity has altered native vegetation. Prior to the establishment of RMNP in 1915, mining, logging and livestock grazing activities introduced exotic plants into the area. Building the infrastructure of the park, as well as increasing visitation, has further contributed to the establishment and spread of exotic plants in RMNP. Developed areas – including roads, campgrounds, visitor centers, employee housing, utility areas and private inholdings – contain the largest concentrations of invasive exotic plants and usually occur in the lower elevations of the park. Some exotic species, however, are spreading to higher elevations. Three species - yellow toadflax, spotted knapweed and curly dock - were found along Trail Ridge Road at and above tree line. High altitude was previously thought to be a natural barrier to invasive exotic plant infestations.

Fire plays a significant role in altering native vegetation and soils. Fire is the major agent in initiating and terminating forest succession; it controls the age, structure, species composition and physiognomy of the vegetation; it influences nutrient cycles, energy flows, productivity, diversity, and stability throughout the ecosystem (Heinselman 1981). Fire occurs about once every 300 to 700 years in spruce/fir forests, once every 100 to 150 years in lodgepole pine forests, and once every 22 to 308 years in ponderosa pine forests (Jesse Duhnkrack RMNP, personal communication, and Baker and Ehle, In Press). At times, fire can be detrimental to native species by favoring the growth of invasive exotic plants. However, the effect of fire on native vegetation is dependent on the intensity, and location of a wildland fire. For example, a low intensity wildland fire in ponderosa pine habitat poses a more serious threat of exotic plant infestation than a high intensity wildland fire in spruce-fir. This is because ponderosa pine occurs at lower elevations where invasive exotic plants already have a foothold. For this reason, ponderosa pine habitat is considered a “hot spot” for invasive exotic species and spruce-fir habitat is not.

Species such as cheatgrass and spotted knapweed have increased significantly in some areas of the west following fires (Paige and Ritter 1999, Terry Terrell, personal communication). On the other hand, some exotic plants such as smooth brome, timothy, redtop and sweetclovers decrease following a fire (Wolf 2000).

Appendix B on page 120 identifies the invasive exotic plants that can be effectively controlled by the use of prescribed fire. By using Appendix B in conjunction with Figures 1 through 6 and Table 2, areas of the park can be identified where prescribed fire may be used for exotic plant control. Chapter 5 discusses environmental impacts, including health and safety concerns, related to prescribed fire and the use of chemicals.

About 63% of the park is designated for Wildland Fire Use. If a fire starts naturally by lightning in a Wildland Fire Use zone, and if certain parameters are met, a wildland fire can be managed for resource benefit. These Wildland Fire Use zones are in the more remote areas of the park and in areas where invasive exotic plants are not expected to occur.

Natural Soundscape and Lightscape

RMNP contains various tangible natural and cultural features, such as animals, plants, waters, geologic features, and historic buildings. The park also contains intangible qualities such as natural quiet, solitude, space, night sky and scenery. Both tangible and intangible resources are equally important in management decisions affecting park resources.

About 95% of the park is recommended or designated as Wilderness, where natural quiet and natural light are considered important resources. RMNP strives to preserve the natural quiet and the natural sounds associated with the physical and biological resources of the park.

Aquatic, Wetland and Riparian Communities

RMNP contains the headwaters of four major river basins. These are the Big Thompson, North Fork of the Colorado, North Fork of the St. Vrain, and the Cache La Poudre Rivers. The Continental Divide bisects the park into two distinct watersheds. Water flowing west drains into the Colorado River. Water flowing east empties into the Missouri and Mississippi Rivers.

RMNP contains 147 lakes and 473 miles of stream. Visitor use and atmospheric depositions alter water quality. Hiking trails leading to lakes and occurring along streams are conduits for invasive exotic plants (Benninger 1989, McLendon 1996).

Many high elevation lakes and streams were originally without fish life. Today at least 51 of the lakes sustain trout populations, some due to stocking by settlers or early park managers. Until 1969, lakes were stocked with exotic trout, which displaced native trout species. In the late 1970's park managers stopped stocking exotic trout and began to reintroduce native trout.

Aquatic/riparian areas contain some of the greatest diversity of habitat for flora and fauna in the park. These areas are quite sensitive to environmental stresses. High visitation in these areas increases their susceptibility to exotic plant infestations. Beaver have influenced streams and lakes in the park. Their populations have fluctuated over time. Today, the beaver population is considerably smaller than it was

150 years ago. This is due to a variety of reasons, some of which are not fully understood.

There are two Executive Orders (11988 Floodplain Management and 11990 Protection of Wetlands) that require special consideration on NPS administered land. Whenever possible, occupancy and modification of floodplains and wetlands are to be avoided. As a part of this EA, the NPS must determine whether proposed actions may impact any floodplains or wetlands.

Endangered, Threatened, and Rare Species

The Endangered Species Act requires the NPS to identify and manage federally listed threatened or endangered species. As required under NEPA guidelines, a biological assessment and consultation with the USFWS was done for this plan (Leroy Carlson, personal communication). On December 30, 2002, RMNP sent a letter to the USFWS stating that the alternatives being considered for exotic plant control were not likely to have an adverse affect on endangered, threatened, rare or candidate species. A reply from the USFWS concurring with the RMNP determination was received on July 10, 2003. Appendix L on page 146 contains both letters. It is well within the spirit of the Endangered Species Act that RMNP manage state-listed threatened and endangered species, state special concern species, and any species considered sensitive or rare to prevent future federal listing.

Appendix D on page 127 is the list of endangered, threatened and rare species for RMNP. These species are either known to occur in RMNP at this time or have been observed in the park in the past. Appendix E on page 133 lists the sources used by RMNP to identify endangered, threatened and rare species that must be protected if found within a project site.

Wildlife

Rocky Mountain National Park is home to a variety of wildlife species. About 280 species of birds, 66 species of mammals, 11 species of fish, 5 species of amphibians, and one specie of reptile. The distribution of species within the park varies by season, elevation, and varieties of habitats present.

Birds in the park include year-round residents, seasonal migrants and breeders, and occasional visitors. Three life zones (montane, subalpine, and alpine) support a diversity of avian populations. Common species of birds in RMNP include the American robin, broad-tailed hummingbird, red-tailed hawk, black-billed magpie, Stellar's jay, dark-eyed junco, pine siskin, Lincoln's sparrow, Wilson's warbler, green-tailed towhee, and mountain chickadee. RMNP was designated a Globally Important Bird Area in 2000 due to the diversity of birds and breeding habitat for species of high concern.

Elk, bighorn sheep, moose, and deer are the large ungulates found within the park. Bighorn sheep are particularly sensitive to human disturbances. The montane life zone (7,800 to 9,000 feet in elevation) provides the primary winter range for deer and elk. Moose are found west of the Continental Divide, particularly in the Kawuneeche

Valley. Other common mammals in RMNP include the chickaree, coyote, bobcat, mountain lion, chipmunk, Wyoming ground squirrel, yellow-bellied marmot, and golden-mantled ground squirrel.

Three exotic bird species, three exotic trout species, and one exotic squirrel species reside in the park. Occasionally, a mountain goat or domestic sheep may wander into the park. When encountered, mountain goats are removed.

Wilderness

Wilderness management programs and policies apply to parks that have designated wilderness, potential wilderness, and recommended/study wilderness (NPS-41).

RMNP operates under a land classification system that separates the lands within the park into legally defined zones. These are: recommended wilderness (94% of the total park area), designated wilderness (1%), administrative (1%), historic (2%), and roads (2%).

NPS policies state: *“The NPS will take no action that would diminish the wilderness suitability of an area recommended for wilderness study or for wilderness designation until the legislative process has been completed.”* (USDI-NPS Management Policies Chapter 7:2, 2001, NPS-41). Given this policy, 95% of RMNP is being managed as wilderness, though only 1% of the park has actually been designated.

Air Quality

The Clean Air Act amendment of 1977 recognizes the need to protect visibility and air quality in national parks. RMNP is a mandatory Class I area. Visibility is noticeably impaired in the park 90% of the time. Although pollutants have not been traced to the source, it is likely that pollutants come from the Front Range of Colorado, and as far away as Mexico, Texas, and Los Angeles, California. Visitor use has little impact on air quality in the park.

Research indicates that nitrate levels are increasing at Loch Vale, one of the park's high elevation lakes. Atmospheric deposition (acid rain or acid deposition) occurs in the park, particularly during the summer months. Precipitation measured near park headquarters and at Loch Vale has an average pH below 5.0 during the summer. This pH is below natural levels (Keigly and Porter, 1986, Baron, 1991).

In 1993, RMNP exceeded the National Ambient Air Quality Standard (NAAQS) for ozone. The standard for a 1-hour average is 0.12 ppm ($235 \mu\text{g}/\text{m}^3$). Ozone can be harmful to people and damaging to some species of plants (Peterson and Arbaugh, 1989). Within RMNP, ozone levels of 0.08 ppm ($157 \mu\text{g}/\text{m}^3$) for a 1-hour average have been recorded 130 times since 1987. Levels above 0.08 ppm can damage sensitive plant and animal species

Cultural Resources

Historic Resources

There are more than 450 historic structures remaining in the park. Historic resources relate to mining, ranching, logging, tourist activities, and to facilities associated with early development of the park. Mining, ranching, logging and many facilities predating the park's establishment in 1915 have been removed. Many areas disturbed from the mid-1800's to the early 1900's have been restored to natural conditions.

Historic use of the park resulted in significant impacts to native plants and animals. Uses that predated the establishment of the park, and even early park activities, contributed to the introduction of exotic plants.

Prehistoric Resources

Various archeological surveys have identified prehistoric sites and trails. Evidence suggests that the earliest occupation of what is now RMNP occurred between 10,000 and 15,000 years ago. From at least 9000 years ago and onward there has been continuous human use of the area (Husted, 1959). Archeological studies have identified sites and trails that were used by the Ute and Arapaho tribes, including evidence of historic Ute occupations as late as 1890. Continuous use of the area by the Arapaho is thought to have occurred from about 1790 to 1860. Pawnee and Sioux may have camped in the area.

The Ute Trail provided a route across the Continental Divide for both Ute and Arapaho tribes. Evidence collected from the Ute Trail indicates human use of the area 8,000 years ago.

To date, of the 265,765 acres in the park, about 27,754 acres have been surveyed for prehistoric or historic archeological sites. Further archeological survey work was completed during the summers of 1998 - 2002 (Brunswig). More than 800 archeological resources have been recorded in the park's 88-year history. Few of the recorded sites have been evaluated for listing in the National Register of Historic Places.

Human Environment

Socioeconomics

RMNP is one of the most popular tourist attractions in Colorado. The economies of gateway communities are directly tied to park visitor expenditures. The NPS Money Generation Model (2002) estimates that RMNP contributes \$320 million per year to the Colorado economy (sales, personal income and value added) and creates 3,800 jobs.

Along the Front Range of the Rocky Mountains is a growing metropolitan area that extends from Cheyenne, Wyoming, on the north, to Pueblo, Colorado, on the south. There are over three million people living along the Front Range, all within a relatively short driving distance to RMNP. The Town of Estes Park is the gateway community on

the east side of the park and Grand Lake is the gateway community on the west side. The full-time population is 11,000 in the Estes Valley. The full time population in Grand Lake is 320, and about 5,000 people reside in the area that includes the towns of Grand Lake and Granby.

Visitor Use

People have been recreating in RMNP for more than one hundred years. There were 15,000 visitors during the first year RMNP was open to the public. Since 1994 visitation has exceeded three million visitors per year. Overnight use in the backcountry has increased since 1984 when 6,536 backcountry permits were issued. In 2002, 7,134 permits were issued, a 9% increase (Barry Sweet, personal communication).

A yearlong visitor survey was completed in 1994/1995 (Valdez, 1996). The survey revealed that tranquility, clean air, clean water, and wildlife are extremely important features for RMNP visitors. Enjoying the natural scenery, wildlife viewing, photography, scenic driving, and camping were the main activities visitors engaged in during their visit to RMNP.

Park Operations

The park's operating budget, Fee Demonstration funds and NPS Natural Resources Preservation Project funds (NRPP) are currently being used for managing invasive exotic plants. RMNP retains 80% of funds generated from entrance fees under the Fee Demonstration Program. In Fiscal Year (FY) 2002 (which ended on September 30, 2002), RMNP spent \$42,000 managing invasive exotic plants using mechanical and biological controls, and \$149,200 using cultural controls. Exotic plant management activities required 3,310 hours of RMNP staff time and 796 hours of volunteer time. During FY2002 RMNP staff surveyed 292 miles of trails for exotic plants, and treated or retreated 199 acres (Exotic Plant Management FY2002 Year-end Report).

CHAPTER 5 ENVIRONMENTAL CONSEQUENCES

This chapter includes a description of the potential environmental impacts that could occur to the resources described in Chapter 4 – Affected Environment. Potential impacts were identified for each of the alternatives based on a review of scientific literature, resource management plans, field investigations, and the best professional judgement of resource specialists.

Methodology

This chapter is organized by resource, and is the scientific and analytical basis for the comparison of alternatives. The consequences of the proposed Integrated Pest Management (IPM) techniques are evaluated on their effectiveness in eradicating, suppressing or containing invasive exotic plants while minimizing risks to natural, cultural resources and the human environment. Impacts are described in terms of context (effects are site-specific, local or regional), duration (short- or long-term), and intensity (none, negligible, minor, moderate, major). The thresholds for the intensity of an impact are defined for each impact topic. Short-term impacts are described as those that are typically less than several years, such as temporary construction disturbance. Long-term impacts last many years and often result in long-term changes in land use.

Impacts may be direct, indirect or cumulative:

- **Direct effects** are caused by an action and occur at the same time and place as the action.
- **Indirect effects** are caused by the action and occur later in time or farther removed from the place.
- **Cumulative effects** are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant actions taking place over time. The Council on Environmental Quality (CEQ) regulations, which implement the National Environmental Policy Act, require assessment of cumulative impacts in the decision making process for federal projects. Please refer to the *Cumulative Impacts* section for each topic for an analysis of the cumulative impacts associated with the alternatives.

Past Actions and Reasonably Foreseeable Activities

Cumulative effects were determined by combining the impacts of the proposed alternatives with potential other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or foreseeable future projects within RMNP. Reasonably foreseeable future activities are those actions independent of the Invasive Exotic Plant Management Plan that could result in cumulative effects when combined with the effects of the proposed control techniques. The cumulative effect analysis includes all areas within RMNP as appropriate for each resource.

Past Actions

Previous impacts in most areas proposed for invasive exotic plant control were due to the presence of visitors, invasive exotic plants, past and present invasive exotic plant control, and from earlier anthropic disturbances such as livestock grazing and haying, water diversions and irrigation, cultivation of grassland meadows, mining, settlements, lodges, camps and cabins, a downhill ski area, nine hole golf course and park development activities. The anthropic disturbances varied considerably as to type, intensity, and duration before and after the park was established. The development of homes, driveways, roads and trails near the park boundary have also altered the landscape and has had an indirect impact on the establishment of invasive exotic plants.

Reasonably Foreseeable Activities

The goals of the Invasive Exotic Plant Management Plan are to:

- Eradicate, significantly reduce, or contain populations of 35 invasive exotic plants.
- Prevent further infestations of existing and eradicated species, or new infestations of invasive exotic species that presently do not exist in the park.

Impairment of Park Resources and Values

In addition to determining the environmental consequences of the preferred and other alternatives, NPS policy requires analysis of potential effects to determine whether actions would impair park resources (Management Policies 2001).

The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the NPS the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the NPS the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the NPS must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute an impairment to the extent that it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the enabling legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. An impairment finding is included in the conclusion section for the following impact topics: soils and native vegetation; natural soundscape; aquatic, wetland and riparian communities; endangered, threatened and rare species; wildlife; wilderness; air quality; cultural resources, and the human environment.

Environmental Consequences

The enabling legislation for RMNP (38 Stat. 798) states that said area is *dedicated and set apart as a public park for the benefit and enjoyment of the people of the United States . . . with regulations being primarily aimed at the freest use of the said park for recreational purposes by the public and for the preservation of the natural conditions and scenic beauties* thereof (emphasis added). Therefore, the NPS would like to implement the alternative that would best control invasive exotic plants and represents the greatest value for the investment while minimizing the externalities caused by the decision (water or air pollution is an example of an externality).

Comparison of Alternatives

The types of impacts for each of the alternatives varies because of the various IPM techniques that would be employed to control invasive exotic plants. The primary difference between alternatives is that chemical control (the use of synthetic herbicides) is proposed for Alternative 2. Several documents and many Internet sites were consulted to provide information on the behavior of synthetic chemicals in the environment. The documents and web sites are referenced either in the Literature Cited Section or in Appendix K on page 144. Tables 6 through 9 and Table 11 discuss synthetic herbicide's environmental impacts on soils and native vegetation, aquatic, wetland, and riparian communities, threatened, endangered and rare species, air quality, and human health effects.

Natural Resources

Soils and Native Vegetation

Methodology and Intensity Thresholds

Determination of the intensity of impacts to soils and native vegetation were derived from available soils and vegetation information (NRCS and park files) and park staff's observation of the effects on soils and vegetation from invasive exotic plants and control activities. The thresholds of change for the intensity of impacts to soils and vegetation are defined as follows:

- **No impact** – There is no discernable impact
- **Negligible** – The impact is at the lowest level of detection and causes very little or no physical disturbance/removal, compaction, unnatural erosion, when compared with current conditions.
- **Minor** – The impact is slight, but detectable in some areas, with few perceptible effects of physical disturbance/removal, compaction or unnatural erosion.
- **Moderate** – The impact is readily apparent in some areas and has measurable effects of physical disturbance/removal, compaction or unnatural erosion.

- **Major** – The impact is readily apparent in several areas and has severe effects of physical disturbance/removal, compaction, or unnatural erosion.
- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park’s general management plan or other relevant NPS planning documents.

Impacts of Alternative 1 on Soils and Vegetation

Mechanical Control

Mechanical removal of invasive exotic plants is expected to have **minor localized adverse impacts** on soil and native vegetation. Some soil erosion and loss of native plants may occur at the base of an invasive exotic plant if it is dug from the ground. If a large patch is removed, this could increase soil erosion and have a short-term minor adverse impact on vegetation.

Recent research on diffuse knapweed indicates that digging a plant from the ground (i.e. disturbing the soil) could actually enhance diffuse knapweed seed germination and cause more knapweed seedlings to germinate than if the plant was sprayed with an herbicide and left in place (George Beck, personal communication). Knapweed seed remains viable in the ground for years.

For some invasive exotic plants, like Canada thistle, leafy spurge, field bindweed and yellow toadflax, which reproduce by seed and through rhizomes, hand-pulling large well established patches is ineffective and can actually promote the spread of the invasive exotic plant.

In the long-term, native vegetation is expected to recover when invasive exotic plants are removed (McLendon and Redente 1994). Cutting seed heads and cutting plants at ground level has no effect on adjacent native species.

Mowing or using a string trimmer causes minor adverse impacts to soil, and would have a minor adverse impact on native species growing amongst the exotics by cutting them. When mowed, some invasive exotic species, like diffuse knapweed, still flower in a dwarfed state and still can produce seed. Timing of mowing is also critical. For example, mowing before the plant flowers and sets seed can reduce the amount of viable seed, but mowing after a plant sets seed will scatter seed over a wider area. Mowing generally does not kill (and may even spread) some invasive exotic plants that can sprout from rhizomes. However, mowing in combination with another control technique, such as using a natural or synthetic chemical, can be very effective. Mowing Canada thistle multiple times in riparian habitat with a high water table can be effective over three years (George Beck, personal communication).

Mechanical control (such as hand-pulling) is very effective for new infestations of exotic plants and when plants are few in number. For example, RMNP personnel have hand-pulled one or two spotted knapweed plants from locations in the park and never had any recurrence in that area.

Cultural Control

Cultural control is expected to have a **minor beneficial impact** on soil and native vegetation. Restoring disturbed areas to natural conditions prevents soil erosion and enhances native plant communities. Maintaining native plant communities in a healthy vigorous condition can favor native plants over invasive exotic plants (Redente and McLendon 1994, McLendon 1996).

Prescribed fire can cause a reduction of invasive exotic plants, such as timothy, smooth brome, and sweetclover, and can stimulate growth of native plants. However, the ground disturbance caused by fire can also lead to infestations of invasive exotic plants such as red top, diffuse and spotted knapweed, and yellow and dalmatian toadflax to the detriment of native plant communities. By using Appendix B in conjunction with Figures 1 through 6 and Table 2, areas of the park can be identified where prescribed fire may be used for invasive exotic plant control. Burn Plans developed for prescribed fires would consider known invasive exotic plant locations. Some areas may be avoided if prescribed fire would enhance invasive exotic plants. In some locations, other IPM techniques would be employed prior to a prescribed fire in order to maximize the efficacy of prescribed fire treatment. Some prescribed fires would be planned and carried out specifically to control those invasive exotic plants that would respond favorably to the treatment (i.e. be eradicated or significantly reduced). Fire effect plots and other study plots would be established before a prescribed fire occurs and would be monitored afterwards. Increases or decreases in invasive exotic plants would be noted. General surveys would also be used to detect new infestations after a prescribed fire or wildland fire. Appropriate control techniques would be implemented to eradicate or control invasive exotic plants that begin to invade or spread following a fire. The pros and cons associated with prescribed fire are equal. In other words, the benefits of removing exotic species by using prescribed fire are offset by the potential for exotic plants to invade an area following a prescribed fire.

Biological Control

The biological control insects proposed for use in RMNP (see Appendix H on page 141) should have **no direct adverse impact** on soil or native vegetation, and would have a **minor long-term benefit** on soil and native vegetation as exotic plant species are replaced with healthy native plant communities. There is a slight risk that insect species released in the park may evolve over time and start feeding on native plants closely related to the invasive exotic species. This could cause a reduction in native plant diversity and a possible increase in soil erosion. Carefully screening insects, and long-term monitoring of insects used for biological control, should eliminate these potential risks to soil and native plants. Some exotic insects being released on invasive exotic thistles in Colorado are presently impacting native thistles (Louda et al. 1997 and 1998). These insects entered the park from releases done outside the park. RMNP will work closely with adjacent landowners and will inform them about the risks of using non-native insects for biological control. RMNP will strive to ensure that exotic insects with wide diet breadth are kept out of the park's ecosystem.

Low Risk Methods

Five low risk methods are considered feasible for use in RMNP. These are:

- Hot water or steam
- Natural products that contain acetic acid
- Sugar compounds
- Covering plants with plastic sheeting
- Natural products that effect plant protein

These low risk methods (excluding plastic) have their limitations and are most effective on annuals and some biennials. Plastic can be effective, but it kills all plants that are covered.

Minor localized adverse impacts to native vegetation and soils are expected from hot water, plastic, or natural chemical treatments. Direct impacts are considered minor because the hot water, plastic sheeting or natural chemicals would be carefully applied directly on an invasive exotic plant and used only in selected locations where there are few native plants. Soil erosion following hot water, plastic or natural chemical treatments is also considered a minor adverse impact because the area can be revegetated with native plants if necessary to prevent erosion.

Hot water is applied at a temperature of 230° or 280° Fahrenheit. One of the machines used to heat and apply the water uses a foam additive composed of 100% plant sugars. The foam is not toxic or harmful to soil or vegetation. The foam is considered natural and biodegradable with no negative long-term effects. The heat breaks down the cellular structure of the plant and immediately starts the decomposition process. It is effective at killing annuals and can kill or impact some biennial plants for up to eight weeks. It is anticipated that some deep-rooted invasive exotic plants such as leafy spurge, yellow toadflax and Canada thistle will not be killed by this method. However, the technique may still be effective at preventing some deep-rooted species from flowering and producing seed, especially in sensitive wetland and riparian habitat where a chemical cannot be used. This method is not selective and can negatively impact or kill native species. For this reason, hot water control would only be used on dense patches of invasive exotic plants where there is little risk of impacting native plant species. This system does not use high water pressure, so soil erosion caused by application of the heated water is not a concern. However, once the exotic plants have been eliminated from an area, there is increased potential for soil erosion until native plants can be reestablished to anchor the soil.

Natural products that contain acetic acid only work effectively in warm weather above 70°F (Bruce Badzik, personal communication). Using a proper surfactant may lower the necessary temperature for acetic acid to be effective (Tim Gilpin, personal communication).

Experiments were conducted in 2002 with hot water and sugar. Sugar was applied to Russian thistle. Results will not be known until 2003/2004. Experiments with hot water were not very encouraging. Further experiments are needed before hot water as a

control technique would be fully implemented. Plastic was used on a dense stand of Ox-eyed daisy in the late summer of 2002. Results will not be fully known until 2003. Once the plastic is removed, the area will be reseeded with native species. Plastic is considered a viable option for controlling dense patches of Canada thistle while plants are in the rosette stage. It is preferable to use natural chemicals over synthetic if proven to be an effective technique.

Impacts of Alternative 2 on Soils and Vegetation

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

The use of synthetic herbicide is expected to have a **minor localized short-term adverse impact** to native vegetation and soils.

When using synthetic herbicide, three soil characteristics are particularly relevant. These characteristics are percent organic matter, available water capacity, and soil permeability. When incorporated into the soil, part of the herbicide dissolves in the soil moisture and part is adsorbed onto soil particles (primarily organic matter). The amount of herbicide adsorbed onto soil particles depends on the characteristics of the chemical and on the amount of organic matter and fine material in the soil. Any herbicide that remains in water in the soil is available for uptake by plant roots. However, if the water moves off-site or out of the rooting zone, it takes some of the dissolved herbicide with it. Depending on the distance of travel, the concentration of the herbicide, and type of herbicide used, this herbicide movement can be a problem to susceptible plants (USDA- USFS, 1996). Table 6 presents the behavior of the synthetic herbicides we propose to use and their effects on soil and plants. Please refer to Appendix B on page 120 for a list of invasive exotic species we propose to control using synthetic herbicides. Please refer to Appendix C on page 125 for the threshold levels that would warrant the use of synthetic herbicides and the type of chemical proposed to be used. It is anticipated that 65.25 acres of land would be treated with an synthetic herbicide, which is less than 0.03% of the acreage within the park. If Alternative 2 is fully implemented, it is anticipated that the amount of land needing treatment with an synthetic herbicide would be greatly reduced within three years to about one acre (please see Table 4 on page 28). It is anticipated that after three to five years, sustainable methods of control such as biocontrol, mechanical, cultural or natural chemicals would keep plants below established threshold levels. Thereafter, occasional spot treatments of synthetic herbicides may be required if invasive exotic plants exceed defined threshold levels.

Soil permeability and water-holding capacity determines how much water moves through the soil into groundwater or surface water after a rainfall. If the soil retains a large quantity of water in its upper horizons for later use by plants, the water and dissolved herbicide will have little opportunity to move. In contrast, if a soil is highly permeable and has little water-holding capacity, moisture passes through the soil readily and carries some of the herbicide with it (USDA-USFS 1996). Soil contamination could be a concern in the short-term. If Alternative 2 is selected, RMNP anticipates that over the long-term the use of synthetic herbicides would decrease

significantly, and there would be times when herbicides would not be used in the park for a year or more.

RMNP is presently funding a three-year research project to determine ecosystem impacts resulting from the use of herbicides at the park (Moore 2001). The research results will be available in 2004. The research is examining four montane plant communities where herbicides were used in the past and comparing the four sites to adjacent communities where herbicides have not been applied. Within each site, the researchers will determine plant community structure, soil characteristics, mycorrhizal inoculum potential of the soils, the decomposition of the dominant plant litter, and the soil anthropod community structure (diversity and abundance). Based on the research, sites treated with synthetic herbicides may be reinnoculated with small amounts of topsoil from adjacent undisturbed sites to replace mycorrhizal inoculum impacted by the herbicides, once the invasive exotic plants have been eradicated or suppressed below established threshold levels.

To reduce the potential for contaminating groundwater with herbicides, an aquifer vulnerability scoring system – Relative Aquifer Vulnerability Evaluation (RAVE) developed by the Montana Department of Agriculture was adapted for use at the park (see Appendix G on page 136). The scoring system takes into account soil texture and the percent of organic material in the soil. The score card would be used for every location where a herbicide is proposed to be used. It would indicate which herbicide should or should not be used, or if the area is not suited for herbicide application.

Table 6 - Behavior of Synthetic Herbicides in Soil and Effects on Target and Non-target Plants

Herbicide/Active Ingredient	Behavior of the Herbicide in soil and impact to plants
Redeem R&P (Triclopyr & Clopyralid)	Half-life in soil is on average 30 days but ranges from 10 to 46 days depending on soil type, moisture, and temperature. It is slightly toxic to practically nontoxic to soil microorganisms. It is not strongly absorbed in soil, which varies with soil and clay content, but its major degradate TCP is expected to be very mobile. Triclopyr is moderately persistent, with persistence increasing as it reaches deeper soil levels and anaerobic conditions. Leaching potential is medium. It decomposes by UV light and the solubility is miscible. It is a growth regulating herbicide for broadleaf plants. It mimics natural plant hormones. Death usually occurs to the plant within 3-5 weeks. The herbicide penetrates foliage, with a rain free period of 4 hours and is rapidly transported in plants. Spraying Redeem is not recommended in loamy sand or sand or where the water table is shallow. If deemed necessary to treat Canada thistle in these areas, a wick applicator may be used.
2,4-D Amine or 2,4-D Ester (LVE)	Half-life in soil is 10-days. It rapidly degrades in soil, and is readily taken by target plants minimizing leaching. It has no effect on microorganisms at recommended field application rates. At higher levels, 2,4-D suppresses soil fungi and nitrogen-fixing algae. Half-life in the soil is 10 days, and has a medium leaching potential. Average persistency is generally 1-4 weeks in warm moist soil. It has moved 30-46 cm in sandy soils with heavy amounts of applied water. Amine is less volatile than Ester formulations. Shows little

Herbicide/Active Ingredient	Behavior of the Herbicide in soil and impact to plants
	to no activity on native grasses. If Canada thistle is found in loamy sand or sandy soil or the water table is close to the surface, 2,4-D Amine or 2,4-D Ester may be used if the RAVE scoring is favorable, but would only be used as a last resort.
Transline (Clopyralid)	The average half-life in soil is one to two months but can range from one week to one year depending on the soil type, temperature, and rates of application. Soil microbes degrade it. Where clopyralid leaches to lower soil depths, it persists longer than it does at the surface because the microbial populations generally decrease with soil depth. Under aerobic soil conditions, the half-life is 71 days. No information is available on impacts to microorganisms. It is weakly absorbed in soil and does not adsorb to soil particles, with a moderate to high leaching potential. Clopyralid is relatively persistent in soil, water, and vegetation. Roots and foliage readily absorb the herbicide. Native grass species are especially tolerant of Transline. It can easily leach into water and is not recommended in loamy sand or sandy soil or where the water table is close to the surface.
Roundup & Rodeo (Glyphosate)	Half-life in soil is as low as 3 days and as long as 141 days. Glyphosate and the surfactant have no known effect on soil microorganisms. Rapidly and tightly adsorbed to soil. Low mobility in soils and low potential for run-off. Is non-selective on plants and will kill all plants it comes in contact with. Protection of non-target plants is imperative.
Plateau (Imazapic)	Average half-life in soil is 120 days. Weakly absorbed in high pH soil, but adsorption increases with lower pH and increasing clay content. Primarily degraded by microbes. It has limited mobility, but moderately persistent in soil. It does not volatilize from the soil surface. The use of Plateau on invasive exotic plants has restored native plant species. Reseeding can occur after the herbicide has been applied. This chemical remains in the top 12-18 inches of the soil. Non-target species such as grasses show some browning after application but no death. There will be no long-term impacts to native grasses and forbs.
Tordon (Picloram)	Average half-life in soil is 90 days, but could be as high as 278 days. Highly translocated herbicide, active throughout both foliage and roots and many broadleaf plants. It is persistent and more toxic to some broadleaf plants than 2,4D Amine or Ester, thus precautions must be followed diligently to avoid injury to non-target plants. It is a restricted herbicide because of potential injury to susceptible non-target plants. This herbicide has the highest potential for impacts to non-target species. It is leachable in sandy soil and not recommended for use in this soil type when the water table is less than 20 feet. The maximum depth of detectable residue was 18 to 24 inches. It is mobile in water, and leaching is higher with sandy soil or soil with low organic content. Most grasses are resistant, but most broadleaf plants are impacted.
Paramount (Quinclorac)	Half-life in soil is from 18 to 176 days. Slightly absorbed by soil, mobility is variable depending on soil type. A growth regulator with mainly systemic action. Adequate soil moisture and/or light rain after application is important for soil uptake. Thorough coverage is important for consistent weed control. The organic matter in the soil binds more active material than the clay factor. Microorganisms degrade the herbicide. Length of residual control can extend

Herbicide/Active Ingredient	Behavior of the Herbicide in soil and impact to plants
	for several weeks depending on soil type, moisture regime, etc. The compound is not volatile and will not influence adjacent plants, but drift onto desirable broadleaf plants especially in the <i>Linaceae</i> family is a concern and should be avoided. There is one native species in the park <i>Linum lewisii</i> in the family <i>Linaceae</i> . The herbicide should be carefully applied if field bindweed is located with native broadleaves. Application should be by a backpack sprayer for bindweed patches to minimize drift and consequential impact to adjacent native plants.
Escort (Metsulfuron methyl)	The half-life is from 120 to 180 days (in silt loam soil). Insufficient information is available to determine possible impacts to soil microorganisms. Generally active in soil, usually absorbed from the soil by plants. Absorption varies with amount of organic material. Adsorption to clay is low. Broken down to nontoxic and nonherbicidal products by soil microorganisms. May injure non-target plants. Application should be carefully done to protect non-target plants.
Telar (Chlorsulfuron)	Telar has no effect on soil microorganisms. Half-life in soil is 40 days, but can range up to 4-6 weeks. Recommended for soils with a pH of 7.5 or less. It is used at very low rates and is very active. Microbial breakdown is slow. Moderately mobile at high pH. Leaching is less at pH<6. It has a rapid foliar and root absorption. It is generally active in the soil and usually absorbed from the soil by plants. It will leach in sand, sandy loam, silty clay loam, and silt loam.

Summary of Impacts to Soils and Native Vegetation

Alternative 1 is expected to provide less invasive exotic plant control when compared with Alternative 2. With the implementation of Alternative 1, some species of invasive exotic plants would likely be contained if significant resources (time and money) were devoted to mechanical, cultural, biological and low risk methods of control. There would be no associated impacts or beneficial effects from synthetic herbicide control.

Hot water, natural chemicals, prescribed fire or plastic could pose a short-term risk to soil and native vegetation, but native vegetation should return in the long-term. Using hot water, natural chemicals or plastic only on dense patches of invasive exotic plants would minimize the risk to native vegetation.

Without the option of using synthetic herbicides, it is expected that some areas would become “weedier,” negatively impacting native flora and fauna mostly in open meadow, willow and aspen habitat, which have the highest biological diversity in the park. There would be **long-term moderate negative impacts** if synthetic herbicides were not used to control certain invasive exotic plants. Invasive exotics such as spotted knapweed, yellow toadflax, Canada thistle, field bindweed and leafy spurge are expected to increase.

Driving motorized vehicles in frontcountry areas when using hot water, or applying an synthetic herbicides would have a **short-term localized minor impact** on soils and native plants.

Implementing Alternative 1 would partially meet the mandate for which the park was established, which is preservation and protection of natural conditions. This alternative

only partially meets the guidelines of the Federal Noxious Weed Act, Executive Order 13112 on Invasive Plants, the Carlson-Foley Act, and the Colorado Undesirable Plant Management Act.

Alternative 2 would result in the greatest **long-term beneficial effects** to soil and native vegetation but would have some **localized short-term minor impacts** to soil and native vegetation. Preventing new infestations of invasive exotic plants and reducing or eliminating current infestations would help restore the vigor of native vegetation. Healthy native plants benefit the soil by preventing erosion.

The use of synthetic herbicides can pose a short-term risk to native vegetation and soils. However, the park is committed to using other control techniques first, and would use the least toxic effective synthetic chemicals only as a last resort. Synthetic chemicals are an effective means of controlling certain species of invasive exotic plants. The impacts from using chemicals are short-term, while the benefits to natural resources are long-term. About 65.25 acres of land have been infested with invasive exotics that have exceeded defined thresholds and warrant synthetic herbicide control. Without the use of synthetic herbicides, it is anticipated that the number of infested acres would increase despite the use of other IPM techniques to control invasive exotics. If Alternative 1 is implemented instead of Alternative 2, park managers must accept the fact that biological diversity would be impacted in important habitat mostly below 9,000 feet elevation.

Implementing Alternative 2 would fully meet the mandate for which the park was established, which is preservation and protection of natural conditions. This alternative fully meets the guidelines of the Federal Noxious Weed Act, Executive Order 13112 on Invasive Plants, the Carlson-Foley Act, and the Colorado Undesirable Plant Management Act.

Cumulative Impacts

Previous impacts to soils and native vegetation in most areas proposed for invasive exotic plant control are due to the presence of invasive exotic plants, past and present invasive exotic plant control, and from earlier anthropic disturbances such as livestock grazing and haying, water diversions and irrigation, cultivation of grassland meadows, mining, settlements, lodges, camps and cabins, a downhill ski area, nine hole golf course and park development activities. The anthropic disturbances varied considerably as to type, intensity, and duration before and after the park was established.

Implementation of **Alternative 1 would have a minor cumulative impact** on soils and native vegetation in specific areas of the park primarily due to mechanical control such as hand pulling and digging, and using natural chemicals. Some impacts could also occur from motorized vehicles driving in grassland meadows in front country areas if a method like hot water is used. These cumulative effects would be ameliorated over time as native vegetation is restored and natural conditions return to previously disturbed sites. It is anticipated that Alternative 1 may not be effective at controlling some aggressive invasive exotic plants like spotted knapweed, yellow toadflax, field bindweed and leafy spurge. If some exotic plant species continue to spread within the park, it is anticipated that there would be **minor to moderate cumulative impacts** due

to further soil erosion and loss of native plant biodiversity. Disturbances to soil and native plants would increase as more emphasis is placed on mechanical control.

Alternative 2 would have a minor cumulative impact similar to Alternative 1. It is anticipated that troublesome invasive exotic plants would decrease as the full range of IPM techniques are implemented, and native vegetation would be restored, resulting in the amelioration of cumulative impacts. Native plant biodiversity is expected to increase in the long-term.

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to soils or native vegetation whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

Natural Soundscape and Lightscape

Weed management activities will not be conducted at night, so there will be **no impacts to the natural lightscape** associated with any of the IPM techniques.

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts were derived from park staff's observations of the effects on the natural soundscape from invasive exotic plant control activities. The thresholds of change for the intensity of impacts to the natural soundscape are defined as follows:

- **No impact** – There is no discernable impact
- **Negligible** – The impact is at the lowest level of detection and causes very little or no physical disturbance when compared with current conditions.
- **Minor** – The impact is slight, but detectable in some areas, with few perceptible effects of physical disturbance.
- **Moderate** – The impact is readily apparent in some areas and has measurable effects of physical disturbance.
- **Major** – The impact is readily apparent over a larger area and has severe effects of physical disturbance.
- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of Alternative 1 on the Natural Soundscape

Mechanical Control

There would be **negligible short-term localized noise impacts** associated with hand pulling, digging, or cutting of noxious weeds. There would be **minor short-term localized noise impacts** associated with the use of string trimmers or mowers powered with gasoline engines.

Cultural Control

There would be **negligible to minor localized short-term noise impacts** associated with revegetation activities and prescribed fire activities.

Biological Control

There would be **no noise impacts** associated with biological control.

Low Risk Methods

The hot water machine is noisy and would cause **short-term localized minor noise impacts** to park visitors and wildlife within hearing distance of the machine. Because of the weight of the machine, it has to be placed in the back of a truck or towed in a trailer behind an All Terrain Vehicle (ATV).

Impacts of Alternative 2 on the Natural Soundscape

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

Backpack sprayers carried by a contractor, park employees, or by horse would be used to apply herbicides in some locations. There would be **negligible short-term localized noise impacts** associated with the use of backpack sprayers. Tractors or ATVs would be used when applying chemicals in front country meadows. This would result in **short-term localized minor noise impacts**. There would be no aerial application of herbicides, so impacts from a helicopter or fixed winged aircraft will not occur.

Summary of Impacts to the Natural Soundscape and Lightscape

Alternative 1 would result in **short-term localized negligible to minor noise impacts** because of invasive exotic plant management activities. Most noise would be associated with mechanical control methods such as digging and cutting of plants and the use of a hot water machine. In limited cases, a gasoline-powered string trimmer or a mower would be used in the Natural, Historic and Developed Zones. Occasionally string trimmers may be used in designated or recommended wilderness if determined to be the minimum tool needed to accomplish the work.

Alternative 2 would result in **short-term localized minor noise impacts** from the use of tractors or all-terrain vehicles which would be used when applying synthetic herbicides in front country meadows. There would be no aerial application of herbicides, so impacts from a helicopter or fixed winged aircraft will not occur.

Cumulative Impacts

Noise impacts in RMNP are most often caused by aircraft overflights, vehicle traffic and human voices (noisy campers, hikers, etc.). When added to these existing noise impacts within the park, weed management activities can result in **short-term localized minor cumulative impacts**.

The NPS has removed numerous camps, lodges, and other developments from the park, including a nine-hole golf course and a ski area. Natural quiet, sounds and light have been restored to these previously developed sites. However, the NPS has also developed numerous facilities for park visitors and to facilitate the management of the park. These facilities include roads, campgrounds, trails, visitor centers, entrance stations, administrative and maintenance facilities, and housing for park employees. All of these facilities have impacted natural quiet, sounds and light.

Alternative 1 would create **negligible to minor localized cumulative impacts** to the natural soundscape with **no cumulative impacts** to the lightscape. This impact would be of short duration and localized to specific areas of the park where mechanical control (i.e., use of a mower, string trimmer or a hot water machine) was being done. Use of a hot water machine or mower would be restricted to front country areas, but a string trimmer could be used in wilderness areas if deemed the necessary minimum tool. It is anticipated that Alternative 1 may not be effective at controlling some aggressive invasive exotic plants like spotted knapweed, yellow toadflax, Canada thistle, field bindweed and leafy spurge. If some exotic plant species continue to spread within the park, additional mechanical, cultural and low-risk control would be required, which would create additional cumulative impacts to natural quiet and sounds.

Alternative 2 would create **negligible to minor localized cumulative impacts** to the natural soundscape with **no cumulative impacts** to the lightscape. In addition to the use of mowers, string trimmers or a hot water machine, noise would also be generated by spraying equipment and vehicles used to transport the equipment. This impact would be of short duration and localized to specific areas of the park where control work was being done. It is anticipated that troublesome invasive exotic plants would decrease as the full range of IPM techniques are implemented, and native vegetation would be restored. This would reduce the need for exotic plant control and would reduce impacts to natural quiet and sounds.

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to the natural soundscape and lightscape whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

Aquatic, Wetland and Riparian Communities

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts were derived from research conducted in the park, park files, scientific literature, and park staff's observations of the effects on aquatic, wetland and riparian communities from invasive exotic plants and control activities. The thresholds of change for the intensity of impacts to aquatic, wetland and riparian communities are defined as follows:

- **No impact** – There is no discernable impact
- **Negligible** – The impact is at the lowest level of detection and causes very little or no physical disturbance when compared with current conditions.
- **Minor** – The impact is slight, but could be detectable in some areas, with few perceptible effects.
- **Moderate** – The impact is readily apparent in some areas and has measurable effects.
- **Major** – The impact is readily apparent in several areas and has severe effects.
- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of Alternative 1 to Aquatic, Wetland and Riparian Communities

Mechanical Control

Removing invasive exotic plants by tools is expected to have **minor impacts to aquatic, wetland and riparian communities**. Some soil erosion and loss of native plants may occur at the base of an invasive exotic plant if dug from the ground. If a large patch is removed from a wetland this could increase soil erosion and have a short-term impact on riparian communities and water quality, but a long-term benefit is expected with the restoration of the native plant community.

Native riparian vegetation is expected to recover when invasive exotic plants are removed over the long-term (Redente and McLendon 1994). Cutting seed heads and cutting plants at ground level would have no negative effect on adjacent native species. The removal of invasive exotic plants would enhance native species. Water quality should remain good or improve in the long-term with the restoration of native vegetation and protection of soils.

Mowing would not be allowed in riparian communities, but a string trimmer could be used. Cutting invasive exotic plants would not disturb the soil, but could have a minor impact on native species growing amongst the exotics. Cutting is not an effective means of control for many invasive exotic plants that occur in riparian habitat, but could be effective at preventing some species from flowering and producing seed. The one exception could be cutting Canada thistle. Repeated mowing or cutting of Canada thistle over several years could be effective where the root system is restricted by a high water table, such as near rivers (Beck and Sebastian 2000). Cutting invasive exotic

plants generally does not kill (and may even spread) some invasive exotic plants that reproduce by seed and through rhizomes.

Cultural Control

Restoring disturbed riparian communities to natural conditions by replanting native plant species will reduce soil erosion, enhance native plant communities, and improve water quality. Cultural control through native plant restoration will result in a **minor benefit to aquatic, wetland and riparian communities**. Maintaining riparian communities in a healthy vigorous condition favors native plants over invasive exotic plants (Redente and McLendon 1994, McLendon 1996).

Prescribed fire may be used to maintain healthy native plant communities in sedge, grass or rush communities in riparian areas, and in willow habitat. Due to the negative effects of heavy elk browsing in willow and aspen communities, prescribed fire is not likely to be used for the foreseeable future. The combination of prescribed fire and elk browsing can negatively impact willow and aspen. Timothy is an invasive exotic plant that could be managed with prescribed fire in riparian areas. Red top and yellow toadflax are species that could increase from a prescribed fire in riparian areas. Areas infested with red top or yellow toadflax should not be burned. Burn units in riparian communities have to be inventoried, and invasive exotic species documented to determine whether prescribed fire should be used. Prescribed fire would have a **short-term minor impact on aquatic and wetland communities** by increasing sediment. Prescribed fire would have a long-term benefit when riparian communities are restored.

Biological Control

The use of biological control insects proposed for use in RMNP (see Appendix H on page 141) should have **no impact on aquatic, wetland or riparian communities**. Biological control insects would be carefully chosen to selectively feed on the invasive exotic plants to be controlled. However, one biological control insect that was released outside the park has become established within the park. This insect, though inadvertently introduced to the park, is negatively impacting native thistles in and near wetland habitat.

Low Risk Methods

There would be **minor short-term adverse impacts** to aquatic, wetland and riparian communities associated with the use of low risk methods. Because of concerns related to the use of synthetic herbicides in or near aquatic, wetland and riparian communities, low risk methods would be more extensively used. There would be long-term benefits when invasive exotics are removed and riparian communities are restored to natural conditions. Hot water, depending on the machine used, is applied at a temperature of 230° or 280° Fahrenheit. One of the machines uses a foam that is composed entirely of plant sugars. The foam formula would have a **negligible short-term impact** on aquatic, wetland and riparian communities. The recommended mix for the foam formula is .0004 mg/l, which is well below the 10 mg/l at which detrimental effects on aquatic organisms would occur. Deep rooted invasive exotic plants, such as leafy spurge, yellow toadflax, and Canada thistle, may not be killed using the hot water method. Corn or wheat gluten meal may be effective for controlling Canada thistle.

Using natural chemicals would not be effective on deep-rooted invasive exotic plants such as leafy spurge.

Impacts of Alternative 2 to Aquatic, Wetland and Riparian Communities

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

With the implementation of the Mitigation Measures that appear on page 104, the use of synthetic herbicides near water could result in **negligible to minor short-term adverse impacts** to aquatic, wetland and riparian communities. Herbicides have the potential to enter open water through runoff and spills. Herbicide concentrates are potential point sources of pollution that can impact surface and groundwater. When the concentrate is mixed with water and applied to invasive exotic plants, contamination of surface waters because of runoff is unlikely except when heavy rainfall occurs soon after application. Applying herbicides when rainfall is imminent would be prohibited except for Paramount, where adequate soil moisture and/or light rain is important for soil up take. Leaching, root uptake, and movement in soil and groundwater are the primary hydrologic processes governing herbicide movement (Neary and Michael 1988).

RMNP adopted the Relative Aquifer Vulnerability Evaluation (RAVE) developed by the Montana Department of Agriculture and modified for RMNP, to help reduce the potential of contaminating groundwater with herbicides (see Appendix G on page 136). The scoring system takes into account depth to groundwater, topographic position, distance to surface water, annual precipitation, herbicide application frequency, herbicide application method, and leachability. The score card would be used for every location where a synthetic herbicide application is proposed. Using this system would indicate which herbicide should be used or if the area is not suited for herbicide use. Table 7 presents the behavior of the synthetic herbicides proposed for use in RMNP in aquatic, wetland and riparian communities. Herbicides proposed for use near water resources must be approved for use in and around water. Hand application methods, such as using a wick or wand applicator, may be used. Personnel applying herbicides would follow all label directions and precautions. Herbicide drift would be negligible with implementation of mitigation measures including requiring the use of buffer zones (see Mitigation Measures on page 104). Implementation of mitigation measures associated with the protection of water quality, and use of the RAVE score card system, would minimize effects on aquatic, wetland and riparian areas.

The potential impact of herbicides on fish and other aquatic organisms is a function of two factors: the toxic characteristics of the herbicide and the concentration of the herbicide to which the fish or other organisms are exposed. Herbicides applied in accordance with label restrictions are expected to have **negligible impacts** on fish or aquatic organisms because concentrations are so dilute. Table 7 provides a summary of the risks associated with use of the herbicides identified in this plan/EA. This summary is based on previous risk assessments for herbicide (USDA-USFS 1992).

Table 7 - Behavior of Synthetic Herbicides in Aquatic, Wetland, and Riparian Communities

Herbicide/Active Ingredient	Behavior of the Herbicide in Aquatic, Wetland and Riparian Communities
Redeem R&P (Triclopyr & Clopyralid)	Leaching potential is medium, half-life in soil is on average 30 days but ranges from 10 to 46 days depending on soil type, moisture, and temperature. Spraying Redeem is not recommended where the water table is shallow. If deemed necessary to treat Canada thistle in these areas, a wick applicator may be used. Avoid drift into surface water. Both triclopyr BEE and triclopyr TEA may produce TCP, which is relatively mobile and persistent and has the potential to degrade groundwater. Triclopyr and TCP do not absorb to soil and sediment particles, and may be transported by surface runoff waters. However, Troclopyr is not predicted to persist in surface waters. The half-life in river water using natural light sources was 1.7 days.
2,4-D Amine or 2,4-D Ester (LVE)	In surface water, microorganisms readily degrade 2,4-D. Rates of breakdown increase with increased nutrients, sediment load, and dissolved organic carbon. Under oxygenated conditions, the half-life is 1 to several weeks. 2,4-D has only limited potential to contaminate groundwater. 2,4-D is mobile to highly mobile in sand, silt, loam, clay loam, and sandy loam soils. However, it is unlikely to be a ground-water contaminant due to the rapid degradation of 2,4-D in most soils and rapid uptake by plants. 2,4-D residues dissipate rapidly in surface water, especially in moving water. 2,4-D residues may be detected in still water after 6 months. Do not apply 2,4-D directly to water or wetlands such as swamps, bogs, marshes, and potholes except as specified for certain aquatic uses. Most cases of groundwater contamination have been associated with mixing/loading and disposal sites where it is heavily used, but this will not occur in RMNP. 2,4-D Amine is toxic to aquatic invertebrates. Avoid drift and runoff that may adversely affect aquatic invertebrates and non-target plants.
Transline (Clopyralid)	It is highly soluble in water. Because it is highly soluble it does not adsorb to soil particles and is not readily decomposed in some soils. It may leach into groundwater. Groundwater may be contaminated if Transline is applied to areas where soils are very permeable and the water table is shallow. There is also the potential to contaminate surface waters. Clopyralid is relatively persistent in soil, water, and vegetation. Warm, moist soils treated at low rates will lose clopyralid in a comparatively short period, whereas when applied to cold, dry soils or waterlogged soils, and at higher rates, clopyralid residues may persist for several years.
Roundup & Rodeo (Glyphosate)	The Roundup and Rodeo formulations are two of only a few herbicides approved for controlling weeds in delicate aquatic environments. Strongly adsorbed to suspended organic and mineral matter, which makes it unlikely to leach into water. However, glyphosate can move into surface water when soil particles to which it is bound are washed into streams, rivers or lakes. Primarily broken down by microorganisms. Half-life in soil is 30 days.

Herbicide/Active Ingredient	Behavior of the Herbicide in Aquatic, Wetland and Riparian Communities
Plateau (Imazapic)	Plateau is soluble in water and is hydrolytically stable in aqueous solution. Plateau in water is, however, rapidly photo degraded by sunlight with a half-life in water of from less than 8 hours to one to two days. Based on the chronic reference dose (RfD) of 0.05 mg/kg b.w./day, set by EPA for the time-limited tolerance and the EPA's default factors for body weight and drinking water consumption, the Drinking Water Level of Comparison (DWLOC) was 1700 ppb and for children the DWLOC was estimated to be 500 ppb. It has little lateral movement in soil. No residues were found below the 18-24 inch soil layer. Plateau does not readily move off site and binds moderately to most soil types. Imazapic is not registered for aquatic use.
Tordon (Picloram)	Is soluble in water, and may be mobile. Can, under certain conditions, contaminate groundwater, which may be used for irrigation and drinking purposes. Under some conditions, Tordon may also have a high potential for runoff into surface water (primarily via dissolution in runoff water). These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters or stream banks that are unstable and may slip into the stream, sites with a water table within 72 inches (6 feet) of the surface and coarse textured soils, areas inside the annual flood plain, frequently flooded areas, or areas over-laying extremely shallow groundwater. These properties combined with its persistence, means it may pose a risk to groundwater contamination. The buffer zone for use of Tordon within RMNP would be 200 feet from any aquatic, wetland or riparian area because of its potential to contaminate aquatic systems. Tordon will not be used when depth to water is less than 72 inches. The RAVE score card would determine if Tordon is appropriate in a particular location.
Paramount (Quinclorac)	After application there is little potential for movement off of the treated area. It is not volatile and binds moderately to most soil types once applied. There are no known instances where Paramount has moved from a treated site into surface water. It is rather persistent in soil and prone to leach into groundwater, so Paramount will not be used where the water table is close to the surface (<60 inches). DWLOCs for chronic dietary exposure in drinking water, 12,000 micrograms/L for U.S. population in surface water, 2,700 micrograms/L for infants/children.
Escort (Metsulfuron methyl)	Escort dissolves easily in water. It has the potential to contaminate groundwater at very low concentrations. It leaches through silt loam and sandy soils. The half-life is from 120 to 180 days in silt loam soil. Because it is soluble in water, there is a potential for surface waters to be contaminated if it is applied directly to bodies of water or wetlands. Tests show that the half-life for Escort in water, when exposed to artificial sunlight ranged from 1 to 8 days.
Telar (Chlorsulfuron)	Telar may be dispensed as a suspension in water with constant agitation. Purified chlorsulfuron, which is the active ingredient, is soluble in water. The potential for leaching is high in permeable soils. However, significant groundwater contamination should not occur because of the low use rates and the dispersion of residues with leaching. No information is available for surface water. For this reason, a buffer zone would be maintained when applying it near surface water, or hand methods such as a wick applicator could be used to avoid drift.

Summary of Impacts to Aquatic, Wetland and Riparian Communities

Alternative 1 would result in some **long-term minor beneficial effects** to aquatic, wetland, and riparian communities. In the long term, this alternative has a higher risk for failure. Without the limited use of synthetic herbicides, infestations of some exotic plants would increase in wetland, and riparian communities, negatively impacting these sensitive resources. Other IPM techniques, such as hot water and using natural chemicals, would be more extensively used to control persistent plants, which may reduce the amount of infested acres.

With the implementation of mitigation measures (Please see page 104) and the use of the RAVE scorecard, **Alternative 2** would result in **short-term negligible to minor impacts** to aquatic, wetland and riparian communities. The level of impact is dependent on the herbicide selected and distance to surface and groundwater. Some of the synthetic herbicides proposed for use in RMNP would not be used near aquatic, wetland or riparian communities, others would only be used with a wand or wick applicator.

Selection of the most appropriate chemical is based on current information acquired and approved through the following sources:

- NPS-Pesticide Use Proposal System (Intermountain Region IPM Specialist)
- Internet sources
- Environmental documents prepared by the Bureau of Land Management (BLM 1991)
- Environmental documents prepared by the U.S. Forest Service (USDA-USFS 1992).

Any pesticide use in RMNP requires review and approval by the regional NPS IPM Specialist.

This alternative would result in a **long-term moderate benefit** to aquatic, wetland, and riparian communities. The implementation of this alternative would ultimately decrease the use of chemicals and some years the park would be herbicide free.

Cumulative Impacts

Previous impacts to aquatic, wetland and riparian communities in most areas proposed for invasive exotic plant control are due to continued visitor use, the presence of invasive exotic plants, past and present invasive exotic plant control, and from earlier anthropic disturbances such as livestock grazing and haying, water diversions and irrigation, cultivation of grassland meadows, a nine hole golf course, a downhill ski area and park development activities. The anthropic disturbances varied considerably as to type, intensity, and duration before and after the park was established.

Alternative 1 would result in **minor cumulative impacts** to wetland and riparian vegetation in specific areas of the park primarily due to mechanical control such as hand pulling and digging. No motorized vehicles would be allowed in wetland and riparian communities. It is anticipated that Alternative 1 would not be effective at

controlling some aggressive invasive noxious weeds like yellow toadflax and leafy spurge that occur in or near wetland habitat. Weed cutting and using corn or wheat gluten meal may be effective in controlling Canada thistle. Plastic sheeting may also be used on dense patches of some invasive exotics. If some exotic plant species continue to spread within the park, additional mechanical, cultural and low-risk controls would be required, which would create additional cumulative impacts to wetland and riparian vegetation.

Alternative 2 would result in **minor cumulative impacts** to wetland and riparian vegetation in specific areas of the park primarily due to mechanical control and synthetic herbicide control. Using the RAVE scoring system (please refer to Appendix G on page 136) and implementation of mitigating measures would reduce the potential for contaminating groundwater and impacting wetland and riparian communities. To minimize cumulative impacts on wetland and riparian communities, synthetic chemicals would only be used after other IPM techniques were determined to be ineffective. If synthetic herbicides are used, wick or wand applicators would be used to further minimize impacts to wetland or riparian communities. It is anticipated that troublesome invasive exotics plants would decrease as the full range of IPM techniques are implemented, and native vegetation would be restored. This would reduce the need for exotic plant control and would reduce impacts to wetland and riparian areas.

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to aquatic, wetland or riparian communities whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

Endangered, Threatened and Rare Species

Studies demonstrate that invasive exotic plants cause reduced abundance of and/or diversity of birds, reptiles, small mammals and insects (Huenke 1996). Habitat tends to degrade from the invasion of exotic plants, which has a direct impact on endangered, threatened and rare species (Olson 1995). Grass production can drop by as much as 90% with the expansion of invasive exotic plants (Harris and Cranston 1988). This in turn reduces forage and cover for wildlife. Displacement of native plants by non-native invaders may be a primary mechanism for global and regional loss of biodiversity (Stolgen 1999). Containing, controlling, and eradicating the 35 invasive exotic plants addressed in this Plan would protect endangered, threatened and rare species within the boundaries of the park. The U.S. Fish and Wildlife Service (FWS) Ecological Services, Colorado Field Office, was consulted in December 2002 regarding this Plan. RMNP sought concurrence for our initial assessment that implementation of the alternatives is **not likely to have an adverse effect** on the park's federally listed, candidate or rare species. A copy of the letter is in Appendix L on page 146. On July 3, 2003, RMNP received concurrence from the FWS via a telephone call and received a letter on July

10, 2003 concurring with the park's assessment. A copy of the letter is in Appendix L on page 147.

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts were derived from available information on endangered, threatened and rare species. Map locations of sensitive resources were compared with known invasive exotic plant populations. Predictions about short- and long-term site impacts were based on existing inventory and monitoring data from RMNP. The thresholds of change for the intensity of impacts to endangered, threatened and rare species are defined as follows:

- **No impact** – There is no discernable impact
- **Negligible** – The impact could result in a change to a population or individuals of a species or resource but the change would be so small that it would not be of any measurable or perceptible consequence.
- **Minor** – An action that could result in a change to a population or individuals of a species or a resource. The change would be small and localized and of little consequence.
- **Moderate** – An action that would result in some change to a population or individuals of a species or resource. The change would be measurable and of consequence to the species or resource but more localized.
- **Major** – An action that would have a noticeable change to a population or individuals of a species or resource. The change would be measurable and result in a severely adverse or major beneficial impact, with possible permanent consequences for the species or resource.
- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of Alternative 1 on Endangered Threatened and Rare Species

Mechanical Control

Removing invasive exotic plants using tools would have **negligible adverse impacts** to **federally listed** threatened, endangered or rare species. Every area proposed for invasive exotic control work would be checked before work begins, and work would be adjusted accordingly to protect these sensitive species. No threatened or endangered species is known to occur in any area presently proposed for control work, but some rare plants do occur. There are no known federally listed threatened or endangered plants within the boundaries of RMNP, but there are some listed wildlife (refer to Appendix D on page 127).

Removing invasive exotic plants using tools would have **negligible adverse impacts** to **state listed** threatened or endangered species. Surveys documenting rare plants have been ongoing for a number of years, and all known rare plant locations are being mapped and entered into the park's Geographical Information System (GIS) database.

Rare plant locations are being assessed for threats by invasive exotic plants (DBG 2000). This information would be made available to crews involved in control efforts.

Some soil erosion and loss of native plants may occur at the base of an invasive exotic plant if it is dug from the ground. If a large patch is removed, this could increase the chance that rare plant species could be affected. Flagging would be used to identify known locations of rare plants when exotic plant control work is to be conducted nearby. If invasive exotic plants are intermixed with rare plants, control work would be carefully done by hand pulling or digging.

Native vegetation is expected to recover in areas where invasive exotic plants are removed (McLendon and Redente 1994). Cutting seed heads and cutting plants at ground level would have no effect on adjacent native species. With the removal of invasive exotic plants, the native species will be enhanced.

There could be a short-term displacement of endangered, threatened and rare wildlife when working in the area. Presently, there are no known patches of invasive exotic plants near known breeding locations of endangered, threatened or rare wildlife species. The Northern goshawk (a state vulnerable species) is at the greatest risk for displacement since its habitat falls within known areas of invasive exotic plants, but goshawks tend to nest in dense forest that is not conducive to invasive exotic plants. Goshawks forage in open meadows where invasive exotic plants occur, and the long-term consequences of removing invasive exotic plants would enhance native flora and consequently native prey.

Gas powered mowers or string trimmers would not be used near endangered, threatened or rare flora or fauna. Mechanical treatment is labor intensive, but is recommended for small infestations. Because some areas require periodic mechanical control, impacts from mechanical treatment can be recurring.

Cultural Control

Restoring disturbed plant communities to natural conditions through revegetation efforts would provide a **long-term benefit** to threatened or rare species. Cultural treatments can benefit native plants and wildlife. Rare plants are managed under a Class I designation when revegetation is considered as per the Vegetation Restoration Management Plan for RMNP (McLendon & Redente, 1994). The primary goal of revegetation efforts is to insure that rare plant communities are protected. Genetic integrity and local genotypes of rare plants must be preserved. Revegetation near rare plants would be the minimum necessary to ensure the preservation of the rare species, and would rely heavily on passive versus active planting (i.e. allowing the site to restore naturally versus collecting plant material and growing species in the park's greenhouse for planting back at the disturbed site).

Prescribed fire may be used to maintain healthy native plant communities in some habitat types. The combination of fire and elk browsing can negatively impact some native plant communities such as aspen, upland shrub and willow (Nesvacil and Olmsted, 2003, Connor et. al., 2003). For any prescribed fire, endangered, threatened and rare species are considered. Fire can enhance some invasive exotic plants while reducing populations of others. Burn units have to be inventoried and invasive exotic species documented to determine where prescribed fire is appropriate. Also, known

endangered, threatened and rare species locations must be identified for fire personnel. A prescribed fire, if applied correctly, would have a **short-term minor impact** on plant and animal communities, but would have a **long-term minor to moderate benefit** when those communities are restored to natural conditions.

Biological Control

The use of biological control insects (see Appendix H on page 141) should have **no impact** on threatened, endangered or rare species. Biological control insects would be carefully chosen to insure that they only feed on the invasive exotic plants to be controlled. Native plant species are expected to benefit from the use of biological control, which would also have a long-term benefit on threatened, endangered or rare species by enhancing habitat.

Low Risk Method

There would be **negligible short-term adverse impacts** to threatened, endangered or rare species of flora and fauna from using hot water or other low risk methods such as natural biodegradable chemicals, or plastic sheeting. Hot water and other low risk methods could impact a rare plant if applied directly to that plant, so it is imperative that rare plant locations are identified and avoided when controlling invasive exotic plants using these techniques. One hot water machine uses a foam composed of 100% plant sugars. The foam formula would not have any secondary effect on rare plants from residue. The foam formula is EPA registered as a low risk natural herbicide and quickly biodegrades after application.

The hot water machines used to control exotic plants are noisy, and short-term displacement of threatened, endangered or rare wildlife may occur when they are in operation. The Northern goshawk is likely to be the only specie that has the potential to be displaced when the machine is in use. Northern goshawks are likely to avoid using open meadows for foraging when a hot water machine is in use. It is very unlikely that threatened, endangered or rare wildlife would abandon an area due to short-term noise generated by a hot water machine, but some species could be temporarily displaced while the machine is in use. A hot water machine would probably not be used near the threatened greenback cutthroat trout or Colorado River cutthroat trout because of accessibility limitations. However, low risk natural chemicals may be used by wick or wand applicators near water, but impacts are expected to be negligible.

Impacts of Alternative 2 on Endangered, Threatened, and Rare Species

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

RMNP would use the least toxic synthetic herbicide only as a last resort after trying other IPM techniques. Monitoring at RMNP indicates that some invasive exotic species have exceeded defined threshold levels and are not currently being effectively controlled using the other IPM techniques. Synthetic herbicide use has the potential to create a **short-term minor impact** to endangered, threatened or rare species.

Herbicides have the potential to enter systems and some can bioaccumulate in wildlife,

though the herbicides proposed for use in RMNP are considered low-risk and should not bioaccumulate. Synthetic herbicides would not be used in boreal toad habitat or near native Greenback cutthroat or Colorado River cutthroat trout. Contamination of sensitive plant species because of runoff or drift is unlikely except when heavy rainfall occurs soon after application. For this reason, herbicides would not be applied when rainfall is imminent, with the exception of Paramount, which requires adequate soil moisture and/or a light rain for soil uptake. Paramount is proposed for only field bindweed. All known locations of field bindweed are not near rare plant, boreal toad or threatened or endangered fish habitat.

Herbicide treatments can present some risks, especially for rare plants. RMNP has been documenting the location of rare plant species within the park. Presently there are only two known populations of rare plants that are located near invasive exotic plants (DBG 2000). One is threatened by musk and Canada thistle and the other by invasive grasses. No chemicals (natural or synthetic) would be used near these two locations of rare plants. If rare plants are found among invasive exotic plants proposed for control by either natural or synthetic chemical means, further review would be required prior to chemical use. The potential impacts to the rare plants would be reviewed by NPS Intermountain Regional Wildlife and Plant Specialists and by the Intermountain Region IPM Specialist. If federally listed or candidate species are involved, the NPS would consult with the U.S. Fish and Wildlife Service (FWS).

With the implementation of mitigation measures (please see page 104) the risk of impacting T&E species and rare plants with chemical control would be reduced to a **negligible** level.

Long-term persistence of herbicides in the food chain, and subsequent toxic effects, is not expected to occur in RMNP. This is primarily due to the chemicals proposed for use, the rates at which they would be applied, and the quantities proposed to be used. The chemicals proposed for use do not contain organo-chlorines that can cause egg-shell thinning and other harmful effects to wildlife.

For the typical concentrations of herbicides proposed for use, the risk to fish and aquatic organisms is low. There is no proposal to use herbicides in or near greenback cutthroat trout habitat. Implementation of mitigation measures for protection of water quality can effectively minimize or eliminate most impacts to the aquatic environment, which includes habitat for the federally threatened greenback cutthroat trout and rare Colorado River cutthroat trout. Table 8 presents the impacts of synthetic herbicides proposed for use in RMNP to threatened, endangered or rare wildlife. Impacts to vegetation are also discussed in Table 6 on page 53.

Table 8 - Impact of Synthetic Herbicides on Threatened, Endangered and Rare Species

Herbicide/Active Ingredient	Impacts of the Herbicide on Threatened, Endangered and Rare Species
Redeem R&P (Triclopyr & Clopyralid)	Contact with non-target sensitive plants may injure or kill them. Avoid drift around known locations of sensitive plants by establishing buffer zones. It has low toxicity to fish. It rapidly breaks down in water to a less toxic form. It is not known to accumulate in fish. It is slightly toxic to nontoxic to invertebrates. It is slightly toxic to mammals, and mammal species that feed on short grasses are the most susceptible to possible acute impact from the use of triclopyr TEA and BEE above 3.0 lb ae/A. RMNP proposes to use Redeem at 1.5 ozs. per acre. Although the persistence of triclopyr acid/anion on avian food items is unknown, it is possible environmental concentrations would remain high enough for sufficient duration to produce some chronic effect(s) when triclopyr is used at higher amounts. The triclopyr degradate, TCP, is more toxic than the TEA or tricolpyr acid and is similar to BEE in acute toxicity to fish. The EPA is currently requiring additional confirmatory data to better characterize the fate and chronic toxicity to fish of triclopyr degradate TCP. Mammals excrete most of it unchanged in urine. It has low toxicity to birds and is nontoxic to bees. It has not been tested for chronic effects in terrestrial animals. In an eight-day dietary study on birds, the LC ₅₀ ranged from 2,935 to greater than 5,000 ppm.
2,4-D Amine or 2,4-D Ester (LVE)	It is highly toxic to non-target plants and must be used with extreme caution around known endangered, threatened, rare or other non-target plants. Buffer zones are imperative. 2,4-D when used in large amounts can bioaccumulate in animals. However, the amount of 2,4-D proposed for use in RMNP should not be enough to bioaccumulate in animals. 2,4-D Amine and Ester are generally nontoxic to fish. LC ₅₀ levels for bluegill, sunfish, and rainbow trout are 263 and 377 mg/L, respectively (Tu et al., version April 2001). 2,4-D forms range from being practically nontoxic to moderately toxic to birds. It is relatively nontoxic to honey bees. Mammals have moderate sensitivity to 2,4-D exposure, and it should be used with caution around known locations of endangered, threatened, or rare animals. Toxic effects were noted in tested animal's kidneys at low dosages in two-year dietary tests in mice and rats. Some animals such as dogs are significantly more sensitive to 2,4-D organic acids than are rats and humans, which means species such as coyotes, fox and other similar native mammals may be sensitive. RMNP currently has no known population of T&E listed species such as the lynx or gray wolf. It may cause eye damage and skin irritation to animals that come in contact with 2,4-D formulations. 2,4-D formulations were not mutagenic in most studies.
Transline (Clopyralid)	Contact with non-target plants may injure them, so Clopyralid should be used with caution around known threatened, endangered or rare plants. It has low toxicity to fish and aquatic invertebrate animals. It does not bioaccumulate in fish tissues. It has low toxicity to birds and mammals and is not toxic to bees. However, clopyralid can cause severe eye damage to mammals including permanent loss of vision. It is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor.

Herbicide/Active Ingredient	Impacts of the Herbicide on Threatened, Endangered and Rare Species
Roundup & Rodeo (Glyphosate)	<p>Contact with threatened, endangered or rare plants may injure or kill them so non-target plants must be protected. Roundup and Rodeo have an intermediate to acute toxicity to freshwater fish and aquatic invertebrates. Glyphosate is practically nontoxic to birds and mammals. It is practically nontoxic to bees but exposure to freshly dried Roundup killed over 50% of three other species of beneficial insects: a parasitic wasp, lacewing, and a ladybug. The surfactant MONO818 included in Roundup may interfere with cutaneous respiration in frogs and gill respiration in tadpoles and is highly toxic to fish. RMNP will avoid using MONO818. Glyphosate and its formulations have not been tested for chronic effects in terrestrial animals, but does show blood and pancreatic effects during subchronic feeding studies with rats and mice. Some studies indicate that glyphosate does not cause genetic damage, but other studies have shown that both glyphosate and glyphosate products are mutagenic. Glyphosate may be a hazard to threatened, endangered or rare species if applied to areas where they live. The Roundup and Rodeo formulations are two of only a few herbicides approved for controlling weeds in delicate aquatic environments. Strongly absorbed to suspended organic and mineral matter. Primarily broken down by microorganisms.</p>
Plateau (Imazapic)	<p>Plateau is not mutagenic or teratogenic and would not be expected to have any adverse effect on wildlife. Plateau is considered nontoxic to mammals, aquatic invertebrates and birds, but is of moderate toxicity to fish. Imazapic is nontoxic to bees. It does not have the potential to “mimic” estrogen, nor can it be considered an endocrine disrupter. It is considered nontoxic to mammals through physical exposure or ingestion. If ingested, Plateau is rapidly excreted in the urine and feces and does not bioaccumulate in animals. It is also highly unlikely to move through the food chain. However, no specific toxicology studies have been conducted on amphibians, though impacts to these sensitive species should have no adverse effect based on research on other species.</p>
Tordon (Picloram)	<p>The preponderance of data shows Picloram to be non-mutagenic in ‘In vitro’ (test tube) tests and in animal test systems. However, one study found that chromosome aberrations increased in frequency in hamster ovary cells exposed to picloram. Some other recent studies show additional evidence of mutagenicity. The herbicide is slightly to moderately toxic to aquatic organisms on an acute basis (LC₅₀/EC₅₀ between 10 and 100 mg/L in most sensitive species). There is evidence that picloram is lethal to fish at a concentration of 1 ppm. Picloram has very low toxicity to soil microorganisms at up to 1,000 parts per million. Picloram is almost nontoxic to birds. It is relatively nontoxic to bees. Picloram is low in toxicity to mammals; animals excrete most picloram in the urine, unchanged. Picloram may be a hazard to threatened, endangered or rare plants when used on or near them. Known locations of threatened, endangered or rare plants should be avoided and a buffer zone established around them. Picloram may be a hazard to some endangered invertebrates if it is applied to areas where they live. There are no federally threatened or endangered invertebrates in the park, but there are rare insects and one rare capshell snail. Picloram would not be used near known capshell populations. It is not expected to be a</p>

Herbicide/Active Ingredient	Impacts of the Herbicide on Threatened, Endangered and Rare Species
	hazard to other threatened, endangered or rare animals.
Paramount (Quinclorac)	It is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. It is considered practically nontoxic to avian species, fish, aquatic invertebrates, and honey bees. Avian and aquatic studies show no significant effects. It does not bioaccumulate in animals. It is not considered an estrogen disrupter and is rapidly excreted in urine. No adverse effects to threatened, endangered, rare or other wildlife are expected from the use of this herbicide. Application should be by a backpack sprayer for bindweed patches to minimize drift and consequential impact to adjacent native plants.
Escort (Metsulfuron methyl)	Contact with non-target sensitive plants may injure or kill them. It is practically nontoxic to fish and aquatic invertebrates. It does not bioaccumulate in fish. It is practically nontoxic to birds and mammals. It is practically nontoxic to bees. It may be a hazard to threatened, endangered or rare plants, and has to be used around known locations of these plants with extreme caution, and buffer zones must be established. It is not considered a hazard to endangered, threatened or rare animals.
Telar (Chlorsulfuron)	Contact with endangered, threatened or rare plants may injure or kill them so must be used with extreme caution around known locations of non-target and/or sensitive plants. Buffer zones will be established. It is practically nontoxic to most fish and aquatic invertebrate animals. It does not bioaccumulate in fish. It is practically nontoxic to birds and mammals. It is not considered a hazard to threatened, endangered or rare species or other species of animals. Should be used with caution near any known locations of sensitive wildlife. It is not known to be carcinogenic to animals.

Summary of Impacts on Endangered, Threatened and Rare Species

Alternative 1 would result in some **long-term benefits** to endangered, threatened and rare species, but at a lower level than Alternative 2. Some invasive exotic plant species, such as leafy spurge, yellow toadflax, or field bindweed cannot be effectively controlled without the use of synthetic herbicides. Alternative 1, because of its limited ability to control exotic plants, does pose some risk because of the potential loss of native flora and fauna, biodiversity and habitat, which could have a negative impact on threatened, endangered and rare species.

Alternative 2 would result in the greatest **long-term benefit** to threatened, endangered and rare species. By effectively controlling invasive exotic plants, there would be an increase in the availability of habitat for breeding, nesting, and feeding for fauna and a decrease in competition between native flora and exotic plants.

Synthetic herbicide treatments can present some risks to threatened, endangered and rare species, especially for plants. The herbicides and amounts proposed for use in RMNP are expected to pose little risk to animals, but could be a risk to rare plants. With the implementation of mitigating measures (please see page 104, mapping of known locations of rare plants, and establishing buffer zones, the risk would be kept to a minimum. Being proactive versus reactive in preventing the spread of invasive exotic

plants would be a **long-term moderate benefit** to threatened, endangered or rare species.

Cumulative Impacts

Previous impacts to endangered, threatened and rare species in areas proposed for invasive exotic plant control are due to the presence of earlier anthropic disturbances such as livestock grazing and haying, water diversions and irrigation, cultivation of grassland meadows, mining, settlements, lodges, camps and cabins, a downhill ski area, a nine hole golf course, intensive grazing by native ungulates, hunting, park development activities and continuing visitor use. Previous invasive exotic plant control has resulted in negligible cumulative impacts to endangered, threatened and rare species. The anthropic disturbances varied considerably as to type, intensity, and duration before and after the park was established.

Alternative 1 would have a **negligible to minor cumulative impact** to endangered, threatened and rare species due primarily to areas being surveyed for these species before control occurs. Alternative 1, which would result in a continuation of current management practices for managing invasive exotic plants, has not been effective at controlling the spread of some invasive species such as yellow toadflax, field bindweed and leafy spurge. If these exotic plant species continue to spread within the park, additional mechanical, cultural and low-risk control would be required, which would create additional cumulative impacts to endangered, threatened or rare species.

Alternative 2 would have a **negligible to minor cumulative impact** to endangered, threatened and rare species. It is anticipated that troublesome invasive exotics plants would decrease as the full range of IPM techniques are implemented. As native vegetation is restored and habitat improves, cumulative impacts to endangered, threatened and rare species would be ameliorated.

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to endangered, threatened or rare species whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

Wildlife

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts were derived from all available information on wildlife. Map locations of sensitive resources were compared with known invasive exotic plant populations. Predictions about short- and long-term site impacts were based on existing inventory and monitoring data from RMNP. The thresholds of change for the intensity of impacts to wildlife are defined as follows:

- **No impact** – There is no discernable impact

- **Negligible** – The impact could result in a change to a population or individuals of a species or resource but the change would be so small that it would not be of any measurable or perceptible consequence.
- **Minor** – An action that could result in a change to a population or individuals of a species or a resource. The change would be small and localized and of little consequence.
- **Moderate** – An action that would result in some change to a population or individuals of a species or resource. The change would be measurable and of consequence to the species or resource but more localized.
- **Major** – An action that would have a noticeable change to a population or individuals of a species or resource. The change would be measurable and result in a severely adverse or major beneficial impact, with possible permanent consequences for the species or resource.
- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park’s general management plan or other relevant NPS planning documents.

Impacts of Alternative 1 on Wildlife

Mechanical Control

Removing invasive exotic plants by using tools (including mowing and the use of string trimmers) would have a **negligible adverse impact** on wildlife. Some soil erosion and loss of native plants may occur at the base of an invasive exotic plant if it is dug from the ground, resulting in a negligible loss of habitat. If a large patch is removed this could increase the potential impact to some wildlife, but this impact is still considered negligible.

Native vegetation is expected to recover when invasive exotic plants are removed, benefiting wildlife in the long-term. Cutting seed heads and cutting plants at ground level has no effect on wildlife in the short-term, but would have a beneficial effect in the long-term. There may be short-term displacement of wildlife in the vicinity of exotic plant management operations.

Mechanical treatment is labor intensive and will often require periodic retreatment for many of the 35 invasive exotic plants. Therefore, the impacts from mechanical treatment can be recurring.

Cultural Control

Restoring native vegetation through revegetation efforts is expected to result in a **long-term benefit** to wildlife. Restoring disturbed plant communities to natural conditions enhances wildlife habitat.

Prescribed fire can cause the spread of some invasive exotic plants while reducing populations of others. The combination of fire and elk browsing on the elk winter range can negatively impact some wildlife habitat such as aspen, upland shrub and willow plant communities (Connor, et.al. 2003, Nesvacil and Olmsted, 2003).

Prescribed fires for invasive exotic plant control will not occur in these habitat types on the elk winter range until the park has developed and approved an Elk and Vegetation Management Plan that would determine how these habitat types should be managed. For any prescribed fire, wildlife resources (snags with tree cavities, for example) are considered and protected to the degree possible. Burn units have to be inventoried and invasive exotic species documented to determine where fire should or should not be applied. A prescribed fire has **short-term adverse impacts** on wildlife, but long-term benefits to wildlife when plant communities are restored.

Biological Control

The biological control insects proposed for use in RMNP should have **no impact** on wildlife, and the long-term benefit of using biocontrol insects should enhance wildlife habitat. There is a possible long-term risk that some biocontrol insects could evolve over the long-term and have a negative impact on native flora and fauna. Some native insects may be displaced from the use of biocontrol insects, but there is no documentation to indicate that this will occur. Research is needed to substantiate this potential impact.

Low Risk Methods

The use of hot water or other low risk methods including using natural chemicals would result in **short-term negligible impacts** to wildlife, with long-term benefits resulting from the removal of invasive exotic plants and the restoration of native plant communities. One of the hot water machines uses a foam composed of 100% plant sugars. The weed foam formula would not have any secondary effect on wildlife. Like other natural chemicals, the foam formula does require registration as a natural herbicide, but is known to quickly biodegrade after application.

The hot water machines are noisy, and short-term displacement of wildlife may occur when wildlife are in the area during use. Due to potential impacts on elk and deer, the use of a hot water machine may be limited during the calving and fawning season (late May to mid-June). It is unlikely that wildlife would abandon an area from the noise, but could be temporarily displaced. Some natural chemicals, such as Burn Out, could have short-term impacts on some wildlife because of strong fumes. The fumes are strongest during application, but quickly dissipate as the product dries. Some wildlife may temporarily leave a treatment area.

Impacts of Alternative 2 on Wildlife

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

RMNP would use the least toxic synthetic herbicide only as a last resort after trying other IPM techniques. Monitoring at RMNP indicates that some invasive exotic species cannot be effectively controlled without using some synthetic herbicides. Synthetic herbicide use has the potential to create a **short-term minor impact** to wildlife species. Herbicides have the potential to enter systems, and some can bioaccumulate in wildlife, though the herbicides and amount proposed for use in

RMNP should not bioaccumulate. Contamination of sensitive wildlife species because of runoff or drift is unlikely except when heavy rainfall occurs soon after application. For this reason, herbicides would not be applied when rainfall is imminent, with the exception of Paramount, where adequate soil moisture and/or light rain is important for soil uptake.

Implementation of mitigation measures requiring the use of buffer zones (please see page 104) would help protect aquatic organisms and wildlife species that utilize riparian habitat for food and shelter. Implementation of mitigation measures associated with the protection of wildlife would effectively eliminate any negative impact. Synthetic herbicides would not be applied by spraying within 100 feet of aquatic, wetland or riparian areas. On a limited basis, synthetic herbicides could be applied within 100 feet of aquatic, wetland or riparian areas with a wick or wand applicator. Applying any synthetic chemical near aquatic, wetland or riparian areas would require approval through the RAVE scoring system and by the Intermountain Region IPM Coordinator.

Table 8 on page 71 presents the potential impacts to threatened, endangered or rare wildlife species from the various chemicals proposed for use in RMNP. This information also applies to non-listed wildlife species.

Summary of Impacts on Wildlife from the Alternatives

Alternative 1 would result in some **long-term beneficial effects** to wildlife but with a moderate risk to wildlife because some invasive exotic plants would not be effectively controlled. Negative impacts to wildlife habitat from invasive exotic plants may increase under this alternative. Fumes from natural chemicals, such as the product Burn Out, could temporally displace some wildlife.

Biocontrol species may have potential long-term secondary impacts on native species and should be carefully evaluated before they are selected for use in RMNP. For example, one species of seed-head weevil introduced to control musk thistle outside the park immigrated into RMNP (Louda et al. 1997, 1998). Due to its wide diet breadth, it is now found on native thistles and is causing negative impacts. The seed-head weevil is also displacing native species of insects that use native thistles in their lifecycle. Another insect recently released in the United States to control Canada thistle is also known to impact native thistles, and there is a possibility that it could migrate to the park (Svata Louda, personal communication). None of the biocontrol insects proposed for release in this Plan/EA are expected to cause similar problems.

Alternative 2 would have the greatest **long-term benefits to wildlife**. Existing native species would remain unimpaired and the danger of some species becoming extirpated due to aggressive exotic plants would be removed. Negative impacts to wildlife habitat from invasive exotic plants would decrease under this alternative. Negative impacts from the use of synthetic herbicides are also expected to decrease as the number of acres needing treatment decreases. Once invasive exotics identified for chemical control are below identified threshold levels, synthetic herbicides would not be used. Natural processes critical for creating and maintaining wildlife habitat (such as fire) may be restored in ponderosa pine savanna by an increase in native understory

vegetation. However, heavy elk grazing is affecting native understory vegetation and is influencing fire more significantly than invasive exotic plants.

Some wildlife would be temporarily displaced during control operations in the short-term, but would benefit in the long-term. Extreme caution would be used during herbicide applications, and wetlands would be avoided to minimize possible negative impacts to wildlife, including invertebrates and aquatic species.

Cumulative Impacts

Previous impacts to wildlife in areas proposed for invasive exotic plant control are due to the presence of earlier anthropic disturbances such as livestock grazing and haying, water diversions and irrigation, cultivation of grassland meadows, mining, settlements, lodges, camps and cabins, a downhill ski area, a nine hole golf course, hunting, visitor use, and park development activities. Previous invasive exotic plant control has resulted in negligible cumulative impacts to wildlife. The anthropic disturbances varied considerably as to type, intensity, and duration before and after the park was established.

Alternative 1 would have a **short-term negligible to minor cumulative impact** to wildlife due primarily to temporary displacement while exotic plant control activities are being conducted. However, Alternative 1 may not be effective at controlling some aggressive invasive noxious weeds like spotted knapweed, yellow toadflax, field bindweed, and leafy spurge resulting in a **long term moderate cumulative impact**. If some exotic plant species continue to spread within the park, additional mechanical, cultural and low-risk control would be required. This would cause additional cumulative impacts to wildlife.

Alternative 2 would have a **short-term negligible to minor cumulative impact** to wildlife. It is anticipated that troublesome invasive exotics plants would decrease as the full range of IPM techniques are implemented resulting in a **long-term moderate benefit** to wildlife. As native vegetation is restored and habitat improves, cumulative impacts to wildlife would be ameliorated.

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to wildlife whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

Wilderness

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts on wilderness were derived from park files, minimum tool analysis and park staff's observations of the effects of control techniques. Predictions on short- and long-term site impacts were based on existing inventory and monitoring data of invasive exotic plant locations from RMNP. The thresholds of change for the intensity of impacts to wilderness are defined as follows:

- **No impact** – There is no discernable impact

- **Negligible** – The impact would be so small that it would not be of any measurable or perceptible consequence.
- **Minor** – The impact is slight but would be small and localized and of little consequence.
- **Moderate** – The impact is readily apparent, would be measurable and consequential, but more localized.
- **Major** – The impact is severely adverse or exceptionally beneficial. The change would be measurable and the consequences could be permanent.
- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park’s general management plan or other relevant NPS planning documents.

Impacts of Alternative 1 on Wilderness

Mechanical Control

Presently there are no known invasive exotic plants in designated wilderness within the boundaries of the park. There are infestations of invasive exotic plants in recommended wilderness, and removing them using tools would have **short-term minor impacts**. Mechanized string trimmers could cause an impact in recommended wilderness primarily due to noise. A minimum tool analysis would be conducted and must be approved by the RMNP Wilderness Coordinator before mechanized equipment can be used in recommended or designated wilderness. Tractors or ATVs would not be allowed in any recommended or designated wilderness.

Cultural Control

Restoring disturbed plant communities to natural conditions by revegetating disturbed sites would have a **long-term minor benefit** on wilderness. Any vegetation restoration project in wilderness is required to follow Class I area revegetation guidelines as described in the Vegetation Restoration Management Plan for RMNP (McLendon & Redente, 1994).

Prescribed fire and wildland fire for resource benefit could be used to maintain healthy native plant communities in some habitat types within recommended or designated wilderness. Fire is a natural component of habitats within RMNP, but has been suppressed for more than 75 years. Fire suppression has affected native vegetation in montane habitats such as densely forested ponderosa pine and aspen, where the natural fire return interval is every 22 to 308 years. In more open ponderosa pine woodlands, fire suppression has had less of an impact (William Baker, personnel communication). However, for most of the forested areas of the park, which includes lodgepole pine and spruce fir, the fire return interval has not been substantially altered, and remains within the natural fire regime.

Fire can cause some exotic plant species to spread while reducing the population of others. Prescribed fire burn units and invasive exotic treatment areas would be inventoried and invasive exotic species documented to determine where fire should or should not be applied. A correctly applied prescribed fire if applied correctly would

have a **short-term minor negative impact** on wilderness, but would have a long-term benefit when plant and animal communities and the ecological balance are restored.

Biological Control

The biological control insects proposed for use in RMNP (see Appendix H on page 141) should have **no effect** on wilderness. Using biocontrol insects to control some invasive exotic plants could result in long-term benefits to wilderness. There is a potential risk that some biocontrol insects could evolve over the long-term and have a negative impact on native flora and fauna and consequently on wilderness.

Low Risk Methods

Impacts to wilderness from using hot water or other proposed low risk methods are considered to be **negligible to minor** with long-term benefits. Machines for hot water application cannot be used in recommended or designated wilderness except along the boundary where a hose could be extended. The wilderness experience for some visitors would be affected for the short-term if within hearing distance of a hot water machine. The noise of the machine is not expected to be noticeable beyond 650 feet. Natural chemicals would be applied using a backpack sprayer or perhaps a unit mounted on a horse. Using plastic sheeting would have to be evaluated by the minimum tool analysis on a case by case basis to determine if it was an appropriate method of control in wilderness.

Impacts of Alternative 2 on Wilderness

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

Specific chemical impacts to natural resources such as wildlife, endangered, threatened or rare species, aquatic resources, air, soil and vegetation are discussed elsewhere in this EA, and would apply to those resources in recommended or designated wilderness areas.

The use of synthetic herbicides may temporarily have a **minor impact** on recommended or designated wilderness. Herbicides have the potential to enter systems. Contamination of sensitive habitat or wildlife in recommended or designated wilderness because of runoff or drift is unlikely except when heavy rainfall occurs soon after application. For this reason, herbicides would not be applied when rainfall is imminent, with the exception of Paramount, where adequate soil moisture and/or light rain is important for soil uptake. However, Paramount is not likely to be used where it could affect wilderness because there are no field bindweed patches located in recommended or designated wilderness.

Implementation of mitigation measures, including the use of buffer zones (please refer to the mitigation measures on page 104) would help protect aquatic organisms and species that utilize riparian habitat for food within recommended or designated wilderness.

Summary of Impacts to Wilderness from the Alternatives

Alternative 1 would result in **short-term minor beneficial effects** to wilderness. This alternative is likely to result in **long-term moderate negative impacts** from some

invasive exotic plants that cannot be effectively controlled using mechanical, cultural, biological or low risk control techniques. RMNP's goal would be to aggressively control invasive exotic plants in areas outside recommended or designated wilderness to prevent the spread of invasive exotic plants into recommended or designated wilderness. However, Alternative 1 would not stop the spread of some invasive exotic plants already established in recommended wilderness.

Alternative 2 would have the greatest **long-term moderate benefits** to recommended or designated wilderness as compared to Alternative 1. The long-term integrity of wilderness values would be protected and enhanced. RMNP's goal is to aggressively control invasive exotic plants in areas outside recommended or designated wilderness to prevent the spread of invasive exotic plants into recommended or designated wilderness. Presently, most of the 427 acres of land infested with invasive exotic plants occurs outside recommended wilderness, and no known invasive exotic plants occur in designated wilderness. Synthetic herbicides would be used on 65.25 acres of the 427 acres infested with invasive exotic plants, and most of the acres proposed for treatment with synthetic herbicides are located outside recommended wilderness. A large percentage of recommended wilderness (>99 percent) would remain chemical free.

Mechanical and chemical control may impact wilderness values in the short-term, but would benefit wilderness values in the long-term. The minimum tool concept would be used for exotic plant management activities that are proposed to occur in wilderness or recommended wilderness. No vehicle, such as a tractor or ATV, would be allowed in recommended or designated wilderness. Backpack sprayers or a sprayer mounted on a horse may be used to chemically treat invasive exotic plants in recommended wilderness, or in designated wilderness should it become necessary in the future due to a new infestation. However, by being proactive, it is anticipated that invasive exotic plants will not become a problem in wilderness areas.

Cumulative Impacts

Previous impacts to wilderness in areas proposed for invasive exotic plant control are due to the presence of park visitors, earlier anthropic disturbances such as livestock grazing and haying, water diversions and irrigation, cultivation of grassland meadows, mining, settlements, lodges, camps and cabins, a downhill ski area, a nine hole golf course, hunting and park development activities. Previous invasive exotic plant control has resulted in negligible cumulative impacts to wilderness. The anthropic disturbances varied considerably as to type, intensity, and duration before and after the park was established.

Alternative 1 would have a **negligible to minor short-term cumulative impact** to wilderness in specific areas of the park primarily due to mechanical control such as hand pulling and digging. Motorized vehicles would not be allowed in wilderness. However, Alternative 1 may not be effective at controlling some aggressive invasive noxious weeds like spotted knapweed, yellow toadflax, field bindweed, and leafy spurge. The continued spread of these species could cause a **long-term moderate cumulative impact** to wilderness. Likely effects include increased soil erosion, loss of native plant biodiversity and wildlife habitat. If exotic plants continue to spread in

wilderness, additional mechanical, cultural and low-risk control would be required, which would create additional cumulative impacts to wilderness.

Alternative 2 would have a **negligible to minor short-term cumulative impact** to wilderness with a **long-term moderate benefit**. It is anticipated that troublesome invasive exotics plants would decrease as the full range of IPM techniques are implemented. As native vegetation is restored and habitat improves, cumulative impacts to wilderness would be ameliorated.

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to designated or recommended wilderness whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

Air Quality

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts from the effects of control techniques on air quality were derived from park files and literature cited in this plan. The thresholds of change for the intensity of impacts to air quality are defined as follows:

- **No impact** – There is no discernable impact
- **Negligible** – The impact would be so small that it would not be of any measurable or perceptible consequence.
- **Minor** – The impact is slight but would be small and localized and of little consequence.
- **Moderate** – The impact is readily apparent, would be measurable and consequential, but more localized.
- **Major** – The impact is severely adverse or exceptionally beneficial. The change would be measurable with possible permanent consequences.
- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of Alternative 1 on Air Quality

Mechanical Control

Removing invasive exotic plants using tools would have negligible impacts on air quality. The greatest impact would be localized air pollution from the use of gasoline powered string trimmers or mowers that would cause some dust and exhaust emissions. This would have a **short-term localized negligible impact** on air quality.

Mechanical treatment is labor intensive except for small invasive exotic plant infestations. Because mechanical treatment does not always remove all of the exotic

plants in an infested area, periodic retreatment is often required. Therefore, impacts from mechanical treatment can be recurring.

Cultural Control

Protecting and restoring native plants through active or passive revegetation efforts has a **negligible beneficial impact** on air quality by stabilizing soil, which reduces dust.

Fire is a natural component of the ecosystem within RMNP, but has been unnaturally suppressed in some areas of the park over a period of many years. Prescribed fires and wildland fires for resource benefit would be used to maintain healthy native plant communities in some habitat types. State smoke permits are required for any prescribed fire, and prescriptions are designed to minimize smoke impacts (Jesse Duhnkrack, personal communication). Impacts to air quality from smoke are addressed in the park's 1992 Fire Management Plan and EA, and the 2002 Wildland-Urban Interface Fuels Management EA. A correctly applied prescribed fire would only have a **short-term localized minor adverse impact** on air quality, but would result in a **long-term minor benefit** when plant and animal communities are restored and the ecological balance of fire is restored.

Biological Control

Biological control would have **no impact** on air quality.

Low Risk Methods

Impacts to air quality from the use of hot water or other low risk methods are considered to be **negligible to minor**. A tractor or ATV might be used to transport a hot water machine, and a tractor or ATV could be used to apply a natural chemical if an invasive exotic species covered a large area outside recommended or designated wilderness. Trucks, tractors and ATVs use fossil fuels. The machine that produces the hot water burns either propane and/or gasoline. Emissions would have a **short-term localized negligible impact** on air quality in the park. The product Burn Out produces fumes that can have a short-term localized impact on air quality, which could impact humans and wildlife.

Impacts of Alternative 2 on Air Quality

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

The use of synthetic herbicides can pose a **short-term minor adverse impact** to air quality, principally from drift. Impacts to air quality can be reduced by limiting spraying to days when the air is calm, or the wind speed is less than that indicated on the label (please refer to the mitigation measures on page 104).

Conducting prescribed fires on land that has been previously treated with an herbicide can be problematic. Chemicals released into the air through burning could be carried in air currents for some distance beyond the treated area, which could pose a health risk to employees conducting the burn and/or the public. It is important that chemical application be coordinated with prescribed fires. Areas treated with a chemical should not be burned for a time. An area may be treated with a chemical after a prescribed fire, but not before. The length of time that an herbicide would remain active and

thereby available for re-release if a fire occurred depends on the herbicide used. Table 9 addresses air quality issues for the chemicals we propose to use. Most chemicals should not be a concern three to four months after application, but some residue could last for up to one year. To air on the side of caution, our goal would be to apply a synthetic herbicide at least one year ahead of a planned prescribed burn or two or more months after a burn. Close coordination with the park's Fire Management Officer and his staff is essential to maintain the safety of park employees, visitors and park neighbors. With a successful weed management program, the use of chemicals can be significantly reduced over time, which would help to minimize the impact of chemicals on air quality.

If the use of herbicides is approved, areas where chemicals are to be applied would be identified using signs, and made known to fire management personnel. In the event a wildland fire occurs following chemical application, chemicals could be released into the air. Most areas where chemicals are proposed for use are in relatively safe open meadows, which are not often threatened by wildland fires.

Implementing mitigating measures for chemical application, such as the size of the spray nozzle, distance to the ground, no aerial application, etc., would minimize air quality impacts (please refer to the Mitigation Measures on page 104).

The use of tractors or ATVs for chemical application could occur, which in turn would have a **short-term localized negligible adverse impact** on air quality from exhaust emissions or dust.

Table 9 - Impact of Synthetic Herbicides on Air Quality

Herbicide/Active Ingredient	Impacts on Air quality
Redeem R&P (Triclopyr & Clopyralid)	Avoid drift. Triclopyr does not evaporate easily, volatilization is negligible on the soil surface, and photolysis does not occur. It degrades to CO ₂ and organic matter. The relatively small amount of CO ₂ released into the air from the amounts of Triclopyr proposed for use in RMNP would have a negligible impact on air quality. There is no information available on potential by-products produced from burning treated vegetation.
2,4-D Amine or 2,4-D Ester	Avoid drift. Average persistence of phytotoxicity is generally 1-4 weeks. Volatilization is considered to be minor (typically negligible) for amine or LVE in the field. Isooctyl esters are considered low-volatile esters. Oil-soluble amines are considered the least volatile. The burning of vegetation treated with 2,4-D Amine has not generated detectable 2,4-D by-products in the field.
Transline (Clopyralid)	Avoid drift. Volatilization produced insignificant losses. It does not evaporate easily. However, the potential to volatilize increases with increasing temperature, increasing soil moisture, and decreasing clay and organic matter content. Clopyralid is not degraded significantly by sunlight and the photolysis half-life in soil is >12 years. There is no information available for the potential for by-products from burning treated vegetation. Potential for adverse health effects from contacting

Herbicide/Active Ingredient	Impacts on Air quality
	treated vegetation are below expected exposure levels that could cause harmful effects.
Roundup & Rodeo (Glyphosate)	Avoid drift. Studies documented about a 10% mortality of seedlings for noncrop plants downwind at 66 feet from where Glyphosate was applied by a tractor. Volatilization produced negligible losses. It does not evaporate easily. Potential by-products from burning treated vegetation include phosphorus pentoxide, acetonitrile, carbon dioxide and water. Phosphorus pentoxide forms phosphoric acid in the presence of water. None of these compounds are known to be a health threat at the levels which would be found in a vegetation fire.
Plateau (Imazapic)	Avoid drift. It does not evaporate easily, and volatilization is negligible on the soil surface. Photolysis does not occur. A study was conducted in 1988 with a prescribe fire occurring 30 to 106 days after herbicide application and no herbicide residues were detected in the smoke. The herbicide residue detection limits were several hundred to several thousand times below occupational exposure limits to herbicides.
Tordon (Picloram)	Avoid drift. Picloram does not easily evaporate. More than 95% of picloram residue is destroyed during burning. There were no losses from volatilization. There have been no identified by-products from burning treated plants in the field, though by-products have been identified in laboratory experiments. Carbon dioxide is the major end-product of the breakdown of Picloram in soil. The relatively small amount of CO ₂ released into the air from the amounts of picloram proposed for use in RMNP would have a negligible impact on air quality.
Paramount (Quinclorac)	Avoid drift. Volatilization produced negligible losses. It does not evaporate easily. Photo degradation on the soil surface was slight to negligible. No studies have been done with Quinclorac to determine the potential residues in smoke resulting from burning after herbicide application. A study was conducted in 1988 with a prescribe fire occurring 30 to 106 days after herbicide application and no herbicide residues were detected in the smoke. The herbicide residue detection limits were several hundred to several thousand times below occupational exposure limits to herbicides.
Escort (Metsulfuron-methyl)	Avoid drift. It is broken down by microorganisms and chemical hydrolysis to nontoxic and nonherbicidal products. Volatilization produced insignificant losses and it does not evaporate easily. There was insufficient information available for determining by-products from burning treated vegetation. Expected exposure levels from coming into contact with treated vegetation are below the lowest level that would cause harmful effects.
Telar (Chlorsulfuron)	Avoid drift. There were negligible losses from volatilization. There is no information available for the potential for by-products from burning treated vegetation.

Summary of Impacts to Air Quality from the Alternatives

Alternative 1 would have **negligible to minor impacts** on air quality from gasoline-powered equipment or prescribed fire. A truck, tractor or ATV would have some minor localized impacts on air quality from emissions or dust.

Alternative 2 would have a **short-term minor local impact** on air quality because of drifting, but volatilization of herbicides should not be a problem given the proposed application methods within the park. We do not plan on applying any chemical by fixed wing aircraft or by a helicopter. Chemicals would be applied with ground-based equipment at a height of less than three feet above the ground. Chemicals would not be applied when the wind is stronger than 3 mph. Air quality impacts can be further reduced by requiring that a surfactant be mixed with herbicides (reduces drift) in addition to other mitigation measures (please refer to page 104).

Herbicide applications would be done at least one year ahead of a prescribed burn, or two or more months after a burn. Close coordination with the park's Fire Management Officer would help to ensure the safety of park employees, visitors and park neighbors.

Cumulative Impacts

Existing impacts to air quality in areas proposed for invasive exotic plant control are primarily due to pollutants originating from outside the park. Pollutants originating inside the park have a negligible to minor cumulative impact on air quality. The combined impact of past and present actions, and the implementation of Alternative 1 or 2 would have a **negligible cumulative impact** on air quality. Mitigation measures associated with the application of herbicides are designed to minimize impacts to air quality.

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to air quality whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

Cultural Resources

Invasive exotic plants may have long-term negative impacts on prehistoric sites due to the altering of native vegetation and potential for increased soil erosion. This can lead to erosion of cultural resources. In general, the removal of invasive exotic plants would contribute to the restoration and maintenance of the historic and ethnographic cultural landscapes in the park, especially around National Register sites such as the Never Summer Ranch, McGraw Ranch and the National Historic Landmark Beaver Meadows Visitor Center. Invasive exotic plants would be removed by mechanical and cultural control techniques in these areas. All treatments around National Register Sites should be planned and implemented in accordance with NPS-28 (USDI, 1993).

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts on cultural resources were derived from park files, the park's archeologist and other park staff's observation of the effects of

control techniques. Predictions on short- and long-term site impacts were based on existing inventory and monitoring data from RMNP. The thresholds of change for the intensity of impacts to cultural resources are defined as follows:

- **No impact** – There is no discernable impact. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- **Negligible** – Impact is at the lowest levels of detection – barely measurable consequences, either adverse or beneficial, to prehistoric or historic resources. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- **Minor** – Adverse impact – site disturbance results in little, if any, loss of cultural significance or integrity and the National Register eligibility of the site is unaffected. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Beneficial impact – Exotic plant management activities result in maintenance and preservation of a site. For purposes of Section 106, the determination of effect would be *no adverse effect*.

- **Moderate** – Adverse impact – site disturbance does not diminish the cultural significance or integrity of the site to the extent that its National Register eligibility is jeopardized. For purposes of Section 106, the determination of effect would be *adverse effect*.

Beneficial impact – Exotic plant management activities result in stabilization of a site. For purposes of Section 106, the determination of effect would be *no adverse effect*.

- **Major** – Adverse impact – site disturbance diminishes the cultural significance and integrity of the site to the extent that it is no longer eligible to be listed in the National Register of Historic Places. For purposes of Section 106, the determination of effect would be *adverse effect*.

Beneficial impact – Exotic plant management activities result in maintenance and preservation of a site. For purposes of Section 106, the determination of effect would be *no adverse effect*.

- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impacts of Alternative 1 on Cultural Resources

Mechanical Control

Ground disturbing activities, such as digging weeds, pulling weeds, or using a string trimmer, could have a **long-term minor adverse impact** on cultural resources. In the long-term, the removal of invasive exotic plants would have positive benefits for the protection of prehistoric or historic sites by protecting and enhancing native plant communities that stabilize the soil.

Cultural Control

Ground disturbing activities related to revegetation work (raking soil and digging in new plants) could have a **long-term negligible adverse impact** on cultural resources. Prescribed fires could also have an adverse **negligible or minor** impact on cultural resources. Because of the potential for adverse impacts, revegetation work and prescribed fires must be reviewed and approved by an archeologist before work occurs in areas where there are documented cultural resources.

Biological Control

There would be **no impact** to cultural resources from the implementation of biological control methods.

Low Risk Methods

A truck or ATV would be used to carry the hot water machine. These vehicles could have a **long-term negligible to minor adverse impact** on prehistoric or historic sites. Potential problem areas include open meadows outside of wilderness such as Moraine Park, Upper Beaver Meadows, Horseshoe Park and Hollowell Park. An archeologist would be consulted before an area is treated using hot water equipment or a natural chemical, and known sites would be avoided.

Impacts of Alternative 2 on Cultural Resources

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

A tractor or ATV could be used to apply herbicides. Driving equipment over a prehistoric site could have a **long-term negligible to minor adverse impact**. Areas where a tractor or ATV are proposed to be used would be cleared with the park archeologist prior to the start of any work. Potential problem areas include open meadows such as Moraine Park, Upper Beaver Meadows, Horseshoe Park and Hollowell Park.

Summary of impacts to cultural resources from the alternatives

Alternative 1 would result in **minor adverse impacts** to archeological sites caused by mechanical control techniques, such as hand pulling, digging, mowing or using a string trimmer. Equipment used to transport a hot water machine (either a truck or an ATV) has the potential to cause **minor adverse impacts** to archeological resources. Cultural control techniques (revegetation and prescribed fire) would be cleared by an archeologist before work occurs, and known cultural sites would be avoided.

Alternative 2 would result in **minor adverse impacts** to cultural resources caused by mechanical control techniques and the use of ATVs or tractors to haul hot water equipment or chemical sprayers. Cultural resources would receive greater protection under Alternative 2 when compared to Alternative 1 because all IPM control techniques would be available. The most appropriate IPM control technique can be selected to protect sensitive cultural resources from invasive exotic plants. The park archeologist would be consulted prior to any herbicide application using a sprayer mounted on a truck or an ATV and known cultural resources would be avoided.

Cumulative Impacts

Previous impacts to cultural resources in most areas proposed for invasive exotic plant control are due to visitor use, past and present invasive exotic plant control and from earlier anthropic disturbances that damaged or destroyed cultural resources, such as water diversions, irrigation reservoirs and ditches, cultivation of grassland meadows, mining, settlements, lodges, camps and cabins, logging, development of a downhill ski area and a nine-hole golf course. Park development activities have also impacted cultural resources. Use of the park by Native Americans dates back thousands of years. The anthropic disturbances varied considerably as to type, intensity, and duration before and after the park was established, and many developments within the park are now culturally significant.

The implementation of Alternative 1 would have a **negligible cumulative impact** on cultural resources primarily due to mechanical control, such as hand pulling and digging. Some impacts to cultural resources could occur from motorized vehicles driving in grassland meadows in front country areas if a low risk method like hot water is used. It is anticipated that Alternative 1 may not be effective at controlling some aggressive invasive noxious weeds like spotted knapweed, yellow toadflax, field bindweed and leafy spurge. If some exotic plant species continue to spread within the park, additional mechanical, cultural and low-risk control would be required, which would create additional cumulative impacts to cultural resources.

Alternative 2 would have a **negligible cumulative impact** on cultural resources primarily due to mechanical control, such as hand pulling and digging. The use of a motorized vehicle to apply chemicals in front country areas may impact some cultural resources, but guidance by the park archeologist would help to avoid any negative impacts. It is anticipated that troublesome invasive exotics plants would decrease as the full range of IPM techniques are implemented. Less mechanical control would be required, which would ameliorate cumulative impacts to cultural resources. As native vegetation is restored, and as mechanical control activities are reduced, cultural resource sites would stabilize

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to cultural resources whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

Human Environment

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts from the effects of control techniques on the human environment were derived from park files and literature cited in this plan. The impact on the ability of the visitor to experience a full range of park resources was analyzed by examining resources mentioned in the park significance statement. The

thresholds of change for the intensity of impacts to the human environment are defined as follows:

- **No impact** – There is no discernable impact
- **Negligible** – The impact would be so small that it would not be of any measurable or perceptible consequence.
- **Minor** – The impact is slight but would be small and localized and of little consequence.
- **Moderate** – The impact is readily apparent, would be measurable and consequential, and/or will affect many visitors.
- **Major** – The impact is severely adverse or exceptionally beneficial. The change would be measurable with possible permanent consequences, and/or will affect the majority of park visitors.
- **Impairment** – A major, adverse impact to a resource or value whose conservation is (1) necessary to fulfill specific purposes identified in the enabling legislation or proclamation of RMNP; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Socioeconomics

RMNP is one of the top tourist attractions in Colorado. RMNP contributes about \$320 million to the Colorado economy each year in direct, indirect and value added economic inputs (2002 Money Generation Model). About 3,800 jobs have been created in neighboring counties as a direct or indirect result of the existence of RMNP. Visitors come to RMNP expecting to see a pristine environment with clear vistas and abundant wildlife.

Today, invasive exotic plants infest approximately 2.6 million acres in the national park system, reducing the natural diversity of these special places. The NPS mandate is to preserve and protect natural and cultural resources for the enjoyment of future generations. It is estimated that about 70 million acres in the United States are infested with invasive exotic plants, and about 4,600 acres are being newly infested every day. The cost to the United States to control invasive exotic plants and in lost revenue is measured in the billions of dollars each year.

RMNP staff estimates that there are about 427 acres of park land infested with 29 invasive exotic herbaceous species. Of this acreage, about 65.25 acres (15%) may be treated with an synthetic herbicide if Alternative 2 is implemented (see Table 4 on page 28 for the species and number of acres that may be treated, and Table 10 on page 92 for the estimated cost of herbicide treatment). In addition, an unknown acreage is infested with six invasive exotic grasses. If left unchecked, these 29 herbaceous invasive exotic plant species and 6 invasive exotic grasses (35 species total) will cause damage to resources within the park and would ultimately lead to impairment of park resources. RMNP has the opportunity to bring these problem plants within manageable levels, particularly if the full range of IPM techniques can be employed.

RMNP spends a considerable amount of time using mechanical and cultural methods of control for invasive exotic species. In 2002, park staff and volunteers devoted 2,523 hours to mechanical control of invasive exotic plants (pulling, digging, and using a gas-

powered string trimmer). Approximately 142 acres were treated in this manner at a cost of about \$33,300. The average amount of time spent per acre was 17 ¾ hours, and the average cost per acre was about \$235.

Synthetic herbicides were last used in the park in 1999. That summer, approximately six acres were treated with a herbicide in about four hours by one certified applicator using a tractor with two ten foot booms. The average amount of time spent per acre was 40 minutes, and the average cost per acre was about \$500.

The superintendent of RMNP must weigh the consequences of controlling invasive exotic plants against the potential impairment that can occur if these plants are not managed. National Park superintendents are expected to vigorously apply existing legislative act guidelines, Executive Orders and NPS national regulatory standards and policies in regards to managing invasive exotic plants. Park superintendents are also expected to determine if invasive exotic plants and the management of those species are impairing park resources and values.

If invasive exotic plants are not controlled, there will be an **indirect moderate long-term impact** on the economic resources of the gateway communities of Estes Park and Grand Lake. Wildlife viewing is one of the major attractions of the park and the surrounding communities. If invasive exotic plants, which rarely are of benefit to wildlife, displace native vegetation, they can displace native wildlife such as elk, deer and bighorn sheep, which are some of the major wildlife attractions. Loss of wildlife habitat could cause economic impacts to local economies.

Impacts of Alternative 1 on Socioeconomics

Mechanical Control

Based on 2002 figures, mechanical control requires approximately 18 hours per acre and costs approximately \$235 per acre. Because some species cannot be effectively controlled except by using the full range of IPM techniques (including the use of synthetic herbicides), a significant number of acres infested with species such as yellow toadflax, leafy spurge, and field bindweed, would have to be retreated on an annual basis. Even if acres were retreated, it is expected that some invasive exotic species would continue to spread. There would be significant on-going costs associated with mechanical control with little progress made to reduce the population of some invasive exotic plants.

Cultural Control

Based on 2002 figures, revegetation costs about \$11,000 per acre (including labor and materials), and prescribed fire costs about \$500 per acre. Revegetation can be particularly effective because once native vegetation has been restored there are few recurring costs. Vigorously growing healthy native plants can inhibit invasive exotic plant establishment (McLendon 1996).

There are risks associated with the use of prescribed fire because the treated area could be susceptible to infestation with invasive exotic plants until the native vegetation recovers. If a prescribed burn area becomes infested with invasive exotic plants, there would be the added cost of weed control and possible revegetation.

Biocontrol

Biocontrol techniques are relatively inexpensive to implement. The maximum cost for 5,000 flea beetles to be released on leafy spurge is \$100.00. Other insects are substantially more expensive, but in comparison to mechanical and cultural control, biocontrol is less costly. Biocontrol will not eradicate an invasive exotic plant species, but it does help to reduce invasive plant populations.

Low Risk Methods

The cost of a hot water machine ranges from about \$8,000 to \$28,000. The initial cost of the machine could be shared by other federal, state, county or local agencies. It is anticipated that using this lower risk method could reduce the amount of time devoted to digging or hand-pulling dense patches of invasive exotic plants. Over time, it is expected that the hot water machine could result in a cost-savings as the amount of hand labor would be reduced.

In 2002, the park experimented with hot water and the results were not encouraging. Most treated plants did not die and later flowered and set seed. The area was retreated by mechanical control. Other low risk methods, such as the natural biodegradable products Burn Out and corn gluten meal, are also being considered for use in the park, but like hot water, are only considered effective on annuals and perhaps some biennials. Corn and wheat gluten meal may be effective on Canada thistle (Susan Wolf, personnel communication). Burn Out and corn gluten meal are also very expensive and cost more than \$500 per acre. Perennial plants like spotted knapweed, yellow toadflax, field bindweed, dalmatian toadflax, and leafy spurge may not be effectively controlled by hot water or natural herbicides. Further experiments are proposed.

Impacts of Alternative 2 on Socioeconomics

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

Table 10 provides the estimated cost to treat all known infestations of the 15 invasive exotic plants identified for synthetic herbicide control. For species with more than one herbicide identified, the cost would depend on which chemical were applied. Estimated cost includes the cost of the herbicide and labor. Because some herbicides are more expensive, the cost per acre can range from \$500 to \$1000.

Table 10 - Estimated Initial Treatment Cost for Synthetic Herbicide Control

Species	Estimated Acres	Product	Estimated Initial Treatment Cost
Canada Thistle	16.35	Redeem or 2,4-D Amine or 2,4-D Ester or Transline	\$8,000
Cheatgrass	<1.00	Roundup	\$1,000
Common St. Johnswort	Eradicated	Escort	*

Dalmatian Toadflax	3.50	Plateau+MSO	\$2,000
Diffuse Knapweed	1.65	Transline or Tordon	\$2,000
Field Bindweed	<4.75	Paramount or Rodeo	\$5,000
Houndstongue	2.50	Plateau+MSO	\$2,000
Leafy Spurge	13.75	Plateau+MSO	\$7,000
Oxeye Daisy	1	Escort	\$500
Orange Hawkweed	<100 plants	2,4-D Amine	*
Quack grass	1.00	Roundup	\$1,000
Smooth Brome	5.00	Roundup	\$7,000
Spotted knapweed	<1.00	Transline or Tordon or 2,4-D Amine	\$1,000
Sulfur Cinquefoil	1.00	Tordon or 2,4-D Ester	\$2,000
Yellow Toadflax	12.75	Telar	\$10,000
Totals	65.25		\$49,500

* Orange hawkweed and Common St. Johnswort are below the defined threshold level and do not warrant chemical control at this time.

Summary of Impacts to Economic Resources from the Implementation of the Alternatives

Alternative 1 Invasive exotic plant control would be limited to mechanical, cultural, biological and low risk methods. Implementation of Alternative 1 is expected to be more costly than Alternative 2. Because there are several exotic plant species that cannot be effectively controlled through mechanical, cultural, biological or low risk methods alone, some weed infested areas would need to be retreated on a regular basis, resulting in higher costs over time with **limited minor long-term benefits**.

Alternative 2 Using the full range of IPM techniques would result in effective control and eradication of several invasive exotic species. Once an invasive exotic has been effectively controlled or eradicated, chemical use can be suspended until the plant reaches the threshold where chemical use is again warranted (Please refer to Appendix C on page 125). It is anticipated that there will be some years where herbicides would not be used in the park. We anticipate that there would be a significant reduction in herbicide use within three years of implementation of Alternative 2, resulting in cost-savings to the park and taxpayers resulting in a **long-term moderate benefit** in cost savings.

Visitor Experience

Impacts of Alternative 1 on the Visitor Experience

Mechanical Control

Activities related to mechanical control of invasive exotic plant species (digging, pulling, and use of gasoline-powered mowers and string trimmers) is expected to have a **short-term localized minor adverse impact** on visitor experience. Invasive exotic plant management activities would occur primarily during the summer months when

weeds are actively growing and park visitation is at its highest. Weed control work would take place only in localized areas of the park and should impact only a small percentage of park visitors. There would be short-term noise impacts associated with the use of powered equipment, and short-term visual impacts associated with personnel working on weed control at various locations within the park.

Cultural Control

Revegetation work is expected to cause **short-term localized minor adverse impacts** to visitor experience with **long-term minor to moderate benefits**. Impacts are primarily related to the short-term visual intrusion of personnel and equipment at various restoration areas within the park. Until replanted vegetation fills in the disturbed area, a significant amount of bare ground or mulch is often visible, which can be a visual intrusion in an otherwise natural landscape. Restoration areas are usually closed to visitors by fencing and signing until the area is considered recovered. In some limited situations, this could be for up to 20 years. Closures would not affect an established trail or road unless such closure had been addressed in a NEPA document, such as an Environmental Assessment (EA). No roads or trails would be closed for revegetation because of the adoption of one of the alternatives in this Invasive Exotic Plant Management Plan and EA.

When prescribed fire is used for exotic plant management, it is expected that there would be a **short-term minor adverse impact** on visitor experience. Immediately following the burn there would be blackened ground and vegetation, and little groundcover. Some visitors would perceive this as a negative visual impact. Usually native grasses and forbs would return within one year. Smoke may impede a scenic vista for a short time, but smoke dispersal is considered in any burn plan. Prescribed burns are not conducted if conditions are not favorable for smoke dispersion.

Biological Control

Biological control should have **no impact** on visitor experience.

Low Risk Methods

The use of a hot water machine would have a **short-term localized minor adverse impact** on visitor experience. There would be short-term noise and visual impacts while the equipment is being used. Following the application of hot water, visitors would see wilted exotic plants, and ultimately brown (dead) exotic plants in an otherwise natural appearing landscape. Over the long-term, the exotic plants would be replaced with healthy native vegetation. Visitors would also see wilted plants when natural biodegradable chemicals are used. Notification signs would remain in place at all areas treated with natural chemicals for up to 120 days after the chemical was applied.

Impacts of Alternative 2 on the Visitor Experience

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

Synthetic herbicide control is expected to have a **short-term localized minor adverse impact** with a **long-term moderate benefit** on visitor experience. Chemical control activities (use of backpack sprayers, use of a truck or ATV with a boom sprayer) would

create short-term noise impacts and visual impacts. Chemical control work would take place only in localized areas of the park and would impact only a small percentage of park visitors.

By April 30 of each year, park personnel would identify locations in the park where herbicide application is warranted. Herbicide treatment would not be done outside of the identified locations. Based on this information, RMNP would identify trail segments, trailheads, picnic areas, parking lots and campsites that are located within or adjacent to the planned treatment areas. RMNP would also identify all campgrounds in the park that would remain chemical free for that year. This information would be made available to the public via the RMNP website and other print media.

To the extent possible, RMNP would not conduct chemical application near trails, trailheads, picnic areas, parking lots and campsites between Memorial Day and Labor Day. Areas to be treated with a herbicide would be identified with yellow signs and would be closed to the public during chemical application. Hard surfaced areas (parking lots, trails, trailheads, picnic areas and campsites) adjacent to treated areas would be reopened within 4 to 48 hours, in accordance with the reentry time stated on the chemical manufacturer's label. Notification signs would remain in place at all treated areas for up to 120 days after the chemical was applied.

Park visitors, chemically sensitive people, park neighbors and owners of private inholdings near proposed treatment areas would be notified. The notification would identify where herbicides are to be used, when they would be applied and how long the area would remain closed (please refer to the mitigation measures beginning on page 104). Some people may avoid the park entirely, or may avoid areas where chemicals have been applied even after an area is reopened to the public.

Summary of Impacts to Visitor Experience from the Implementation of the Alternatives

Alternative 1 Mechanical, cultural, biological and low risk control methods are expected to result in **short-term localized minor adverse impacts** on visitor experience. These impacts are primarily related to noise and the visual intrusion of equipment and personnel. Without synthetic herbicide control, it is anticipated that some invasive exotic plants would continue to spread within the park, most notably leafy spurge, yellow toadflax, field bindweed and possibly Canada thistle. Over time these exotic species could displace native plant species, affecting the abundance and distribution of wildlife. Ultimately, these landscape changes could have a **long-term moderate adverse** effect on visitor experience.

Alternative 2 This alternative allows the park to implement the full range of IPM techniques for invasive exotic plant control, including the use of synthetic herbicides. Chemical use would create **short-term localized minor adverse impacts** for park visitors. During and after chemical application, limited areas of the park would be closed to visitors, which would inconvenience some visitors. People with Multiple Chemical Sensitivity (MCS) may choose to avoid the park entirely for a period of time.

Through the judicious use of herbicides, invasive exotic plant species can be effectively managed and displacement of native plant species and wildlife can be avoided. Over the **long-term** this would be a **moderate benefit** to visitor experience.

Human Health and Safety

Impacts of Alternative 1 on Human Health and Safety

Mechanical Control

Mowing, digging or using a gasoline-powered string trimmer on invasive exotic plants is expected to have a **minor impact** on human health and safety.

Volunteers or park employees who engage in mechanical control activities face risks that are similar to those encountered when people are involved in strenuous outdoor activities during the summer months. Risks include dehydration, fatigue, heat exhaustion, or heat stroke. Falls or other accidents are also possible. Other potential hazards related to manual operations include eye irritation or damage from flying debris, and bodily injuries from hand tools such as pulaskis, shovels, or hoes.

There are other hazards associated with digging or hand-pulling invasive exotic plants. Canada thistle has sharp spines that can penetrate the skin. Some of the knapweeds and leafy spurge produce irritants that may cause sneezing, blisters, inflammation, and dermatitis. Workers may be at risk from biting or stinging insects. For example, bees frequent thistle flower heads, so workers may be stung.

Cultural Control

Revegetation work within the park is expected to have a **minor impact** on human health and safety. Volunteers or park employees who engage in revegetation activities face risks that are similar to those mentioned above.

Prescribed fire activities within the park are expected to have a **short-term minor impact** on public health and safety, related to smoke. Smoke produced from prescribed fires can be an eye irritant and can cause respiratory problems. Prescribed fire activities would occur in a limited area within the park, and park visitors would be able to avoid these areas. Limited use of prescribed fire to control invasive exotic plants is possible near the park boundary, so there may be minor impacts to nearby residents related to smoke.

For a period of one year, prescribed fires would be excluded from areas where herbicides have been applied, so there would be no impact related to chemical exposure. A prescribed fire may be conducted before a chemical is applied and chemicals may be used one to two months after a prescribed fire. Smoke from burning some invasive exotic plants like leafy spurge or knapweed could irritate fire fighters. Fire fighters would be encouraged to always stay upwind to avoid inhaling smoke.

Personnel who engage in prescribed fire activities face risks that are similar to those encountered with weed control and revegetation activities. Fire control workers may also be exposed to smoke during a prescribed burn.

Biological Control

Biocontrol techniques are expected to have **no impact** on human health or safety.

Low Risk Method

Applying hot water to invasive exotic plants would have a **minor impact** on human health and safety. Park employees applying hot water to vegetation may be at risk of increased fatigue, heat exhaustion or heat stroke. Falls or other accidents may occur. Other potential hazards related to hot water operations include burns from scalding water. Workers applying the hot water would use Personal Protective Equipment (PPE).

The foam that is applied with the hot water machine is made from plant sugars and is not harmful to the environment or to human health. The public can enter an area during and immediately after treatment as long as they are not in the immediate vicinity of the hot water machine, hose, or spray nozzle.

Park employees applying natural chemicals may be at risk because the products with acetic acid have a low pH that could cause burns to exposed skin. The fumes, even though not caustic, may be irritating. Workers applying any natural chemical would use PPE as specified on the label or Material Safety Data Sheets (MSDS) including wrap around goggles.

The park will use the same public notification process for natural and synthetic herbicides. By April 30 of each year, park personnel will identify locations in the park where natural herbicide application is warranted. Natural herbicide treatment will not be done outside of the identified locations. Areas to be treated with a natural herbicide would be closed to the public during chemical application and for at least 4 to 48 hours after the natural chemical was applied, based on the re-entry time interval stated on the product label and MSDS sheets. Park visitors, chemically sensitive people, and park neighbors and owners of private inholdings near proposed treatment areas would be notified. The notification will identify where the natural herbicides are to be used, when they will be applied, and how long the area will remain closed (please refer to the mitigation measures beginning on page 104). With implementation of the mitigating measures, there should be **no impact** from the application of natural herbicides on the health and safety of park visitors, private inholders, or park neighbors.

Impacts of Alternative 2 on Human Health and Safety

The environmental consequences of using mechanical, cultural, biological and low risk IPM methods are the same as Alternative 1.

Synthetic Herbicide Control

Evaluations of potential human health effects due to herbicide exposure are based on results of toxicity tests in laboratory animals or studies conducted on human health from chemical exposures. Table 11 on page 98 summarizes the potential effects on human health of the nine (9) herbicides proposed for use in RMNP. All of the herbicides, except for Plateau, were evaluated using the following sources:

- Risk Assessment for Herbicide Use (USDA-USFS, 1992)
- The Nature Conservancy 2001 Weed Control Methods Handbook
- Numerous web sites (please see Appendix K on page 144).

The 1992 USDA-USFS Risk Assessment quantified general systemic and reproductive human health risks for a given herbicide by dividing the dose found to produce no ill

effects in laboratory animal studies by the exposure a person might get from applying herbicides or from being near an application site. Human cancer risk was calculated for those herbicides that caused tumor growth in laboratory animal studies by multiplying a person's estimated lifetime dose of the herbicide by a cancer probability value (cancer potency) calculated from the animal tumor data. The risk assessment included a qualitative analysis of the risk of heritable mutation and synergistic effects. Those risks, summarized below, are based on conservative, worst-case assumptions, including comparing short-term exposure to long-term safety levels. There can be an indirect effect on human health from herbicide use through improper application, mixing, or contamination of a water source.

Table 11 - Impact of Synthetic Herbicides on Human Health

Herbicide/Active Ingredient	Impacts of the Herbicide on Human Health Effects
Redeem R&P (Triclopyr & clopyralid)	It is not known to be carcinogenic to animals. No reported effects of acute toxicity. The exposure levels a person could receive from routine operations, are below levels shown to cause harmful effects in laboratory studies. Surfactants and emulsifiers used with Redeem are generally low in toxicity. Triclopyr is classified as a Group D chemical (not classifiable as to human carcinogenicity). The most common breakdown product of triclopyr in mammals is 3,5,6-trichloro-2-pyridinol (TCP). The most significant health hazard identified for TCP is that it may be hazardous to children.
2,4-D Amine, 2,4-D Ester	Nervous system damage has resulted from absorption of 2,4-D through the skin. Nerve damage may be irreversible. Prolonged inhalation may cause dizziness, burning in the chest or coughing. Ingestion of large quantities of 2,4-D formulations has led to death within 1 to 2 days of poisoning. Long-term exposure of 2,4-D formulations has been reported to cause liver, kidney, digestive, muscular, or nervous system damage. Some commercially-formulated 2,4-D products such as 2,4-D Amine have LC ₅₀ s which are much higher than the 2,4-D acid. This indicates that Amine may have considerable less acute toxicity than the acid form. Mammals have a moderate sensitivity to 2,4-D exposure. It may cause eye damage and skin irritation for humans that come into contact with 2,4-D formulations. Some pesticide applicators who spray 2,4-D and other herbicides have altered levels of male sex hormones in their blood and a heightened rate of non-Hodgkin's lymphoma. 2,4-D formulations were not mutagenic in most studies. LC ₅₀ for birds ranged from 472 to >2000 mg/kg and for mammals 639 to >5000 mg/kg. 2,4-D can be absorbed through the skin or through the lungs if inhaled. Applicators of 2,4-D, particularly those using back-pack sprayers, are at greatest risk of exposure.
Transline (Clopyralid)	It 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 including permanent loss of vision, so protective wrap around goggles are mandatory for applicators. Expected exposure levels are below the lowest level that should cause harmful effects. Prolonged exposure may irritate the skin. Repeated exposures to high amounts may cause liver and kidney damage. No hazardous contaminants have been identified in Transline.

Herbicide/Active Ingredient	Impacts of the Herbicide on Human Health Effects
Roundup & Rodeo (Glyphosate)	<p>Roundup and Rodeo are not considered carcinogenic to humans and are often portrayed as toxicologically benign. However, two new studies indicate that Glyphosate is a hormone-disrupter and is associated with birth defects in humans. Other studies conducted on rats and mice indicate higher levels of toxicity. A Swedish study of hairy cell leukemia (HCE), a form of non-Hodgkin's lymphoma, found that people who were occupationally exposed to glyphosate herbicides had a threefold higher risk of HCE. Roundup and Rodeo cause genetic damage in laboratory animals and in human blood cells. Long-term glyphosate exposure has been linked to reproductive problems in humans. Most reported incidents of impacts to humans have involved skin or eye irritation while mixing and loading. Swallowing Roundup or Rodeo causes mouth and throat irritation, pain in the abdomen, vomiting, low blood pressure, reduced urine output, and in some cases, death. These effects have only occurred when the concentrate was accidentally or intentionally swallowed. The amount swallowed averaged about ½ cup. The exposure levels a person could receive from Roundup or Rodeo in RMNP as a result of application operations would be below levels shown to cause harmful effects in laboratory studies.</p>
Plateau (Imazapic)	<p>Plateau is not mutagenic, carcinogenic or teratogenic and would not be expected to have any adverse effect on humans. Plateau is considered of low toxicity to mammals. It does not have the potential to “mimic” estrogen, nor can it be considered an endocrine disrupter. It is considered nontoxic to mammals through physical exposure or ingestion. If ingested, Plateau is rapidly excreted in the urine and feces and does not bioaccumulate. There are no human health effects of the inert ingredients in Plateau.</p>
Tordon (Picloram)	<p>The preponderance of data shows Picloram to be non-mutagenic in ‘In vitro’ (test tube) tests and in animal test systems. More recent studies that followed the EPA decision to allow re-registration of picloram show some evidence of mutagenicity. The potential for causing tumors (oncogenicity) has not been determined but more studies are ongoing. EPA has found that there is some added cancer risk for applicators, based on the contamination of picloram with Hexachlorobenzene (HCB) and the structural similarity to di-(2-ethylhexyl)-phthalate or DEHP. In contrast to picloram, HCB is absorbed by the body and does bioaccumulate. A few cases of eye and skin irritation have been reported in workers. There are no reported cases of long-term health effects in humans. The exposure levels a person could receive from these sources, resulting from routine operations, are below levels shown to cause harmful effects in laboratory studies. No serious health effects in humans have been verified. Picloram, when commercially produced, is contaminated with trace amounts of hexachlorobenzene (HCB). Although HCB may cause cancer in humans, the EPA considers the risk from the small amount of HCB present in picloram to be small. Picloram is not fat soluble, does not accumulate in the human body, is not modified by metabolism to more harmful compounds, and is excreted unchanged from the human body within 24 to 48 hours. EPA has established a 12 hour restricted reentry interval for applicators using picloram, and this restriction would also apply to visitors.</p>

Herbicide/Active Ingredient	Impacts of the Herbicide on Human Health Effects
Paramount (Quinclorac)	It is not classified as a carcinogen, teratogen, mutagen, or reproductive inhibitor. It is considered practically nontoxic to avian species, fish, aquatic invertebrates, and honeybees. Avian and aquatic studies show no significant effects. It does not bioaccumulate in animals. It is not considered an estrogen disrupter and is rapidly excreted in urine.
Escort (Metsulfuron methyl)	No reports of acute poisoning in humans have been found. No reports of chronic poisoning in humans have been found. Expected exposure levels are below the lowest level that would cause harmful effects. Exposure to Escort may cause skin and eye irritation. No hazardous contaminants have been identified in Escort. It is practically nontoxic to birds and mammals and is not considered a carcinogen, mutagen, teratogen or reproductive inhibitor.
Telar (Chlorsulfuron)	No reports of poisoning in humans were found. There are no reported cases of long-term health effects in humans. The exposure levels a person could receive from Telar resulting from routine operations, are below levels shown to cause harmful effects in laboratory studies. Telar may cause irritation to the skin, eyes, nose and throat. It is not known to be carcinogenic to animals.

The Human Toxicity Potential (HTP) is an indicator of the danger posed by a chemical's release to air or surface water. It was developed to compare emissions in life-cycle assessment (LCA) and public emissions inventories, such as the U.S. Toxic Release Inventory (TRI). HTP contains two elements:

1. The toxicity of the chemical. This is represented by the unit risk factor (for carcinogens) or the safe dose (RFD) for non-carcinogenic effects.
2. The potential dose. This is represented by the intake of the pollutant by an individual living in a certain model environment (Hertwich et al. 2001, Hertwich et al. 2000).

HTP data are addressed in the plan and are available at the following Internet address:
http://design.ntnu.no/ansatte/hertwich/HTP_ETC.html

Chemical effects on the public

Members of the public, including individuals with Multiple Chemical Sensitivity (MCS), may be exposed to herbicide via dermal, respiratory, and dietary routes (e.g. contact with vegetation at a recently treated site, breathing herbicide vapors in or near recently treated areas, touching or eating berries with residues)

Toxicology – With the implementation of the mitigation measures found on page 104, it is unlikely that the general public would receive doses above “**no observed effect**” levels.

Cancer and Mutation – Human cancer risks from exposure appear to be **negligible** from the amount of herbicides proposed. However, scientific uncertainty over cancer risks remain. Known risks to the general public are thought to be too low to detect in epidemiology studies (USDA-USFS 1996).

Bioaccumulation – Given the herbicides and amounts proposed for use in RMNP, the potential for bioaccumulation or biomagnification appears to be **negligible**. Humans

and animals high in the food chain that occur in the park (humans, eagles, coyotes, mountain lions, peregrine falcons) are not expected to receive concentrated doses of the chemicals by feeding on contaminated plants or animals. The herbicides are water-soluble and are excreted rapidly (USDA-USFS 1996).

Multiple Chemical Sensitive Population

There are individuals who are extremely sensitive to pesticides and other chemicals. Individual susceptibility to the toxic effects of pesticides is variable and unpredictable. The normal margin of safety is generally considered by toxicologists to be sufficient to ensure that most people would experience no toxic effects from pesticides applied in accordance with label provisions. However, MCS individuals may experience effects from extremely small amounts of pesticides. For this reason, RMNP will notify all persons listed in the Colorado Registry of Pesticide Sensitive Persons at least annually regarding planned applications of natural and synthetic chemicals for weed control.

Chemical Effects on Employees

Workers applying herbicides may be exposed to chemicals via dermal, respiratory, and dietary routes (e.g. contact with vegetation at a recently treated site, breathing herbicide spray particles, breathing herbicide vapors at a recently treated site, touching or eating berries with residues).

Toxicology – Routine-typical exposures are those likely to occur in the vast majority of applications. Routine-typical exposures are based on average conditions such as average application rate, average number of acres treated, average buffer distances, and average doses seen in field-based exposure guides (USDA 1992). Barring accidents, it is unlikely workers would receive doses above the “**No observed effect**” level. Exposure would exceed “acceptable daily intake” only if they fail to use Personal Protective Equipment (PPE).

During routine operations, workers may be dermally exposed to an herbicide if the herbicide concentrate, mixture, or drifting spray droplets contact their skin; or if the workers contact sprayed vegetation. Respiratory exposure may result from inhaling air-borne spray droplets if workers fail to wear protective masks or respirators. Field studies of workers have demonstrated that inhalation exposure represents only a small part of the total exposure. Dermal exposure can be up to 50 times greater than inhalation exposure.

Research shows that PPE such as long-sleeved shirts, coveralls, rubber gloves, and hats can substantially reduce dermal exposure. Inhalation of herbicides is reduced by using protective breathing devices.

Cancer and Mutation – Human cancer risks from exposure to the herbicides we propose to use are **negligible**. However, there is scientific uncertainty over cancer risks. The lifetime risk to workers (assuming application for 30 days each year for 30 years) range from 0.5 to 50 cancer occurrences in a population of one million applicators.

Bioaccumulation – Given the herbicides and amounts proposed for use in RMNP, the potential for bioaccumulation or biomagnification appears to be **negligible**. The number of acres proposed to be treated is also low, which will minimize exposure risk. Humans and animals high in the food chain (humans, eagles, coyotes, mountain lions)

are not expected to receive concentrated doses of these chemicals by feeding on contaminated plants or animals. The herbicides are water-soluble, generally not lipid soluble, and are excreted rapidly (USDA-USFS 1996).

Summary of Impacts on Human Health and Safety from the Implementation of the Alternatives

Alternative 1 The invasive exotic plant control techniques that would be employed for Alternative 1 are expected to create **minor impacts** to park visitors, nearby private inholders or nearby residents. The only impact of significance would be from smoke generated during prescribed burning activities used for exotic plant management. Park employees and volunteers would be exposed to risks inherent with strenuous outdoor activities during the summer months, and the hazards associated with the use of hand tools, gasoline powered equipment, natural chemicals and a hot water machine. Some employees may be sensitive to toxins found in knapweeds and leafy spurge, and PPE gear such as long-sleeved shirts and gloves are recommended. Fire fighters are encouraged to avoid inhaling smoke when conducting prescribed fires where leafy spurge and knapweed exists.

Alternative 2 If this alternative is selected the same risks associated with Alternative 1 would also be present for Alternative 2. In addition, visitors, private inholders, nearby residents, park employees and volunteers would be exposed to the risks associated with the use of synthetic herbicides. With the implementation of the mitigation measures found on page 104, the potential impact of herbicide use on human health is expected to be **negligible**.

Cumulative Impacts

With implementation of the Mitigation Measures (please refer to page 104), which include employee safety measures and adequate notification of the public, there would be **no cumulative impact** to human health and safety.

Conclusion for Alternative 1 or 2

Because there would be no major, adverse impacts to the **Human Environment** whose conservation is: 1) necessary to fulfill specific purposes identified in the enabling legislation of RMNP; 2) key to the natural or cultural integrity of the Park; or 3) identified as a goal in the Master Plan (1976) or other relevant NPS planning documents, there would be no impairment of the Park's resources or values if either Alternative 1 or 2 is selected.

CHAPTER 6 SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

The implementation of either Alternative 1 or Alternative 2 would result in environmental impacts, but these impacts would be small in comparison with the benefits derived from controlling and eradicating invasive exotic plants.

Alternative 1 allows for the use of mechanical, cultural, biocontrol and low risk methods including natural chemical treatments, but not synthetic chemicals. Biological treatments can have some long-term benefit to natural resources, but biocontrol is limited to a few invasive exotic species and could have some long-term negative impacts. Because some invasive exotic plants are expected to persist with the implementation of Alternative 1 (most notably leafy spurge, yellow toadflax, and field bindweed) this alternative would cause some long-term negative impacts on the productivity of habitats within the park.

Alternative 2 would have the least impacts on the long-term productivity of resources by providing the most effective control of invasive exotic plants through the use of the full range of IPM techniques. However, this alternative would result in some short-term impacts primarily related to the application of synthetic herbicides. Herbicides would have a negative, short-term impact on some natural resources. It is anticipated that the use of herbicides would taper off substantially over time and the park may become herbicide free for one or more years at a time.

CHAPTER 7 MITIGATION MEASURES

Mitigation Measures Common to Alternatives 1 and 2

1. Conduct on-site field surveys prior to treatment to determine the presence and proximity of resources that may be at risk from invasive exotic plant treatments, including aquatic resources, T&E and rare species, proposed or designated wilderness and cultural resources.
2. Mechanical and cultural treatments that involve any kind of soil disturbance will be cleared with the park's archeologist to ensure work is not occurring in an archeological site. If soil disturbance will occur in an identified archeological site, a qualified archeologist or para-archeologist must be on site while work is being performed.
3. Protection of cultural resources will be included in training programs for the exotic plant seasonal work crew.
4. Provide for minimum feasible soil disturbance in or around wetlands. Keep vehicles out of streams, and swales. Do not use vehicles within 100 feet of a stream if in a wetland.
5. Limit the use of hot water or natural chemicals to only dense patches of invasive exotic plants to minimize impacts to native vegetation, or use a wick or wand applicator for spot treatment. Any natural biodegradable chemical will require either an EPA registration number or a Colorado State permit before it can be used. Revegetating denuded areas after treatment may be needed, particularly on drier steeper slopes.
6. Limit control techniques to those that do not adversely affect native plant and wildlife species.
7. Conduct on site reviews with NPS or USFWS wildlife biologist in riparian areas infested with invasive exotic plants that are adjacent to greenback cutthroat trout, Colorado River cutthroat trout, and in boreal toad habitat during peak spawning and reproduction periods.
8. Avoid work near active birds of prey nests during the breeding season from March through July. Consult with the park's wildlife technician, GIS Specialist, or Natural Resources Specialist for known raptor nest locations.
9. Include job hazard analysis for invasive exotic plant work. Ensure all employees and volunteers are given proper personnel protective equipment (PPE) and safety instructions for all treatment methods.
10. Do not remove all organic matter - unless site-specific soil types warrant complete removal - when pulling, cutting, or mowing exotic plants.
11. Maintain or add organic matter or soil inoculate to areas disturbed by mechanical methods and to sites denuded by removal of dense invasive exotic plant infestations. Revegetate heavily disturbed sites or denuded areas with native vegetation in accordance with RMNP's Vegetation Restoration Plan (McLendon

and Redente 1994), the park's genetic guidelines, Go No Go checklist for active verses passive restoration and Class I, II, III area descriptions.

12. Use the "Minimum Requirement Decision Guide," provided by the RMNP Wilderness Coordinator, for invasive exotic plant work in recommended or designated wilderness.
13. Consult RMNP plant databases to identify known locations of rare plants. If surveys are warranted, conduct them when plants are expected to be flowering or have aerial stems or catkins to determine presence or absence of sensitive species in the project area prior to treatment.
14. Ensure that all invasive exotic plant inventory personnel and crews removing plants are able to identify all exotic plants and at least one crew member is able to identify rare native species. For example, where native thistles occur with exotic thistles, it is imperative the native thistles are not inadvertently destroyed.
15. Avoid ground disturbance that could lead to erosion in the alpine tundra. Drier steeper sites in alpine tundra disturbed by removing invasive exotic plants may need to be revegetated with local genotypic plants.
16. Avoid treatment in sensitive wildlife habitat during lambing, calving or denning periods. This generally occurs between May 1 to mid-June for low elevation areas and from May 1 to August 31 for high elevation areas.
17. When transporting biological control insects with host plant material, use containers that prevent release of the insects prematurely and release of seed from the invasive exotic plant.
18. Identify sensitive plant species that could be affected by selected biological control agents, survey proposed project sites for those species, and develop project-specific measures to protect them. Biocontrol insects or pathogens may not be used if native plants will be adversely affected

Mitigation Measures Specific to Alternative 2

1. The Communication Plan (please see Appendix F on page 135) will be implemented.
2. Use only water as a carrier for herbicides.
3. Use the Relative Aquifer Vulnerability Evaluation (RAVE) scoring system to 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 required in all situations.
4. Use only aquatic-labeled herbicide formulations for spraying in riparian ecosystems, wetlands, or water influence zones or conduct spot treatments with a wand or wick applicator based on the RAVE scoring system, herbicide labels, and recommendations from the NPS Intermountain Region IPM Coordinator. Water treatment zones are defined as the land next to water bodies where vegetation plays a major role in sustaining long-term integrity of aquatic systems. The water influence zone varies, but a recommended buffer zone is 100 feet from the top of each stream bank, or a distance equal to the mean height of mature dominant late-

seral upland vegetation, whichever is greater. This measure also applies to areas along roads, trails, and utility corridors within 100-feet of stream crossings.

5. Use the hot water treatment or natural chemicals in sensitive riparian or wetland areas to the degree possible. Synthetic herbicides will only be used as a last resort if other techniques are not successful and invasive exotic plants exceed established threshold levels. If synthetic herbicide use is warranted in a riparian or wetland area, use only hand-held wand or wick applicators. Use spot treatment strategy if possible. This measure also applies to areas along roads, trails, and utility corridors within 100-feet of stream crossings.
6. Determine buffer zones where herbicide spraying will be prohibited. Identify buffer zones with pin flags before spraying begins to avoid open water, habitat for rare plants and animals, desired vegetation such as trees, and private inholdings. Buffers will be a minimum of 100-feet, and shall be larger where required by applicable law, regulation or policy. Wand or wick application may be approved within the buffer zone based on the herbicides label, RAVE scoring, and approval by the NPS Intermountain Region IPM Coordinator.
7. Select application methods, equipment, and rates that minimize potential for drift and off-target impacts while meeting invasive exotic plant objectives. Use drift reduction techniques, including appropriate surfactants, coarse, low-pressure spray of less than 30 psi, appropriate nozzle size and type, and keeping spray nozzles close to the ground.
8. Ensure contractors are state-licensed commercial applicators and require a qualified supervisor to oversee herbicide applications, whether conducted by contractor or NPS personnel.
9. All use of herbicides with an EPA registraton number must be approved by the NPS Pesticide Approval System and designated IPM Coordinator from the Intermountain Region and the park. Annual Pesticide Use Logs must be filled out in the NPS approval system.
10. Follow all label instructions and additional instructions provided by the regional and park IPM Specialists during the NPS Pesticide Approval review.
11. 2,4-D low volatile Ester (LVE) is proposed for orange hawkweed, which is presently below the threshold for warranting chemicals. 2,4-D Ester (LVE) is also proposed for Canada thistle in places where the water table is too close to the surface for the use of Transline or Redeem. 2,4-D Easter (LVE) will not be sprayed within buffer zones as discussed in mitigating measure #6 or when the RAVE score is too high. Require RAVE score cards to determine groundwater contamination potential. If proven effective, the natural chemicals corn or wheat gluten meal would be preferable over 2,4-D for controlling Canada thistle.
12. When a product such as Roundup or an natural chemical like Burn Out is selected for use, target invasive exotic plants should be monoculture patches, or the loss of adjacent non-target plants must be an acceptable aspect of the control project. Revegetating with native plants will be required unless the patch is small enough that revegetation would occur naturally from surrounding undisturbed vegetation.

- The natural herbicide Burn Out or hot water if effective is preferable over the herbicide Roundup.
13. Monitor weather conditions before and during all herbicide application projects. Do not apply herbicides when rain appears imminent except for Paramount, which requires moist soil. In some cases the ground may be watered before or after Paramount is applied. Do not apply herbicides when temperature, humidity, or wind conditions specified on the label are exceeded.
 14. Use the application rates specified by the manufacturer unless directed otherwise by a certified applicator or IPM Coordinator.
 15. Monitor treated areas to determine effectiveness of the herbicide.
 16. Avoid spraying herbicides in known boreal toad, greenback cutthroat and Colorado River cutthroat habitat.
 17. For NPS personnel applying chemicals:
 - 1) Transport only the quantity needed for that day's work;
 - 2) Transport concentrate to treatment site in original containers in a manner that will prevent tipping or spilling, and in a compartment that is isolated from food, clothing, and safety equipment.
 18. Ensure that park employees and contractors follow manufacturer's instructions for mixing, loading, and disposal of chemicals.
 19. Ensure that all chemical applicators, including employees and contractors, inspect all herbicide application equipment for leaks or other problems before each application and at intervals during the application day. Test all nozzles, caps or other fittings for seating at intervals throughout the workday. Set aside any faulty equipment immediately for repair or replacement.
 20. If herbicides are stored in the park they should be kept only in facilities designed and constructed in accordance with provisions of Title 35, Article 10 of the Colorado Pesticide Applicator Act; Part 11 of "Rules and Regulations Pertaining to Administration and Enforcement of the Pesticide Applicator Act." All pesticide storage facilities will be constructed with adequate sump capacity to contain spillage of the entire quantity of pesticide stored.
 21. Dispose of all herbicide containers in accordance with State and Federal requirements. Empty containers thoroughly, rinse them three times and puncture them to prevent reuse.
 22. Assess all herbicide treated areas for revegetation needs. Re-establish vegetation on bare ground to minimize the opportunity for invasive exotic plant re-establishment, unless the patch is small enough that natural revegetation will occur from adjacent undisturbed native vegetation.
 23. Ensure that all applicators wear protective clothing, provided by the park as necessary for either natural or synthetic chemicals. Workers must also wear non-permeable gloves, hats, and footwear, and any other safety clothing and equipment recommended or required by the herbicide label and MSDS sheets. During mixing

- and loading, eye protection and additional protective clothing (e.g. polypropylene-coated overalls or aprons) maybe needed.
24. Personnel applying herbicides should carry additional safety equipment to the work site including soap, water that is separate from drinking water and clearly labeled as non-drinking water, eyewash kits, first aid equipment, and extra clothing.
 25. Personnel should go through a safety briefing each day prior to beginning herbicide application.
 26. Ensure that MSDS are available at storage facilities, in vehicles, and readily available to workers.
 27. Ensure that all herbicide applicators are aware of (and can identify) threatened, endangered or rare plants or animals in the area. Flag rare plants with a 100-foot buffer zone and advise applicators to stay out of the area. Do not use herbicides in rare plants locations unless warranted under special circumstances and applied in such a way that will not harm rare plants.
 28. By April 30 of each year, park personnel will identify locations in the park where herbicide application is warranted. Herbicide treatment will not be done outside of the identified locations. Based on this information, RMNP will identify trail segments, trailheads, picnic areas, parking lots and campsites that are located within or adjacent to the planned treatment areas. RMNP will also identify all campgrounds in the park that will remain chemical free for that year. This information will be made available to the public via the RMNP website and other print media.
 29. As a safety precaution, prescribed fire shall not be used in any area that has been treated with an natural or synthetic chemical for a period of one (1) year following chemical application.

CHAPTER 8 CONSULTATION AND COORDINATION

The Branch of Planning and Compliance within RMNP's Division of Resources Management and Research developed this plan/EA with substantial input from the NPS Biological Resources Management Division (a WASO office), the solicitor's office of the Department of the Interior (Lakewood Colorado), the Intermountain Region Support Office, and the Intermountain Regional Integrated Pest Management Coordinator.

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List of Agencies and Organizations

The following agencies, universities or environmental organizations were contacted for information; or assisted in identifying important issues, developing alternatives, or analyzing impacts; or that will review and comment upon the management plan and environmental assessment.

Arapaho Roosevelt National Forest

Boulder County Open Space

Boulder, Grand and Larimer Counties weed extension services

City of Boulder Open Space

Colorado Coalition for Alternatives to Pesticides

Colorado Department of Agriculture

Colorado Department of Natural Resources

Colorado State University

Denver Botanical Gardens

Department of the Interior Solicitor's Office.

Earth Law

Nature Conservancy

Northern Colorado College

Sierra Club

U.S. Fish and Wildlife Service

University of Colorado

University of Nebraska

University of Wyoming

Wyoming Department of Agriculture

List of Persons Consulted

The following people were involved in the development of this Plan/EA. They provided assistance in identifying issues, developing alternatives, or analyzing impacts related to this plan. They did not necessarily review the entire Plan/EA, nor do they necessarily agree with the proposed action or all of the material presented.

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LITERATURE CITED

Act to Expand Redwood National Park. Public Law 95-250 Title I, S. 101(b). March 1978. Amending the Act of October 2, 1968.

Act of January 26, 1915, commonly called the Enabling Legislation for Rocky Mountain National Park, 16 U. S. C. 195, 38 Stat. 798.

Baker W.L. and D.S. Ehle. In Press. Uncertainty in fire history and restoration of ponderosa pine forests in the Western United States. Ecological Monographs.

Baron, J.S., H.M. Rueth, A.M. Wolfe, K.R. Nydick, E.J. Allstott, J.T. Minear, and B. Moraska. 2000. Ecosystem Responses to Nitrogen Deposition in the Colorado Front Range. *Ecosystems* 3:352-368.

Beck, George K. 1991 to 1994. Service in Action Fact Sheets for diffuse and spotted knapweeds (#3.110), Canada thistle (#3.108), Musk thistle (#3.102), leafy spurge (#3.107). Colorado State University Cooperative Extension.

Benninger, M.C. 1989. Trails as Conduits of Movement for Plant Species in Coniferous Forests of Rocky Mountain National Park. MS Thesis, Miami University, Oxford, Ohio, 46 pp.

Brunswick, R.H. 1999. Report on 1998 archeological survey in Rocky Mountain National Park by the University of Northern Colorado.

----. 2000. Report on 1999 archeological survey in Rocky Mountain National Park by the university of Northern Colorado.

Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.)
Carlson-Foley Act (P.L. 90-583).

Chong, G.W. 2002. Multi-scale Sampling of Native Plant and Non-native Diversity: Examples of Data Analyses and Applications. Dissertation, Colorado State University, 116pp.

Clean Air Act. 42 USC 7401. 1977.

Clean Water Act. 33 USC 1251-1376 (1982). 1972.

Colorado Natural Heritage Program. 2000. Creating an Integrated Weed Management Plan. Caring for Land Series Volume IV.

Colorado Undesirable Plant Management Act (Title 35, Article 5.5 CRS).

Connor J., Johnson T. and R. Monello. 2003. White Paper on Wildland Fire Effects, Prescribed Fire Effects, and Elk Herbivory on the Elk Winter Range and Portions of Their Summer Range of Rocky Mountain National Park. In review, park files.

Denver Botanical Gardens Research Department. 2000. Rocky Mountain National Park Rare plant Survey, Final Report . Rare plant list occurrence records.

Executive Order 11990 - "Protection of Wetlands." 42 USC 4321 (1982). May 24, 1977.

Executive Order 13112 – “Invasive Species.” 42 USC February 3, 1999.

Geer, S. 2000. Unpublished Proposal: non-native plant invasions along roads at the urban-forest interface.

Harris, P. and R. Cranston. 1988. An economic evaluation of control methods for diffuse and spotted knapweed in western Canada. *Canadian Journal of Plant Science* 59: 375-382.

Henselman, M.L. 1981. Fire intensity and frequency as factors in the distribution and structure of Northern ecosystems. *Fire Regimes and Ecosystem Properties*. Proceedings of the conference, Honolulu, Hawaii. Pp. 757.

Hertwich E.G., Mateles S.F., Pease W.S., Mckee T.E. 2001. Human toxicity potentials for life cycle assessment and toxic release inventory risk screening. *Environ. Toxicol. Chem.* 20(4):928-939.

Hertwich E.G., Mckone T.E., Pease W.S. 2000. A systematic uncertainty analysis of an evaluative fate and exposure model. *Risk Anal.* 20(4):437-452.

Hueneke, L. 1996. Ecological impacts on invasive plants on natural resource areas. *Proceedings: Western Society of Weed Science* 49:119-121.

Husted, W.F. 1962. A proposed archeological chronology for Rocky Mountain National Park based on projectile points and pottery. Unpublished M.A. Thesis, Department of Anthropology, University of Colorado, Boulder

Jollif, G.D. 1969. Campground site - vegetation relationships. Ph.D. Thesis, Colorado State University, Ft. Collins. 139 pp.

Kalkan, M.A., T.J. Stohlgren, G.W. Chong, L.D. Schell, R.M. Reich. 200. A Predictive Model of Plant Diversity: Integration of Remotely Sensed Data, GIS, and Spatial Statistics. Eight Biennial Remote Sensing Application Conference (RS 2000). April 10-14, 2000, Albuquerque, New Mexico.

Keigley, R. B. 1986. Restoration of Alpine Plant Communities Utilizing Local Genetic Stock Abstract. Conference on Science in the National Parks. Fort Collins, Co. July 13-18, 1986.

Keigley, R.B. 1988. Developing Methods of Restoring Vegetation Communities while Preserving Genetic Integrity. pp. 129-138. Proceedings of High Altitude Revegetation Workshop No. 8; Ed. W.R. Keammerer and L.F. Brown. Colo. Water Resources Res. Inst. Info. Ser.No. 59, 319 pp.

Louda, S.M., D. Kendall, J. Connor, D. Simberloff, 1997. Ecological Effects of an Insect Introduced for the Biological Control of Weeds. Science 22 August 1997, Vol. 277, pp. 1088-1090.

Louda, S.M., D. Simberloff, G. Boettner, J. Connor, D. Kendall, A. Arnett. 1998. More on Flowerhead Weevils in Weed Biocontrol. Biocontrol News and Information 19(3).

Lym, R.G. 2000. Leafy spurge identification and control. NDSU Extension Service.

Mansfield, D.H. 1988. Plant succession at Lawn Lake: Vegetation Development on the Exposed Shores of Lawn Lake. Unpublished typewritten report, Dept. of Biology and Environmental Studies, Rollins College, Winter Park, FL, 51 pp.

McLendon, T. 1996. Factors Controlling the Distribution of Canada Thistle *Cirsium Arvense* in Montane Ecosystems: Rocky Mountain National Park, Colorado. NPS Contract #1268-1-9002.

McLendon, T. and E.F. Redente. 1994. Vegetation Restoration Management Plan. Rocky Mountain National Park. 62 pp.

Messersmith, C.G. and R. Zollinger, R.G. Lym. 1995. Integrated management of leafy spurge. NDSU Extension Service.

Memorandum of Understanding between the State of Colorado: Department of Natural Resources, Department of Agriculture, Department of Transportation, Colorado State University Cooperative Extension, Colorado State University and State Forester; and U.S. Department of Agriculture: Forest Service, Rocky Mountain Region, Natural Resources Conservation Service, Agricultural Research Service, Animal and Plant Health Inspection Service; U.S. Department of Interior: Bureau of Land Management, National Park Service, National Biological Service, US Fish and Wildlife Service, and Bureau of Reclamation, 1996.

Moore J. 2001. Ecosystem Impacts Resulting from the use of Herbicides at Rocky Mountain National Park, CO. Northern Colorado College, 2001 Researchers Annual Progress Report. Ongoing research project not to be completed until 2004.

National Park Service (NPS). 1976. Final Master Plan for Rocky Mountain National Park.

----- 1985. Guide for pesticide use in the national park system. Biological Resources Division, Washington, D.C.

----- 1987. 27 years of Exotic Plant Control in Rocky Mountain National Park - Summary and Recommendations. Resources Management Report No. 1.

----- 1988 revised 2001. Management Policies, U.S. Department of the Interior, National Park Service. Washington, D.C.

----- 1991. Natural Resources Management Guideline/ NPS-77.

----- 1991. Alien Plant Survey, Monitoring and Control. Rocky Mountain National Park, Resources Management Report No. 13.

----- 1992. Statement for Management, Rocky Mountain National Park.

----- 1992. Fire Management Plan and Environmental Assessment, Rocky Mountain National Park.

----- 1993. NPS #28. National Register Site Protection

----- 1994. Commercial Horse Use and Management Plan and Environmental Assessment, Rocky Mountain National Park.

----- Draft Greenhouse/Nursery Operations Plan. Rocky Mountain National Park.

----- 1999. Wilderness Preservation and Management. Reference Manual 41.

----- 2000. Director's Order #55: Interpreting the National Park Service Organic Act.

----- 2002. Exotic Plant Management Team Annual Report – FY 2002, National Park Service.

----- 2002. Exotic Plant Management Year-end Report. Rocky Mountain National Park.

----- 2003. Wildland Urban Interface Environmental Assessment, Rocky Mountain National Park.

National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et seq.)

Nesvacil K. and C. E. Olmsted. 2003. The effects of prescribed fire and ungulate herbivory 6 and 7 years post burn in the upland bitterbrush (*Purshia tridentata*) communities of Rocky Mountain National Park, Colorado. An abbreviated version presented at the 2002 Fire Conference: Managing fires and fuels in the remaining wildlands and open spaces of the Southwest, December 2-5, 2002, San Diego, California.

Olson, R.A. 1995. Impacts of noxious weeds on wildlife. Symposium on non-native invasive plants: A biological disaster, September 19, 1995.

Organic Act. 16 U.S.C. 1 et seq. U.S. Department of the Interior, National Park Service. 1916.

Paige C., and S.A. Ritter. 1999. Birds in a sagebrush sea: Managing sagebrush habitats for bird communities. Partners in Flight Western Working Group, Boise, ID.

Peet, R.K. 1978. Forest Vegetation of the Colorado Front Range: Patterns of species and diversity. *Vegetation* 37:65-78.

Rutledge, C.R., and T. McLendon. 1996. An Assessment of Exotic Plant Species of Rocky Mountain National Park, An evaluation of the potential impacts of known exotic plants and summary of management options for species of concern.

Spackman, S., B. Jennings, J. Coles, C. Dawson, M. Minton, A. Kratz, and C. Spurrier. 1997. Colorado Rare Plant Field Guide. Prepared for the Bureau of Land Management, the U.S. Forest Service, and the U.S. Fish and Wildlife Service by the Colorado Natural Heritage Program.

Stevens, D.R. 1976. Special Needs and Problems of High Altitude Revegetation in National Parks. pp. 83-92. in proceedings: High Altitude Revegetation Conference. No. 2., R.H. Zuck and L.F. Brown. *Env. Res. Ctr, CSU No. 21*, 131 pp.

Stohlgren, T.J., J.D. Binkley, G. Chong, M.A. Kalkhan, L.D. Schell, K.A. Bull, Y. Otsuki, G. Newman, M. Bashkin, Y. Son. 1999. Exotic Plant Species Invade Hot Spots of Native Plant Diversity. *Ecological Monographs* 69(1):25-46.

Stohlgren, T. G., Chong, M. Kalkhar, L. Schell. 1997a. Multiscale Sampling of Plant Diversity: Effects of Minimum Mapping Unit Size. *Ecological Applications*. 7:1064-1074.

Stohlgren, T.J., G.W. Chong, M.A. Kalkan, and L.D. Schell. 1997b. Rapid Assessment of Plant Diversity Patterns: A Methodology for Landscapes. *Ecological Monitoring and Assessment* 48:25-43.

Stohlgren, T.J., M.B. Coughenour, G.W. Chong, D. Binkley, M.A. Kalkhan, L.D. Schell, J.D. Buckley, J. Berry. 1997c. Landscape Analysis of Plant Diversity. *Landscape Ecology* 12:155-170.

Summer, R.M. 1978. Impact of Horse Traffic on Trails in Rocky Mountain National Park. U.S. National Park Service (unpublished report). 58 pp.

Tu. A. 2001. Weed Control Methods Handbook. The Nature Conservancy, version April 2001.

U.S. Department of the Interior, Bureau of Land Management. 1991. Vegetation treatment on BLM lands in thirteen Western states. EIS, Washington D.C.

U.S. Department of the Interior, National Park Service. "NPS-77, Natural Resources Management Guidelines." 1994.

U.S. Department of Interior, National Park Service. "Management Policies." Chapters 1, 4, and 6. 1985, revised in 1988 and 2001.

U.S. Department of Interior, National Park Service. "Wilderness Recommendation for Rocky Mountain National Park." 1974.

The Federal Noxious Weed Act of 1974 (P.L. 93-629) (7 U.S.C. 2801 et seq.), as amended by the Food, Agriculture, Conservation and Trade Act of 1990; Section 1453; ("Section 15 - Management of Undesirable Plants on Federal Lands").

USDA Forest Service. 1992. Risk Assessment for Herbicide Use in Forest Service Regions 1,2,3,4, and 10 and on Bonneville Power Administration Sites. Contract number 53-3187-9-30

USDA Forest Service. 1996. Environmental Assessment for the Management and Control of Noxious Plants on the San Juan/Rio Grande National Forests, Colorado.

USDA Forest Service. 2001. Draft Noxious Weed Management Plan and Environmental Assessment for the Arapaho and Roosevelt National Forests and Pawnee National Grassland (ARNF & PNG, Forests and Grassland).

Valdez S.D. 1996. Rocky Mountain National Park Visitor Use Survey: 1994-1995.

Weaver, T., D. Gustafson, J. Lichthardt, and B. Woods. 1989. Distribution of Exotic Plants in the N. Rocky Mountains by Environmental Type and Disturbance Condition. Montana State University, Bozeman, Mt.

Weber, W.A. and R.C. Whittmann. 1996. Colorado Flora: Eastern Slope. University Press of Colorado, Niwot, CO.

Whitson, T.D., L.C. Burill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R. D. Lee, R. Palmer. 1992. Weeds of the West. Pioneer of Jackson Hole Printing, Wyoming.

Whitson, T.D., L.C. Burill, S.A. Dewey, R. Stougaard. 1999-2000. Weed Management Handbook for Montana, Utah and Wyoming.

Wilderness Act 16 USC. 1131 et seq. 1964

Willard, B.E., and J.W. Marr. 1963. Effects of Visitors on Natural Ecosystems in Rocky Mountain National Park. Final Report on 1959-1963 Study, Unpublished Mimeo, Institute of Arctic and Alpine Research, U. of Colorado, Boulder.

Wolf, J. 2000. Dynamics in Montane Grasslands: Exotic Invasion in Rocky Mountain National Park. Thesis. Department of Geography, University of Colorado.

APPENDIX A How the Non-Native Plants were Prioritized

In 1996 there were 1,022 known species of vascular plants in RMNP, of which 102 (10%) were considered exotic. Since 1960, we have monitored, investigated, and documented the persistent spread of some of these exotic plants in the park. In 1995-96, Rutledge and McLendon of Colorado State University completed a risk assessment on the 102 exotic plants. The risk assessment was developed based on a modified Heibert and Stubbendieck's Handbook for Ranking Exotic Plants (1993). All known exotic plants of Rocky Mountain National Park at that time were evaluated to assess their ecological impact. Based upon the evaluation, Rutledge and McLendon identified 21 species of concern, which are listed below. The table contains information on the level of ecological impact for each species, and the relative ease of control. Species were also assigned 'urgency scores' ranging from 'high' (delay in action will result in significant effort required for control) to 'medium' (delay in action will result in moderate increase in effort required for control) to 'low' (delay in action will result in little increase in the effort required for control).

Summary of Final Assessment for Exotic Plant Species of Concern

Species Name	Potential Distribution (Max. = 15)	Potential Impact (Max. = 40)	Current Impact (Max. = 50)	Ease of Control (Max. = 100) (0 = Difficult)	Urgency
<i>Agropyron repens</i>	6	33	4	40	Med
<i>Bromus inermis</i>	6	33	25	18	Med/High
<i>Bromus tectorum</i>	13	25	17	24	Med
<i>Carduus nutans</i>	11	26	29	25	Med
<i>Centaurea diffusa</i>	11	33	22	26	High
<i>Centaurea maculosa</i>	11	26	22	31	High
<i>Cirsium arvense</i>	11	31	30	8	Med
<i>Cirsium vulgare</i>	11	26	25	34	Med
<i>Chrysanthemum leucanthemem</i>	9	29	8	33	Med
<i>Convolvulus arvensis</i>	6	26	6	22	Med
<i>Dactylis glomerata</i>	6	29	12	34	Med
<i>Euphorbia esula</i>	11	38	42	20	High
<i>Gypsophilia paniculata</i>	9	26	--	40	Low/Med
<i>Hypericum perforatum</i>	13	38	9	21	Med
<i>Linaria dalmatica</i>	9	31	37	27	Med
<i>Linaria vulgaris</i>	11	27	40	19	High
<i>Lythrum salicaria</i>	11	31	*	31	Med
<i>Melilotus alba</i>	9	24	9	30	Med
<i>Phalaris arundinaceae</i>	9	24	--	21	Med
<i>Poa pratensis</i>	11	27	23	26	Med
<i>Sonchus uliginosus</i>	9	27	--	31	Med

* Currently not found in RMNP, but was found adjacent to RMNP. It is currently eradicated from the Estes Valley.

- A. Of the 21 species of concern listed in the table, we are proposing to suppress, contain or eradicate 17 of the species. These are:
1. Baby's breath (*Gypsophila paniculata*)
 2. Bull thistle (*Cirsium vulgare*)
 3. Canada thistle (*Cirsium arvense*)
 4. Cheatgrass (*Bromus tectorum*)
 5. Common St. Johnswort (*Hypericum perforatum*)
 6. Dalmatian toadflax (*Linaria dalmatica*)
 7. Diffuse knapweed (*Centaurea diffusa*)
 8. Field bindweed (*Convolvulus arvensis*)
 9. Kentucky bluegrass (*Poa pratensis*)
 10. Leafy spurge (*Euphorbia esula*)
 11. Musk thistle (*Carduus nutans*)
 12. Oxeye daisy (*Chrysanthemum leucanthemum*)
 13. Quackgrass (*Agropyron repens*)
 14. Smooth brome (*Bromus inermis*)
 15. Spotted knapweed (*Centaurea maculosa*)
 16. White sweetclover (*Melilotus alba*)
 17. Yellow toadflax (*Linaria vulgaris*)
- B. Four species listed in the table will not be managed at this time by the park. These are:
1. Orchard grass (*Dactylis glomerata*)
 2. Purple loosestrife (*Lythrum salicaria*)
 3. Reed canary grass (*Phalaris arundinaceae*)
 4. Swamp sow-thistle (*Sonchus uliginosus*)
- Purple loosestrife does not currently exist in the park. If purple loosestrife is ever found in the park it will become a high priority plant and will be eradicated. The other three species, even though they are currently found in the park, will not be managed due to funding constraints and a lack of research on how best to control these species without negatively impacting native species. We believe the funds that are available will be better spent to control the 35 species we have identified. In addition, further survey and research work is needed to determine appropriate Integrated Pest Management (IPM) strategies for the four species we will not control.
- C. Since the 1996 risk assessment, eighteen (18) new invasive exotic plants have been documented in the park that we are proposing to eradicate or control. These are:
1. Bouncingbet (*Saponaria officinalis*)
 2. Common burdock (*Arctium minus*)
 3. Common mullien (*Verbascum thapsus*)
 4. Curly dock (*Rumex crispus*)
 5. Dame's rocket (*Hesperis matronalis*)
 6. Deptford pink (*Dianthus armeria L.*)
 7. Hoary alyssum (*Berteoa incana*)
 8. Houndstongue (*Cynoglossum officianale*)

9. Orange hawkweed (*Hieracium aurantiacum*)
10. Red-top grass (*Agrostis gigantea*)
11. Russian thistle sp. (*Salsola collina*)
12. Common Russian thistle sp. (*Salsola australis*)
13. Scentless chamomile (*Matricaria perforata*)
14. Scotch thistle (*Onopordum tauricum*)
15. Sheep fescue (*Festuca ovina*)
16. Sulphur cinquefoil (*Potentilla recta*)
17. Timothy (*Phleum pratense*)
18. Yellow sweetclover (*Melilotus officianalis*)

APPENDIX B Proposed Action and Control for 35 Invasive Exotic Plants

	Natural Zone	Historic Zone	Developed Zone
Baby's breath (<i>Gypsophila paticulata</i>)			
Extent of Population	<0.25 acre	No known infestation	No known infestation
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical	-Mechanical	-Mechanical
Bouncingbet (<i>Saponaria officianalis</i>)			
Extent of Population	No known infestation	No known infestation	<0.25 acre
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical	-Mechanical	-Mechanical
Bull thistle (<i>Cirsium vulgare</i>)			
Extent of Population	<1.25 acres	No known infestation	<1.25 acres
Recommended Action	Eradicate	Eradicate if found	Eradicate
Recommended Control	-Mechanical		-Mechanical
Canada thistle (<i>Cirsium arvense</i>)			
Extent of Population	<100 acres	<12.5 acres	<25 acres
Recommended Action	Contain or suppress	Contain or suppress	Contain or suppress
Recommended Control	-Mechanical. -Chemical within ½ mi. of boundary or in other sensitive locations ~ 2.5 acres. -Biological if deemed safe.	-Mechanical. -Chemical within ½ mi. of boundary or in other sensitive locations ~ 6 acres. -Biological if deemed safe.	-Mechanical. -Chemical within ½ mi. of boundary or in other sensitive locations ~ 2.5 acres -Biological if deemed safe.
Cheatgrass (<i>Bromus tectorum</i>)			
Extent of Population	Unknown	Unknown	~ 5 acres may be controlled along Bear Lake Road and < 1 acre in the Headquarters area
Recommended Action	Suppress in sensitive areas	Suppress in sensitive areas	Suppress in sensitive areas
Recommended Control	-Cultural -Sugar applied at 160 grams per sq. meter when < 100 square meters -Chemical when > 100 sq. meters or when > 10 square meters when impacting a revegetation site.	-Cultural -Sugar applied at 160 grams per sq. meter when < 100 square meters at any one location. -Chemical when > 100 sq. meters or when > 10 square meters when impacting a revegetation site.	-Cultural -Sugar applied at 160 grams per sq. meter when <100 square meters at any one location. -Chemical when > than 100 sq. meters or when > 10 square meters when impacting a revegetation site.

	Natural Zone	Historic Zone	Developed Zone
Common burdock (<i>Arctium minus</i>)			
Extent of Population	No known infestation	No known infestation	<5 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control			-Mechanical
Common mullien (<i>Verbascum thapsus</i>)			
Extent of Population	50 acres	<2.5 acres	<2.5 acres
Recommended Action	Contain or suppress	Eradicate	Eradicate or contain
Recommended Control	-Mechanical	-Mechanical	-Mechanical
Common St. Johnswort (<i>Hypericum perforatum</i>)			
Extent of Population	Currently eradicated	Currently eradicated	Currently eradicated
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical -Chemical -Biological	-Mechanical -Chemical -Biological	-Mechanical -Chemical -Biological
Curly dock (<i>Rumex crispis</i>)			
Extent of Population	~ 2.5 acres	No known infestation	No known infestation
Recommended Action	Eradicate or contain	Eradicate or contain	Eradicate or contain
Recommended Control	-Mechanical	-mechanical	-Mechanical
Dalmatian toadflax (<i>Linaria dalmatica</i>)			
Extent of Population	<7.5 acres	<2.5 acres	<5 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical -Chemical	-Mechanical -Chemical	-Mechanical -Chemical
Dames rocket (<i>Hesperis matronalis</i>)			
Extent of Population	No known infestation	No known infestation	Currently eradicated
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical	-Mechanical	-Mechanical
Deptford pink (<i>Dianthus armeria L.</i>)			
Extent of Population	<2.5 acres	No known infestation	No known infestation
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical	-Mechanical	-Mechanical
Diffuse Knapweed (<i>Centaurea diffusa</i>)			
Extent of Population	No known infestation	No known infestation	<2.5 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical -Chemical	-Mechanical -Chemical	-Mechanical -Chemical
Field bindweed (<i>Convolvulus arvensis</i>)			
Extent of Population	<3.1 acres	No known infestation	<1.7 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical -Chemical		-Mechanical -Chemical

	Natural Zone	Historic Zone	Developed Zone
Hoary alyssum (<i>Berteroa incana</i>)			
Extent of Population	No known infestation	<2.5 acres	<2.5 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical	-Mechanical	-Mechanical
Houndstongue (<i>Cynoglossum officianale</i>)			
Extent of Population	2.5 acres	No known infestation	2.5 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical -Chemical		-Mechanical -Chemical
Kentucky bluegrass (<i>Poa pratensis</i>)			
Extent of Population	Unknown	Unknown	Unknown
Recommended Action	Contain or suppress	Contain or suppress	Contain
Recommended Control	-Fire -Cultural	-Fire -Cultural	-Fire -Cultural
Leafy Spurge (<i>Euphorbia esula</i>)			
Extent of Population	4 acres	5 acres	2.5 acres
Recommended Action	Contain and then Eradicate	Contain and then Eradicate	Contain and then Eradicate
Recommended Control	-Chemical -Biological -Mechanical such as digging when a patch is < 10 sq. meters	-Chemical -Biological -Mechanical such as digging when a patch is < 10 sq. meters	-Chemical -Biological -Mechanical such as digging when a patch is <10 sq. meters
Musk thistle (<i>Carduus nutans</i>)			
Extent of Population	<38 acres	<2.5 acres	<2.5 acres
Recommended Action	Contain and then eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical -Biological	-Mechanical -Biological	-Mechanical -Biological
Orange Hawkweed (<i>Hieracium aurantiacum</i>)			
Extent of Population	110 sq. ft.	No known infestation	No known infestation
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	- Mechanical - Chemical		
Oxeye daisy (<i>Chrysanthemum leucanthemum</i>)			
Extent of Population	<0.25 acre	No known infestation	<0.25 acre
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical -Chemical		-Mechanical -Chemical
Quack grass (<i>Agropyron repens</i>)			
Extent of Population	Unknown	Unknown	<2.5 acres
Recommended Action	Contain and then eradicate	Eradicate	Eradicate
Recommended Control	-Fire -Chemical	-Fire -Chemical	-Fire -Chemical

	Natural Zone	Historic Zone	Developed Zone
Red-top Grass (<i>Agrostis gigantea</i>)			
Extent of Population	Unknown	Unknown	Unknown
Recommended Action	Contain or suppress	Contain or suppress	Contain or suppress
Recommended Control	-Cultural -Limited mechanical	-Cultural -Limited mechanical	-Cultural -Limited mechanical
Russian thistle (<i>Salsola collina</i>)			
Extent of Population	No known infestation	2.5 acres	2.5 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Cultural -Mechanical -Sugar applied at 160 grams per square meter	-Cultural -Mechanical -Sugar applied at 160 grams per square meter	-Cultural -Mechanical -Sugar applied at 160 grams per square meter
Common Russian thistle (<i>Salsola australis</i>)			
Extent of Population	No known infestation	2.5 acres	2.5 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Cultural -Mechanical -Sugar applied at 160 grams per square meter	-Cultural -Mechanical -Sugar applied at 160 grams per square meter	-Cultural -Mechanical -Sugar applied at 160 grams per square meter
Scentless chamomile (<i>Matricaria perforata</i>)			
Extent of Population	2.5 acres	No known infestation	1.25 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical	-Mechanical	-Mechanical
Scotch thistle (<i>Onopordum tauricum</i>)			
Extent of Population	Presently eradicated	No known infestation	No known infestation
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical	-Mechanical	-Mechanical
Sheep Fescue (<i>Festuca ovina</i>)			
Extent of Population	2.5 acres	No known infestation	2.5 acres
Recommended Action	Contain and then eradicate	Contain or suppress	Contain or suppress
Recommended Control	-Fire -Mechanical		-Fire -Mechanical
Smooth Brome (<i>Bromus inermis</i>)			
Extent of Population	Unknown	7.5 acres	12.5 acres
Recommended Action	Contain and suppress in sensitive areas	Contain and suppress in sensitive areas	Contain and suppress in sensitive areas
Recommended Control	-Fire -Cultural -Chemical	- Fire -Cultural -Chemical	- Fire -Cultural -Chemical
Spotted Knapweed (<i>Centaurea maculosa</i>)			
Extent of Population	Unknown	1.25 acres	1.25 acres
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	-Mechanical -Chemical	-Mechanical -Chemical	-Mechanical -Chemical

	Natural Zone	Historic Zone	Developed Zone
Sulfur cinquefoil (<i>Potentilla recta</i>)			
Extent of Population	1.25 acres	No known infestation	No known infestation
Recommended Action	Eradicate	Eradicate	Eradicate
Recommended Control	- Mechanical - Chemical	- Mechanical - Chemical	- Mechanical - Chemical
Timothy (<i>Phleum pratense</i>)			
Extent of Population	Unknown	Unknown	Unknown
Recommended Action	Contain and suppress	Contain	Contain
Recommended Control	-Fire	-Fire	-Fire
White sweetclover (<i>Melilotus alba</i>)			
Extent of Population	<20 acres	<5 acres	<5 acres
Recommended Action	Contain and suppress	Contain and suppress	Contain and suppress
Recommended Control	-Mechanical -Fire (Propane flamer)	-Mechanical -Fire (Propane flamer)	-Mechanical -Fire (Propane flamer)
Yellow sweetclover (<i>Melilotus officianalis</i>)			
Extent of Population	<25 acres	<5 acres	<5 acres
Recommended Action	Contain and suppress	Contain and suppress	Contain and suppress
Recommended Control	-Mechanical -Fire (Propane flamer)	-Mechanical -Fire (Propane flamer)	-Mechanical -Fire (Propane flamer)
Yellow toadflax (<i>Linaria vulgaris</i>)			
Extent of Population	<37 acres	<12.5 acres	<25 acres
Recommended Action	Contain and then eradicate	Contain and then eradicate	Contain and then eradicate
Recommended Control	-Mechanical -Chemical ~ 30 acres -Biological	-Mechanical -Chemical ~ 6 acres	-Mechanical -Chemical ~ 6 acres

APPENDIX C Threshold level for 15 invasive exotic plants that warrant chemical control

Species	Threshold Level for Chemical Control	Acreage that Exceeds the Threshold	Amount of Herbicide Required	Timetable for Chemical Control
Canada Thistle (Limited control)	> 100 plants in any one location where control is warranted such as ½ mile from park boundary or in other sensitive locations.	~16 acres with ~10 acres identified for control	Corn or Wheat gluten – 15 gallons Redeem – 25 Ozs. Or 2,4-D Amine – 6.25 gallons or 2,4-D LVE – 6.25 gallons or Transline – 1.6 gallons	2 to 3 years to treat all locations with possible follow-up work
Cheatgrass (Limited control)	-Sugar applied at 160 grams per sq. meters when < 100 square meters -Chemical when > 100 square meters or when >10 square meters when impacting a revegetation site.	<1 acre	Burnout – 2.5 gallons Roundup – 14 to 70 ozs.	1 year
Common St. Johnswort	> 100 plants at any one location.	Eradicated at the present time	0	0
Dalmatian Toadflax	> 20 locations (weed patches) within the park, or > 100 plants at any one location.	3.5 acres	Plateau + MSO – 40 ozs.	2 years to treat all locations
Diffuse Knapweed	> 1000 plants in any one location.	1.65 acre	Transline – 10ozs. or Tordon – 1 pint	1 year
Field Bindweed	> 20 plants at any one location	4.75 acres	Paramount 1.78 lb. or Rodeo 2 gallons	3 years to treat all locations and retreatment if necessary
Houndstongue	> 10 locations (weed patches) within the park, or > 2,000 plants at any one location.	2.5 acres	Plateau + MSO – 40 ozs.	1 year
Leafy Spurge	> 10 sq. ft. in any one location	13.75 acres	Plateau +MSO – 1.55 gallons.	3 years
Oxeye Daisy	> 100 plants & > 2 locations	1 acre	Escort – 2 Ozs.	1 year
Orange Hawkweed	> 100 plants in any one location.	0.10 acre	2,4-D Amine – 0.5 pint	1 year

Species	Threshold Level for Chemical Control	Acreage that Exceeds the Threshold	Amount of Herbicide Required	Timetable for Chemical Control
Quack grass	> 100 plants at any one location	1 acre	Roundup – 14 ozs.	1 year
Smooth brome (Limited Control)	>0.1 acre	5 acres along Bear Lake Road	Burnout – 2.5 gallons Roundup – 1.1 gallons	1 year
Spotted Knapweed	> 100 plants in any one location.	0.80 acre	Transline – 0.2 oz. Or Tordon – 0.2 oz. Or 2,4-D amine – 1 pint	1 year
Sulfur Cinquefoil	> 10 locations (weed patches) within the park, or > 100 plants at any one location.	1 acre	Tordon –0.5 pint or Redeem – 2.4 ozs.	2 years
Yellow toadflax	>1,000 plants at one location or over 2,000 plants at more than 10 locations	12.65 acres	Telar – 34 ozs.	3 years to treat all locations and retreatment if necessary

APPENDIX D Endangered, Threatened, and Rare Species of Rocky Mountain National Park

Last Revised June 2003

Rocky Mountain National Park uses the following table to identify endangered, threatened and rare species that must be protected if found within a proposed project site.

Agencies have a variety of ways of tracking and measuring the biological imperilment of species. The U.S. Fish and Wildlife Service (USFWS) determines if a given specie needs protection under the Endangered Species Act. There are four primary categories to federal listing that are applicable to Rocky Mountain National Park:

Federal Status Codes

LE	Federal Endangered – Listed as endangered by the U.S. Fish and Wildlife Service. The specie is in danger of extinction throughout all or a significant portion of its range. Endangered species have legal protection under federal law.
LT	Federal Threatened – Listed as threatened by the U.S. Fish and Wildlife Service. The specie is likely to become endangered within the foreseeable future. Threatened species have legal protection under federal law.
C	Federal Candidate – The U.S. Fish and Wildlife Service is considering federal listing.
PS:LT	Partial Status – Intraspecific taxon or population is listed as Threatened in only a portion of the species' range

The Colorado Division of Wildlife also maintains a list of imperiled species for the state of Colorado. There are three primary categories in the state listing:

State Status Codes

E	State Endangered – Listed as endangered by the Colorado Division of Wildlife. Include elements of native wildlife whose prospects for survival or recruitment within Colorado are in jeopardy. State endangered species have legal protection under Colorado Revised Statutes 33-2-105 Article 2.
T	State Threatened – Listed as threatened by the Colorado Division of Wildlife. Include elements of native wildlife that are not in immediate jeopardy of extinction, but are vulnerable due to small numbers, restricted throughout its range, or experiencing low recruitment or survival. State threatened species have legal protection under Colorado Revised Statutes 33-2-105 Article 2.
SC	State Special Concern – Listed as specie of special concern by the Colorado Division of Wildlife.

The Colorado Natural Heritage Program (CNHP), based in Fort Collins manages a large database and ranking system for Colorado species. The database can be accessed through the Internet at www.cnhp.colostate.edu. The CNHP ranking system has two primary components – a ranking for the global status of the specie (G), and a ranking for that part of the range found within the state (S). Numeric extensions are added to these on a scale of 1 (critically imperiled) to 5 (demonstrably secure).

Natural Heritage ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection.

Global Rank Codes

G1	Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
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- G2** Globally imperiled because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range.
- G3** Globally vulnerable throughout its range or found locally in a restricted range (21 to 100 occurrences).
- G4** Globally apparently secure, though it might be quite rare in parts of its range, especially at the periphery (>100 occurrences).
- G5** Globally demonstrably secure, although it may be rare in parts of its range, especially at the periphery.
- T#** Rank applies to a subspecies or variety. These species are ranked on the same criteria as G1-G5.
- Q** Taxonomic status is questionable.
- ?** Indicates uncertainty about an assigned global rank.

State Rank Codes

- S1** State critically imperiled; typically 5 or fewer occurrences, or because of some factor of its biology making it especially vulnerable to extirpation from the state.
- S2** State imperiled; typically 6 to 20 occurrences, or because of other factors demonstrably making it very vulnerable to extirpation from the state.
- S3** State vulnerable; typically 21 to 100 occurrences.
- S4** State apparently secure; usually >100 occurrences.
- S5** State demonstrably secure.
- S#B** Refers to the breeding season imperilment of species that are not permanent residents.
- S#N** Refers to the non-breeding season imperilment of species that are not permanent residents.
- SX** State extinct; unlikely to be rediscovered.
- SR** Recently reported in the state, but not confirmed.
- ?** Indicates uncertainty about an assigned state rank.

The Rocky Mountain National Park list of Endangered, Threatened, and Rare Species does not include State Ranks Codes S4 and S5 because these rankings indicate that the species is secure throughout its range. If a species is listed as unconfirmed, it either means it occurred historically and is presently not confirmed, or it is highly probable the species occurs in the park, but is presently not confirmed.

Scientific Name	Common Name	Time of Occurrence	Status		CNHP Rank	
			Federal	State	Global	State
Amphibians						
<i>Bufo boreas popl</i>	Boreal toad	All year	C	E	G4T1Q	S1
<i>Rana Pipiens</i> (unconfirmed)	Northern leopard frog	All year		SC	G5	S3
<i>Rana sylvatica</i>	Wood Frog	All year			G5	S3
Birds						
<i>Accipiter gentilis</i>	Northern goshawk	All year			G5	S3B
<i>Aegolius funereus</i>	Boreal owl	All year			G5	S2
<i>Amphispiza belli</i>	Sage sparrow	Summer or migrant			G5	S3B
<i>Bucephala islandica</i>	Barrow's goldeneye	Winter or migrant		SC	G5	S2B
<i>Buteo regalis</i>	Ferruginous hawk	Migrant		SC	G4	S3B, S4N
<i>Catharus fuscescens</i>	Veery	Summer or migrant			G5	S1B
<i>Catoptrophorus semipalmatus</i>	Willet	Winter			G5	S1B
<i>Coccyzus americanus occidentalis</i> (unconfirmed)	Western Yellow-billed cuckoo	Only two recorded occurrences, 1947& 1980	C	SC	G5T3	SR
<i>Cypseloides niger</i>	Black swift	Summer			G4	S3B
<i>Dendroica graciae</i>	Grace's warbler	Only one recorded occurrence, 1990			G5	S3B
<i>Dolichonyx oryzivorus</i>	Bobolink	Summer or migrant			G5	S3B
<i>Egretta thula</i>	Snowy Egret	Migrant or rare summer			G5	S2B
<i>Falco peregrinus anatum</i>	American peregrine falcon	Summer or migrant		SC	G4T3	S2B
<i>Glaucidium gnoma</i>	Northern pygmy owl	All year			G5	S3B
<i>Grus canadensis tabida</i>	Greater sandhill crane	Summer or migrant		SC	T4	S2B, S4N
<i>Haliaeetus leucocephalus</i>	Bald eagle	All year	LT	T	G4	S1B, S3N
<i>Leucosticte australis</i>	Brown-capped rosy-finch	All year			G4	S3B, S4N
<i>Loxia leucoptera</i>	White-winged crossbill	All year, Irregular visitor			G5	S1B
<i>Numenius americanus</i>	Long-billed curlew	Migrant		SC	G5	S2B
<i>Pelecanus erythrorhynchos</i>	American white pelican	Migrant		SC	G3	S1B
<i>Plegadis chihi</i>	White-faced ibis	Migrant			G5	S2B
<i>Seiurus aurocapillus</i>	Ovenbird	Rare summer or rare migrant			G5	S2B
<i>Sterna forsteri</i>	Forster's tern	Migrant			G5	S2B

Scientific Name	Common Name	Time of Occurrence	Status		CNHP Rank	
			Federal	State	Global	State
Fish						
<i>Oncorhynchus clarki pleuriticus</i>	Colorado River cutthroat	All year	C	SC	T3	S3
<i>Oncorhynchus clarki stomias</i>	Greenback cutthroat	All year	LT	T	T2T3	S2S3
Mammals						
<i>Canis lupis</i> (unconfirmed)	Gray wolf		PS:LT		G4	SX
<i>Felis lynx canadensis</i> (unconfirmed)	Lynx	All year	PS:LT	E	G5	S1
<i>Gulo gulo</i> (unconfirmed)	Wolverine	All year		E	G4	S1
<i>Plecotus townsendii pallescens</i>	Townsend's big-eared bat	Summer. Unconfirmed winter.			G4T4	S2
<i>Sorex hoyi montanus</i>	Pygmy shrew	All year			G5T2 T3	S2
<i>Sorex nanus</i>	Dwarf shrew	All year			G4	S2
<i>Ursus arctos</i> (unconfirmed)	Grizzly or Brown bear				G4	SX
Invertebrates (Insects)						
<i>Colorado luskii</i>	Lusk's pinemoth	Summer			G4	S1?
<i>Hyles galli</i>	Galium sphinx moth	Summer			G5	S3?
<i>Paratrytone snowi</i>	Snow's skipper	Summer			G5	S3
<i>Pyrgus ruralis</i>	Two-banded skipper	Summer	(PS)		G4	S3
Mollusk						
<i>Acroloxus coloradensis</i>	Rocky mountain capshell	All year		SC	G1G2	S1
Plants						
<i>Aletes humilis</i> (unconfirmed)	Larimer aletes				G2G3	S2S3
<i>Alsinnanthe stricta</i>	Rock sandwort				G5	S1
<i>Aquilegia saximontana</i>	Rocky mountain columbine				G3	S3
<i>Artemisia pattersonii</i>	Patterson's wormwood				G3G4	S3
<i>Asplenium septentrionale</i>	Grass-fern				G4G5	S3S4
<i>Botrychium echo</i>	Reflected moonwort				G2	S2
<i>Botrychium hesperium</i>	Western moonwort				G3	S2
<i>Botrychium lanceolatum</i> var <i>lanceolatum</i>	Lance-leaved moonwort				G4T4	S3
<i>Botrychium lunaria</i>	Moonwort				G5	S3
<i>Botrychium minganense</i>	Mingan moonwort				G4	S1
<i>Carex diandra</i>	Lesser panicled sedge				G5	S1
<i>Carex leptalea</i>	Bristle-stalk sedge				G5	S1
<i>Carex limosa</i>	Mud sedge				G5	S2
<i>Carex oreocharis</i>	A sedge				G3	S1

Scientific Name	Common Name	Time of Occurrence	Status		CNHP Rank	
			Federal	State	Global	State
<i>Carex stenoptila</i>	River bank sedge				G2	S2?
<i>Chionophila jamesii</i>	Rocky mountain snowlover				G4?	S3S4
<i>Cyripedium calceolus ssp. Parviflorum</i>	Yellow lady's slipper				G5	S2
<i>Cyripedium fasciculatum</i>	Purple's lady's-slipper				G4	S3
<i>Cystopteris montana</i>	Mountain bladder fern				G5	S1
<i>Draba crassa</i>	Thick-leaf whitlow-grass				G3	S3
<i>Draba fladnizensis</i>	Arctic Draba				G4	S2S3
<i>Draba grayana</i>	Gray's peak whitlow-grass				G2	S2
<i>Draba porsildii</i>	Porsildraba				G3G4	S1
<i>Draba streptobrachia</i>	Colorado divide whitlow-grass				G3	S3
<i>Drymaria effusa var. depressa</i>	Spreading drymaria				G4T4	S1SE?
<i>Dryopteris expansa</i>	Spreading wood fern				G5	S1
<i>Erocallis triphylla</i>	Dwarf Spring Beauty				G4?	S2
<i>Gastrolychnis kingii</i>	King's campion				G2G4Q	S1
<i>Gymnocarpium dryopteris</i>	Oak fern				G5	S2S3
<i>Hippochaete variegata</i>	Variegated scouringrush				G5	S1
<i>Isoetes setacea ssp. Muricata</i>	Spiny-spored quillwort				G5?T5?	S2
<i>Juncus tweedyi</i>	Tweedy rush				G3Q	S1
<i>Juncus vaseyi</i>	Vasey bulrush				G5?	S1
<i>Lewisia rediviva</i>	Bitterroot				G5	S2
<i>Liatris ligulistylis</i>	Gay-feather				G5?	S1S2
<i>Lilium philadelphicum</i>	Wood lily				G5	S3S4
<i>Listera borealis</i>	Northern twayblade				G4	S2
<i>Listera convallarioides</i>	Broad-Leaved twayblade				G5	S2
<i>Luzula subcapitata</i>	Colorado wood-rush				G3?	S3?
<i>Mimulus gemmiparus</i>	Weber monkey flower				G2	S2
<i>Nuttallia sinuata</i>	Wavy-leaf stickleaf				G3	S2
<i>Nuttallia speciosa</i>	Jeweled blazingstar				G3?	S3?
<i>Papaver kluanense</i>	Alpine poppy				G5T3 T4	S3S4
<i>Parnassia kotzebuei</i>	Kotzebue grass-of-parnassus				G4	S2
<i>Penstemon harbourii</i>	Harbour beardtongue				G3	S3S4
<i>Polypodium hesperium</i>	Western polypody				G5	S1S2

Scientific Name	Common Name	Time of Occurrence	Status		CNHP Rank	
			Federal	State	Global	State
<i>Potentilla effusa</i> Var. <i>rupincola</i>	Rocky mountain cinquefoil				G5?T2	S2
<i>Pyrola picta</i> (unconfirmed)	Pictureleaf wintergreen				G4G5	S3S4
<i>Ranunculus gelidus</i> ssp <i>grayi</i>	Tundra buttercup				G4G5	S2
<i>Salix serissima</i>	Autumn willow				G4	S1
<i>Sisyrinchium pallidum</i>	Pale blue-eyed grass				G2G3	S2
<i>Telesonix jamesii</i>	James' telesonix				G2G3	S2?
<i>Tonestus lyallii</i>	Lyall haplopappus				G5	S1
<i>Viola Selkirkii</i>	Selkirk violet				G5?	S1

APPENDIX E List of sources used by Rocky Mountain National Park to identify endangered, threatened and rare species that must be protected if found within the proposed project site.

Andrews, T. 1991. A Survey of Rocky Mountain National Park and Surrounding Areas of Arapaho and Roosevelt National Forests for Wolverine and Lynx, Winter 1990-1991.

Armstrong, David M. 1987. Rocky Mountain Mammals. A Handbook of Mammals of Rocky Mountain National Park and Vicinity.

Colorado Bird Observatory. 1997 Reference Guide to the Monitoring and Conservation Status of Colorado's Breeding Birds. Colorado Bird Observatory, Brighton, Co.

Colorado Division of Wildlife. 1998. Endangered, Threatened and Special Concern species.

Colorado Natural Heritage Program. 1997. Colorado's Natural Heritage: Rare and Imperiled Animals, Plants, and Natural Communities. Volume 3, No. 1. Colorado Natural Heritage Program, Fort Collins, Colorado.

Denver Botanic Gardens. 1999. ROMO Working Herbarium. 1998 Herbarium Collection Summary.

Denver Botanic Gardens. 2000. ROMO Rare Plant Survey, Final Report 2000 Rare Plant List Occurrence Records.

Reed, D.F., G. Byrne, J. Kindler. 1998. Snowshoe Hare Density/Distribution Estimates and Potential Release Sites for Reintroducing Lynx in Colorado. Colorado Division of Wildlife Report.

Spackman, S., B. Jennings, J. Coles, C. Dawson, M. Minton, A. Kratz, and C. Spurrier. 1997. Colorado Rare Plant Field Guide. Prepared for the Bureau of Land Management, the U.S. Forest Service and the U.S. Fish and Wildlife Service by the Colorado Natural Heritage Program.

U.S. Bureau of Land Management. 1998. Bureau of Land Management Sensitive Species List for Colorado.

U.S. National Forest Service. 1998. Rocky Mountain Region Sensitive Species List.

U.S. Fish and Wildlife Service. 1995. Migratory Nongame Birds of Management Concern in the United States: The 1995 List.

U.S. Fish and Wildlife Service 1996. Candidates for Endangered Species Act Protection. 1996 Notice of Review, Questions and Answers.

U.S. Fish and Wildlife Service. 1997. Endangered and threatened wildlife and plants; review of plant and animal taxa that are candidates for listing as endangered or threatened species. 50 CFR 17.11 and 17.12. 52pp.

U.S. National Park Service. 1994. Memorandum of Understanding with the U.S. Fish and Wildlife Service, Bureau of Land Management, and the National Marine Fisheries Service.

U.S. National Park Service. 1996. Automated National Catalog System (ANCS) for Rocky Mountain National Park.

U.S. National Park Service. 1996. Memorandum on Interim Category 2 Candidate Species Guidance.

- U.S. National Park Service. 1998. Checklist of Birds of Rocky Mountain National Park.
- U.S. National Park Service. 1998. Wildlife Observation Database for Rocky Mountain National Park. Rocky Mountain National Park.
- Weber, W.A. 1976. Rocky Mountain Flora. Colorado Associated University Press, Boulder, Colorado.
- Weber, W.A. 1988. Catalogue of the Vascular Plants of Rocky Mountain National Park. University of Colorado Museum. Boulder, Co. 2nd Edition. 103 pp.
- Yeatts, L. 1990. Botanical Survey of Rocky Mountain National Park. The Denver Botanic Gardens. Denver, Co. 41pp. Yeatts, L. 1987. Survey of Special Interest Plants and General Flora, Rocky Mountain National Park. The Denver Botanic Gardens, Denver, Colorado.

APPENDIX F Communications Plan for Herbicide Use within RMNP

1. By April 30 of each year, park personnel will identify locations in the park where herbicide application is warranted. Herbicide treatment will not be done outside of the identified locations. RMNP will identify trail segments, trailheads, picnic areas, parking lots and campsites that are located within or adjacent to the planned treatment areas. RMNP will also identify all campgrounds in the park that will remain chemical free for that year. This information will be made available to the public via the RMNP website and other print media.
2. The following individuals and entities will be notified in writing of the proposed herbicide application plan developed in #1:
 - a) All park inholders located within ¼ mile of the proposed treatment sites.
 - b) All adjacent landowners located within ¼ mile of the proposed treatment sites.
 - c) All individuals listed on the Colorado Registry of Pesticide Sensitive Persons. RMNP will obtain a new registry each year from the Colorado Department of Agriculture, Division of Plant Industry
 - d) The RMNP Information Office.
 - e) The RMNP Fee Collection Supervisor (entrance gate personnel).
 - f) RMNP District Law Enforcement Rangers
 - g) The RMNP Public Information Officer.
 - h) RMNP Dispatch Center
 - i) The information be included in the RMNP Morning Report, which is available to all park employees with intranet access.
 - j) The information will be included on the RMNP web page, which is available to the public.
3. The Information Office will keep a list of all hiking trail segments, trailheads, parking lots, picnic areas, and campsites that are located within planned herbicide treatment areas. The Information Office will also keep a list of all campgrounds in the park that will remain chemical free for that year. These lists will be updated annually.
4. All sites where herbicides are proposed to be applied will be posted with yellow signs that contain the following information:
 - a) Treatment Date
 - b) Targeted invasive exotic plants
 - c) Name of the herbicide to be applied.
 - d) Restricted travel period.
 - e) Contact Name and Telephone Number.

Signs will be posted at access points (e.g. trailheads) two weeks before application. Signs will remain in place for three months following application.

APPENDIX G Relative Aquifer Vulnerability Evaluation (RAVE)

As adapted from the Users Guide for the Vegetation Management Risk Assessment
Risk Assessment for Herbicide Use in Forest Service
Regions 1, 2, 3, 4, and 10 and on
Bonneville Power Administration Sites
December 1992

The USFS adapted their RAVE from the Montana Department of Agriculture,
Environmental Management Division.

Introduction

To help RMNP reduce the potential for contaminating groundwater with herbicides, an aquifer vulnerability scoring system – Relative Aquifer Vulnerability Evaluation (RAVE) – was adapted to the park. This numeric scoring system will help RMNP evaluate herbicide 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 herbicide application required in all situations.

Wetlands, rivers, streams and lakes, and areas of the park where groundwater is within 20 feet of the surface are particularly vulnerable to herbicide contamination and thus require special consideration prior to making an application. The use of the score card may indicate whether an alternative herbicide should be used within a given area, or if the area is not suited to herbicide applications. If the area is not suitable for herbicide use, other control methods should be used such as mechanical, cultural, biocontrol, natural chemicals and/or the hot water low risk method hot water.

Several major factors in a particular area determine the relative vulnerability of groundwater to herbicide 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. Soil and water level information exists for the park in areas where a herbicide might be used. Herbicide leaching potential is based on the persistence and mobility of an herbicide in the soil. A list of leaching and surface runoff potentials for herbicides planned for use in RMNP 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 predominately gravelly, sandy, loamy, or clayey.
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 of the soil in the park is less than 3 percent).

Topographic Position:	<p>Physical surroundings of the location where the herbicide application is to be made.</p> <ul style="list-style-type: none"> • Flood Plain = within a river, stream or lake valley such as Moraine Park, Hollowell Park, Horseshoe Park, Kawuneeche Valley (vegetation is composed of wetland species such as sedges and willow). • Alluvial Fan or Bench = lands immediately above a river or lake valley but may still have some riparian vegetation such as willow or aspen (example would be the alluvial fan in Endo Valley, or aspen in Upper Beaver Meadows). • Upland Habitat = uplands above a floodplain or alluvial bench such as sagebrush, antelope bitterbrush, aspen and ponderosa pine savanna. • Transition zone = land not immediately affected by open water (for example lodgepole pine and spruce/fir near a wetland, stream or river. Lodgepole and spruce/fir could be adjacent to a stream, river, lake, floodplain).
Distance to Surface Water:	Distance in feet from treatment boundary to the nearest flowing or stationary surface water.
Annual Precipitation:	<ul style="list-style-type: none"> • > 60” annual precipitation. • 30-60” annual precipitation. • < 30” annual precipitation on the treatment site.
Herbicide Application Frequency:	Number of times the particular herbicide is applied during one growing season.
Herbicide Application Method:	Whether the herbicide is applied to the soil or to the plant.
Herbicide Leachability:	A relative ranking of the potential for a herbicide to move downward in soil and ultimately contaminate groundwater based upon the persistence and mobility of the herbicide.

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.

Interpretation of RAVE Score

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. RMNP will always be evaluating information to determine herbicides that maybe appropriate. A RAVE score of 80 or greater indicate that herbicide 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 than 45 indicate a low potential for groundwater contamination by the herbicide being evaluated. Even in such cases, careful use of herbicides and adherence to label instructions is imperative to protect groundwater.

Note: Some products such as Telar are used in very small quantities. In cases where less than ½ pound AI per acre is applied, it would be reasonable to reduce the final RAVE score by 2-5 points.

THE RAVE SCORE CARD (circle one of each category)

Depth to Groundwater	Annual Precipitation
* 2-10 ft. <u>20</u>	>60" <u>5</u>
10-25 ft. <u>12</u>	30-60 " <u>2</u>
25-50 ft. <u>5</u>	<30" <u>0</u>
> 50 ft. <u>0</u>	
Soil Texture	Herbicide Application Frequency
Gravelly <u>15</u>	>1/yr <u>5</u>
Sandy <u>15</u>	1/yr <u>2</u>
Loamy <u>10</u>	<1/yr <u>1</u>
Percent Soil Organic Mater	Herbicide Application Method
0-1% <u>5</u>	Applied to Soil <u>5</u>
**1-3% <u>3</u>	Applied to Foliage <u>2</u>
>3% <u>2</u>	
Topographic Position	***Herbicide Leaching Potential
Flood Plain <u>15</u>	Large <u>20</u>
Alluvial Bench <u>10</u>	Medium <u>10</u>
Upland Habitat <u>5</u>	Small <u>5</u>
Transition Zone <u>2</u>	
Distance to Surface Water	Total all Rankings
0-100 ft. <u>5</u>	_____ = Rave Score
100-500 ft. <u>3</u>	
>500 ft. <u>2</u>	

* If water table is less than 2 feet deep applications should not be made or possibly done with a wick or wand applicator, but only for a herbicide that can be used with that method in wetland habitat.

** If unknown use this value

*** See attached Table (Herbicides and their Properties) for leaching potential for the pesticide in question.

**Herbicides and their Properties
(for use with the Rave Scorecard)**

Common Name	Trade Name	Solubility in Water ppm	Soil Sorption Index (Koc)	Half Life in Soil (days)	Surface Runoff (Loss) potential	Leaching
Chlorsulfuron	Telar	300 (pH 5) 28,000 (pH7)	40 @ pH7 (avg.)	30 – acid soil 30+ alkaline	Small	Large
Clopyralid	Transline	1,000 (acid) 300,000 (salt)	1.4	20	Small	Large
2,4-D Amine		890	20	10	Small	Medium
2,4-D Ester		900	100 (Estimated)	10	Medium	Small
Glyphosate	Roundup & Rodeo	12,000	24,000	30	Large	Small
Imazapic	Plateau	2,200	10-26	31 - 410	Small	Medium
Metsulfuron methyl	Escort	548 @ pH5 2,790 @ pH7 213,000 @ pH9	35 @ pH 7	120	Medium	Large
Picloram	Tordon	430	Avg. 16	90	Small	Large
Triclopyr	Redeem	430	780	46	Large	Medium
Quinclorac	Paramount	69	13 to 54	18-176	Variable	Medium

APPENDIX H Biological Control Insects

Leafy spurge - *Aphthona lacertosa* & *Aphthona flava* - 7,000 released in 2001 and 17,000 in 2002.

Canada thistle - *Ceuthorrhynchus litura* - possible release but further research is needed to determine if the insects feed on native thistles.

Common St. Johnswort - *Chysolina quadrigemina* & *Chysolina hyperici* - currently we do not have any St. Johnsonwort in the park. It was eradicated and the preferred method of control is mechanical treatment if a new infestation is found. Biocontrol would only be used if the infestation is beyond mechanical control.

Diffuse knapweed - *Larinus minutus* - this insect may pose a possible risk to native plants closely related to knapweeds. Further research would be needed before any release in the park. Currently, diffuse knapweed in the park is in small patches that are below the threshold warranting biocontrol releases.

Spotted knapweed - *Agapeta coegana* & *Sphenoptera jugoslavica* - these insect may pose a possible risk to native plants closely related to knapweeds. Further research would be needed before any release in the park. Spotted knapweed in the park is also currently below the threshold warranting a biocontrol release.

Musk thistle - The biocontrol insect *Rhinocyllus conicus* already exists in the park, but was not released by the NPS. The insect moved into the park from releases outside the park. It is presently having a negative impact on native thistles in the park.

Yellow toadflax – *Calophasia lunula*, *Eteobalea intermediella* & *Mecinus janthinus* - These insects may pose a possible risk to native plants closely related to toadflax. Further research funded by RMNP and the University of Colorado is scheduled to start in 2003 with results submitted to RMNP in the spring of 2005.

APPENDIX I Letter from Colorado Commissioner of Agriculture

STATE OF COLORADO

DEPARTMENT OF AGRICULTURE

700 Kipling Street, Suite 4000
Lakewood, Colorado 80215-5894
(303) 239-4100
FAX (303) 239-4125



October 15, 2002

Vaughn Baker, Superintendent
Rocky Mountain National Park
1000 Highway 36
Estes Park, CO 80517-8397

Bill Owens
Governor
Don Ament
Commissioner
Robert G. McLavey
Deputy Commissioner

Dear Mr. Baker,

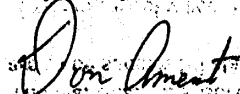
Congratulations on your recent assignment as superintendent of Rocky Mountain National Park. I look forward to working with you in the years to come.

I would like to bring to your attention a matter of significant importance. Invasive weeds are a serious problem and a threat to the health and vitality of our natural ecosystems in Colorado. Land managers and landowners in our state are diligently working together to help solve this problem. In many areas, cooperative agreements have been created among private landowners and public land managers to facilitate a coordinated effort in the management of invasive weeds. The National Park Service is an essential partner in this effort and we need your cooperation if we are to be successful statewide.

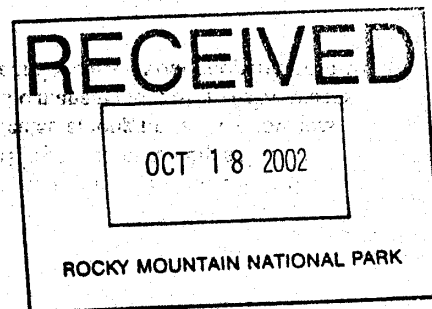
However, Rocky Mountain National Park has failed to complete an Environmental Assessment (EA) for weed management. This has significantly stalled the park's progress toward implementing and maintaining an effective weed management program. In addition, Boulder, Grand, and Larimer counties and surrounding private lands are negatively affected by the situation. Invasive weeds continue to spread not only on land managed by the National Park Service but also to the neighbors of federal lands. This situation has gone on for too long now. I strongly urge Rocky Mountain National Park to complete its Environmental Assessment concerning invasive weed management by April 1, 2003 and implement an aggressive and effective weed management program for these federal lands beginning next year.

I have asked our state weed coordinator, Eric Lane, to contact your office next week to discuss the matter in greater detail. I hope you and your staff will work with us to ensure that this matter is resolved in a timely manner.

Respectfully,


Don Ament
Commissioner of Agriculture

Cc: Representative Udall
Regional Director Karen Wade



APPENDIX J Invasive Exotic Plants to Watch for in Colorado

Published in 1993 by:
Richard R. Old, Ph.D.
Post Office Box 272
Pullman, Washington 99163

- *Abutilon theophrasti**
- *Acroptilon repens*
- *Aegilops cylindrica**
- *Alhagi pseudalhagi*
- *Anchusa arvensis*
- *Anchusa officinalis*
- *Anthriscus caucalis*
- *Anthriscus sylvestris*
- *Anthoxanthum odoratum*
- *Apera interrupta*
- *Bryonia alba*
- *Carduus acanthoides**
- *Carduus nutans**
- *Carduus pycnocephalus*
- *Carthamus lanatus*
- *Centaurea calcitrapa*
- *Centaurea diffusa**
- *Centaurea maculosa**
- *Centaurea pratensis**
- *Centaurea solstitialis**
- *Chaenorrhinum minus*
- *Chondrilla juncea**
- *Crupina vulgaris**
- *Cynosurus echinatus*
- *Cytissus scoparius*
- *Echium vulgare*
- *Euphorbia cyparissias**
- *Euphorbia esula**
- *Euphorbia myrsinites**
- *Galiopsis tetrahit*
- *Galium pedemontanum*
- *Glaucium corniculatum*
- *Hieracium auranticum**
- *Hieracium pratense*
- *Hypochaeris radicata*
- *Iris pseudacorus*
- *Isatis tinctoria**
- *Lepidium latifolium**
- *Linaria dalmatica**
- *Linaria vulgaris**
- *Lysimachia vulgaris*
- *Lythrum salicaria**
- *Nardus stricta*
- *Onopordum acanthium**
- *Peganum harmala**
- *Picris echoides*
- *Potentilla recta**
- *Reseda lutea*
- *Salvia aethopsi**
- *Senecio jacobaea**
- *Silybum marianum*
- *Sisymbrium irio*
- *Sphaerophysa salsula**
- *Taeniatherum caput-medusae**
- *Tamarix ramosissima**
- *Tanacetum vulgare*
- *Torilis arvensis*
- *Verbascum virgatum*
- *Ventenata dubia*
- *Zygophyllum fabago*

* Since 1993 these species have been found in the state and are being controlled. They are currently listed on the State of Colorado Noxious Weed List, or are proposed for listing in an amendment to the 2001 state list and are listed in Table 1 on page 3.

APPENDIX K Reference Material for Behavior of Synthetic Herbicides in the Environment

Two federal documents are relevant to RMNP's Invasive Exotic Plant Management Plan. These documents are: Final Environmental Impact Statement for Vegetation Treatment on BLM Lands in Thirteen Western States dated May 1991 (BLM 1991 FEIS); and Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 4 and 10 and on Bonneville Power Administration Sites, September 1992, USDA, Forest Service (FS 1992 Risk Assessment). The Final Environmental Impact Statement for Vegetation Treatment on BLM Lands evaluates the effects of proposed treatment methods on several resources including, but not limited to: vegetation, soils, aquatic resources, fish and wildlife, cultural resources, recreation, and livestock. The U.S. Forest Service Risk Assessment for Herbicide Use evaluates the effects of herbicides on natural systems and human health and safety.

The human toxicity potential (HTP) is an indicator of the danger posed by a chemical's release to air or surface water. It was developed to compare emissions in life-cycle assessment and public emissions inventories (Hertwich et al. 2001, 2000). HTP data are available on the following web site: http://design.ntnu.no/ansatte/hertwich/HTP_ETC.html. Evaluations of potential human health effects caused by herbicide exposure are generally based on results of toxicity tests in laboratory animals. In summary, risk assessments conducted on the various herbicides proposed for use in RMNP quantified general systemic and reproductive human health risks for a given herbicide by dividing the dose found to produce no ill effects in laboratory animals studies by the exposure a person might get from applying the herbicide or from being near an application site. Members of the general public may be exposed to herbicides via dermal, respiratory, and dietary routes (e.g. contact with vegetation at a recently treated site, breathing herbicide vapors in or near recently treated areas, touching or eating berries with residues). By implementing the mitigation measures in Chapter 7 (see page 104), employee and park visitor exposure would be minimized.

It is unlikely that the general population would receive doses above "no observed effect" levels for the synthetic herbicides and the amount proposed for use in RMNP. For further information refer to the following web pages:

- USDA risk analyses for herbicides – <http://www.fs.fed.us/foresthealth/pesticide/>
- EPA assessing health risks for pesticides
http://www.epa.gov/pesticides/factsheets/alpha_fs.htm
- <http://www.infoventures.com/e-hlth/>

Other pertinent internet web pages related to invasive exotic plants and synthetic herbicide information:

- Purdue University Agricultural Communication – <http://www.agcom.purdue.edu/>
- USDA Pesticide Fact Sheets – <http://infoventures.com/e-hlth/pesticide/pest-fac.html>
- Extension toxicology network – <http://npic.orst.edu/>
- Toxicological documentation center – <http://www.envtox.ucdavis.edu/>
- Environmental Protection Agency pesticide web site – <http://www.epa.gov/ecotox/>
- Department of Defense pest web site – www.afpmb.org
- A Strategic Plan for Managing Invasive Nonnative Plants on National Park System Lands – http://www1.nature.nps.gov/wv/strat_pl.htm

- Colorado Department of Agriculture Biological Pest Control –
<http://www.ag.state.co.us/DPI/>
- Human Toxicity Potential (HTP) data –
http://design.ntnu.no/ansatte/hertwich/HTP_ETC.html
- Journal of Pesticide Reform v. 108 –
<http://www.mindfully.org/Pesticide/2003/pesticide2003.htm>
- The following web site will link data together when doing a search –
www.dogpile.com

APPENDIX L U.S. Fish & Wildlife Service Correspondence



United States Department of the Interior

NATIONAL PARK SERVICE
Rocky Mountain National Park
Estes Park, Colorado 80517

DEC 30 2002

IN REPLY REFER TO:

A3815 (ROMO)

CERTIFIED MAIL: 7002 0510 0002 5367 9472

LeRoy W. Carlson
Colorado Field Supervisor
Fish and Wildlife Service
755 Parfet Street, Suite 361
Lakewood, Colorado 80215

Dear Mr. Carlson:

We are currently developing an Invasive Exotic Plant Management Plan and Environmental Assessment for Rocky Mountain National Park. We are seeking concurrence related to impacts to threatened, endangered and candidate species from the alternatives. Our preferred alternative would implement the full range of Integrated Pest Management (IPM) techniques including mechanical, cultural, low risk methods such as using hot water, organic biodegradable chemicals, biological control and inorganic chemical control. Attachment 1 is a copy of the proposed alternatives; and, Attachment 2 is Rocky Mountain National Park's list of threatened, endangered and rare species that we evaluated in the management plan and environmental assessment.

Currently, at known locations of the Boreal toad (*Bufo boreas popl*) there are no known invasive exotic plants we plan to control, so there will be no impact. There may be instances where invasive exotic plants may be controlled in the vicinity of Greenback cutthroat trout (*Oncorhynchus clarki stomias*) and the Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), but our proposed inorganic herbicides and mitigating measures should protect those species. Beside the species listed in Attachment 2, our records indicate that Ute Ladies'-tresses (*Spiranthes diluvialis*), Colorado butterfly plant (*Gaura neomexicana spp. Coloradensis*) and Prebles Jumping mouse (*Zapus hudsonius preblei*) even though they occur in Larimer County, do not occur in the park, either due to being outside their elevation range or habitat type.

Attachments 3 and 4 are lists of the inorganic chemicals we are proposing to use and their impacts on threatened, endangered and rare species and aquatic, wetland and riparian communities. We also include a list of proposed mitigating measures (Attachment 5), we plan to implement for the various control techniques. Based on a full evaluation of the alternatives, we conclude that there will **not likely be an adverse affect** on our federally listed and candidate species and our rare species.

We will send you a copy of the management plan and environmental assessment when it is released for public review, unless you would prefer to see the assessment earlier during the

internal review period. You can contact, Larry Gamble, Chief of the Branch of Planning & Compliance, at (970)-586-1320 or Jeff Connor, Natural Resources Specialist, at (970)-586-1296 for any further information.

Sincerely,

/s/ Vaughn L. Baker

Vaughn L. Baker
Superintendent

Enclosures



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Colorado Field Office
755 Parfet Street, Suite 361
Lakewood, Colorado 80215

IN REPLY REFER TO:
ES/CO:NPS/RMNP
Mail Stop 65412

JUL 8 2003

Vaughn L. Baker
Superintendent
Rocky Mountain National Park
Estes Park, Colorado 80517


Dear Mr. Baker:

The U.S. Fish and Wildlife Service (Service) received your letter of December 30, 2002, regarding the Invasive Exotic Plant Management Plan and Environmental Assessment (Plan and EA) for Rocky Mountain National Park. You requested concurrence that various control techniques (which include a series of mitigation measures to reduce the potential for affecting species of concern) are not likely to adversely affect federally-listed or candidate species. We received the Plan and EA on May 16, 2003.

Based on the information provided, the Service concurs that measures described in the Plan and EA are not likely to adversely affect federally-listed or candidate species. These comments have been prepared under the provisions of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et. seq.).

If the Service can be of further assistance, contact Peter Plage of this office at (303)275-2370.

Sincerely,


For Allan R. Pfister
Acting Colorado Field Supervisor

cc: Plage

Reference: PeterVT&E.2003.01

