CITY OF WHEAT RIDGE OPEN SPACE WEED MANAGEMENT PLAN

Prepared by

City of Wheat Ridge
Parks and Recreation Department

with

ERO Resources Corporation

September 2003

CITY OF WHEAT RIDGE
Parks and Recreation Department

OPEN SPACE WEED MANAGEMENT PLAN

Recommended for Adoption by the Wheat Ridge Parks and Recreation Commission on September 21, 2003.

Floyd Sasa, Chairperson

Adopted by the Wheat Ridge City Council on December 8, 2003.

Gretchen Cerveny, Mayor

Attest: Pam Anderson, City Clerk

CITY OF WHEAT RIDGE SEAL COLORADO

Acknowledgments

The City of Wheat Ridge Weed Management Plan is the product of a collaborative process between the City of Wheat Ridge Parks and Recreation Commission and Staff. The individuals listed below contributed substantially by sharing their time, skills, knowledge, and thoughtful participation throughout the planning process. As its foundation, the Weed Management Plan emphasizes a focus on the desired plant species and vegetation communities on the City of Wheat Ridge Open Space, rather than on simply eliminating weeds.

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Executive Summary

Weed control is part of the overall site management and restoration program on the City of Wheat Ridge's Open Space. In an effort to facilitate this management and restoration, the Parks and Recreation Department completed the ***City of Wheat Ridge Open Space Weed Management Plan***. The Weed Management Plan provides a framework for integrating weed management with other resource management activities as outlined in the ***City of Wheat Ridge Open Space Management Plan***.

The Parks and Recreation Department approaches its weed management with a focus on the desired species and communities, rather than on simply eliminating weeds. Through its Weed Management Plan, the Parks and Recreation Department has set priorities for the control or elimination of weeds that have already established on the Open Space, according to their actual and potential impacts on native species and communities, particularly on conservation targets within the Open Space. In addition, the Parks and Recreation Department will implement preventative programs to keep the Open Space free of species that are not yet established there but which are known to be pests elsewhere in the region.

Priorities have been set in the Weed Management Plan in the hope of minimizing the total, long-term workload. Therefore, the Parks and Recreation Department will act to prevent new infestations and has assigned highest priority to existing infestations that are the fastest growing, most disruptive, and affect the most highly valued areas within the Open Space. Ultimately it is important to consider the difficulty of control, giving higher priority to infestations that are most likely to be controlled with available technology and resources.

1.0 Introduction

1.1 Purpose of the Weed Management Plan

The purpose of the City of Wheat Ridge Open Space Weed Management Plan (Weed Management Plan) is to provide the Parks and Recreation Department with a:

- Baseline of information for weed infestations;
- Systematic manner for tracking the spread of noxious weeds in succeeding years; and
- Set of priorities and recommendations for the weed management program within the Wheat Ridge Greenbelt and Lewis Meadows ("Open Space") (Figure 1).

The Weed Management Plan supplements and should be used in an integral fashion with the *City of Wheat Ridge Open Space Plan* (City of Wheat Ridge 2002) and the *City of Wheat Ridge Wildfire Management Plan* (City of Wheat Ridge 2003). The Weed Management Plan addresses in more detail a specific management issue identified by the Wheat Ridge Parks and Recreation Department within the *City of Wheat Ridge Open Space Plan* (Open Space Plan). This plan represents the best information available for the management of weeds within the Open Space. The intention is to provide detailed mapping completed by the Colorado Natural Heritage Program (CNHP), a detailed set of weed management priorities, and the best available control information appropriate for the Open Space. A linked set of spreadsheets in MSExcel is provided with this plan as a tool for continuing monitoring and tracking.

1.2 Weed Management Goal and Objectives

The principal weed management goal and associated objectives from the Open Space Plan provide the foundation on which to base the Weed Management Plan. The following goal and five objectives from Section 3.0, *Vegetation* in the Open Space Plan establish the basic principles of weed management on the Open Space.

Goal

- Preserve and maintain native plant communities, protect rare species and communities, and restore native vegetation in suitable areas.

Objectives

- Control noxious weeds within the Greenbelt and Lewis Meadows.
- Plan trails and trail use to minimize the risk of weed introduction and spread.
- Implement trail construction and maintenance with weed strategy in mind.
- Educate staff, landowners, and visitors about noxious weed control.
- Implement noxious weed management with a regional perspective.

1.3 How to Use the Plan

At its core, the Weed Management Plan presents a number of tools to assist in addressing weed management within the Open Space—

- Table 2 identifies noxious weed species mapped on the Open Space and the size in acres of individual species.
- Section 3.0 contains all weed mapping completed by the Colorado Natural Heritage Program for the Open Space.
- Section 4.0 sets priorities for weed management and contains weed control plans for the each species that occur in Table 2.
- Section 5.0 contains general restoration principles.
- Appendices include the revised Colorado Weed Management Act (Appendix A), 2002 Quarterquad Survey Distribution and Abundance Data in Colorado (Appendix B), Material Safety Data Sheets (MSDS) for herbicides used by the Parks and Recreation Department (Appendix C), Species Profiles (Appendix D), Preliminary Seed Mixes for Restoration (Appendix E), and an electronic Weed Management Plan Worksheet created in MSExcel (Appendix F).

As an integral part of the Open Space Plan, the Weed Management Plan should change and evolve with the Open Space Plan. Future open space planning efforts should incorporate and build on the additional recommendations set forth in the Weed Management Plan. As the Wheat Ridge Parks and Recreation Department implements

management actions outlined in the Weed Management Plan, Wildfire Management Plan, and the Open Space Plan, all three documents should be updated to reflect those changes.

1.4 Overview of Approach to Weed Management

The Parks and Recreation Department uses an integrated pest management, a decision-making process that selects, integrates, and implements control methods to prevent or manage noxious weeds (Table 1). It focuses on long-term prevention or suppression of undesirable species while reducing the impact that control techniques may have on the environment, human health, and non-target species.

The spread of noxious weeds has often been termed a biological wildfire. As with wildfire, the most important part of a noxious weed management program is early detection and prevention. Areas such as road shoulders, trailheads, and picnic areas, are surveyed to find new infestations, and infestations should be removed before they become well established. The City also notes noxious weeds along open space boundaries and on adjacent property and notify the appropriate landowners or managers about problem plants.

Prevention will have the most significant long-term benefit for the Wheat Ridge open space and surrounding areas. Vigorous and consistent prevention reduces the opportunities for dispersal of noxious weeds, which, in turn, minimizes the need for future control actions. Prevention is proactive rather than reactive, and is the most cost-effective management action. Restoring and maintaining healthy plant communities and reducing human impacts and use patterns also can prevent noxious weed invasion.

Table 1. Integrated weed management techniques.

Technique	Definition
Mechanical	Physical removal by mowing, mulching, tilling, prescribed burning, grazing or hand pulling.
Cultural	Enhancement of the native plant community using fertility management or re-vegetation.
Biological	Releasing a weed's native natural enemies using insects, grazing animals or disease.
Chemical	Destroying weeds using herbicides that do not adversely affect the desired plant community.

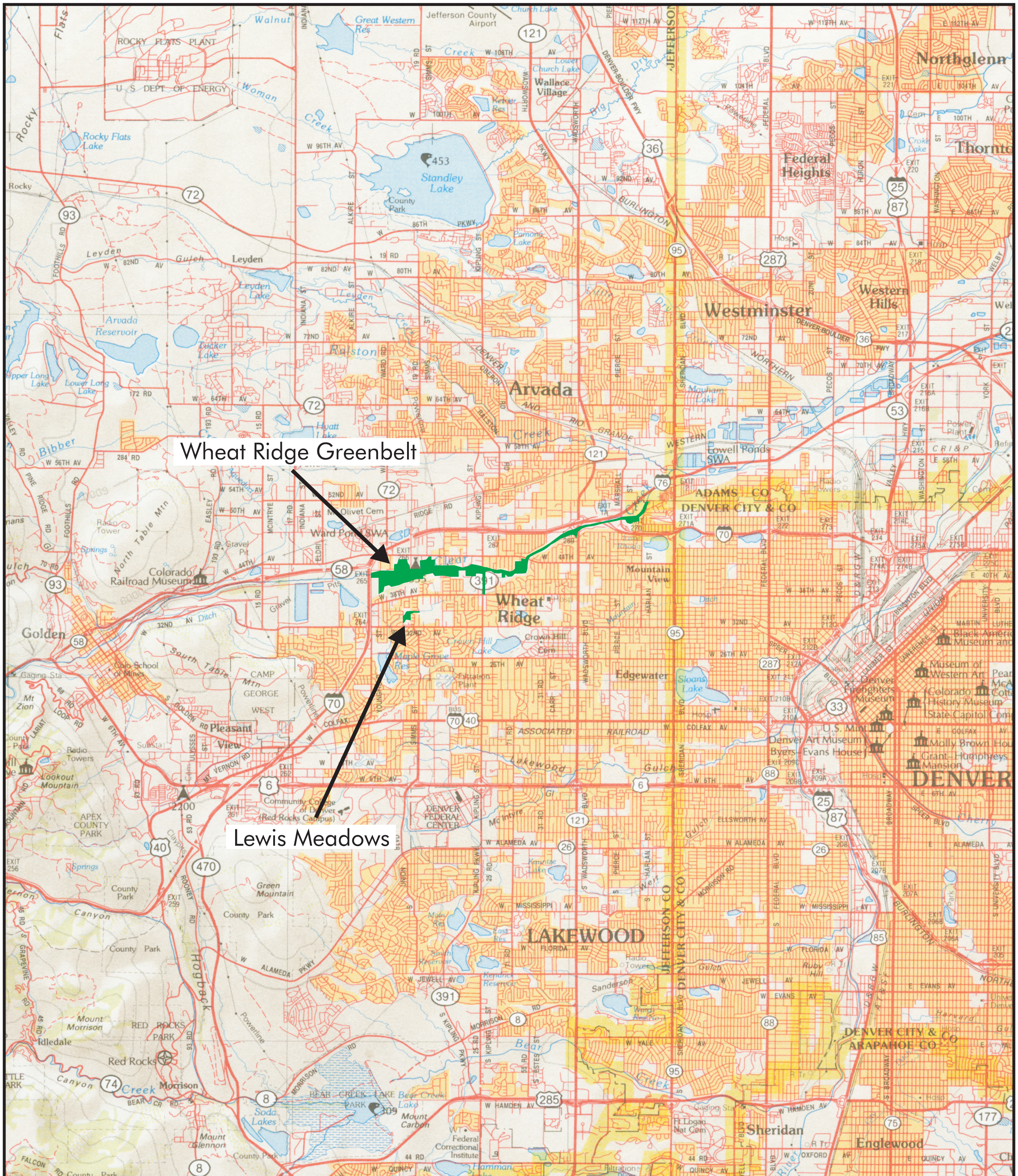

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Figure 1
Regional Setting

Prepared for: City of Wheat Ridge
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2.0 Management Area

2.1 General Description

Located near the mouth of Clear Creek in the foothills west of Denver, Colorado, the City of Wheat Ridge owns about 300 acres of open space, the majority of which is located along the Clear Creek corridor within the Wheat Ridge Greenbelt. Wheat Ridge's additional open space area is Lewis Meadows, which is situated along Lena Gulch, which flows into Clear Creek within the Wheat Ridge Greenbelt (Figure 2). Management and oversight of open space properties fall under the Wheat Ridge Parks and Recreation Department.

2.2 Wheat Ridge Greenbelt

The Wheat Ridge Greenbelt is the larger of Wheat Ridge's two open space properties, stretching 5 miles along Clear Creek and consisting of about 300 acres. The Greenbelt is bounded on the west by Youngfield Street, on the east by Harlan Street, and on the north and south by various private properties. The Greenbelt is located within the 100-year floodplain of Clear Creek, where the elevation varies from 5,450 to 5,280 feet. The Greenbelt is generally flat with a very gradual downward slope from southwest to northeast and is completely surrounded by development, which closely abuts its borders. There is no buffer zone, making it difficult to maintain some preferred resource conservation practices. It is accessible by seven trailheads along its 5-mile stretch, along with many additional neighborhood access points.

Although the Wheat Ridge Greenbelt historically has been hayed, cropped, and grazed, much of it has remained free from residential, commercial, and non-mining industrial development. Today, the Wheat Ridge Greenbelt provides habitat for a wide array of native wildlife and vegetative species, including the federally threatened Ute ladies'-tresses orchid, a globally imperiled species that is protected under the Endangered Species Act.

2.3 Lewis Meadows

The 10-acre Lewis Meadows is located southwest of the Wheat Ridge Greenbelt just off of 34th Avenue and is surrounded entirely by private residential homes. Lewis Meadows is situated within the 100-year floodplain of Lena Gulch.

Lewis Meadows became designated open space in 1972 when residents from Jefferson County approved a one-half cent sales tax to raise money for open space purchases. Lewis Meadows features stands of mixed cottonwoods, mixed shrubs, and mesic grasses and is a popular area for dog walking. Lewis Meadows serves as a floodplain park, receiving overflows of Lena Gulch, which runs through the middle of the site.

2.4 Natural Values and Management Goals

The Wheat Ridge Greenbelt provides an important wildlife corridor and habitat for a wide range of vegetative and wildlife species. In terms of vegetation, remnant examples of naturally occurring riparian communities include the plains cottonwood/chokecherry riparian woodland type and the plains cottonwood/western snowberry riparian woodland type. In addition to these important riparian communities, the Conservation Management Zone within the Wheat Ridge Greenbelt supports the federally protected Ute ladies'-tresses orchid (CNHP 2000). The Conservation Management Zone also may contain the only known occurrence worldwide of a newly discovered species of earthstar, a type of fungus.

In addition to important vegetation communities and vegetative species, the Wheat Ridge Greenbelt and Lewis Meadows provide important habitat for a number of wildlife species including yellow warbler (*Dendroica petechia*), white-breasted nuthatch (*Sitta carolinensis*), wood duck (*Aix sponsa*), northern shoveler (*Anas acuta*), American kestrel (*Falco sparverius*), screech owl (*Otus kennicottii*), deer mouse (*Peromyscus maniculatus*), eastern cottontail rabbit (*Sylvilagus floridanus*), prairie vole (*Microtus ochrogaster*), striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale putorius*), raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), and beaver (*Castor canadensis*).

Management goals for the City of Wheat Ridge Open Space are outlined in detail in the ***City of Wheat Ridge Open Space***

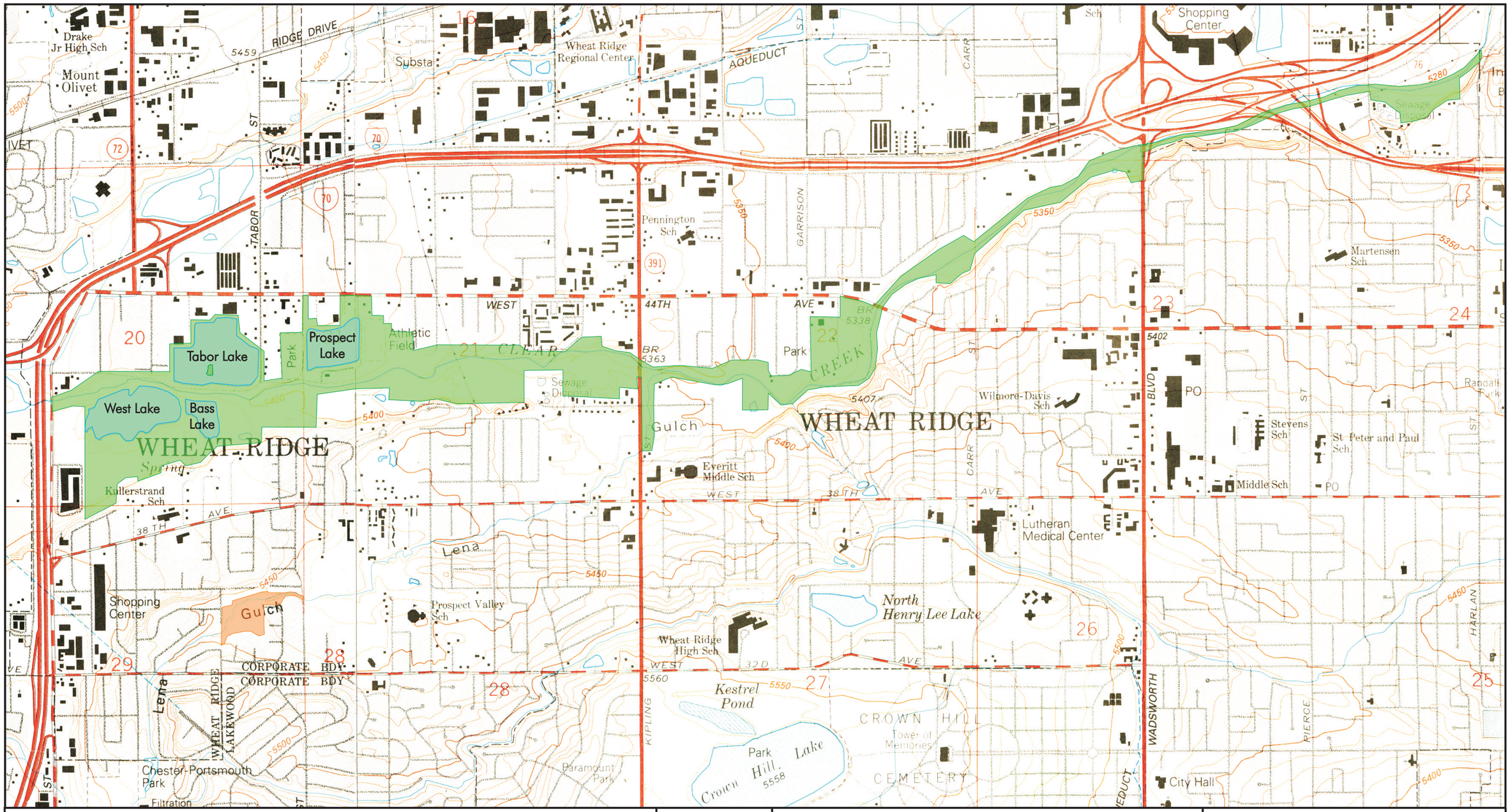
Management Plan and are not repeated here in their totality for the sake of brevity. The primary natural resource management goals for the City of Wheat Ridge Open Space are highlighted below.

- Protect and/or restore open space and sensitive areas
- Maintain and improve wildlife habitat and diversity
- Monitor and map the health of the environment over time
- Control and eradicate where possible non-native and invasive species
- Protect the scenic and natural landscape
- Improve water quality in lakes and streams
- Protect and preserve land through acquisition, conservation easements, donations, and other means
- Prevent possible uncontrolled fires through fuel loading management

2.5 Impact of Noxious Weeds

Noxious weeds threaten native plant communities and species diversity by displacing desirable native species. Alien plants that are highly invasive usually do not have natural pathogens and predators to keep their populations under control. Some non-natives, such as diffuse knapweed (*Acosta diffusa*), contain allelopathic chemicals that can suppress the growth of other species and allow diffuse knapweed to grow in single-species stands (Watson and Renney 1974).

Noxious weeds and undesirable plant species mapped in the City of Wheat Ridge open space appear in Table 2 in Section 3.0, *Noxious Weed Inventor*y. All of the species in Table 2 pose a significant threat to native communities and potential restoration efforts.



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Greenbelt

Lewis Meadows

Boundaries Approximate

1 inch = 1,500 Feet

N

Figure 2
City of Wheat Ridge Open Space

Prepared for: City of Wheat Ridge
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July 2002

3.0 Noxious Weed Inventory

The City of Wheat Ridge Parks and Recreation Department contracted with the Colorado Natural Heritage Program (CNHP) in April 2000 to map vegetation types, selected noxious weed species, rare plants, and selected animals. Due to the small area (300 acres) and management needs of the Open Space, noxious weeds were mapped on a very fine scale for the Parks and Recreation Department. Sixteen noxious weed species including their extent were mapped throughout the Open Space (Table 2). Several additional noxious weeds occur in the Open Space, but have not been mapped in detail. A list of these species appears in the *Wheat Ridge Open Space Areas Biological Inventory* (CHNP 2000).

All weed occurrences were mapped on field copies of 1:600-scale aerial photographs to a resolution of approximately 20 feet. Thus, where two occurrences of the same species were found within 20 feet of each other, they were amalgamated into a single polygon. For shrubs and trees (i.e., buckthorn and Russian olive), the smallest polygon size usually equates to a single individual. This is considerably more resolution than most weed mapping efforts currently used in Colorado, but it was assumed that this level of precision would facilitate eradication, management, and restoration efforts (CNHP 2000). Additional mapping efforts will use the *North American Invasive Plant Mapping Standards* as approved by the North American Weed Management Association (NAWMA 2003).

Following mapping in the field, all weed polygons were digitized and attributed in an ArcView 3.2 shapefile. All completed mapping follows in this section. In addition to noxious weeds, the Colorado Natural Heritage Program also mapped poison ivy (*Toxicodendron rydbergii*) in the Open Space with the exception of the western portion of the Greenbelt in the vicinity of West and Bass Lakes. Poison ivy is a native species, but is controlled in selected areas (e.g., along recreation trail edges) by the Parks and Recreation Department. Although poison ivy appears in the accompanying mapping, control of the species is not covered in the Weed Management Plan. The

Park and Recreation Department also works to inform visitors about and controls puncturevine (*Tribulus terrestris*) along recreation trails. Puncturevine forms dense mats on open ground and is notorious as a cause of bicycle tire punctures.

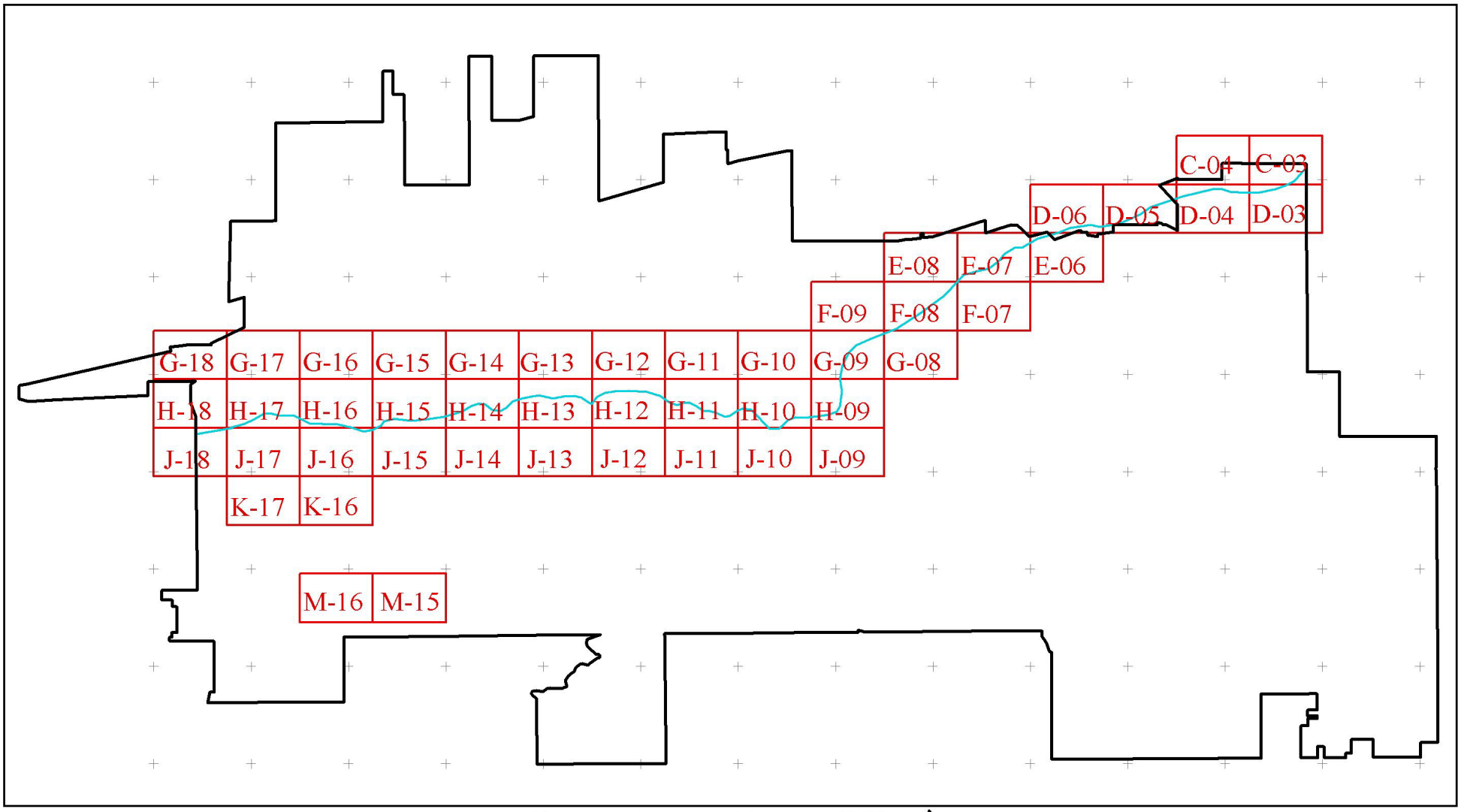
Noxious weeds that are aquatic species have not been inventoried on the Open Space, but also present a management challenge. The Parks and Recreation Department pays particular concern to one species: Eurasian watermilfoil (*Myriophyllum spicatum*). Milfoil is an attractive plant with feathery underwater foliage. It was once commonly sold as an aquarium plant. Eurasian watermilfoil was introduced to North America many years ago and is now found over much of the United States. The introduction of milfoil can drastically alter a waterbody's ecology. Milfoil forms very dense mats of vegetation on the surface of the water. These mats interfere with recreational activities such as swimming, fishing, and boating. When milfoil invades a new area, the species diversity of aquatic plants typically declines. Control efforts focus on education and ensuring that equipment that comes into contact with aquatic resources on the Open Space is clean and free of milfoil.

Table 2. Noxious weeds and acres infested on Open Space.

Scientific Name	Common Name	Acres
Acosta diffusa	Diffuse knapweed[1, 2]	9.85
Cirsium arvensis	Canada thistle[1, 2]	12.77
Carduus nutans	Musk thistle[1, 2]	0.47
Cirsium vulgare	Bull thistle[2]	0.02
Clematis orientalis	Chinese clematis[2]	1.16
Conium maculatum	Poison hemlock	2.57
Dipsacus fullonum	Common teasel[1]	0.68
Dipsacus laciniatus	Cutleaf teasel	4.46
Eleagnus angustifolia	Russian olive[2]	22.98
Euphorbia esula	Leafy spurge[1, 2]	5.67
Linaria genistifolia ssp. *dalmatica*	Dalmatian toadflax[2]	4.88
Linaria vulgaris	Yellow toadflax[2]	11.64
Lythrum salicaria	Purple loosestrife[1, 2]	0.19
Onopordum acanthium	Scotch thistle[1, 2]	0.35
Rhamnus cathartica	Buckthorn	21.25
Tamarix ramosissima	Tamarisk[2]	0.01

[1]Appears on the current Jefferson County Noxious Weed List.
[2]Species mapped as part of 2002 Quarterquad Survey Distribution and Abundance Data in Colorado (see Appendix B).

City of Wheat Ridge Greenbelt and Lewis Meadows Study Area



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Map Date: 28 March 2001
GIS Dept: ael

Images provided by the City of Wheat Ridge

Legend

- Wheat Ridge Boundary
- Clear Creek
- Image Boundaries
- Tic Marks

Disclaimer

The data contained herein are provided on an as-is, as-available basis without warranties of any kind, expressed or implied, including (but not limited to) warranties of merchantability, fitness for a particular purpose, and non-infringement. CNHP, Colorado State University and the State of Colorado further expressly disclaim any warranty that the data are error-free or current as of the date supplied.

4.0 Priorities for Weed Management

Prioritization of weed management efforts is based on several factors. Attempting to control all the non-native species present on the Open Space can be overwhelming and ultimately unsuccessful, so it is important to develop a strategy to ensure the most efficient use of resources. This type of strategy is built upon two principles. First, instead of managing against weeds, the philosophy is to manage for the desired target species and communities on the Open Space. With this spirit, the species that have been identified in the Weed Management Plan are those that threaten the survival of the desired conservation targets on the Open Space. Second, to minimize the total, long-term weed control workload, the Parks and Recreation Department will act to prevent new infestations and contain the spread of plants with expanding ranges. Prioritization of weed management efforts considers legal mandates, weed biology, and species distribution.

4.1 Legal Mandates

In Colorado, the authority and responsibility of the state to formulate and implement a noxious weed management program comes from Colorado Revised Statutes Title 35 Article 5.5 or the Colorado Weed Management Act (Act). In 2003, legislation (House Bill 1140) that significantly revised the Act was signed into law (Appendix A). Revisions to the Act create an effective framework for coordinated, statewide management while avoiding any erosion of private property rights and recognizing the need for local governments to establish additional management priorities.

Some specifics of House Bill 1140 restructure and outline management objectives for the State Noxious Weed List; create a package of incentives and regulatory mechanisms to implement changes in the State Noxious Weed List; and establish a weed advisory committee. Under the revised Act, the Colorado Commissioner of Agriculture will classify noxious weeds onto one of a minimum of three lists:

List A—rare noxious weed species that are subject to eradication wherever detected statewide in order to protect neighboring lands and the state as a whole.

List B—noxious weed species with discrete statewide distributions that are subject to eradication, containment, or suppression in portions of the state designated by the Commissioner in order to stop the continued spread of these species.

List C—widespread and well-established noxious weed species for which control is recommended but not required by the state, although local governing bodies may require management.

The A, B, and C lists establish a minimum threshold whereby noxious weeds in Colorado will need to be managed. As part of the minimum standard, beginning in August 2003, the Commissioner of Agriculture will develop and implement noxious weed management plans for species classified as List A or List B species. The management plans will define the objectives for all lands within Colorado in order to meet the stated purpose of the species classification. The Commissioner of Agriculture also will prescribe integrated management techniques for List A species and populations of List B species designated for eradication. Prioritization for weed management on the Open Space takes into account these classifications, but as the management plans from the Department of Agriculture become available, the information should be incorporated into the Weed Management Plan.

4.2 Weed Biology

As previously stated in Section 1.2, one of the principal goals on the Open Space is to preserve and maintain native plant communities, protect rare species and communities, and restore native vegetation in suitable areas. Therefore, the Parks and Recreation Department sets priorities for the control or elimination of species that have the greatest potential to significant resources on the Open Space. These priorities reflect each weed's present or future harmful impacts. In general, perennial species pose a greater threat to native ecosystems than do annual or biennial species. More particularly, weed species with deep root systems or creeping rhizomes are especially difficult to

control. Descriptions of the potential impacts of specific species mapped on the Open Space appear below in Section 4.4.

4.3 Species Distribution

In addition to legal mandates and weed biology, the existing distribution of weeds on the Open Space is an important factor in prioritizing weeds for management activities. The analogy of a wildfire has often been used to describe the spread of noxious weeds. Using this analogy, small, isolated patches of weeds are generally considered a higher priority for control activities than large, well-established infestations. Small, isolated patches are easier to eradicate because there is a smaller distribution of plants smaller seed bank, less-developed root system, and potentially, a desirable vegetation community. The Parks and Recreation Department also notes species that are not yet on the Open Space, but are found nearby and could be problems if they spread to the Open Space. The weed management program includes regularly monitoring the Open Space for these species in order to quickly detect and eliminate them if they ever do appear.

With this reasoning in mind, higher priority will be given to:

- Weed species that are new or relatively rare to the region or Open Space
- Species not well established in surrounding areas
- Small infestations of species known to be highly invasive
- Infestations likely to spread because of location (e.g., road sides, trail sides, drainages, irrigation ditches or wind breaks)
- Infestations adjacent to or likely to spread into areas containing conservation targets
- Edges of large infestations

Lower priority will be given to:

- Large, well-established infestations for which there is little potential for eradication on the Open Space
- Species that are well established in surrounding areas and thus provide a constant seed source to the Open Space
- Species confined to disturbed areas
- Species that are easier to control relative to others

Table 3 summarizes by noxious weed species the number of acres infested on the Open Space and the overall priority of management

for the species. It is important to note that specific patches for a given species may have a higher management priority that the overall management priority. For example, the management priority for Russian olive is medium, but a patch of Russian olive in an area with Ute Ladies'-tresses orchid present may be high.

Table 3. Priority for noxious weed management.

Scientific Name	Common Name	Acres	Priority
Acosta diffusa	Diffuse knapweed[1, 2]	9.85	High
Cirsium arvensis	Canada thistle[1, 2]	12.77	Medium
Carduus nutans	Musk thistle[1, 2]	0.47	Medium
Cirsium vulgare	Bull thistle[2]	0.02	Eradicate
Clematis orientalis	Chinese clematis[2]	1.16	Eradicate
Conium maculatum	Poison hemlock	2.57	Medium
Dipsacus fullonum	Common teasel[1]	0.68	High
Dipsacus laciniatus	Cutleaf teasel	4.46	High
Eleagnus angustifolia	Russian olive[2]	22.98	Medium
Euphorbia esula	Leafy spurge[1, 2]	5.67	Highest
Linaria genistifolia	Dalmatian toadflax[2]	4.88	Highest
Linaria vulgaris	Yellow toadflax[2]	11.64	High
Lythrum salicaria	Purple loosestrife[1, 2]	0.19	Eradicate
Onopordum acanthium	Scotch thistle[1, 2]	0.35	High
Rhamnus cathartica	Buckthorn	21.25	Medium
Tamarix ramosissima	Tamarisk[2]	0.01	Eradicate

[1]Appears on the current Jefferson County Noxious Weed List.
[2]Species mapped as part of 2002 Quarterquad Survey Distribution and Abundance Data in Colorado (see Appendix B).

4.4 Specific Weed Control Outlines

The following section provides control outlines for noxious weed species that have been mapped on the Open Space. The control outlines are intended to provide a brief overview of the species target for management on the Open Space. Detailed species profiles and control methods are provided in Appendix D.

4.4.1 Diffuse knapweed (*Acosta diffusa*)

Priority

High — especially in areas with heavy recreation use that in turn may facilitate seed spread.

Description

Diffuse knapweed is a biennial or short-lived perennial forb that can quickly invade disturbed and undisturbed grassland, shrubland, and

riparian communities. Once established, diffuse knapweed outcompetes and reduces the cover of native species such as perennial grasses.

Current Distribution on the Open Space

Diffuse knapweed is found throughout the Greenbelt and is concentrated in larger patches adjacent to the lakes on the west side. This is consistent with anticipated establishment after a disturbance activity such as the gravel mining that occurred.

Measurable Objectives and Goal

Goal: Contain

1. Monitor patches of diffuse knapweed and areas adjacent to the patches two to three times a year in spring, summer, and fall.
2. Destroy newly discovered rosettes adjacent to known patches.

Control Options

The most effective method of control for diffuse knapweed is to prevent establishment of the plant. Areas that are adjacent to known patches of diffuse knapweed on the Open Space should be monitored two to three times a year (spring, summer, and fall). Newly discovered rosettes should be destroyed by pulling or spot treated with Tordon®. Mowing alone is an ineffective control option for diffuse knapweed because it increases the plant's density. Seeding native perennial grasses is essential to prevent reinvasion.

Treatment Schedule

Any cutting or pulling program must be repeated several times during the growing season. Cutting should be conducted at least three times (spring, summer, and fall) and followed up with herbicides on the mature plants before they set seed or to rosettes in the fall. The first pulling should be conducted in spring when the soil is moist; the second pulling should focus on bolted plants in June, and a third pulling just before seed dispersal. Herbicides can be applied to mature plants prior to seed set or rosettes in the fall.

4.4.2 Canada thistle (*Cirsium arvensis*)

Priority

Medium — as Canada thistle is widespread and well established on the Open Space.

Description

Canada thistle is a perennial forb that is an aggressive, creeping weed common along roads, trails, fields, pastures, meadows, ditches, and wetlands.

Current Distribution on the Open Space

Canada thistle is widespread and well established throughout the entire Greenbelt and Lewis Meadows.

Measurable Objectives and Goal

Goal: Contain and reduce

1. Concentrate control efforts in high-quality areas on the Open Space.
2. Follow-up control efforts by reseeding with native perennial grasses.

Control Options

The most important factor in Canada thistle control is to reduce the plant's nutrient reserves through persistent management. With this in mind, a combination of mowing and herbicides can be highly effective. Herbicides can be applied in the spring or fall depending on local environmental conditions. Prescribed burning in the spring can also be used as a means to slow the spread of Canada thistle. Such fires reduce the number of mature plants, decrease seed production, and stimulate the growth of native grasses.

Treatment Schedule

Herbicide (e.g., Curtail®) should be used on rosettes in the spring. Once the plants in large patches have reached about one foot in height, mow them. Patches should be cut monthly throughout the summer. Curtail® can be applied to all patches in October or about one month after the last mowing. Patch density should significantly decrease after about three years.

4.4.3 Musk thistle (*Carduus nutans*)

Priority

Medium — as the species is not widespread and easy to control relative to other species on the Open Space.

Description

Musk thistle is a biennial or sometimes a winter annual. The species is highly competitive and invades disturbed areas and can spread rapidly to form extensive stands.

Current Distribution on the Open Space

Musk thistle is scattered throughout the Greenbelt in small patches, which in total add up to less than 0.5 acres.

Measurable Objectives and Goal

Goal: Reduce and eventually eradicate

1. Repeat treatments over several years to eliminate infestations.
2. Follow-up control efforts by reseeding with native perennial grasses.

Control Options

Musk thistle is most often controlled with herbicides. The most effective time for herbicide application occurs when the plant is in the rosette stage. Repeated mowing, cutting, or hand pulling are highly effective methods in controlling the spread of musk thistle.

Treatment Schedule

Foliar herbicides should be applied in the spring with a wick to prevent damage to surrounding desirable vegetation. Bolted plants should be cut or pulled by hand in the summer. It is important to remove seed heads prior to cutting or hand pulling. Patches should be revisited multiple times during the flowering season, as all plants do not flower simultaneously.

4.4.4 Bull thistle (*Cirsium vulgare*)

Priority

Eradicate — as the infestation size on the Open Space is still quite manageable.

Description

Bull thistle is a biennial forb that grows in dry to moist habitats. It thrives on nitrogen-rich soils, and it grows on gravelly to clay-textured soils. Potential habitats for bull thistle include pastures, overgrazed rangeland, roadsides, and trail edges.

Current Distribution on the Open Space

Bull thistle is not widely distributed on the Open Space. Mapping identified an infestation size of only 0.02 acres in 2000. The single patch identified was located on the north side of Clear Creek between Tabor and Prospect Lakes.

Measurable Objectives and Goal

Goal: Eradicate

1. Eradicate existing plants within one year
2. Continue yearly surveillance.

Control Options

Bull thistle does not tolerate shade and therefore does not compete well in areas with tall forbs and grasses. In tandem with avoiding disturbance to natural areas, improving the health of native vegetation is an excellent preventive measure against bull thistle. Cutting, mowing, or severing the taproot just below the root crown before seed set will eliminate the current year's seed production. If continued annually, mowing can eliminate the infestation. Spot herbicide applications of Tordon®, Transline®, Curtail®, or 2,4-D are effective.

Treatment Schedule

Apply herbicides to rosettes in early spring (May, June), and then mow or sever taproots after the plants have bolted but before flowering (late June to July).

4.4.5 Chinese clematis (*Clematis orientalis*)

Priority

Eradicate — as the species is not widespread and is attracting increasing attention from regional land managers and the State.

Description

Chinese clematis is a perennial herbaceous to woody vine with solitary flowers with four yellow sepals (petal-like structures), often nodding. Each flower produces numerous feathery long-tailed seed heads fruits, which are conspicuous all winter

Current Distribution on the Open Space

Chinese clematis is not currently widespread, but may be spreading rapidly in the eastern portion of the Greenbelt. The species is abundant in sunny areas where it can climb on fences, trees, and shrubs.

Measurable Objectives and Goal

Goal: Eradicate

1. Eradicate existing plants within three years.
2. Continue yearly surveillance especially in areas with young native trees and shrubs.

Control Options

The only recommendation available is for herbicide control with Escort® (metsulfuron).

Treatment Schedule

Herbicide application should take place prior to seed production, which occurs from summer to fall. The Parks and Recreation Department should discourage its use as an ornamental by conducting an outreach program for local residents and nurseries.

4.4.6 Poison hemlock (*Conium maculatum*)

Priority

Medium — as the plant is not an aggressive invader, has a tendency to grow in wet areas that may restrict herbicide use, and is highly poisonous. Avoid touching this plant.

Description

Poison hemlock is a biennial forb that grows at low elevations where moisture is adequate and disturbance is relatively frequent (e.g., along stream and ditch banks, and in riparian woodlands and flood plains).

Current Distribution on the Open Space

Poison hemlock is scattered through most areas throughout the Greenbelt and along Lewis Gulch.

Measurable Objectives and Goal

Goal: Contain

1. Eradicate existing plants within three years.
2. Continue yearly surveillance especially in areas with young native trees and shrubs.

Control Options

It is important to prevent the expansion of poison hemlock from small-scale to large-scale infestations. To prevent seeds from spreading along Clear Creek, ditches, and the wetlands within the Open Space, soil disturbance should be avoided. The best way to contain populations of poison hemlock is to spray the borders of the infested area with a herbicide. Containment is a long-term management commitment because it does not eliminate or reduce the infestation level, it simply limits the weed spread. Eradicate new infestations of one to a few plants immediately (preferably before the plant sets seed) by hoeing or spot-applying herbicide.

Treatment Schedule

Foliar herbicides should be applied during the rosette stage with a wick to avoid damage to surrounding desirable vegetation. Stems that arise after treatment can be cut. Herbicide treatments may need to be repeated for several years until the seed bank is depleted.

4.4.7 Common teasel (*Dipsacus fullonum*)

Priority

High — as the area infested is low, the species can be an aggressive competitor, and control measures are relatively easy.

Description

Common teasel is a biennial forb that is capable has massive seed production and high germination that allow it to quickly invade an area.

Current Distribution on the Open Space

Common teasel occurs in small, scattered patches that are primarily located on the west side of the Greenbelt.

Measurable Objectives and Goal

Goal: Reduce and eventually eradicate.

1. Annually cut stalks of flowering plants.
2. Continue yearly surveillance of wetland and riparian areas.

Control Options

The key to controlling common teasel is to eliminate seed production and exhaust the seed bank in the soil. Common teasel does not reproduce vegetatively and dies after seed production. Therefore, cutting the stalks of flowering plant is the best control in natural areas. Cut stalks should be bagged and ideally burned.

Treatment Schedule

Cut flowering stalks from July to August.

4.4.8 Cutleaf teasel *(Dipsacus laciniatus)*

Priority

High — with consideration that cut-leaved teasel is more aggressive than common teasel and has infested more of the Open Space.

Description

Although usually called a biennial, teasel is better described as a monocarpic perennial. The plant grows as a basal rosette for a minimum of one year (this rosette period frequently is longer) then sends up a tall flowering stalk and dies after flowering. The period of time in the rosette stage apparently varies depending on the amount of time needed to acquire enough resources for flowering to occur. Cut-leaved teasel blooms from July through September.

Current Distribution on the Open Space

About 4.5 acres on the Open Space are infested with cutleaf teasel. Most patches occur primarily on the west side of the Greenbelt.

Measurable Objectives and Goal

Goal: Reduce and work long term to eradicate.

1. Recruit volunteers to annually cut stalks of flowering plants.
2. Continue yearly surveillance of wetland and riparian areas.

Control Options

For small populations or if large groups of volunteers are available mechanical methods work quite well. Young rosettes can be dug up using a dandelion digger. Once the rosettes get large, it is difficult to dig the roots up without doing damage to the natural area around the plant. Very small seedlings can be pulled up by hand when the soil is moist. Flowering plants can be cut before seed set. At the initiation of flowering, the flowering heads should be cut off and removed. Removed immature seed heads left in place can still develop some viable seeds. Once the flowering heads have been removed, the flowering stalk should be cut off at or slightly below ground level. Cutting off the flowering stalks just at flowering time will usually prevent resprouting from the root crown. Cutting flowering stalks prior to flowering should be avoided since the plants will resprout and flower again. A later inspection should be performed to catch any root crowns that do resprout.

Probably the most cost effective method of control is the use of foliar applied herbicides. Any of the herbicides recommended below for buffer or disturbed sites can be used, but with greater care to prevent damaging native plants. Spot treatment with backpack sprayers is probably the preferred method in high quality areas as opposed to high volume units. Triclopyr is a good choice during the growing season since it usually does not harm the monocots. Some grass species will be burned back by Triclopyr, but will usually come back. During the dormant season Glyphosate has worked in controlling teasel in some situations.

Treatment Schedule

Cut flowering stalks from June to September.

4.4.9 Russian olive (*Eleagnus angustifolia*)

Priority

Medium — as large, mature stands of Russian olive are nearly impossible to eradicate throughout an entire watershed once it

becomes well established. Patches in an area with Ute Ladies'-tresses orchid present should be addressed first.

Description

Russian olive is a shrub or small tree that can grow up to 30 feet in height and is often thorny. It can flower and set fruit in three years. Although Russian olive establishes primarily by seed, vegetative propagation can also occur

Current Distribution on the Open Space

Russian olive occurs in a variety of soil and moisture conditions on the Open Space but generally prefers sandy floodplains and is often associated with open, moist riparian habitats.

Measurable Objectives and Goal

Goal: Reduce Russian olive cover on the Open Space

1. Remove existing trees in Ute Ladies'-tresses orchid habitat within three years.
2. Continue Russian olive removal as part of wildfire management.

Control Options

Control of seedlings and sprouts can easily be hand-pulled when the soil is moist. Once Russian olive becomes firmly established, the most effective control method is the cut-stump herbicide treatment. This method is both labor-intensive and expensive, but can be highly effective (good kill rate if applied correctly), and is more target-specific than foliar applications of herbicide. The stump-cut method consists of the following steps: 1) cut stems of Russian olive within 5 cm of the ground surface; 2) apply herbicide within a few minutes of cutting; 3) cut and treat the entire circumference of the stem cambium; and 4) treat any resprouted foliage between 4 to 12 months after the initial treatment.

Treatment Schedule

The best time to apply herbicide to control Russian olive is when the plants are actively growing from May through September. Care should be taken to ensure that birds are not nesting in the targeted tree.

4.4.10 Leafy spurge (*Euphorbia esula*)

Priority

Highest — as leafy spurge's two reproductive techniques (i.e., large seed production and production of underground shoot buds) allow it to rapidly displace native species and form a monoculture.

Description

Leafy spurge is a persistent, deep-rooted perennial that reproduces by seeds and roots. Leafy spurge has a somewhat woody crown below the soil surface. Each crown area produces several upright stems giving the plant a clump-like appearance. In addition, new stems arise from buds on lateral, secondary roots. Stem growth starts in April, making leafy spurge an early, vigorous competitor with native vegetation.

Current Distribution on the Open Space

Leafy spurge is scattered in a number of locations in the Greenbelt and currently infest about 6 acres.

Measurable Objectives and Goal

Goal: Control and reduce leafy spurge cover on the Open Space.

1. Immediately control new infestations.
2. Contain infestation at current level and work to reduce.

Control Options

Biocontrols and grazing animals (i.e., sheep and goats) are effective methods for leafy spurge controls, but are generally appropriate only for larger infestations. Herbicides are most commonly used to control leafy spurge.

Treatment Schedule

A repeated application of a mix of Tordon plus 2,4-D during true flowering (May through June) is an effective herbicide treatment.

4.4.11 Dalmatian toadflax (*Linaria genistifolia*)

Priority

Highest — as the species is a persistent, aggressive invader and capable of forming colonies through adventitious buds from creeping root systems. These colonies can push out native grasses and other

perennials, thereby altering the species composition of natural communities.

Description

Dalmatian toadflax is a perennial forb that can be easily identified by its bright-yellow, snapdragon-shaped flowers. It is a persistent, aggressive invader and can push out native grasses and other perennials. Dalmatian toadflax is most commonly found along roadsides, fences, rangelands, croplands, clear cuts, and pastures.

Current Distribution on the Open Space

Dalmatian toadflax is found in scattered patches throughout the Greenbelt, but principally west of Wadsworth. Several small patches have been mapped on the west side of the Greenbelt in areas with Ute Ladies'-tresses orchid present.

Measurable Objectives and Goal

Goal: Control and reduce Dalmatian toadflax cover.

1. Reduce cover of Dalmatian toadflax in areas with Ute Ladies'-tresses orchid.
2. Control Dalmatian toadflax within areas of native vegetation.

Control Options

Pulling by hand can be effective for small infestations and necessary in areas with Ute Ladies'-tresses orchid. Hand pulling may have to be continued for up to 10 years to completely remove a stand of the plant. Mowing or cutting is not recommended as these actions do not affect root reserves or buried seeds. Herbicides that are effective when applied during flowering include picloram, dicamba, and glyphosate.

Treatment Schedule

Monitoring should be conducted in early June when toadflax plants have formed buds and are beginning to flower. Any management program should also be conducted during the month of June. This is when root carbohydrate reserves are at their lowest, which makes it more difficult for the root system to recover. Follow-up work in late June or early July is recommended to locate and remove any late-flowering plants.

4.4.12 Yellow toadflax (*Linaria vulgaris*)

Priority

High — as infestations are widespread, but communities that are in good condition may recover without replanting of desirable species as long as follow-up control visits are conducted annually.

Description

Yellow toadflax is a perennial herb of the figwort family (Scrophulariaceae). The species is classified as a weed in Europe, Russia, Canada, and the United States, and is common throughout North America. Yellow toadflax is smaller than Dalmatian toadflax and grows to be 8 to 30 inches tall. Yellow toadflax leaves are soft, linear or linear lanceolate, sessile, and pale green. Yellow toadflax flowers are similar to Dalmatian toadflax. Yellow toadflax flowers from May to August.

Current Distribution on the Open Space

Yellow toadflax is widely distributed throughout the Greenbelt with about 12 acres of total infestation. Several areas with known occurrences of Ute Ladies'-tresses orchid contain yellow toadflax infestations.

Measurable Objectives and Goal

Goal: Control and reduce yellow toadflax cover.

1. Reduce cover of yellow toadflax in areas with Ute Ladies'-tresses orchid, especially near Anderson Park and east of Prospect Park.
2. Control yellow toadflax within areas of native vegetation.

Control Options

Permanent, long-term control cannot be achieved with herbicide treatment alone. Herbicides should be applied during flowering when carbohydrate reserves in the root of the plants are at their lowest. At the latest, herbicide treatment should be applied before seed dispersal, if it is to be effective. The herbicides glyphosate, dicamba and picloram are considered effective for controlling toadflax. Pulling by hand can be effective for small infestations and necessary in areas with Ute Ladies'-tresses orchid. Hand pulling may

have to be continued for up to 10 years to completely remove a stand of the plant. Mowing or cutting is not recommended as these actions do not affect root reserves or buried seeds.

Treatment Schedule

Monitoring should be conducted in early June when toadflax plants have formed buds and are beginning to flower. Any management program should also be conducted during the month of June. This is when root carbohydrate reserves are at their lowest, which makes it more difficult for the root system to recover. Follow-up work in late June or early July is recommended to locate and remove any late-flowering plants.

4.4.13 Purple loosestrife (*Lythrum salicaria*)

Priority

Eradicate (in all wetland and riparian areas) — Purple loosestrife has only been found in a few small, isolated patches in the Wheat Ridge Greenbelt and is not widely distributed in Colorado. If it establishes itself within the Greenbelt it may rapidly spread into large infestations, and would then be very difficult to control. Once it is established, purple loosestrife often displaces native wetland species and degrades wildlife habitat.

Description

Purple loosestrife is a rhizomatous perennial forb with showy rose-purple flowers that bloom in long vertical racemes. The lance-shaped leaves have smooth edges. It often grows up 6 to 8 feet tall in riparian areas, wetlands, and ditchbanks.

Current Distribution on the Open Space

Purple loosestrife is distributed in isolated patches in the Wheat Ridge Greenbelt. The three general locations are: 1) east of Bass Lake, 2) along Clear Creek near West 44th Avenue, and 3) along Clear Creek in the vicinity of Johnson Park.

Measurable Objectives and Goal

Goal: Eradicate

1. Eradicate existing plants within three years
2. Continue yearly surveillance.

Control Options

Hand dig or pull small infestations prior to seed set. The stems and roots must be bagged and removed from the site to prevent formation of new plants. Clipping and bagging can be followed by a herbicide application to the immediate area. Herbicide control would be more appropriate for larger infestations. Glyphosate in an aquatic formulation such as Rodeo®, with a non-ionic surfactant, can be applied to a cut surface. Aquatic-labeled 2,4-D is effective on seedling and re-growth less than 2 feet tall.

Treatment Schedule

Purple loosestrife begins its growth about a week to 10 days after cattail and reed canarygrass. Seedlings established in the spring grow rapidly and produce flowers 8 to 10 weeks after germination. Known or suspected infestation areas should be surveyed annually. Any control effort should be followed up with immediately.

4.4.14 Scotch thistle (*Onopordum acanthium*)

Priority

High — as Scotch thistle is not widely distributed and easy to control.

Description

This is a biennial that grows up to 12 feet tall. It is an aggressive species that can form dense stands along roadsides, irrigation ditches, waste areas, and rangelands. Wind, water, clothing, and the fur of animals can aid in the dispersal of Scotch thistle seed heads. Seeds may also be transported in hay and machinery.

Current Distribution on the Open Space

Scotch thistle is not widely distributed on the Open Space. About 0.35 acres are infested with one of the largest patches located west of Kipling Street on the south side of Clear Creek.

Measurable Objectives and Goal

Goal: Reduce Scotch thistle cover on the Open Space.

1. Concentrate on areas of Scotch thistle removal with volunteer weed control projects.
2. Reduce cover over time.

Control Options

Scotch thistle is best controlled in the rosette stage and can be controlled by severing its taproot 1 to 2 inches below the ground. Rosettes can also be sprayed with 2,4-D. Treated areas should be reseeded with desirable vegetation.

Treatment Schedule

Severing the taproot as described above can easily control Scotch thistle. Unfortunately, these weeds do not bolt as individual plants at the same time. Mechanical control in any given area needs to be repeated throughout the growing season. Herbicides should generally be applied in the spring before Scotch thistle bolts or in the fall to rosettes.

4.4.15 Buckthorn (*Rhamnus cathartica*)

Priority

Medium — as extensive stands on the Open Space will take a considerable investment to eradicate.

Description

Common buckthorn is a deciduous shrub or small tree six to twenty feet tall. Although seedlings invade apparently stable habitats, recruitment is most successful where there is ample light and exposed soil.

Current Distribution on the Open Space

Common buckthorn has formed extensive stands in the Greenbelt primarily along the bluff on the south side of Clear Creek.

Measurable Objectives and Goal

Goal: Reduce buckthorn cover on the Open Space.

1. Continue buckthorn removal as part of wildfire management.

Control Options

Effective cultural controls include cutting, mowing, girdling, and "underplanting." Repeated cutting reduces plant vigor. "Underplanting" disturbed woods with native woody species is potentially effective to prevent primary invasion, or re-invasion of buckthorn. The stump-cut method can also be used. The stump-cut method consists of the following steps: 1) cut stems of tamarisk

within 2 inches of the ground surface; 2) apply herbicide within a few minutes of cutting; 3) cut and treat the entire circumference of the stem cambium; and 4) treat any resprouted foliage between 4 to 12 months after the initial treatment.

Treatment Schedule

Girdling may be done year-round, does not disrupt the soil, nor adversely affects sensitive wetlands. The best time to apply herbicide to control buckthorn is when the plants are actively growing from May through September.

4.4.16 Tamarisk (*Tamarix ramosissima*)

Priority

Eradicate — as only a single tamarisk was found during the 2000 weed mapping.

Description

Tamarisk is an aggressive, woody invasive plant species that has become established over as much as a million acres of floodplains, riparian areas, wetlands and lake margins in the western United States.

Current Distribution on the Open Space

A single tamarisk was found in the Open Space, on a bench above Clear Creek in the eastern portion of the Greenbelt.

Measurable Objectives and Goal

Goal: Eradicate

1. Continue yearly surveillance.
2. Eradicate plants immediately.

Control Options

In general the stump-cut method should be used for tamarisk control on the Open Space. The stump-cut method consists of the following steps: 1) cut stems of tamarisk within 2 inches of the ground surface; 2) apply herbicide within a few minutes of cutting; 3) cut and treat the entire circumference of the stem cambium; and 4) treat any resprouted foliage between 4 to 12 months after the initial treatment.

Treatment Schedule

The Open Space should be survey annually for tamarisk. Locations of plants should be mapped and plants should be controlled immediately.

Table 4. Detailed control calendar for priority species.

Weed Species	Spring (April to Mid-June)	Summer (Mid-June to August)	Fall (September to October)
Diffuse knapweed	Pull plants emerging from small patches when the soil is moist enough to remove the entire plant and taproot.	Mow, cut, or pull after rosettes have bolted. Patch density may increase as additional plants germinate from the seed bank. Herbicides can be used to treat mowed patches and should be done before seed set.	Pull or cut new plants and those that have bolted again. Efforts should concentrate on small patches to contain spread. This type of effort may need to be continued for 8 to 10 years.
Canada thistle	Use herbicide on rosettes (i.e., Curtail if available). Mow large patches once plants have reached about one foot in height.	Mow or cut patches monthly through the summer.	Apply Curtail to all patches in October or about a month after the last mowing. Patch density should be significantly reduced after about three years. Be sure to follow up with revegetation.
Musk thistle	Apply herbicide to rosettes.	Cut bolted plants prior to see production. Remove and bag flowerheads for disposal prior to seed production because seeds can still mature after cutting.	Revegetate control areas with desirable native grass mix.
Bull thistle	Apply herbicide (e.g., Curtail, Transline, or Tordon) to rosettes.	Mow large patches and sever taproots of scattered plants after rosettes have bolted, but before flowering.	Cut or mow late bolting plants.
Chinese clematis	Herbicide control with Escort® (metsulfuron).	Herbicide control with Escort® (metsulfuron).	Herbicide control with Escort® (metsulfuron).

Weed Species	Spring (April to Mid-June)	Summer (Mid-June to August)	Fall (September to October)
Poison hemlock	Apply foliar herbicides with a wick while plants are in rosettes stage.	Cut bolted plants or remove seed heads before seeds mature. Avoid skin contact with the plant.	Revegetate control areas with desirable native seed mix.
Common teasel	Cut flowering stalks from July to August.	Cut flowering stalks from July to August.	Cut flowering stalks from July to August.
Cutleaf teasel	Cut flowering stalks from June to September.	Cut flowering stalks from June to September.	Cut flowering stalks from June to September.
Russian olive	Seedlings and sprouts can be hand-pulled or weed wrenched out when soil is moist. Cut-stump herbicide treatment beginning in May.	Cut-stump herbicide treatment.	Cut-stump herbicide treatment through September.
Leafy spurge	For small infestations, spray seedlings with picloram when flowers emerge in May. Large stands may be controlled by grazing sheep or goats and releasing biocontrol agents.	Same treatment as spring. Do not mow this plant.	Reseed improving areas with a mixture of early- and late-season grasses.
Dalmatian toadflax	Beginning in mid to late April, pull emerging seedlings from small patches.	Spray plants in flower with a mix of picloram and 2,4-D. Consider release of biocontrol, *Calophasia lunula*, if herbicide is not available.	Hand pulling may continue after seed set, but plants should be bagged and buried or burned. Herbicides may be applied in fall as well, if necessary.

Weed Species	Spring (April to Mid-June)	Summer (Mid-June to August)	Fall (September to October)
Yellow toadflax	Beginning in mid to late April, pull emerging seedlings from small patches and mow large patches.	Spray plants in flower with a mix of picloram and 2,4-D. Consider release of biocontrol, *Calophasia lunula*, if herbicide is not available.	Hand pulling may continue after seed set, but plants should be bagged and buried or burned. Consider a fall fertilizer or other cultural assistance for adjacent native perennials.
Purple loosestrife	Look for seedlings in June. Broadleaf herbicides (2,4-D based) can be effective on loosestrife if applied in late May or early June.	The best time to search for purple loosestrife is in July and August when the plants are blooming. Spraying should be done after the period of peak bloom, usually late August. Use Rodeo ®.	Continue herbicide applications through September.
Scotch thistle	Apply Curtail or Transline to rosettes. Sever taproots of larger bolted plants with a shovel.	Follow up spraying for missed or rebolted plants. Sever taproots of larger bolted plants with a shovel.	Consider reseeding or revegetating in control areas.
Buckthorn	"Underplanting" disturbed woods with native woody species to prevent primary invasion, or reinvasion. Wick application of 2.5 to 3 percent glyphosate in May.	Stump application of 20 percent glyphosate in August.	Girdling may be done all winter.
Tamarisk	Locate plants in the spring or summer when their pink flowers are visible. Begin treatment - stump cut and treat with Garlon4®.	Stump cut and treat with Garlon4®.	Stump cut and treat with Garlon4®.

5.0 Restoration Principles

Conceptual planning identifies the reasons why restoration is needed and the general strategy for conducting it. Conceptual planning is conducted when restoration appears to be a feasible option but before a decision has been made to exercise that option. This section captures the essence and character of potential restoration and includes preliminary considerations on accessing the existing conditions on the Open Space and the general methods to successfully implement a revegetation project.

Throughout Colorado, natural landscapes such as those found along Clear Creek in Wheat Ridge continue to undergo fundamental changes. Areas that previously supported native prairie or riparian ecosystems have been disturbed by agricultural practices or converted entirely to housing and commercial developments. As land use patterns change, negative impacts on native biodiversity are the risks. Non-native plant species often invade disturbed sites, taking over entire landscapes by crowding out native species. Restoring native biodiversity to the land will increase the landscape's ability to provide beneficial habitat for wildlife and will reduce other threats attributed to alien species, as plant competition is an effective way to prevent the invasion of noxious weeds. Proper management and establishment of native perennial grasses will assist in the control of weeds.

Unfortunately, after weed removal, disturbed sites such as the Wheat Ridge Greenbelt or Lewis Meadows often act as a magnet for further noxious weed invasions. Successful restoration of the Open Space with native vegetation should help reduce re-colonization of noxious weeds. For large acreages, it is often recommended that a cover crop (as competition) be planted after all noxious weeds have been removed and before seeding grasses. Just as integrated weed management requires a long-term commitment, disturbed lands require ongoing maintenance beyond initial reseeding to insure long-term restoration success.

Restoring native vegetation from essentially scratch will be a long-term project. It may take three to five years for the grassland areas to look like the vision planners have for it and up to ten years to fully establish. Before beginning a revegetation project on the Open Space, both the soils and hydrology information of the specific site must be understood to ensure successful growth of native plants.

5.1 Soils

The importance of soils in any revegetation plan cannot be overstated. Soil is a determining factor in selecting and planting vegetation and constructing trails. It is the medium that will be manipulated for planting, storing and transmitting water, and supporting diverse plant communities. Good soil conditions exist when water, air, plant roots, and microorganisms are able to move freely through and within the root zone of the soil. Since soil characteristics vary across any landscape, it is important to know the soil characteristics of the property. Prior to revegetation of either upland or riparian areas, a thorough soil analysis should be conducted.

5.2 Precipitation and Hydrology

Knowledge of the amount of water available to plants is critical when determining the type of vegetation for a restoration project. The amount of water combined with soil texture and organic material ultimately determines moisture availability. Sources of water may be from rainfall, runoff from adjacent lands, and the underground water table. Precipitation data for the area is important in any revegetation efforts on a given site.

5.3 Seed Mixes

The soil and hydrology information will help land managers understand site conditions and develop appropriate planting regimes. Some preliminary native grass mix designed for the loamy or clayey soils are provided in Appendix E. It is imperative to consider weed management prior to initiating a restoration project and especially before any further ground disturbance on the Open Space.

6.0 References Cited in Plan

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7.0 Useful Information Sources

Colorado State University Cooperative Extension Natural Resource Online (http://www.ext.colostate.edu/menunatr.html) maintains links to natural resource fact sheets, two to four page articles on forestry, range and wildlife. Several of the articles on range pertain to general weed management and to several specific species.

Colorado Weed Management Association (CWMA) website (http://www.cwma.org/) provides basic noxious weed information. Members of the CWMA enjoy access to a wealth of additional information on noxious weed management.

Environmental Protection Agency Pesticide Product Information System (http://www.epa.gov/opppmsd1/PPISdata/index.html) contains information concerning all pesticide products registered in the United States. The files located in this download area are presented in ASCII to enable interested parties to access them using a variety of database and spreadsheet software.

State of Colorado Department of Agriculture Division of Plant Industry website (http://www.ag.state.co.us/DPI/home.html) provides important links to the Colorado Noxious Weed Act, Executive Orders, weed free forage producers, biological pest control, and pesticide information.

The Nature Conservancy Wildland Invasive Species Team website (http://tncweeds.ucdavis.edu/) provides educational materials, photographs, noxious weed alerts and a link to the management library described below.

The Nature Conservancy Wildland Invasive Species Management Library (http://tncweeds.ucdavis.edu/esadocs.html) includes links to all The Nature Conservancy's resources specific to individual invasive species. Every invasive plant Element Stewardship Abstract (ESA) written for The Nature Conservancy can be downloaded here. An ESA is a complete report summarizing relevant aspects of an organism, including its ecology and control.

USDA Forest Service Fire Effects Information (FEIS) provides updated scientific and technical information about interactions between fire and invasive, nonnative plant species. The site (http://www.fs.fed.us/database/feis/plants/weed/weedpage.html) also maintains several other weed management links.

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Appendices

Appendix A
Colorado Weed Management Act

TITLE 35
AGRICULTURE

ARTICLE 5.5
Colorado Noxious Weed Act

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35-5.5-101. Short title. This article shall be known and may be cited as the "Colorado Noxious Weed Act".

35-5.5-102. Legislative declaration - rule of construction. (1) In enacting this article the general assembly finds and declares that there is a need to ensure that all the lands of the state of Colorado, whether in private or public ownership, are protected by and subject to the jurisdiction of a local government empowered to manage undesirable plants as designated by the state of Colorado and the local governing body. In making such determination the general assembly hereby finds and declares that certain undesirable plants constitute a present threat to the continued economic and environmental value of the lands of the state and if present in any area of the state must be managed. It is the intent of the general assembly that the advisory commissions appointed by counties and municipalities under this article, in developing undesirable plant management plans, consider the elements of integrated management as defined in this article, as well as all appropriate and available control and management methods, seeking those methods which are least environmentally damaging and which are practical and

economically reasonable.

(1.5) The general assembly hereby finds and declares that:

(a) Noxious weeds have become a threat to the natural resources of Colorado, as thousands of acres of crop, rangeland, and habitat for wildlife and native plant communities are being destroyed by noxious weeds each year;

(b) An organized and coordinated effort must be made to stop the spread of noxious weeds and that such an effort can best be facilitated by a state coordinator who will assist in building local coalitions and coordinate the efforts of state, federal, local, and private landowners in developing plans for the control of noxious weeds without unnecessarily disrupting the development of such lands;

(c) The designation and classification of noxious weeds into categories for immediate eradication, containment, and suppression will further assist the state in coordinating efforts to stop the spread of noxious weeds;

(d) Because the spread of noxious weeds can largely be attributed to the movement of seed and plant parts on motor vehicles, and because noxious weeds are becoming an increasing maintenance problem on highway right-of-ways in this state, additional resources are needed to fight the spread of noxious weeds; and

(e) The use of moneys in the noxious weed management fund to assist local governing bodies and affected landowners in the eradication, containment, or suppression of noxious weeds best serves the citizens of Colorado.

(2) This article is in addition to article 5 of this title and is intended to be an expansion of, not a substitution for, the provisions of said article 5.

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35-5.5-103. Definitions. As used in this article, unless the context otherwise requires:

(2) "Alien plant" means a plant species that is not indigenous to the state of Colorado.

(4) "Commissioner" means the commissioner of the department of agriculture or his or her designee.

(4.5) "Department" means the department of agriculture.

(5) "District" means a local governing body's geographic description of a land area where noxious weeds are to be managed.

(7) "Federal agency" means each agency, bureau, or department of the federal government responsible for administering or managing federal land.

(8) "Federal land manager" means the federal agency having jurisdiction over any federal lands affected by the provisions of this article.

(9) "Integrated management" means the planning and implementation of a coordinated program utilizing a variety of methods for managing noxious weeds, the purpose of which is to achieve specified management objectives and promote desirable plant communities. Such methods may include but are not limited to education, preventive measures, good stewardship, and the following techniques:

(a) "Biological management", which means the use of an organism to disrupt the growth of noxious weeds.

(b) "Chemical management", which means the use of herbicides or plant growth regulators to disrupt the growth of noxious weeds.

(c) "Cultural management", which means methodologies or management practices that favor the growth of desirable plants over noxious weeds, including maintaining an optimum fertility and plant moisture status in an area, planting at optimum density and spatial arrangement in an area, and planting species most suited to an area.

(d) "Mechanical management", which means methodologies or management practices that physically disrupt plant growth, including tilling, mowing, burning, flooding, mulching, hand-pulling, hoeing, and grazing.

(10) "Landowner" means any owner of record of federal, tribal, state, county, municipal, or private land.

(10.5) "Local advisory board" means those individuals appointed by the local governing body to advise on matters of noxious weed management.

(11) "Local governing body" means the board of county commissioners of a county, the city council of a city and county or statutory or home rule city, the board of trustees of a statutory town or home rule town, or the board of selectmen or city council of a territorial charter municipality, as the context so requires.

(11.4) "Local noxious weed" means any plant of local importance that has been declared a noxious weed by the local governing body.

(11.6) "Management" means any activity that prevents a plant from establishing, reproducing, or dispersing itself.

(11.7) "Management objective" means the specific, desired result of integrated management efforts and includes:

(a) "Eradication" which means reducing the reproductive success of a noxious weed species or specified noxious weed population in largely uninfested regions to zero and permanently eliminating the species or population within a specified period of time. Once all specified weed populations are eliminated or prevented from reproducing, intensive efforts continue until the existing seed bank is exhausted.

(b) "Containment" which means maintaining an intensively managed buffer zone that separates infested regions, where suppression activities prevail, from largely uninfested regions, where eradication activities prevail.

(c) "Suppression" which means reducing the vigor of noxious weed populations within an infested region, decreasing the propensity of noxious weed species to spread to surrounding lands, and mitigating the negative effects of noxious weed populations on infested lands. Suppression efforts may employ a wide variety of integrated management techniques.

(d) "Restoration" which means the removal of noxious weed species and reestablishment of desirable plant communities on lands of significant environmental or agricultural value in order to help restore or maintain said value.

(12) "Management plan" means the noxious weed management plan developed by any person or the local advisory board using integrated management.

(14) "Municipality" has the meaning set forth in section 31-1-101 (6), C.R.S.

(15) "Native plant" means a plant species that is indigenous to the state of Colorado.

(16) "Noxious weed" means an alien plant or parts of an alien plant that have been designated by rule as being noxious or has been declared a noxious weed by a local advisory board, and meets one or more of the following criteria:

(a) Aggressively invades or is detrimental to economic crops or native plant communities;

(b) Is poisonous to livestock;

(c) Is a carrier of detrimental insects, diseases, or parasites;

(d) The direct or indirect effect of the presence of this plant is detrimental to the environmentally sound management of natural or agricultural ecosystems.

(16.2) "Noxious weed management" means the planning and implementation of an integrated program to manage noxious weed species.

(17) "Person" or "occupant" means an individual, partnership, corporation, association, or federal, state, or local government or agency thereof owning, occupying, or controlling any land, easement, or right-of-way, including any city, county, state, or federally owned and controlled highway, drainage or irrigation ditch, spoil bank, borrow pit, gas and oil pipeline, high voltage electrical transmission line, or right-of-way for a canal or lateral.

(18) "Plant growth regulator" means a substance used for controlling or modifying plant growth processes without appreciable phytotoxic effect at the dosage applied.

(18.5) "State noxious weed" means any noxious weed identified by the commissioner by rule after notifying and consulting with the state noxious weed advisory committee created in section 35-5.5-108.7.

(18.6) "State weed coordinator" means the state weed coordinator under contract with or appointed by the commissioner pursuant to section 35-5.5-117.

(21) "Weed" means any undesirable plant.

35-5.5-104. Duty to manage noxious weeds. It is the duty of all persons to use integrated methods to manage noxious weeds if the same are likely to be materially damaging to the land of neighboring landowners.

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35-5.5-104.5. Intentional introduction, cultivation, or sale of noxious weeds - costs. (1)(a) It shall be unlawful to intentionally introduce, cultivate, sell, offer for sale, or knowingly allow to grow in violation of this article or any rule promulgated hereunder in this state any noxious weed designated pursuant to section 35-5.5-108 (2)(a); except that this prohibition shall not apply to:

(I) Research sanctioned by a state or federal agency or an accredited university or college;

(II) Activities specifically permitted by the commissioner;

(III) Noxious weed management plans that are part of an approved reclamation plan pursuant to section 34-32-116 (7) or 34-32.5-116 (4), C.R.S.;

(IV) Noxious weed management activities that are conducted on disturbed lands as part of an approved reclamation plan pursuant to section 34-33-111 (1), C.R.S.; or

(V) Noxious weed management activities that are part of activities conducted on disturbed lands pursuant to section 34-60-106 (12), C.R.S.

(b) It shall not be a violation of this section for a person to knowingly allow to grow a state noxious weed that is being properly managed in accordance with the rules promulgated by the commissioner.

(2) Any entity or person that violates the provisions of this section shall be responsible for the costs associated with remediation of the noxious weeds. In assessing the cost of remediation, the commissioner may include both actual immediate and estimated future costs to achieve specified management objectives.

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35-5.5-105. Noxious weed management - powers of county commissioners. (1) The board of county commissioners of each county in the state shall adopt a noxious weed management plan for all of the unincorporated lands within the county. Such plan shall include all of the requirements and duties imposed by this article. Guidelines may be included that address no pesticide noxious weed management plans. In addition to and not in limitation of the powers delegated to boards of county commissioners in section 30-11-107 and article 15 of title 30, C.R.S., article 5 of this title, and elsewhere as provided by law, the board of county commissioners may adopt and provide for the enforcement of such ordinances, resolutions, rules, and other regulations as may be necessary and proper to enforce said plan and otherwise provide for the management of noxious weeds within the county, subject to the following limitation: No county ordinance, rule, resolution, other regulation, or exercise of power pursuant to this article shall apply within the corporate limits of any incorporated municipality, nor to any municipal service, function, facility, or property, whether owned by or leased to the incorporated municipality outside the municipal boundaries unless the county and municipality agree otherwise pursuant to part 2 of article 1 of title 29, C.R.S., or article 20 of title 29, C.R.S.

(2) The board of county commissioners shall provide for the administration of the noxious weed management plan authorized by this article through the use of agents, delegates, or employees and may hire additional staff or provide for the performance of all or part of the management plan through outside contract. Any agent, delegate, employee, staff, or contractor applying or recommending the use of chemical management methods shall be certified by the department of agriculture for such application or recommendation. Costs associated with the administration of the noxious weed management plan shall be paid from the noxious weed management fund of each county.

(3) The board of county commissioners may cooperate with other counties and municipalities for the exercise of any or all of the powers and authorities granted by this article. Such cooperation shall take the form of an intergovernmental agreement pursuant to part 2 of article 1 of title 29, C.R.S., or article 20 of title 29, C.R.S.

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35-5.5-106. Noxious weed management - municipal authority. (1) The governing body of each municipality in the state shall adopt a noxious weed management plan for all lands within the territorial limits of the municipality. In addition to and independent of the powers elsewhere delegated by law, the governing body of a municipality may adopt and provide for the enforcement of such ordinances, resolutions, rules, and other regulations as may be necessary and proper to enforce said plan and otherwise provide for the management of noxious weeds within the municipality, subject to the following limitation: No municipal ordinance, resolution, rule, other regulation, or exercise of power pursuant to this article shall apply to unincorporated lands or facilities outside the corporate limits of the municipality, except such lands or facilities which are owned by or leased to the municipality, unless the municipality and the county otherwise agree pursuant to part 2 of article 1 of title 29, C.R.S., or article 20 of title 29, C.R.S.

(2) The governing body of the municipality shall provide for the administration of the noxious weed management plan authorized by this article through the use of agents, delegates, or employees and may hire additional staff or provide for the performance of all or part of the noxious weed management plan through outside contract. Any agent, delegate, employee, staff, or contractor applying or recommending the use of chemical management methods shall be certified by the department of agriculture for such application or recommendation.

(3) The governing body may cooperate with counties and other municipalities for the exercise of any or all of the powers and authorities granted by this article. Such cooperation shall take the form of an intergovernmental agreement pursuant to part 2 of article 1 of title 29, C.R.S., or article 20 of title 29, C.R.S.

(4) To the degree that a municipality has, upon enactment of this article, or subsequent to that date, adopted an ordinance or ordinances for the management of noxious weeds, the adoption of such an ordinance or ordinances shall be deemed to satisfy the requirement for the adoption of a noxious weed management plan imposed by this article.

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35-5.5-107. Local advisory board - formation - duties. (1) The governing body of each county and municipality shall appoint a local advisory board. The local governing body, at its sole option, may appoint itself, or a commission of landowners, to act as the local advisory board for that jurisdiction. The members of each local advisory board shall be residents of the unincorporated portion of the county or residents of the municipality, as the case may be, and in the case of a county, at least a majority of the members of the local advisory board shall be landowners of over forty acres.

(2) In the event a county or municipality elects to cooperate with another county or municipality for any of the purposes set forth in this article, the membership of the local advisory board shall be determined by the governing bodies of such cooperating local governments.

(3) Each local advisory board shall annually elect a chairman and secretary. A majority of the members of the board shall constitute a quorum for the conduct of business.

(4) Local advisory boards shall have the power and duty to:

(a) Develop a recommended management plan for the integrated management of designated noxious weeds and recommended management criteria for noxious weeds within the area governed by the local government or governments appointing the local advisory board. The management plan shall be reviewed at regular intervals but not less often than once every three years by the local advisory board. The management plan and any amendments made thereto shall be transmitted to the local governing body for approval, modification, or rejection.

(b) Declare noxious weeds and any state noxious weeds designated by rule to be subject to integrated management.

(c) Recommend to the local governing body that identified landowners be required to submit an individual integrated management plan to manage noxious weeds on their property.

(5) The local governing body shall have the sole and final authority to approve, modify, or reject the management plan, management criteria, management practice, and any other decision or recommendation of the local advisory board.

(6) The state weed coordinator shall review any recommendations of a local advisory board appointed pursuant to article 5 of this title and note any inconsistencies between the recommendations of the state weed coordinator or the commissioner and any such local advisory board.

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35-5.5-108. Designated noxious weeds - legislative declaration. (1) The general assembly hereby finds and declares that the noxious weeds designated by rule are a present threat to the economic and environmental value of the lands of the state of Colorado and declare it to be a matter of statewide importance that the governing bodies of counties and municipalities include plans to manage such weeds as part of their duties pursuant to this article.

(2)(a) The state list of plant species that are designated as noxious weeds shall be designated by rule and shall be managed under the provisions of this article. On and after August 6, 2003, the commissioner shall classify noxious weeds into one of a minimum of three categories, including:

(I) "List A", which means rare noxious weed species that are subject to eradication wherever detected statewide in order to protect neighboring lands and the state as a whole;

(II) "List B", which means noxious weed species with discrete statewide distributions that are subject to eradication, containment, or suppression in portions of the state designated by the commissioner in order to stop the continued spread of these species;

(III) "List C", which means widespread and well-established noxious weed species for which control is recommended but not required by the state, although local governing bodies may require management.

(b) A local governing body may adopt eradication, containment, or suppression standards that are more stringent than the standards adopted by the commissioner.

(2.1) The commissioner shall review and revise, as necessary, the state noxious weed list at least once every three years.

(2.3) The commissioner shall develop and implement by rule state noxious weed management plans for noxious weed species classified as list A or list B species. For each noxious weed species, each management plan shall designate the management objectives for all lands of the state appropriate to achieve the stated purpose of the species classification.

(2.5) The commissioner shall prescribe integrated management techniques to achieve specified management objectives for each listed species after consulting with the state noxious weed advisory committee. The prescribed management techniques shall be mandatory techniques for list A species and populations of list B species designated for eradication. The commissioner shall develop management techniques pursuant to science-based methodologies, peer reviewed studies, or any other method that is based on credible research.

(2.6) The classifications made pursuant to paragraph (a) of subsection (2) of this section shall primarily reflect the known distribution of the designated species, the feasibility of current control technologies to achieve specified management objectives, and the costs of carrying out the prescribed state weed management plan.

(2.7)(a) The commissioner shall also adopt rules for granting compliance waivers to local governing bodies and landowners; except that a waiver may not be granted to the affected landowner when a landowner has wilfully or wantonly violated the provisions of this section or section 35-5.5-104.5 or 35-5.5-108.5 or attempts to delay eradication of a species without just cause.

(b) Such rules shall include:

(I) A process by which a local governing body or an affected landowner may petition the commissioner to change the management objectives specified in a state noxious weed management plan;

(II) The criteria used to evaluate such petitions; and

(III) Time frames in which the commissioner shall grant or deny such petitions.

(c) Actions sufficient to implement the management objective for a noxious weed species shall continue until the commissioner grants a waiver pursuant to this subsection (2.7).

(3) The board of county commissioners or governing body of a municipality may declare additional noxious weeds, within its jurisdictional boundaries, after a public hearing with thirty days prior notice to the public. Any declaration of additional noxious weeds pursuant to this subsection (3) shall include the management objectives for all affected landowners.

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35-5.5-108.5. Responsibilities related to eradication of designated noxious weeds - commissioner - local governing bodies - affected landowners. (1) This section shall apply to noxious weeds that have been classified as list A species and to populations of list B species designated for eradication pursuant to section 35-5.5-108 (2)(a). This section shall govern the responsibilities of the commissioner, local governing bodies, and affected landowners.

(2) **Duties of commissioner.** (a) The commissioner may enforce the provisions of this section as necessary to ensure the cooperation of local governing bodies and affected landowners.

(b) The commissioner shall provide:

(I) Educational resources to local governing bodies and affected landowners regarding the eradication of list A species and populations of list B species designated for eradication. Such education shall include an explanation of why the species has been listed for eradication, the prescribed techniques for eradication in the most cost-effective manner, and the duties of the local governing body and affected landowner regarding such eradication.

(II) Financial or in-kind resources to local governing bodies or affected landowners to eradicate list A species and populations of list B species designated for eradication from the available moneys in the noxious weed management fund created in section 35-5.5-116. Such financial or in-kind resource allocation shall be determined by the commissioner according to the identified benefits to the citizens of Colorado, the surrounding community, and the affected landowners.

(III) The inventory and mapping infrastructure necessary to facilitate the classification of state noxious weeds and the development and implementation of state noxious weed management plans.

(3) **Duties of local governing bodies.** (a) In compliance with the rules promulgated by the commissioner, a local governing body shall initiate and maintain communications with landowners who are affected by list A species and populations of list B species designated for eradication by the commissioner.

(b) In addition to the existing powers and duties of a local governing body provided in this article a local governing body shall:

(I) Provide affected land owners with technical assistance for the eradication of list A species and populations of list B species designated for eradication by the commissioner;

(II) Carry out sufficient measures, including project oversight and enforcement, as may be necessary to ensure the eradication of list A species and populations of list B species designated for eradication by the commissioner;

(III) Provide the commissioner with assistance in disseminating financial resources to affected landowners and mapping data pursuant to rules promulgated by the commissioner; and

(IV) Determine the cost of eradication to be borne by affected landowners.

(c) Local governing bodies may apply to the commissioner for a waiver of compliance with an eradication designation pursuant to section 35-5.5-108 (2.7).

(d) If the commissioner determines, in consultation with the local governing body, that the most cost-effective manner to eradicate designated noxious weeds is for the commissioner to implement an eradication program, the commissioner may implement the eradication program directly.

(4) **Duties of affected landowners or occupants.** Except as provided pursuant to section 35-5.5-104.5 (1)(a), an affected landowner or occupant whose property may be affected by list A species or by populations of list B species designated for eradication shall allow the commissioner or local weed control officials access to such property for the purpose of immediate inspection and eradication when at least one of the following events has occurred:

(a) The affected landowner or occupant has requested the inspection;

(b) A neighboring landowner or occupant has reported a suspected noxious weed infestation and requested an inspection; or

(c) An authorized agent of the local government or commissioner has made a visual observation from a public right-of-way or area and has reason to believe that a noxious weed infestation exists.

(5)(a) If verbal permission to inspect the land by the affected landowner is not obtained, no entry upon any premises, lands, or places shall be permitted until the local governing body has notified the affected landowner that such inspection is pending by certified mail if the landowner's mailing address is within the United States or mailed in a comparable manner to a landowner whose mailing address is outside of the United States. Where possible, inspections shall be scheduled and conducted with the concurrence of the affected landowner or occupant. A local governing body may notify an affected landowner in an electronic format, in addition to notice by certified mail.

(b)(I) If, after ten days with no response from the affected landowner or upon denial of access before the expiration of ten days, the inspector may seek an inspection warrant issued by a municipal, county, or district court having jurisdiction over the land. The court shall issue an inspection warrant upon presentation by the local governing body of an affidavit stating:

(A) The information that gives the inspector reasonable cause to believe that any provision of this section, section 35-5.5-104.5, or section 35-5.5-108, is being or has been violated;

(B) The affected landowner has failed to respond or the landowner or occupant has denied access to the inspector; and

(C) A general description of the location of the affected land.

(II) No affected landowner or occupant shall deny access to an authorized agent of the local governing body or the commissioner in possession of an inspection warrant.

(6) An affected landowner shall notify a lessee or occupant of affected lands of all notices of inspection and eradication efforts on such lands as soon as practicable.

(7) The local governing body of the county or municipality having jurisdiction over private and public lands on which list A species or populations of list B species designated for eradication are found shall notify the affected landowner or occupant of such lands by certified mail if the landowner's mailing address is within the United States or mailed in a comparable manner to a landowner whose mailing address is outside of the United States. The notice shall name the noxious weeds, identify eradication as the required management objective, advise the

affected landowner or occupant to commence eradication efforts within a specified period or condition, and state the integrated weed management techniques prescribed by the commissioner for eradication. Where possible, the local governing body shall consult with the affected landowner or occupant in the development of a plan for the eradication of noxious weeds on the premises or land.

(8) Within five days after the local governing body mails notification, the landowner shall comply with the terms of the notification or submit an acceptable plan and schedule for the completion of the management objective.

(9)(a) In the event the affected landowner or occupant fails to comply with the notice to eradicate the identified noxious weeds and implement an appropriate eradication program, the local governing body having authority over the public or private land shall:

(I) Provide for and complete the eradication of such noxious weeds at such time, upon such notice, and in such manner consistent with achieving the management objective as the local governing body deems appropriate; and

(II) Do one of the following:

(A) Assess the whole cost of the eradication, including up to one hundred percent of inspection, eradication, and other incidental costs in connection with eradication, upon the lot or tract of land where the noxious weeds are located; except that no local governing body shall levy a tax lien against land it administers as a part of a public right-of-way. Such assessment shall be a lien against each lot or tract of land until paid and shall have priority over all other liens except general taxes and prior special assessments. Such assessment may be certified to the county treasurer of the county in which the property is located and collected and paid over in the same manner as provided for the collection of taxes. Any funds collected pursuant to this section shall be utilized in furtherance of the local governing body's weed management efforts.

(B) In the event the state board, department, or agency fails to comply with the notice to eradicate the identified noxious weeds, the local governing body in whose jurisdiction the infestation is located may enter upon such lands and undertake the management of such noxious weeds or cause the same to be done. The expenses associated with inspection and eradication shall be paid by the state board, department, or agency that has jurisdiction over the lands. An agreement for reimbursement shall be reached within two weeks after the date such statement of expense for eradication is submitted by the local governing body. Such reimbursement agreement shall be in writing. If no reimbursement agreement has been reached or the amount reflected in the agreement is not paid upon presentation, the amount in the agreement shall be submitted to the state controller, who shall treat such amount as an encumbrance on the budget of the state board, department, or agency involved or such charge may be recovered in any court with jurisdiction over such lands. The expense associated with eradication may be recovered in any court with jurisdiction over such infested land.

(b) No local governing body shall provide for or compel the eradication of list A species and populations of list B species designated for eradication or list B noxious weeds on private or public property pursuant to this subsection (9) without first applying the same measures to any land or rights-of-way owned or administered by the local governing body that are adjacent to the property.

(10) The local governing body, through its delegates, agents, or employees, shall have the right to enter upon any premises, lands, or places during reasonable business hours for the purpose of ensuring compliance with the requirements of this section concerning noxious weed eradication.

(11) No agent, employee, or delegate of a local governing body shall have a cause of action against an affected landowner or occupant for personal injury or property damages while on private or public land for purposes of eradication of noxious weeds except when such damages were the result of gross negligence, recklessness, or intentional action by the landowner.

(12) If, in the opinion of the commissioner, any local governing body fails to adequately perform any of the duties set forth in this section, the commissioner is authorized to conduct any of the functions or duties of a local governing body pursuant to this section.

(13) The commissioner or the local governing body may require the affected landowner to pay a portion of the costs associated with eradication of the noxious weeds.

(14) An affected landowner may apply to the commissioner for a waiver of compliance with an eradication designation pursuant to section 35-5.5-108 (2.7).

(15) For the purposes of this section, an "occupant" shall not include the owner of an easement or right-of-way.

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35-5.5-108.7. State noxious weed advisory committee - repeal. (1)(a) There is hereby created the state noxious weed advisory committee, referred to in this section as the "state advisory committee". The state advisory committee shall consist of fifteen members. Such members shall be appointed by the commissioner and shall serve without per diem compensation or expenses. Of the fifteen members, at least one member shall represent private and public landowners or land managers; at least two members shall represent weed management professionals from the federal, state, or local levels; at least one member shall represent public or private weed scientists; at least two members shall represent local governing bodies; four members shall be agricultural producers, as defined in section 35-1-102; and at least three members shall represent knowledgeable resource specialists or industries, including, but not limited to, environmental organizations. Representation on the state advisory committee shall reflect the different geographic areas of the state equally, to the greatest extent possible. Members of the state advisory committee that represent the various stakeholders and regions shall solicit input from similar stakeholders within each member's area of expertise and region of the state. Members of the state advisory committee shall communicate the committee's recommendations to the region and stakeholders represented by each member.

(b) Staggered appointments shall be made so that not more than eight members' terms expire in any one year, and thereafter appointments shall be for terms of two years each. Appointees shall be limited to two full terms each. Each state advisory committee member shall hold office until the expiration of the term for which such member is appointed or until a successor has been duly appointed.

(c) In the event of a vacancy on the state advisory committee, the commissioner shall fill such vacancy promptly to allow a quorum of the state advisory committee to function.

(d) The commissioner may remove any member of the state advisory committee for misconduct, incompetence, or neglect of duty.

(e) A quorum of the state advisory committee shall elect or appoint annually a chairman and a vice-chairman.

(f) A quorum of the state advisory committee shall be a majority of the members appointed to the state advisory committee.

(g) The state advisory committee shall meet at least quarterly.

(2) The state advisory committee shall make recommendations to the commissioner concerning the:

(a) Designation of state noxious weeds;

(b) Classification of state noxious weeds;

(c) Development and implementation of state weed management plans; and

(d) Prescribed techniques for eradication, containment, and suppression of state noxious weeds.

(3) Recommendations of the state advisory committee shall be made by a majority vote of the members of the state advisory committee.

(4) The state advisory committee shall periodically assess the progress made to implement the provisions of sections 35-5.5-104.5, 35-5.5-108.5, 35-5.5-108.7, and 35-5.5-108 (2)(a); measure the results and effectiveness of endeavors to eradicate, contain, and suppress noxious weeds within this state; and recommend to the commissioner ways to enhance statewide efforts to stop the spread of noxious weeds.

(5) This section is repealed, effective July 1, 2013.

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35-5.5-109. Private lands - management of noxious weeds - charges. (1) The local governing body, through its delegates, agents, and employees, shall have the right to enter upon any premises, lands, or places, whether public or private, during reasonable business hours for the purpose of inspecting for the existence of noxious weed infestations, when at least one of the following circumstances has occurred:

(a) The landowner or occupant has requested an inspection;

(b) A neighboring landowner or occupant has reported a suspected noxious weed infestation and requested an inspection; or

(c) An authorized agent of the local government has made a visual observation from a public right-of-way or area and has reason to believe that a noxious weed infestation exists.

(2)(a) No entry upon any premises, lands, or places shall be permitted until the landowner or occupant has been notified by certified mail that such inspection is pending. Where possible, inspections shall be scheduled and conducted with the concurrence of the landowner or occupant.

(b) If after receiving notice that an inspection is pending the landowner or occupant denies access to the inspector of the local governing body, the inspector may seek an inspection warrant issued by a municipal, county, or district court having jurisdiction over the land. The court shall issue an inspection warrant upon presentation by the local governing body, through its agent or employee, of an affidavit stating: The information which gives the inspector reasonable cause to believe that any provision of this article is being or has been violated; that the occupant or landowner has denied access to the inspector; and a general description of the location of the affected land. No landowner or occupant shall deny access to such land when presented with an inspection warrant.

(3) The local governing body of the county or municipality having jurisdiction over private lands upon which noxious weeds are found shall have the authority, acting directly or indirectly through its agent or staff, to notify the landowner or occupant of such lands, advising

the landowner or occupant of the presence of noxious weeds. Said notice shall name the noxious weeds, advise the landowner or occupant to manage the noxious weeds, and specify the best available control methods of integrated management. Where possible, the local governing body shall consult with the affected landowner or occupant in the development of a plan for the management of noxious weeds on the premises or lands.

(4)(a) Within a reasonable time after receipt of notification, which at no time shall exceed ten days, the landowner or occupant shall either:

(I) Comply with the terms of the notification;

(II) Acknowledge the terms of the notification and submit an acceptable plan and schedule for the completion of the plan for compliance; or

(III) Request an arbitration panel to determine the final management plan.

(b) The arbitration panel selected by the local governing body shall be comprised of a weed management specialist or weed scientist, a landowner of similar land in the same county, and a third panel member chosen by agreement of the first two panel members. The landowner or occupant shall be entitled to challenge any one member of the panel, and the local governing body shall name a new panel member from the same category. The decision of the arbitration panel shall be final.

(5)(a) In the event the landowner or occupant fails to comply with the notice to manage the identified noxious weeds or implement the plan developed by the arbitration panel, the local governing body has the authority to:

(I) Provide for and compel the management of such noxious weeds at such time, upon such notice, and in such manner as the local governing body shall prescribe by ordinance or resolution; and

(II) Assess the whole cost thereof, including up to twenty percent for inspection and other incidental costs in connection therewith, upon the lot or tract of land where the noxious weeds are located; except that no local governing body shall levy a tax lien against land it administers as part of a public right-of-way. Such assessment shall be a lien against each lot or tract of land until paid and shall have priority over all other liens except general taxes and prior special assessments. Such assessment may be certified to the county treasurer of the county in which the property is located and collected and paid over in the same manner as provided for the collection of taxes. Any funds collected pursuant to this section shall be deposited in the local governing body's weed fund or any similar fund.

(b) No local governing body shall provide for or compel the management of noxious weeds on private property pursuant to this subsection (5) without first applying the same or greater management measures to any land or rights-of-way owned or administered by the local governing body that are adjacent to the private property.

(c) No local governing body shall assess the cost of providing for or compelling the management of noxious weeds on private property until the level of management called for in the notice or the management plan developed by the arbitration panel has been successfully achieved.

(6) The local governing body, through its delegates, agents, and employees, shall have the right to enter upon any premises, lands, or places, whether public or private, during reasonable business hours for the purpose of ensuring compliance with the requirements of this article concerning noxious weed management and any other local requirements.

(7) No agent, employee, or delegate of a local governing body shall have a civil cause of action against a landowner or occupant for personal injury or property damage incurred while on public or private land for purposes consistent with this article except when such damages were willfully or deliberately caused by the landowner.

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35-5.5-110. Public lands - control of undesirable plants - charges. (1) It is the duty of each state board, department, or agency that administers or supervises state lands to manage noxious weeds on any lands under its jurisdiction using the methods prescribed by the local governing body in whose jurisdiction such state lands are located. The local governing body may give notice to any such state board, department, or agency advising of the presence of noxious weeds and naming them. Such notice shall specify the best available methods of integrated management that are not in conflict with federal law or contractual restrictions included in federal land conveyances to the state. Wherever possible, the local governing body shall consult with the affected state board, department, or agency in the development of a plan for the management of noxious weeds on the premises or lands.

(2)(a) Within a reasonable time after receipt of notification, which at no time shall exceed ten days, the state board, department, or agency shall do one of the following:

(I) Comply with the terms of the notification;

(II) Acknowledge the terms of the notification and submit an acceptable plan and schedule for the completion of the plan for compliance;

(III) Request an arbitration panel to determine the final management plan.

(b) The arbitration panel selected by the local governing body shall be comprised of a weed management specialist or weed scientist, a landowner of similar land in the same county, and a third panel member chosen by agreement of the first two panel members. The state board, department, or agency shall be entitled to challenge any one member of the panel, and the local governing body shall name a new panel member from the same category. The decision of the arbitration panel shall be final.

(3) In the event the state board, department, or agency fails to comply with the notice to manage the identified noxious weeds or implement the plan developed by the arbitration panel, the local governing body in whose jurisdiction the infestation is located may enter upon such lands and undertake the management of such noxious weeds or cause the same to be done, the expense thereof to be a proper charge against said state board, department, or agency which has jurisdiction over the lands. An agreement for payment shall be reached within two weeks after the date such an expense is submitted, with respect to the amount of reimbursement to be paid. Such agreement shall be in writing. If no agreement has been reached and if the charge is not immediately paid, such charge shall be submitted to the controller, who shall treat such amount as an encumbrance on the budget of the state board, department, or agency involved, or such charge may be recovered in any court with jurisdiction over such lands. Any state board, department, or agency may enter into a contract with the local governing body to authorize the management of noxious weeds on state-administered land on terms and conditions satisfactory to both parties.

(4) In addition to the requirements of subsection (3) of this section, the division shall enter into agreements with local governing bodies for the control of weeds on any property the division owns in fee title or has effective surface control over pursuant to a long-term lease or easement agreement. For purposes of this subsection (4) and subsection (5) of this section,

"long-term lease or easement agreement" means any lease or easement agreement that exceeds ten years. Agreements between the division and local governing bodies for weed control shall describe the terms and conditions of weed control, provide an annual estimated budget for such weed control, and identify specific weed control responsibilities for the division and the property owner, if different than the division. Weed control agreements required pursuant to this subsection (4) shall be executed on or before July 1, 1997.

(5) Any weed control expense incurred by a local governing body pursuant to subsection (3) of this section on any lands held by the division in fee title or by long-term lease or easement agreement, as described in subsection (4) of this section, and for which a weed control agreement as described in subsection (4) of this section has been signed, and which costs are in accordance with that long-term agreement, shall be deemed correct and final and shall be paid by the division pursuant to section 33-1-110 (6.5), C.R.S.

35-5.5-111. Cooperation with federal and state agencies. The local governing bodies of all counties and municipalities in this state are hereby authorized to enter into cooperative agreements with federal and state agencies for the integrated management of noxious weeds within their respective territorial jurisdictions.

35-5.5-112. Public rights-of-way - management of noxious weeds - charges. It shall be the duty of each local governing body and each state board, department, or agency to confirm that all public roads, public highways, public rights-of-way, and any easements appurtenant thereto, under the jurisdiction of each such entity, are in compliance with this article, and any violations of this article shall be the financial responsibility of the appropriate local governing body or state board, department, or agency.

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35-5.5-113. Public nuisance - abatement. All noxious weeds, at any and all stages, their carriers, and any and all premises, plants, and things infested or exposed to infestation therewith may be declared to be a public nuisance by the local governing body having jurisdiction over the lands upon which said noxious weeds are situated. Once declared, such nuisances are subject to all laws and remedies relating to the prevention and abatement of nuisances. The local governing body, in a summary manner or otherwise, may take such action, including removal and destruction, with reference to such nuisance as in its discretion appears necessary. The remedies of this section shall be in addition to all other remedies provided by law.

35-5.5-114.1. Survey of compliance on federal land. On or before January 1, 1998, the state weed coordinator shall survey those counties that include significant amounts of federal land to determine the level of cooperation and compliance by the federal government with this article.

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35-5.5-115. Rules. The commissioner shall promulgate rules as necessary to carry out the purposes of this article, which rules shall include a designation of state noxious weeds.

35-5.5-116. Noxious weed management fund - creation - allocation of funds. (1) There is hereby created in the office of the state treasurer the noxious weed management fund. The fund shall consist of any civil penalties collected pursuant to section 35-5.5-118; any gifts, donations, and grants received pursuant to section 35-1-104 (1)(cc); and any moneys approved by the

general assembly for the purpose of funding noxious weed management projects. All interest derived from the deposit and investment of moneys in the fund shall be credited to the fund. The general assembly shall annually appropriate moneys in the fund to the department of agriculture for the purposes specified in subsection (2) of this section.

(2) The interest earned on moneys in the noxious weed management fund and appropriated to the department of agriculture shall be expended for costs incurred by the department of agriculture in administering this article, and any moneys appropriated that exceed the amount needed for such costs may be expended for noxious weed management projects in accordance with this section.

(3) The department may expend moneys through grants or contracts to communities, weed control districts, or other entities it considers appropriate for noxious weed management projects.

(4) The department may expend moneys for the following purposes:

(a) Noxious weed management programs with local weed control districts, if expenses are shared with such districts;

(b) With the approval of the agricultural commission, the department may make special grants to local weed control districts to eradicate or contain state noxious weeds, which grants may be issued without matching funds from the district;

(c) Administrative expenses incurred by the department;

(d) Any project the agricultural commission determines will significantly contribute to the management of noxious weeds within the state;

(e) With the approval of the agricultural commission, grants to the Colorado state university cooperative extension service, the Colorado state university experiment station, and universities for weed management research, evaluation, and education;

(f) Employment of a new and innovative noxious weed management project or the development, implementation, or demonstration of any noxious weed management project that may be proposed, implemented, or established by local, state, or national organizations, whether public or private. Such expenditures shall be shared with such organizations.

(5) If a new and potentially harmful noxious weed is discovered growing in the state and its presence is verified by the department, the governor may declare a noxious weed emergency. In the absence of necessary funding from other sources, the department is authorized to allocate up to fifty thousand dollars of the principal in the noxious weed management fund to government agencies for emergency relief to manage or confine the new noxious weed species.

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35-5.5-117. The state weed coordinator. (1) There shall be designated within the division of plant industry in the department of agriculture a state weed coordinator, who shall be under contract with or appointed by the commissioner.

(2) The state weed coordinator shall:

(a) Develop a recommended management plan for the integrated management of designated noxious weeds within state-owned lands;

(b) Facilitate cooperation between federal, state, and local land managers in the formation of a memorandum of understanding;

(c) Provide guidance and coordination for local governmental weed managers.

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35-5.5-118. Civil penalties. (1)(a) Any person who violates this article or any rule adopted pursuant to this article is subject to a civil penalty, as determined by the commissioner. The penalty shall not exceed one thousand dollars per violation; except that such penalty may be doubled if it is determined that the person has violated the provision or rule more than once. No civil penalty shall be imposed unless and until the person charged is given notice and opportunity for a hearing pursuant to article 4 of title 24, C.R.S.

(b) In addition to any civil penalties assessed pursuant to paragraph (a) of this subsection (1), any person who violates the provisions of section 35-5.5-104.5, 35-5.5-108, or 35-5.5-108.5, or any rule adopted to implement these sections, shall, upon an order of the commissioner, pay the cost of inspection and eradication of list A or list B noxious weed species, including, but not limited to, any immediate remediation costs, the estimated cost of future eradication, any administrative costs, and any court cost and attorney fees incurred by the commissioner in enforcing section 35-5.5-104.5, 35-5.5-108, or 35-5.5-108.5, or any rule adopted to implement these sections. The commissioner may not enforce such order unless and until the person charged is given notice and opportunity for a hearing pursuant to article 4 of title 24, C.R.S. All moneys due and owing pursuant to this paragraph (b) shall be payable to the department for the payment and reimbursement of enforcement and costs associated with such enforcement and are hereby continuously appropriated to the department for such purpose.

(2) If the commissioner is unable to collect a civil penalty, payment of costs imposed pursuant to subsection (1) of this section, or if the person fails to pay all or a specified portion of such penalty or payment, the department may bring suit in any court of competent jurisdiction to recover such amount plus costs and attorney fees.

(3) Before imposing any civil penalty or payment of costs, the commissioner may consider the effect of such penalty or payment of costs on the ability of the person charged to stay in business.

(4) All civil penalties and payment of costs collected pursuant to this section shall be deposited in the noxious weed management fund created in section 35-5.5-116.

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35-5.5-119. County funding. The board of county commissioners is authorized to levy a special tax, subject to the approval of the voters, upon every dollar of valuation of assessment of taxable property within the county for the purpose of creating a county fund to control noxious weeds; except that the amount raised from such levy in any one year shall not exceed the amount raised by five mills.

Effective August 6, 2003

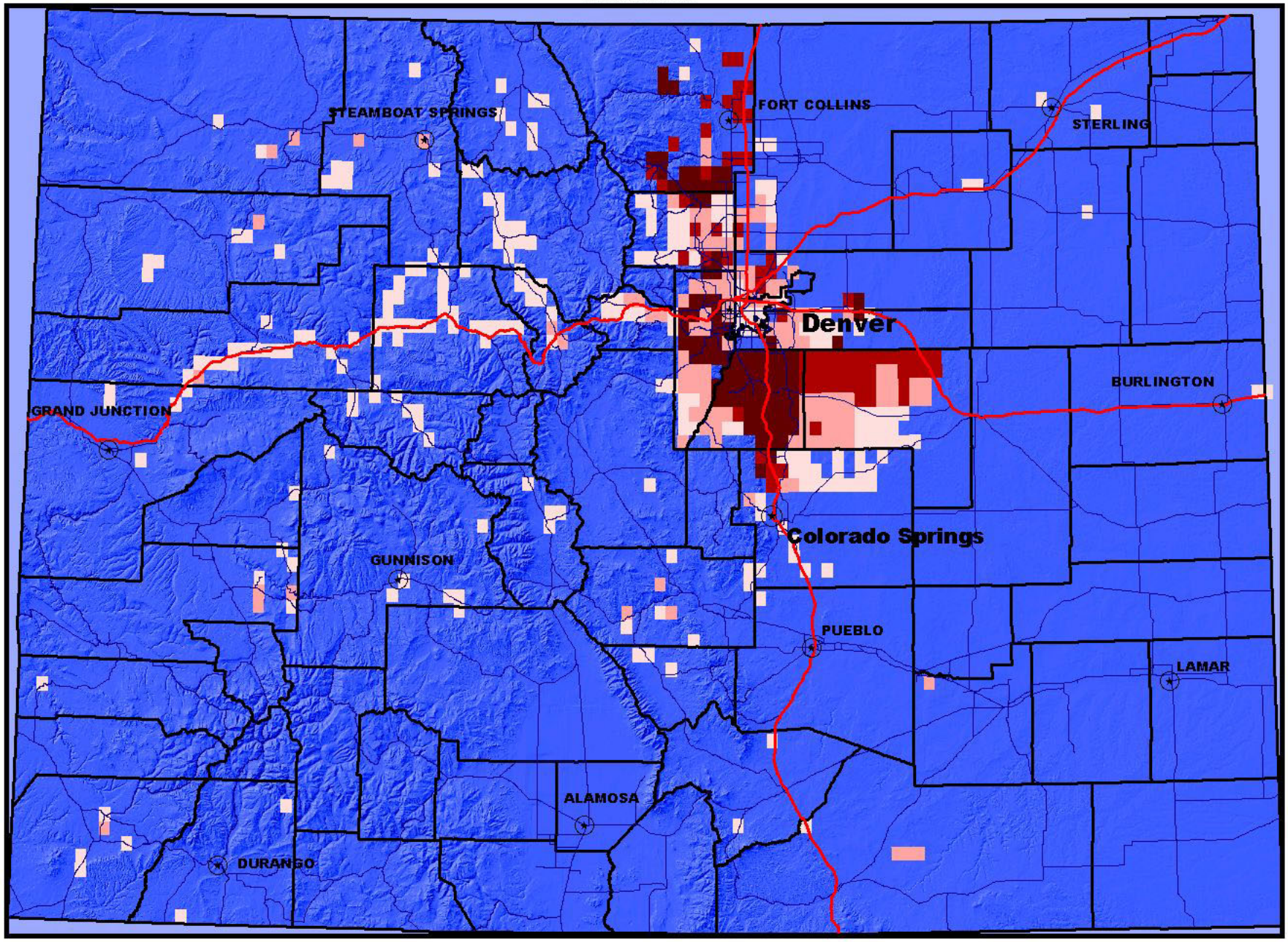
Appendix B
2002 Quarterquad Survey
Distribution and Abundance Data in Colorado

Following are available maps that depict the statewide distribution and abundance for species that have been mapped on the Open Space. Data are requested from the County Weed Supervisors on an annual basis and infested acreage estimates are per 9,000 acre QuarterQuad. A QuarterQuad is one quarter of a standard 1:24,000 U.S.G.S. 7.5min topographic quadrangle. Each block of color represents an infested 9,000 acre area: lighter red blocks indicate the presence of relatively few infested acres while darker red colors indicate the presence of a greater number of infested acres within the QuarterQuad.

Diffuse knapweed

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

145,148+ infested acres



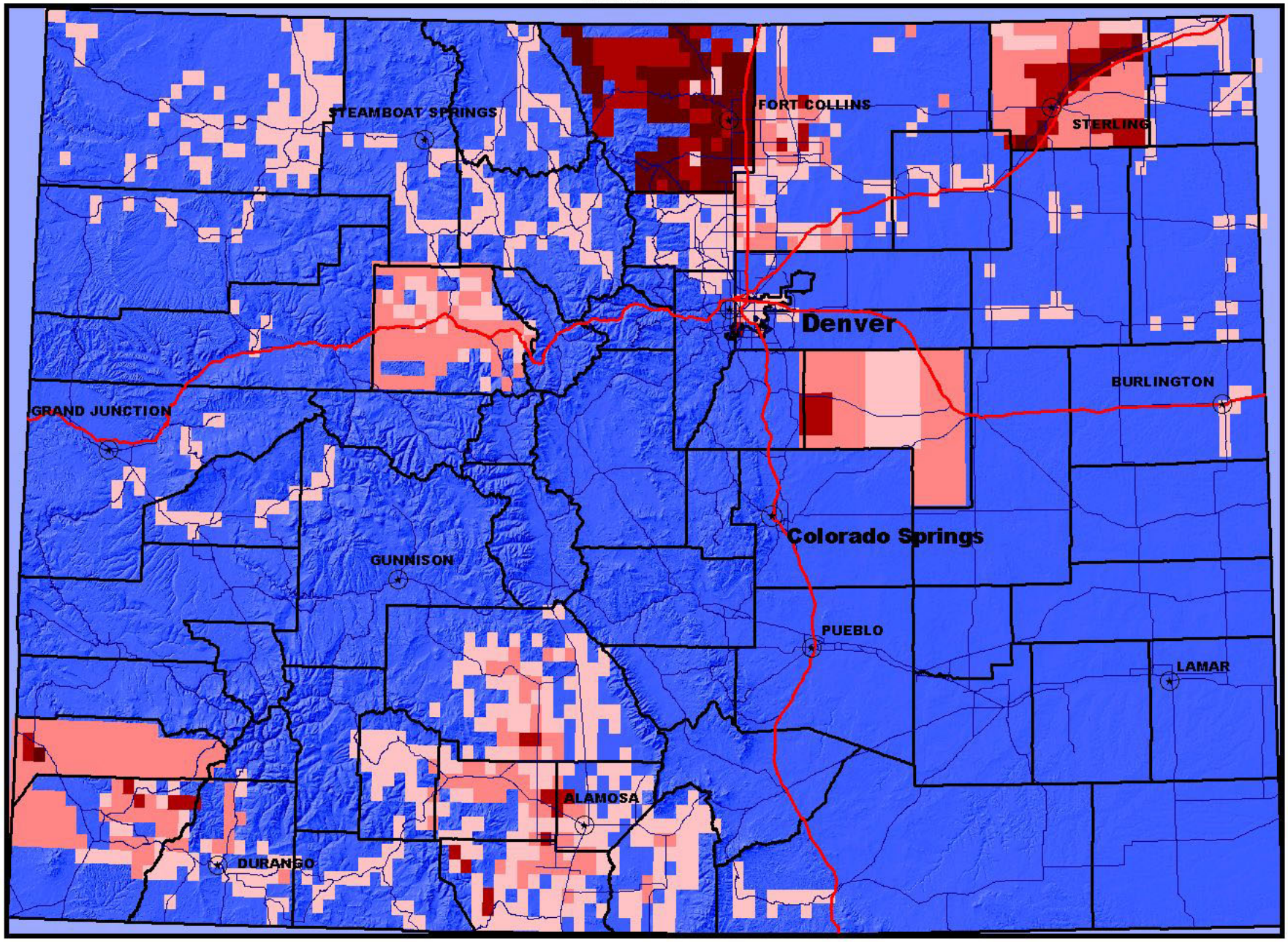
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Canada thistle

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

100,695+ infested acres
(tally of reported only)



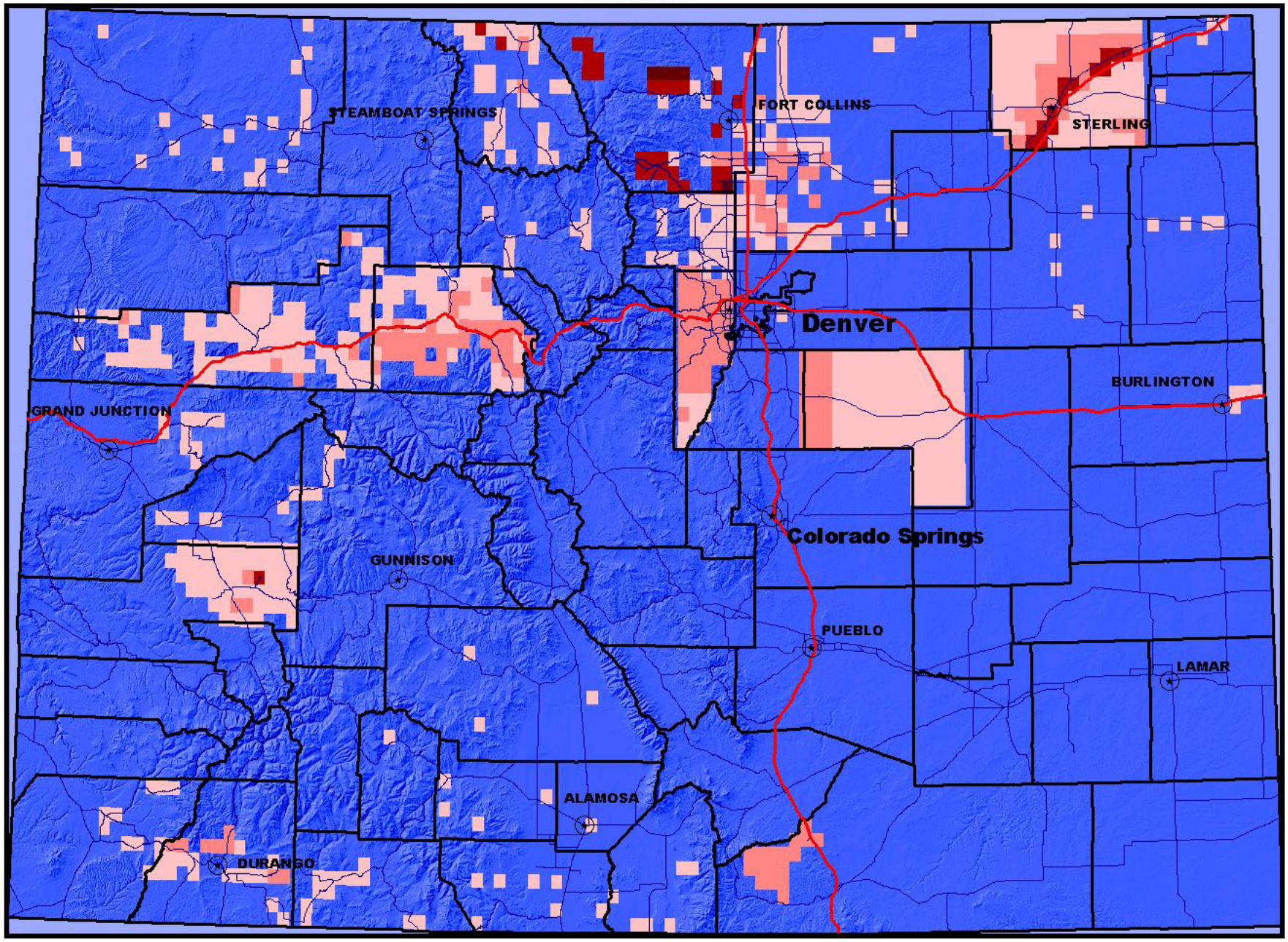
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Musk thistle

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

15,760+ infested acres
(tally of reported only)



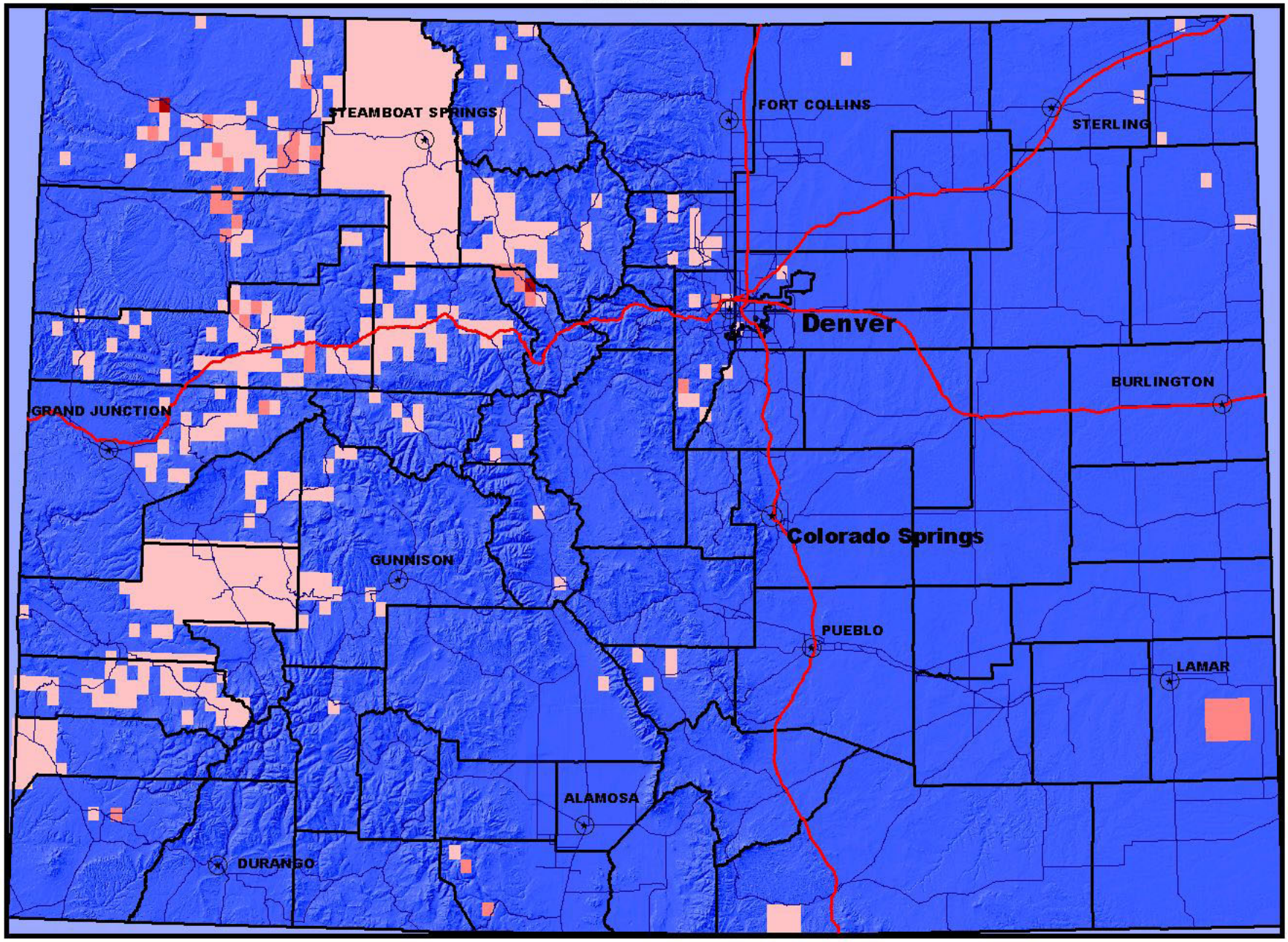
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Bull thistle

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

1,757+ infested acres



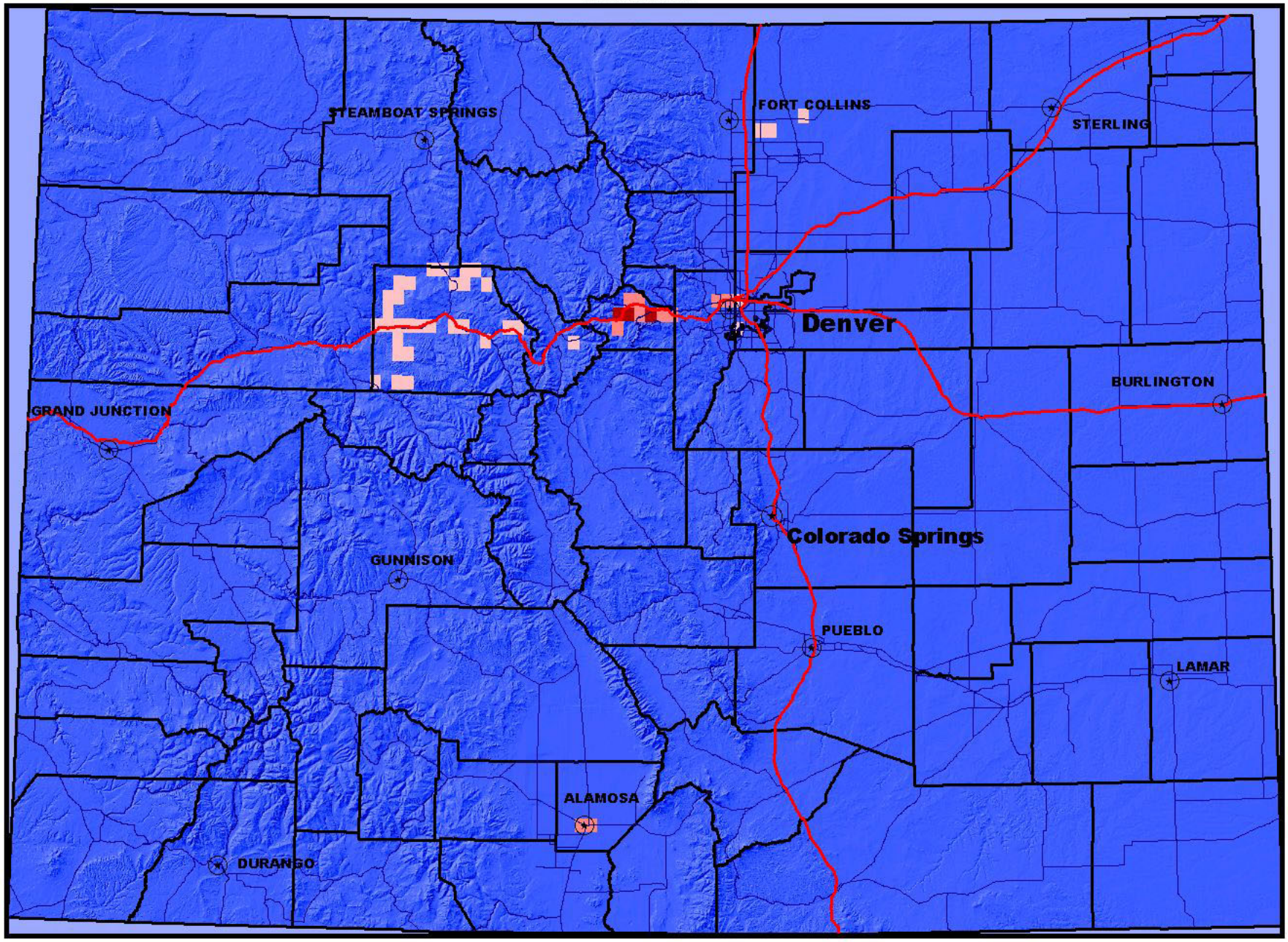
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Chinese clematis

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

749+ infested acres



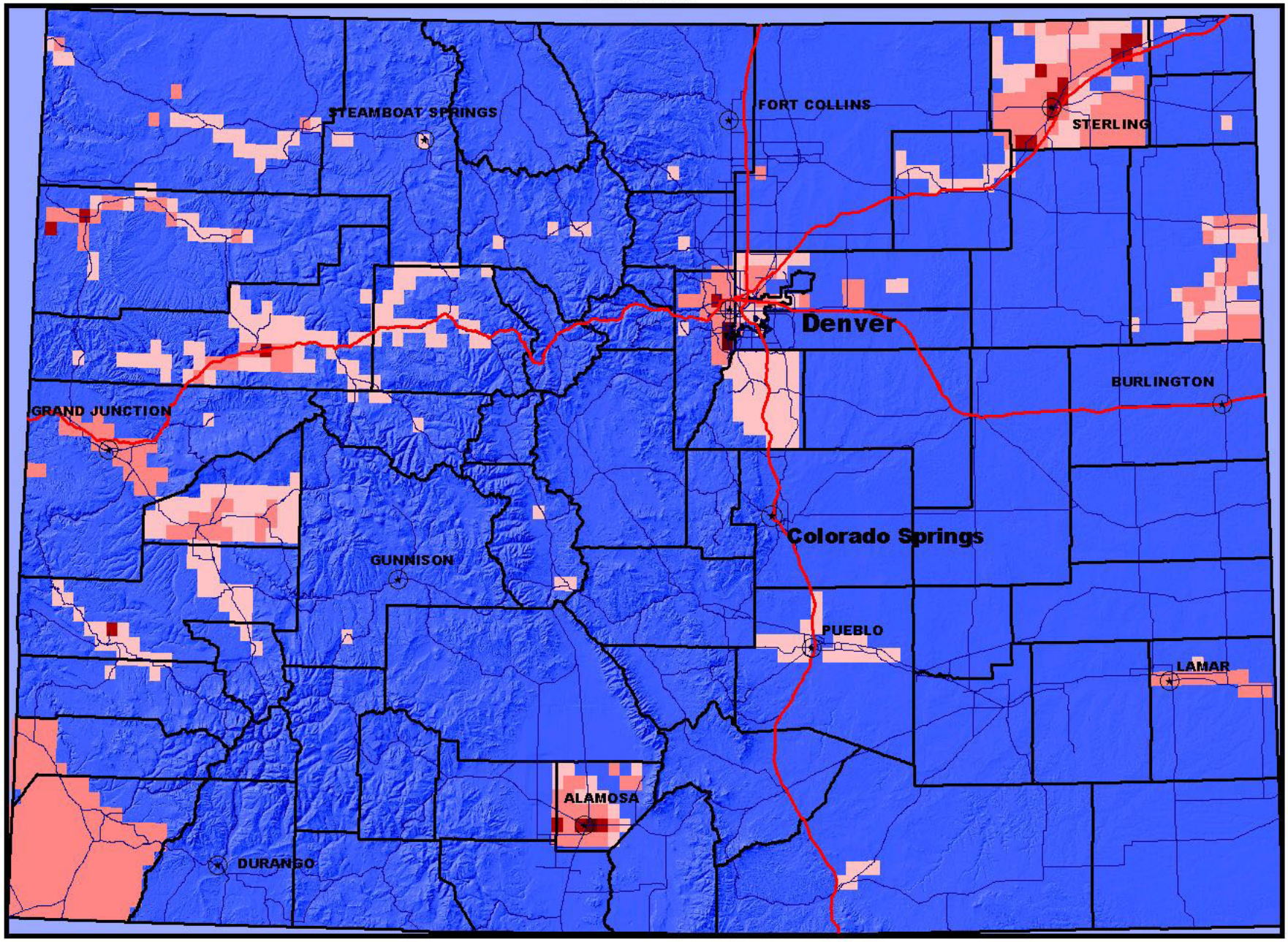
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Russian-olive

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

10,028+ infested acres



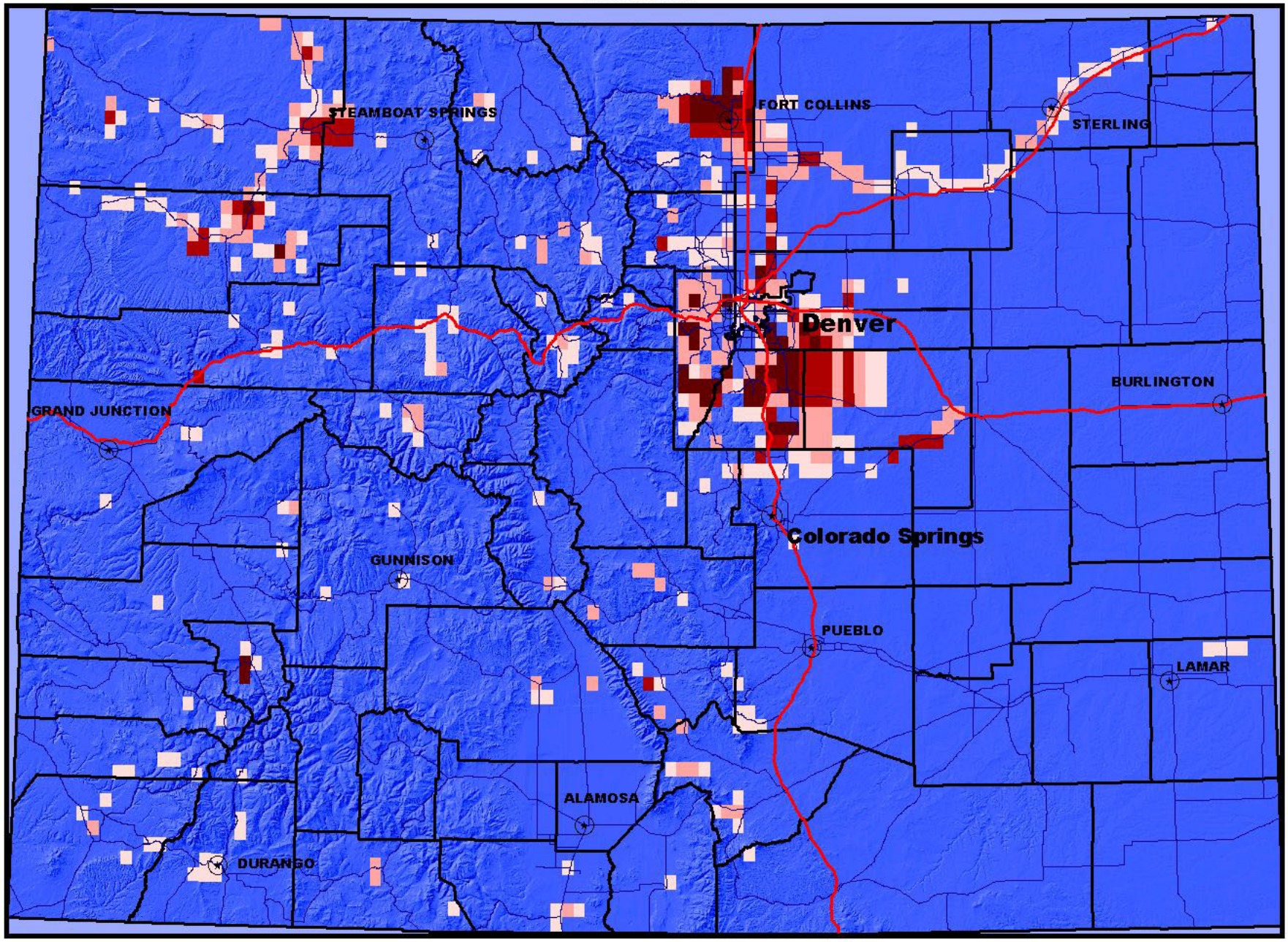
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Leafy spurge

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

73,827+ infested acres



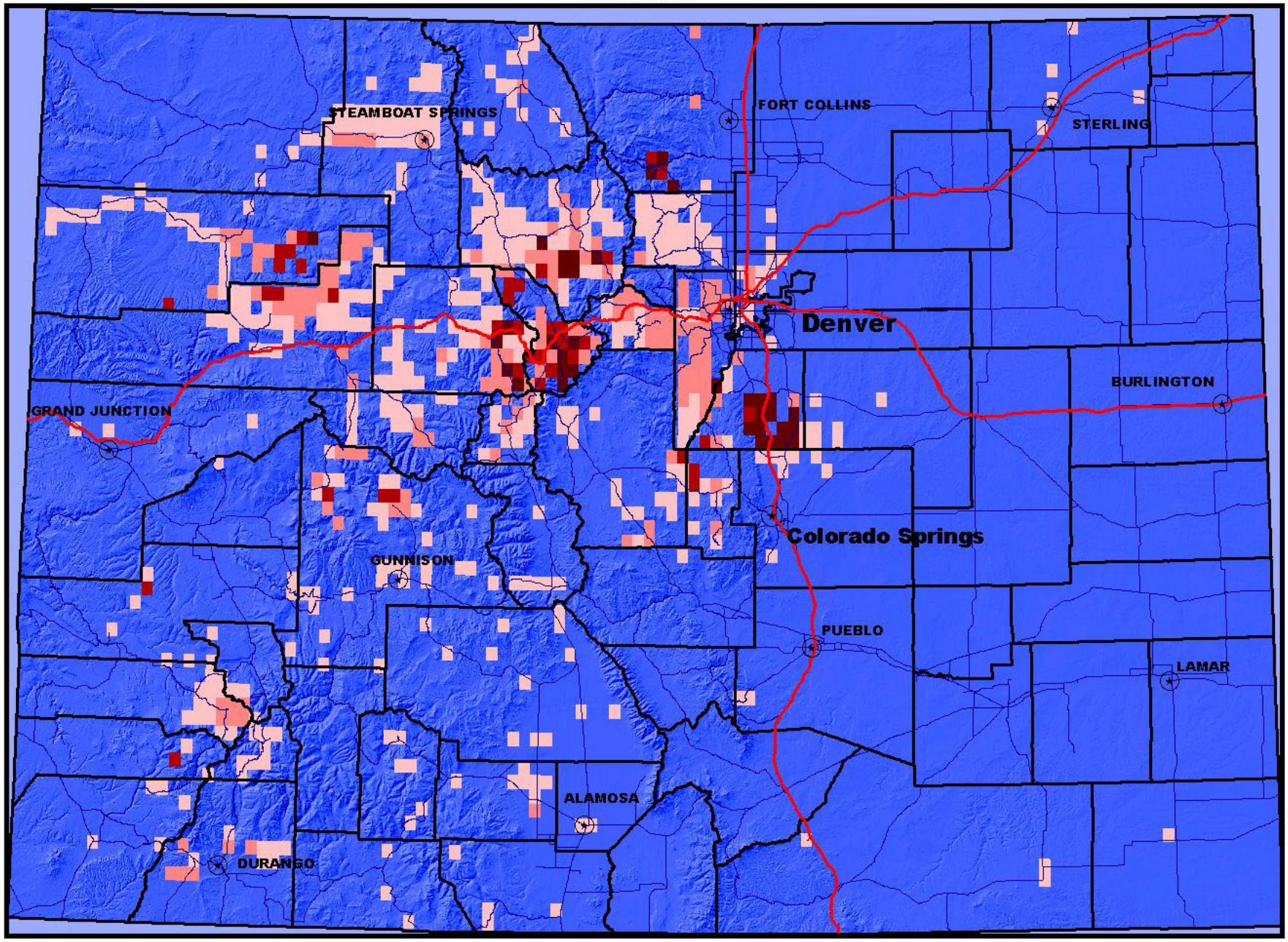
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Yellow toadflax

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

40,703+ infested acres



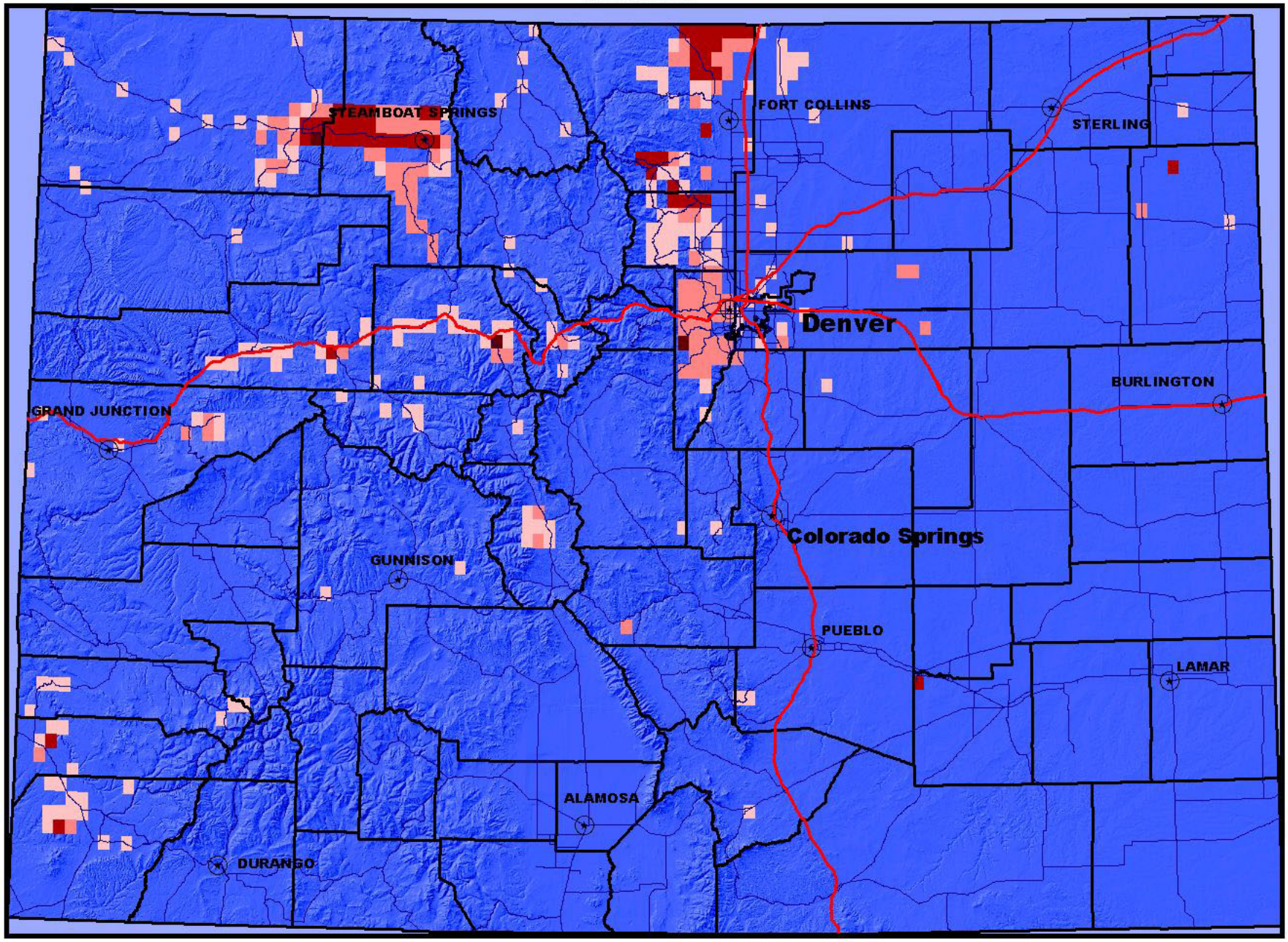
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Dalmatian toadflax

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

11,365+ infested acres



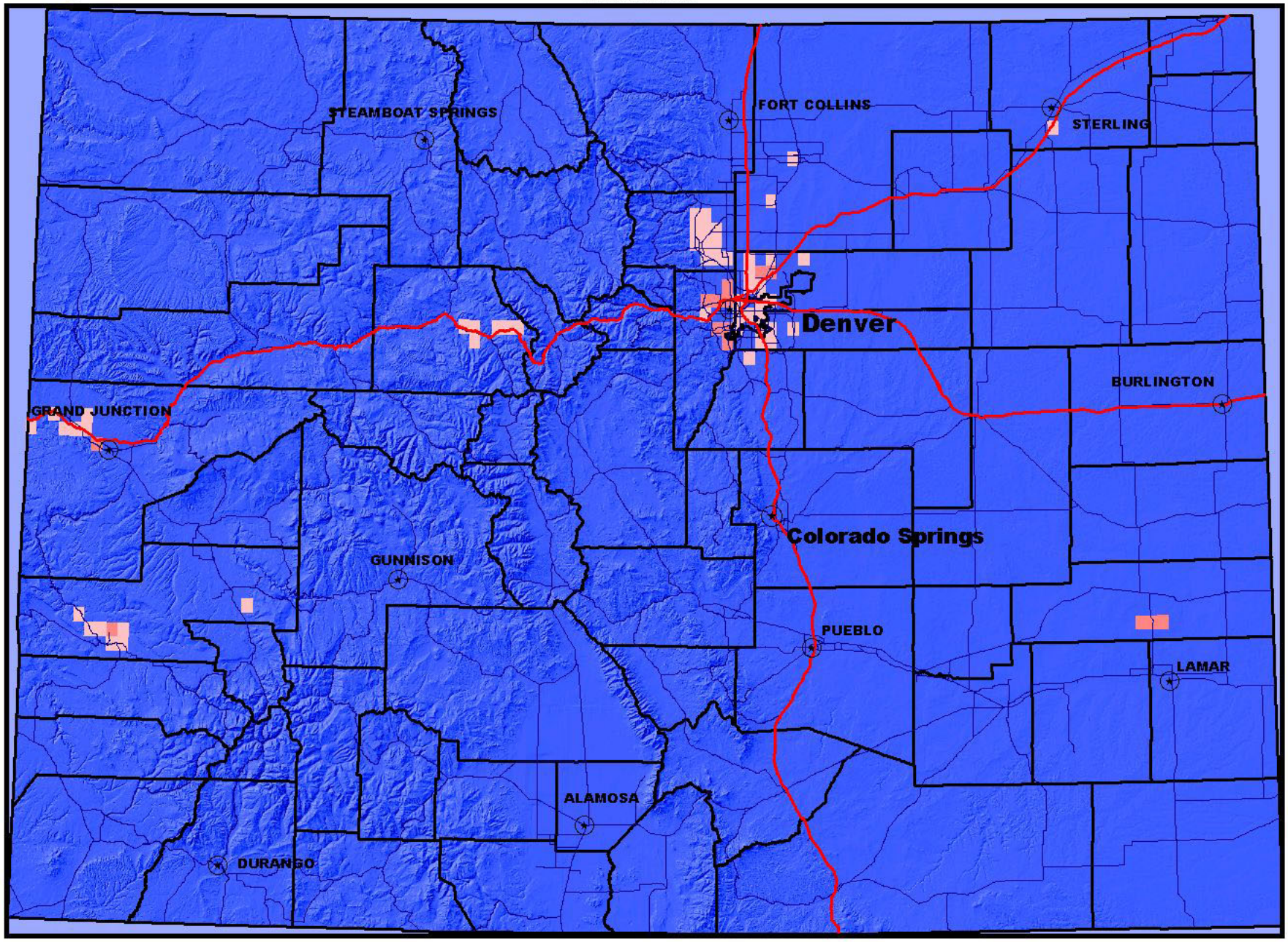
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Purple loosestrife

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

363+ infested acres



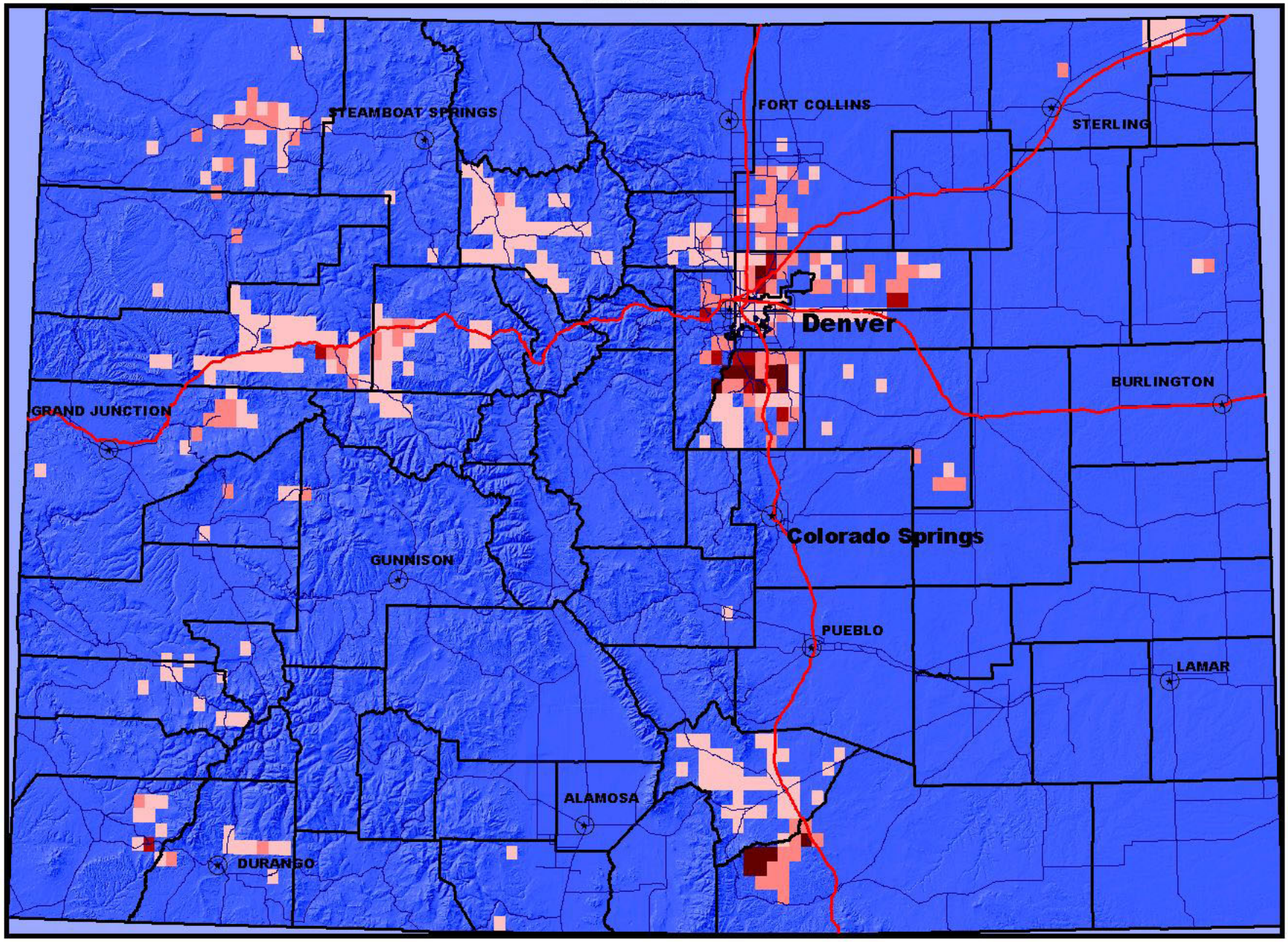
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Scotch thistle

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

19,802+ infested acres



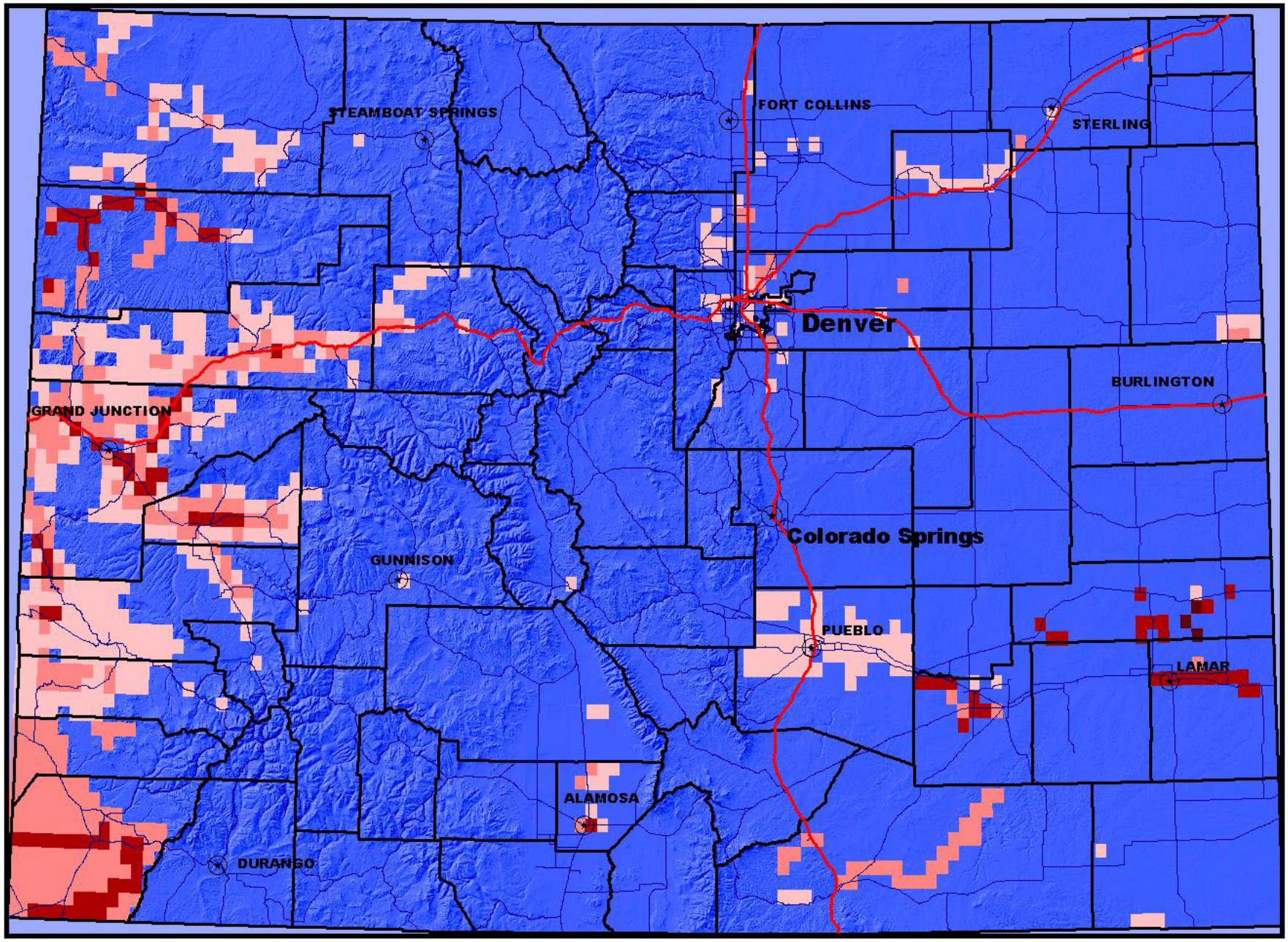
Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Saltcedar

2002 Quarterquad Survey
Distribution and Abundance
in Colorado

28,249+ infested acres



Distribution Legend: 0 acres/9000 acre quarterquad | 1 - 5 acres | 6 - 50 acres | 51- 300 acres | 301 - 5000 acres

Acreage estimates supplied by County Weed Supervisors and compiled by Colorado Department of Agriculture and Colorado State University

Appendix C
Material Safety Data Sheets

Appendix C contains Material Safety Data Sheets for herbicides used on the City of Wheat Ridge Open Space. Current Material Safety Data Sheets are on file with the Parks and Recreation Department.

Appendix D
Species Profiles

Appendix D contains available profiles for species that have been mapped on the Open Space. Species profiles are reproduced from:

CNAP (Colorado Natural Areas Program). 2000. Creating an Integrated Weed Management Plan: A Handbook for Owners and Mangers of Lands with Natural Values. Caring for the Land Series Volume IV. Denver, Colorado.

Diffuse knapweed

Centaurea diffusa Lam.; ***Acosta diffusa*** (Lam.) Sojak

Family: *Asteraceae* (Sunflower)
Other Names: spreading knapweed, tumble knapweed
USDA Code: CEDI3
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:

- The floral bracts have yellow spines with teeth appearing as a comb along the spine margins.
- Flowers are usually white, but may be rose-purple to lavender in appearance.
- Seedlings have finely divided leaves that are covered with short hairs.

Identification

Growth form: Biennial or short-lived perennial forb.
Flower: Flower heads are broadly urn-shaped, 0.6-0.8 inches tall, solitary or in clusters of 2-3 at the ends of the branches. Floral bracts are yellowish with a brownish margin, sometimes spotted, fringed on the sides, and terminating in a slender bristle or spine. The heads contain two types of flowers, ray flowers around the edges surrounding tubular disk flowers. The ray flowers are white, rose-purple, or lavender.
Seeds/Fruit: Seeds are light brown to black.
Leaves: Basal leaves are stalked and divided into narrow, hairy segments. Stem leaves are smaller, alternate, less divided, stalkless, and become bract-like near the flower clusters.
Stems: Stems are upright, 4-24 inches tall, highly branched, angled, with short, stiff hairs on the angles.
Roots: Taproot.
Seedling: Seedlings have finely divided leaves that are covered with short hairs.

Similar Species

Exotics: Diffuse knapweed may be distinguished from other knapweeds by the terminal spine on the floral bract.
Natives: None.

Impacts

Agricultural: Diffuse knapweed reduces the productivity of rangeland by displacing desirable forage species.
Ecological: Diffuse knapweed is a pioneer species that can quickly invade disturbed and undisturbed grassland, shrubland, and riparian communities. Once established, diffuse knapweed outcompetes and reduces the quantity of desirable native species such as perennial grasses. Diffuse knapweed has been reported to contain allelopathic chemicals, which can suppress competitive plant growth and create single species stands (Watson and Renney 1974). The densities of these stands can range from 1-500 plants/m^2. The replacement of native grassland with diffuse knapweed can reduce biological diversity and increase soil erosion (Sheley et al. 1997).
Human: No information available.

Habitat and Distribution

General requirements: Diffuse knapweed is found on plains, rangelands, and forested benchlands. It is generally found on light, dry, porous soils. Diffuse knapweed has been observed at elevations up to 8,500 feet (K.G. Beck, pers. comm.). It grows in open habitats as well as shaded areas (Watson and Renney 1974). Diffuse knapweed is not common on cultivated lands or irrigated pasture because it cannot tolerate cultivation or excessive moisture (Watson and Renney 1974).
Distribution: Diffuse knapweed is now common in the Front Range counties, and has been reported in scattered infestations from both the east and west slope of Colorado.

Historical: Native to Eurasia.

Biology/Ecology

Life cycle: Diffuse knapweed plants first form low rosettes and may remain in this form for one to several years depending on environmental conditions. Diffuse knapweed is a semelparous perennial; it grows as a rosette unitl it reaches a critical size, then bolts, flowers and usually dies (Thompson and Stout 1991). Flower buds are formed in early June and flowering occurs in July and August (Watson and Renney 1974). Mature seeds are formed by mid-August (Watson and Renney 1974).

Mode of reproduction: Reproduces by seeds.

Seed production: A single diffuse knapweed plant can produce up to 18,000 seeds (Harris and Cranston 1979) and a stand of diffuse knapweed can produce up to 40,000 seeds per square meter (Watson and Renney 1974). Along the Colorado Front Range, seed production of 500-1500 seeds pre plant is more typical (Beck et al. 1998).

Seed bank: Seeds may remain dormant for several years.

Dispersal: Seed dispersal for diffuse knapweed is mainly by wind (Watson and Renney 1974). When the seed capsule sways in the breeze or is disturbed, the seeds fall from the small opening in top of the flower head and are distributed around the parent plant (Watson and Renney 1974). However, most of the involucres remain closed until the plant dries up, breaks off at ground level and effectively becomes a tumbleweed, allowing seeds to be dispersed over long distances (Zimmerman 1997). Diffuse knapweed stalks readily lodge under vehicles, expanding their long distance dispersal.

Hybridization: No information available.

Control

Keys to Control:

- Eliminate seed production.
- Stress the plants nutrient reserves as well as the soil seed bank through persistent management.
- Re-seed infested area with desirable species and manage them to produce a vigorous stand of plants.

Biocontrol: Currently, biological control agents are available but the extent to which they effectively control diffuse knapweed populations is unclear. The Division of Plant Industry's Biological Pest Control Section has five species that may be available for redistribution. These five species are *Urophora affinis*, *Urophora quadrifasciata*, *Agapeta zoegana*, *Sphenoptera jugoslavica*, *Cyphocleonus achates*. The seedhead weevil *Larinus minutus* may also become available for distribution.

Mechanical: Cutting or mowing the above-ground portion of the plant, before seed set may be an effective way to reduce seed production, but it will not eliminate the infestation. Mowing usually increases diffuse knapweed density, due to increased germination from the soil seed bank. Mowings should therefore be followed by a fall herbicide treatment (Sebastian and Beck 1999). When a diffuse knapweed plant has been cut, the rosette may live and re-bolt. Additionally, diffuse knapweed seeds can remain dormant for several years, requiring any cutting program to be repeated several times annually (spring, summer, and fall) to be effective. Mowing or fire can be used as a way to remove standing dead material such that subsequently applied herbicide will be more effective (Roché and Roché 1999.)

Pulling can be effective for knapweed control, but it must be repeated frequently. Youtie and Soll (1994) suggested hand-pulling knapweeds three times annually until the plant disappears. The first pulling is in spring when the soil is moist, allowing enough of the plant to be pulled to kill it. The second pulling in June focuses on bolted plants, with the third pulling just before seed dispersal to kill any remaining plants.

Fire: In areas without abundant native perennials, burning has been shown to be an effective control of diffuse knapweed with strong grass regrowth occurring on burned sites (Zimmerman 1997). A low-severity fire may only top-kill (not kill the root) diffuse knapweed, but a severe fire will probably kill the entire plant. Dry soil conditions associated with burns may discourage diffuse knapweed re-infestation as moisture is the limiting factor for diffuse knapweed seed germination. Re-seeding desirable species after burning helps to prevent a re-infestation of diffuse knapweed or other exotic species.

Herbicides: Several herbicides are relatively effective at controlling diffuse knapweed. Picloram is the most widely recommended (Harris and Cranston 1979). Other effective herbicides include clopyralid, dicamba, 2,4-D, and glyphosate (Beck 1997, Youtie 1997, Watson and Renney 1974). To save money and reduce grass injury resulting from higher use rates of a single herbicide, several of these herbicides can be combined (Beck 1997). Tank-mixes of picloram and dicamba (0.25 to 0.5 lb./acre + 0.125 to 0.25 lb./acre), picloram plus 2,4-D (0.188 lb./acre + 1.0 lb./acre), clopyralid (0.25 lb./acre), clopyralid+2,4-D (0.2+1.0 lb./acre) and dicamba plus 2,4-D (0.5 lb./acre + 1.0 lb./acre) all control diffuse knapweed (Beck 1997). A backpack sprayer or a wick is recommended in

small areas to minimize damage to non-target plants. Herbicides should either be applied before the mature plants set seed, or to rosettes in the fall, to maximize effectiveness.
Cultural/Preventive: Prevent establishment of new infestations, and manage grazing or other land use to maintain vigorous native communities.

Integrated Management Summary

Integrated treatment of diffuse knapweed depends on each situation. Single treatments provide temporary but not long-lasting control. In grasslands where the forb component is minimal or expandable, suggested strategies include altering grazing management to promote vigorous grasses, spraying with picloram, re-seeding with competitive grass species, followed by spot treatment with picloram or hand-pulling. According to Roché and Roché (1997), the best case scenario is establishing competitive forage species that can, with the help of biological control agents and proper livestock management, maintain knapweed at low levels. The most effective method of control for diffuse knapweed is to prevent its establishment. Areas that are adjacent to known patches of diffuse knapweed should be monitored two to three times a year (spring, summer, and fall) and any new rosettes should be destroyed. Established plants or stands of diffuse knapweed can be pulled or spot treated with picloram. Burning may be an effective means of controlling diffuse knapweed in areas where seasonal or occasional fires are part of the natural ecosystem (Zimmerman 1997). Seeding desirable perennial grasses is essential to prevent weed reinvasion (Beck 1997).

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Canada thistle

Cirsium arvense (L.) Scop.; ***Breea arvensis*** (L.) Lessing

Family: ***Asteraceae*** (Sunflower)
Other Names: field thistle, Californian thistle
USDA Code: CIAR4
Legal Status: Colorado Noxious List B (top ten worst).

Keys to Identification:
- Purple flowers form in clusters of 1-5 per branch.
- The floral bracts of Canada thistle are spineless.
- Small heads, vanilla scent

Identification
Growth form: Perennial forb.
Flower: Flower heads are white to purple and borne in clusters of 1-5 per branch, with a strong vanilla scent. Heads are only about 1cm in diameter.
Seeds/Fruit: One-seeded fruits (achenes) are straw or light brown in color, straight or slightly curved (Moore 1975).
Leaves: Leaves are spiny, alternate, oblong or lance-shaped, with the base leaves stalkless and clasping, or extended down along the stem.
Stems: Mature plants range from 2-4 feet in height.
Roots: Canada thistle has two types of roots, horizontal and vertical. The horizontal roots produce numerous shoots, while vertical roots store water and nutrients in their many small branches.
Seedling: Early spring growth appears as rosettes with spiny-tipped, wavy leaves.
Other: The floral bracts of Canada thistle are spineless.

Similar Species
Exotics: Bull thistle (*Cirsium vulgare*); flower bracts are somewhat tapered and covered with spines. Scotch thistle (*Onopordum acanthium*); stems appear the have wings, floral bracts are covered with spines. Plumeless thistle (*Carduus acanthoides*); floral bracts are covered with sharp spines. Musk thistle (*Carduus nutans*); floral bracts are broad with spiny tips. Russian knapweed and Canada thistle are often confused.
Natives: Wavyleaf thistle (*Cirsium undulatum*): flower bracts often have a prominent white glandular dorsal ridge (often sticky to touch) and minutely hairy margins (Whitson et al. 1996). Leafy thistle (*Cirsium foliosum*): the leaves surrounding the terminal flowers are pink to white. Yellowspine thistle (*Cirsium ochrocentrum*): flower bracts are covered with cobweb-like hairs and have a spreading yellow spine at the tip. The tall biotype of Colorado thistle *(Cirsium coloradense)* and *Cirsium traceyi* are also similar. Most native thistles are more hairy and lighter green/blue in color. Canada thistle is comparatively darker green.

Impacts
Agricultural: Canada thistle is an aggressive, creeping, perennial weed. It infests crops, pastures, rangelands, roadsides, and riparian areas (Beck 1996).
Ecological: Canada thistle spreads rapidly through horizontal roots, which give rise to shoots (Moore 1975). Its root system can be extensive, growing horizontally as much as 18 feet in one season (Nuzzo 1998). Most Canada thistle patches spread at a rate of 3-6 feet/year, crowding out more desirable species and creating thistle monocultures.
Human: Spiny thickets of Canada thistle can restrict recreational access to infested areas.

Habitat and Distribution

General requirements: Canada thistle thrives in the Northern Temperature Zone due to its day length response and a high temperature limitation on growth (Haderlie et al. 1991). Although Canada thistle mainly invades disturbed areas, it does invade native plant communities, open meadows (including wetlands), and ponderosa pine savanna (Rutledge and McLendon 1998). Canada thistle is adapted to a wide range of soil types and environmental conditions (FEIS 1996). It is best adapted to rich, heavy loam, clay loam, and sandy loam, with an optimum soil depth of 20 inches (FEIS 1996, Rutledge and McLendon 1998). Canada thistle can tolerate saline soils (up to 2% salt) and wet or dry soil (Rutledge and McLendon 1998). However, it does not tolerate waterlogged or poorly aerated soils. Canada thistle usually occurs in 17-35 inch annual precipitation zones or where supplemental soil moisture is available (Beck 1996). Canada thistle is also somewhat shade intolerant. It can grow along the edge of forested areas, but is rarely found within forests.

Distribution: Canada thistle is common found along roadsides, fields, pastures, meadows, and other disturbed areas statewide in Colorado (FEIS 1996, Rutledge and McLendon 1998). In Colorado, Canada thistle is typically found from 4,000-9,500 feet. Canada thistle is found throughout the northern half of the United States and lower portions of Canada.

Historical: Canada thistle is a native of southeastern Eurasia. It was introduced to Canada as a contaminant of crop seed as early as the late 18th century. Since its introduction, it has spread throughout North America (Whitson et al. 1996).

Biology/Ecology

Life cycle: Over-wintering roots develop new underground roots and shoots in January and begin to elongate in February (Nuzzo 1998). Shoots emerge between March and May, when mean weekly temperatures reach 5° C, and form rosettes (Nuzzo 1998). Early in the spring, plants remain near the soil surface until long days (over 14 hours of light) trigger flowering and stem elongation (Haderlie et al. 1991, FEIS 1996). Canada thistle is dioecious (male and female flowers are produced on separate plants). Female flowers can be readily distinguished from male flowers by the absence of pollen (abundant in male flowers) and presence of a distinct vanilla-like fragrance. Flowering occurs from June to October in Colorado (Rutledge and McLendon 1998). Seeds mature July to October.

Mode of reproduction: Canada thistle reproduces primarily vegetatively through creeping horizontal roots, and can quickly form dense stands. Every piece of the root system is capable of forming a new plant (Rutledge and McLendon 1998). This allows dense monocultures of Canada thistle to form even without seed production. Canada thistle growth is limited or stopped when temperatures exceed 30° C for extended periods of time.

Seed production: A female Canada thistle plant can produce up to 5,200 seeds in a season, but the average is about 1,500 seeds/plant (Rutledge and McLendon 1998).

Seed bank: Mature seeds germinate most readily in mid-spring. Seeds that do not germinate may remain dormant for several years but most studies indicate that the majority of seeds do not remain viable after three years of burial (Rutledge and McLendon 1998).

Dispersal: Seeds are distributed by wind.

Hybridization: No information available.

Control

Keys to Control:

- Eliminate seed production.
- Reduce the plant's nutrient reserves through persistent management.

Biocontrol: Currently, there is no single biological control agent that effectively controls Canada thistle. However, there are several agents that have been reported to provide very limited control. One species, *Urophora cardui* (a gall fly), may be available for redistribution from the Division of Plant Industry's Biological Pest Control Section.

Mechanical: Mowing pastures and hay meadows can be an effective control if it is repeated at about one-month intervals throughout the growing season. Combining mowing with herbicides will further enhance control of Canada thistle. However, a recent study (Beck and Sebastian 2000) found that mowing or mowing+herbicide was only effective where the root system of Canada thistle is restricted by a high water table, such as near rivers or sub-irrigated meadows.

Fire: Prescribed burning in the spring has been proposed as a means of slowing the spread of Canada thistle. Such fires could reduce the number of mature plants, decrease seed production, and stimulate the growth of native grasses (FEIS 1996).

Herbicides: Chemical control of Canada thistle should be conducted in the spring or fall depending on local environmental conditions. In general, fall treatments are more effective as herbicide absorption is enhanced in the

late summer and fall when shoot to root translocation is the greatest. However, translocation of the herbicide is dependent on moist soil conditions. If fall is a dry period in your area, a spring application around the flower bud stage (early June), when root carbohydrate reserves are at their lowest, is recommended.

Clopyralid + 2,4-D (commonly sold as Curtail®) applied at a rate of 2-3 quarts/acre will effectively control Canada thistle. Curtail should either be applied in the late spring (when Canada thistle plants are entering the bud growth stage) or in the fall (October) when Canada thistle roots are actively growing. The performance of Curtail can be improved when proceeded by two or three mowings under conditions when the root systems are restricted (Beck 1996, Beck and Sebastian 2000). Begin mowing when Canada thistle is 12-15 inches tall and repeat at about one month intervals (Beck 1996). Apply Curtail in October or about one month after the last mowing. Clopyralid alone can be applied at a rate of 2/3 to 1 pint/acre in the spring or fall. Spring applications should be timed to the rosette to bud growth stages. 2,4-D or picloram are effective when applied at a rate of 1 lb. ai/acre in the spring when Canada thistle is in the pre-bud to early bud growth stages (about 10-15 inches tall). For increased control, retreat with dicamba (1 lb. ai/acre) in the fall to prevent regrowth of plants.

Cultural/Preventive: Reduce the spread of Canada thistle seeds by always purchasing "weed free" seeds. Quickly eliminate new seedlings before they have a chance to form a well-developed root system.

Integrated Management Summary

The tendency of this species to grow in wet areas may restrict the use of certain herbicides. Control efforts should target Canada thistle plants in high-quality areas first (typically areas that contain mostly native species and few undesirable species), and then work on controlling lower quality areas (areas that are already infested with undesirable species and have fewer desirable species present). Management strategies should be adjusted to reflect weather conditions (Nuzzo 1998). For example, drought stress reduces the effectiveness of most herbicides, but increases the effectiveness of mechanical controls (e.g., mowing or burning). It takes at least two years of control to determine whether a particular method is effective. Several studies have recorded a temporary decline in Canada thistle in the first year of control followed by a return to the pre-treatment conditions the second growing season (Nuzzo 1998). For one example of Canada thistle control, see page 60.

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Musk thistle

Carduus nutans L. subsp. ***macrolepsis*** (Peterman) Kazmi

Family: *Asteraceae* (Sunflower)
Other Names: nodding thistle, nodding plumeless thistle
USDA Code: CANUM2
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:

- Musk thistle can be identified by the broad, spine-tipped bracts located under the flower.
- Flowering heads are terminal, solitary and usually nodding.

Identification

Growth form: Biennial, or sometimes winter annual forb.
Flower: Flower heads are terminal, solitary, 1.5 to 3 inches in diameter, and usually nodding. Flowers are deep rose, violet or purple, occasionally white. Flowers are subtended by broad, spine-tipped bracts.
Seeds/Fruit: One-seeded oblong fruit (achene) about 0.2 inches long, shiny, yellowish-brown with a plume (pappus) of white hair-like bristles.
Leaves: Leaves are alternate, dark green, deeply lobed, and spiny margined. The leaf margins are often white. The leaves extend onto the stem giving a winged appearance (Whitson et al. 1996). Basal rosettes are well developed, leaves elliptical to lanceolate, 6-14 inches, smooth to densely hairy.
Stems: Mature plants can grow as tall as 6 feet. It can appear solitarily or with several stems from one base, and is highly branched above.
Roots: Fleshy taproot.
Seedling: No information available.

Similar Species

Exotics: Musk thistle is similar to plumeless thistle *(Carduus acanthoides)*. Rosettes of plumeless thistle are distinguished from those of musk thistle by having leaves that are deeply serrate (saw-toothed) almost to the midrib.
Natives: There are many native thistle species (in the genus *Cirsium*). The natives generally do not have leaves clasping the stem all the way from node to node (strongly decurrent leaves), and many have hairy upper and lower leaf surfaces and are blue-green or gray in color.

Impacts

Agricultural: Likely to infest pastures, and is unpalatable to livestock.
Ecological: Musk thistle is a highly competitive weed which invades disturbed areas, pasture, rangeland, forest land, cropland, and waste areas throughout most of the United States. Musk thistle spreads rapidly and forms extensive stands, which force out desirable vegetation (Rutledge and McLendon, 1998). Musk thistle may produce allelopathic chemicals that inhibit desirable plants beyond the spread of the rosettes (Wardle et al. 1993).
Human: No information available.

Habitat and Distribution

General requirements: Musk thistle does not appear to have any specific climatic requirements other than a cool period of vernalization for flowering (Butterfield et al. 1996). It occurs in areas with as little as 10 inches of annual

precipitation (FEIS 1996). Musk thistle establishes best on bare soil, and small shallow cracks are ideal for seedling establishment (FEIS 1996). Musk thistle grows in all soil textures, but the soils must be well-drained (Butterfield et al. 1996) It occurs on soils with a pH range of 6.0 to 8.9 (Butterfield et al. 1996).
Distribution: In Colorado, musk thistle is found up to approximately 10,000 feet in elevation (Beck 1999). It is found throughout North America.
Historical: Native to Eurasia.

Biology/Ecology
Life cycle: Seeds germinate in the fall, forming a rosette of leaves. Typically, musk thistle over-winters as a rosette and bolts the following spring between April-June. Flowering begins in late May or early June and continues through mid-July (Butterfield et al. 1996). Seeds mature and are dispersed 1 to 3 weeks after flowering. Seedlings establish only on bare soils and grow less when shaded by neighboring plants (Beck 1999).
Mode of reproduction: Musk thistle reproduces solely by seed.
Seed production: Musk thistle is a prolific seed producer Average productivity is approximately 10,000 seeds/plant, however, a single plant can produce up to 100,000 seeds (Beck 1999).
Seed bank: Musk thistle seeds appear to remain viable for at least 10 years.
Dispersal: Seed dispersal is by wind water, wildlife and livestock (Beck 1999).
Hybridization: May hybridize with plumeless thistle *(Carduus acanthoides).*

Control
Biocontrol: A number of insects have been used to help control musk thistle. The Division of Plant Industry's Biological Pest Control Section has two species, *Rhinocyllus conicus*, and *Trichosirocalus horridus*, that may be available for redistribution. The most widely released insect is the weevil *Rhinocyllus conicus* (Butterfield et al. 1996). In the spring, adults will feed on the leaves, mate, and deposit eggs on the bracts (Butterfield et al. 1996). When the eggs hatch the larvae begin to bore into the flowerhead, reducing the ability of the plants to produce viable seed. In some cases the weevil has reduced musk thistle populations to less than 10% pre-release levels (Rutledge and McLendon, 1998). However, this weevil will attack native thistles, including rare species (Louda et al. 1997).

Keys to Control:
- Managing rangeland to minimize the amount of bare soil is essential to long-term control.
- Hand chopping at ground level just before flowering, or cutting and bagging seed heads before dispersal can be used to eliminate seed production.
- Repeated treatments over the course of several years can eliminate a musk thistle infestation.

Mechanical: Repeated mowing, hand pulling, or cutting can be used to stop the spread of musk thistle. Mowing or hand-chopping after flowering, but before seed set, prevents seed development and dispersal (Heidel 1987). When pulling musk thistle, it is important to completely remove the crown so that the plant does not simply re-bolt and produce seeds. Repeated visits at weekly intervals over the 4-7 week flowering period is necessary because not all plants flower at the same time (Heidel 1987). Cut plants should be deeply buried or burned because seeds can mature and become viable after cutting (Rutledge and McLendon, 1998).
Fire: No information available.
Herbicides: Musk thistle is most often controlled with herbicides. The most effective chemical control occurs when musk thistle is still in the rosette stage, and quickly decreases once the plant has bolted (Butterfield et al. 1996). 2,4-D, clopyralid at 0.25 lb., or dicamba at 1 lb. ai/acre are effective when applied 10-14 days prior to bolting. A combination of 2,4-D plus dicamba provided 97% control in an experiment in Minnesota (Butterfield et al. 1996). Fall application of picloram at 0.25 lb. ai/acre to rosettes when other plants are dormant is often effective and has less impact on non-target species (Butterfield et al. 1996). Metsulfuron and chlorsulfuron are effective on bolted plants (Beck 1999).
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Integrated Management Summary
The key to managing musk thistle is to prevent seed production. Most control methods will have a detrimental effect on other plants and may cause a disturbance that will favor re-invasion by other exotic species (Rutledge and McLendon, 1998). Dense musk thistle stands along roadsides and in degraded areas can be treated by spot use of herbicides, and in high-quality areas by a persistent program of pulling or cutting (Rutledge and McLendon, 1998).

Due to the long seed viability of musk thistle, up to 10 years, control methods may have to be repeated for many years to completely eliminate a stand.
One integrated approach to musk thistle management involves 1) managing livestock grazing to increase grass vigor and reduce bare ground; 2) spray rosettes with clopyralid or 2,4-D; 3) re-seed treated ground with competitive desirable plants in the fall after spraying; 4) follow-up with spot cutting of entire plants when first flowers appear annually for several years to deplete the seed bank in the soil.

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Bull thistle

Cirsium vulgare (Savi) Tenore

Family: Asteraceae (Composite)
Other Names: common thistle, spear thistle, fuller's thistle
USDA Code: CIVU
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:

- Bull thistle can be distinguished from other thistles by rubbing the upper surface of its leaves. Bull thistle leaves are prickly hairy above and cottony below.
- Bull thistle has stiff pointy spines on its leaf tips and spine-tipped, purple flower heads.

Identification

Growth form: Biennial forb.
Flower: Flowers are 1.5-2 inches wide and clustered at the ends of branches. The flower bracts are somewhat tapered and covered with spines (Whitson et al. 1996). Flowers are pinkish to dark purple.
Seed/Fruit: Seeds are capped with a circle of plume-like white hairs.
Leaves: Leaves are alternate. Bull are the only thistles in Colorado that are prickly hairy on the top surface of the leaves. They are cottony-hairy on the undersides.
Stems: In mature plants the leaves extend down, clasping the stem and are divided into segments (i.e. strongly decurrent).
Roots: Has a short, fleshy taproot with several primary roots extending from the root crown. Each bears a number of smaller lateral roots.
Seedlings: Seed leaves (cotyledons) are round to spatulate, and smooth. First true leaves are oval to spatulate with spines and a rough, bumpy surface (Carey et al. 1993). First year plants form a rosette with leaves easily distinguished from other thistles by the above leaf characteristics.
Other: Mature plants range between 2-5 feet tall with many spreading branches and (Whitson et al. 1996).

Similar Species

Exotics: Bull thistle is similar to other thistles (*Breea, Carduus, Cirsium* and *Onopordum* genera) but can be distinguished by flower size, bract appearance and leaf surfaces. In rosette form it can be readily distinguished by the prickly upper surface of its leaves.
Natives: There are many native *Cirsium* species, some common (like *Cirsium undulatum*) some rare (like *Cirsium perplexans*). The natives generally do not have leaves clasping the stem all the way from node to node (strongly decurrent leaves), and many have hairy upper and lower leaf surfaces and are blue-green or gray in color.

Impacts

Agricultural: Heavy infestations can exclude livestock from areas. Additionally, the presence of bull thistle in hay decreases the forage value and lowers the market price (Zimmerman 1997). It is an aggressive weed, but it will not survive where cultivation has cut back its stem and destroyed its root system (FEIS 1996).
Ecological: Bull thistle is often a transient species, appearing in recent clear cuts or disturbed areas and becoming a dominant species for several years (Rees et al. 1996).
Human: Bull thistle has been reported to cause hay fever in some individuals (FEIS 1996).

Habitat and Distribution

General requirements: Bull thistle grows in dry to moist habitats. It thrives on nitrogen-rich soils, and it grows on gravelly to clay-textured soils. Bull thistle cannot withstand deep shade, and is nearly absent if light is reduced to less than 40% of full sunlight (FEIS 1996). Potential habitats include pastures, overgrazed rangeland, roadsides, and logged areas.
Distribution: Distribution within Colorado is not well known, but it is certainly found along the Front Range, as well as throughout the Western Slope (A. Green, pers. comm.) In Colorado, bull thistle is most often found between 5,000-10,800 feet in elevation. It is widespread throughout the United States and parts of Canada.
Historical: Bull thistle was introduced to North America as a seed contaminant and is now widespread.

Biology/Ecology

Life cycle: During the first year following germination a basal rosette is formed. The rosette grows until winter, partly dies back, and begins to grow again in early spring (FEIS 1996). Age at bolting is dependent upon plant size and almost all plants require a period of cold temperature to bolt. Flowering occurs from July through September. After flowering and seed production, the plant dies.
Mode of reproduction: Bull thistle reproduces solely by seeds.
Seed production: Mature plants can produce up to 4,000 seeds per plant (Zimmerman 1997).
Seed bank: Seeds have little dormancy, and germinate rapidly whenever conditions are favorable, usually in the spring and fall (FEIS 1996). Although most of the seeds on or near the surface do not remain viable for more than a year, seeds that are buried at a depth of 5 inches may remain viable for up to three years (Zimmerman 1997).
Dispersal: Seeds are capped with a circle of plume-like white hairs and can be windblown for long distances. However, it has been found that 65% of the seeds land within two meters of the parent plant (Zimmerman 1997). Seeds are also likely to be spread by birds, especially goldfinches.
Hybridization: There is no information available on hybridization with other thistles.

Control

Biocontrol: The bull thistle seedhead gall fly (*Urophora stylata*) can reduce seed production up to 80% in some areas (Zimmerman 1997). This agent has been established in Colorado, and prefers open meadows (Rees et al. 1996). However, this species is currently unavailable for redistribution by the Division of Plant Industry's Biological Pest Control Section. Due to its spiny stems and leaves, bull thistle is unpalatable to most livestock (FEIS 1996). However, sheep will graze on bull thistle seedlings or small rosettes.

Keys to Control:
- Kill bull thistle plants after they have bolted, but before plants have flowered.
- Repeat control for several years to deplete the bank of thistle seeds in the soil.

Mechanical: Cutting, mowing, and/or severing the taproot just below the root crown before seed set will eliminate current year seed production, and if continued annually, eliminate an infestation. The best time to cut is late in the season when most of the plants have bolted, but before a significant number have flowered (FEIS 1996). Plants will re-bolt if they are mowed too early. Cutting again a month after the first sweep will eliminate any late bolting plants, and improve the effectiveness of the procedure.
Fire: No information available.
Herbicides: Spot applications of picloram at 0.5 lb., dicamba or 2,4-D at 1 lb. ai/acre will provide effective control. Glyphosate at 1.5 lb. ai/acre is another herbicide that can be used to provide some control of bull thistle. Herbicides should be applied in rosette stage or after mowing as the plant becomes more tolerant of herbicides once the flower stalk is produced (FEIS 1996).
Cultural/Preventive: Minimize disturbance and establish healthy stands of tall grasses or forbs to outcompete bull thistle.

Integrated Management Summary

Bull thistle does not tolerate shade and therefore does not compete well in areas that are populated by tall grasses and forbs. Improving the health of a natural area, and guarding against disturbance or overuse, can be a good preventive measure against bull thistle. Apply herbicides to rosettes in early spring (May, June), and then mow or sever taproots after the plants have bolted but before flowering (probably late June to July). A second mowing or cutting is suggested a month later to pick up late bolting plants. Do not cut or spray if using seedhead biocontrols.

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Chinese clematis

Clematis orientalis L.

Family: *Ranunculaceae* (Buttercup)
Other Names: oriental virginsbower, orange peel, lemon peel
USDA Code: CLOR
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Solitary, yellow-sepaled flowers weth feathery fruits.

Identification
Growth form: Perennial herbaceous to woody vine.
Flower: Flowers solitary, with four yellow sepals (petal-like structures), often nodding.
Seeds/Fruit: Each flower produces numerous feathery long-tailed achenes (single seeded fruits) which are conspicuous as the fruits mature.
Leaves: Opposite leaves, ternate (having 3 leaflets).
Stems: Vigorous climbing vines up to ten feet long.
Roots: No information available.
Seedling: No information available.
Other: Flowers are delicately scented.

Similar Species
Exotics: None known.
Natives: The native virgin's bower, *Clematis ligusticifolia*, has white-sepaled flowers in clusters, and is much more common, especially at lower elevations.

Impacts
Agricultural: No information available.
Ecological: In the past 25 years, Chinese clematis has spread especially rapidly, becoming weedy and constituting a threat to young trees and native shrubby and herbaceous species (Flora of North America Editorial Committee 1997).
Human: No information available.

Habitat and Distribution
General requirements: Most *Clematis* species prefer sunny, well drained soils, although they may be shade tolerant to some degree. In Utah, Chinese clematis is found in sagebrush, mountain brush, and ruderal habitats up to 7,500 feet (Welsh et al. 1987).
Distribution: *Clematis orientalis* has been naturalized in the Rocky Mountains since the late nineteenth century, and is now well established in Utah and Colorado, scattered in several other western states (Flora of North America Editorial Committee 1997). In Colorado, Chinese clematis is found in mountain areas in the south and central parts of the state.
Historical: Clematis species and hybrids are popular as ornamental garden plants.

Biology/Ecology
Life cycle: Perennial woody vine which flowers in summer to fall.
Mode of reproduction: Reproduces by seeds.
Seed production: No information available.

Seed bank: No information available.
Dispersal: No information available.
Hybridization: No information available.

Control

The only recommendation available is for herbicide control with Escort® (metsulfuron). The rate is 1 oz of product per acre plus 0.25% v/v non-ionic surfactant (K.G. Beck, pers. comm.).

Integrated Management Summary

There is little or no information available on the control of Chinese clematis. Preventing the spread of this species by eliminating seed production from established stands, and discontinuing its use as an ornamental are possible strategies.

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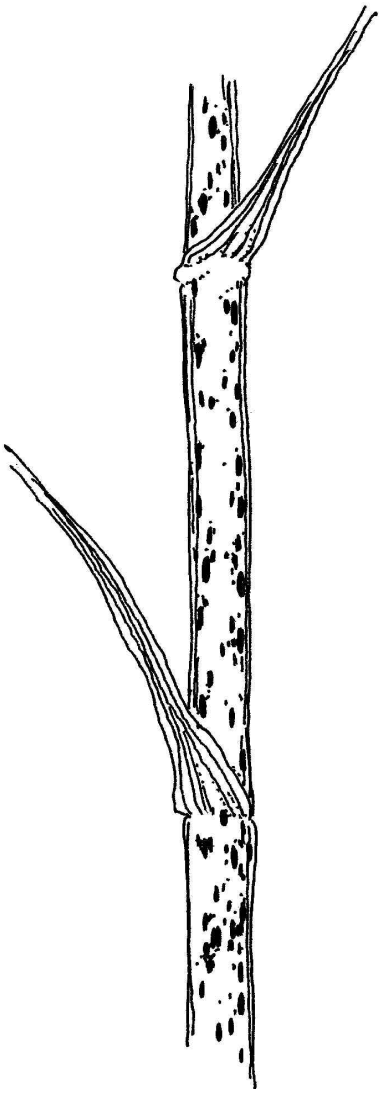
Poison hemlock

Conium maculatum L.

Family: *Apiaceae* (Parsley)
Other Names: hemlock
USDA Code: COMA2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:

- The leaves of poison hemlock are glossy, green and fern-like in appearance.
- The stems are covered with purple spots.



Identification

Growth form: Biennial forb.
Flower: The white flowers are borne in umbrella-like clusters that are supported by a stalk.
Seeds/Fruit: Seeds are light brown, ribbed, and concave.
Leaves: Leaves are generally alternate, but may be opposite above (Stubbendieck et al. 1995). Leaves are shiny, green, finely divided and leaflets are segmented leaves on short stalks. Leaves have a strong musty odor.
Stems: Mature plants grow 4-10 feet tall. Stems are erect, extensively branched, and covered with purple spots.
Roots: Taproot.
Seedling: Seedling leaves are fernlike in appearance.

Similar Species

Exotics: Superficially similar to other exotic members of the Parsley family, such as wild caraway *(Carum carvi)* or wild carrot *(Daucus carota)*. Spotted stems are diagnostic.
Natives: Native members of the Parsley family, including water hemlock *(Cicuta douglasii)*, and osha *(Ligusticum porteri)* are somewhat similar in overall appearance, but lack the distinctive spotted stems.

Impacts

Agricultural: Poison hemlock crowds out desirable forage species and can poison livestock and humans. Sheep are less sensitive than cattle and horses (DiTomaso 1999).
Ecological: Although it is not an aggressive invader, poison hemlock may gradually increase in frequency in native riparian and lowland communities.
Human: Poison hemlock is a highly poisonous plant that should be handled with care. All parts of the plant are poisonous.

Habitat and Distribution

General requirements: Poison hemlock is generally found on dry to moist soils and can tolerate poorly drained soils. Poison hemlock plants tend to be scattered in riparian areas. It is usually found along streams, roadside ditch banks and irrigation ditches, the borders of pastures and cropland, and will gradually invade perennial crops.
Distribution: Naturalized throughout the United States.
Historical: Poison hemlock is a native of Europe, and is generally believed to be the plant that was used to kill Socrates.

Biology/Ecology

Life cycle: Poison hemlock is a biennial that can grow to impressive heights (up to ten feet). The first year plants form a small seedling that resembles wild carrot. Plants typically bolt the second year and produce numerous clusters of white flowers. Plants flower from April through July (USDA 1997). Seeds are dispersed for an extended period beginning in July and continuing into winter. Most seeds mature before dispersal and can germinate immediately if environmental conditions are favorable; however, some seeds are dormant (Baskin and Baskin 1990).
Mode of reproduction: Poison hemlock reproduces by seeds.
Seed production: No information available.
Seed bank: Seeds may remain viable in the soil for about three years (Calweed 1999).
Dispersal: Seeds can be spread in mud which sticks to machinery and clothing, or in transported soil. Also dispersed to a limited extent by water or wind.
Hybridization: No information available.

Control

Keys to Control:
- Eliminate seed production and exhaust the soil seed bank.
- Re-seed controlled areas with desirable species.

Biocontrol: The European palearctic moth (*Agonopterix alstroemeriana*), was somehow introduced into the United States. It apparently feeds exclusively on poison hemlock. It is found in Colorado, and is a biological control agent in Idaho, Oregon and Washington where it is effective (William et al. 1996).
Mechanical: Poison hemlock can be controlled by digging, repeated mowing, pulling, or by spring/winter burns. Care should be taken to avoid contact with bare skin (wear gloves). Wash hands thoroughly after handling any part of this plant, especially when plant sap is present.
Fire: No information available.
Herbicides: Tebithuron can provide excellent pre-emergent control of poison hemlock. Chlorsulfuron and chlorsulfuron + metsulfuron provide both pre-emergent and foliar control (DiTomaso 1999). Picloram, dicamba, 2,4-D at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre, can also be used to provide chemical control of poison hemlock. Apply foliar herbicides during the rosette stage with a wick to minimize damage to adjacent desirable vegetation. Cut any stems that arise after treatment. Herbicide treatment may need to be repeated for several years until the seed bank is depleted (Panter and Keeler 1988).
Cultural/Preventive: Prevent the establishment of new infestations by eliminating seed production and maintaining healthy native communities.

Integrated Management Summary

The tendency of this species to grow in wet areas may restrict the use of certain herbicides. Eliminate seed production and exhaust the soil seed bank by removing seed heads before seeds mature. Use gloves for hand pulling, and avoid touching the plant with bare skin. Integrated management of poison hemlock could also utilize an introduction of the palearctic moth and treatment with herbicides, combined with reseeding and altered livestock grazing management to promote healthy plant communities.

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Common teasel

Dipsacus fullonum (L.) ssp. ***sylvestris*** (Huds.) Clapham

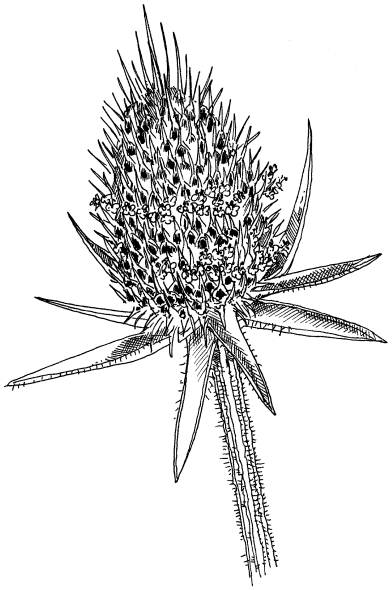
Family: *Dipsacaceae* (Teasel)
Other Names: teasel, fuller's teasel, Venus's basin, card thistle, barbers brush, brushes and combs, church broom
USDA Code: DIFU2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:

- Common teasel can be identified by its distinctive flower head. Flowers are small and packed in dense, oval-shaped heads.
- Flowers are subtended by stiff, spiny bracts that give the flower heads a bristly appearance and texture.

Identification

Growth form: Biennial or sometimes monocarpic perennial forb.
Flower: Flowers are purple, and subtended by spiny, awned bracts. The floral bracts at the base of the head are generally longer than the head.
Seeds/Fruit: The fruits are four-angled, each contains a single seed.
Leaves: Rosette leaves are conspicuously veined, with stiff prickles on the lower midrib (Whitson et al. 1996). Stem leaves are simple, opposite, net-veined, stalkless, and clasp the stem. Flowering plants have large, oblong, opposite leaves that form cups, which are capable of holding water (Wisconsin DNR 1998).
Stems: Mature plants can grow up to six feet tall. The taprooted stem is rigid, furrowed (striate-angled), with several rows of downward turned prickles.
Roots: Shallow taproot with secondary fibrous root system.
Seedling: No information available.



Similar Species

Exotics: None known.
Natives: None known.

Impacts

Agricultural: Common teasel is not considered palatable and is generally ignored by livestock. It displaces native vegetation and decreases range quality.
Ecological: Common teasel can be an aggressive competitor in disturbed areas. Massive seed production and high germination allow it to quickly invade an area and outcompete other plants.
Human: No information available.

Habitat and Distribution

General requirements: Common teasel grows in open, sunny habitats that range from wet to dry. It is generally found along irrigation ditches, abandoned fields, pastures, waste places, and forests.
Distribution: Common teasel is spreading rapidly in America, particularly in the Pacific Northwest. In Colorado, teasel is usually found in relatively moist, disturbed situations. It is known to be collected and spread as an ornamental decoration for dried flower arrangements.
Historical: Common teasel is a native of Europe where it has historically had many uses. The heads of a cultivated variety of teasel are used for wool "fleecing", or raising the nap on woolen cloth. (Grieve 1995). These heads are fixed on the rim of a wheel, or on a cylinder, which is made to revolve against the surface of the cloth (Grieve 1995). No machine has yet been invented which can compete with teasel in its combined rigidity and elasticity

(Grieve 1995). The roots of common teasel are also reported to have various medicinal values ranging from a remedy for jaundice to a cleansing agent (Grieve 1995).

Biology/Ecology

Life cycle: Common teasel is a biennial or sometimes monocarpic perennial. The plant grows as a basal rosette for a minimum of one year, and then sends up a tall, flowering stalk (Wisconsin DNR 1998). After flowering and seed set, the plant dies (Werner 1975). Flowering occurs from July to August.
Mode of reproduction: Reproduces by seeds only.
Seed production: A single teasel plant can produce over 2,000 seeds, of which 30-80% may germinate (Wisconsin DNR 1998).
Seed bank: Seeds can remain viable for at least two years.
Dispersal: No information available.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: Seed production should be eliminated by cutting flowering stalks.
Fire: No information available.
Herbicides: Metsulfuron at 0.3 oz. ai/acre will control teasel. Dicamba at a rate of 0.25-0.5 lb. ai/acre can be applied on teasel rosettes less than three inches in diameter (PMIS). For rosettes 3 inches or more in diameter, increase to 0.5-1.0 lb. ai/acre (PMIS). When teasel is bolting, apply 1.0-1.5 lb. ai/acre (PMIS).
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities.

Keys to Control:

- Eliminate seed production by cutting seed stalks after flowering, and exhaust the seed bank in the soil.
- Re-seed controlled areas with desirable species.

Integrated Management Summary

The key to controlling common teasel is to eliminate seed production and exhaust the seed bank in the soil. Common teasel does not reproduce vegetatively and dies after seed production (Werner 1975). Therefore, cutting the stalks of flowering plants is recommended as the best control in natural areas. Cut stalks should be bagged and burned. This usually requires several years of control to eliminate an infestation.

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Leafy spurge

Euphorbia esula L.; ***Tithymalus esula*** (L.) Scopoli

Family: *Euphorbiaceae* (Spurge)
Other Names: none widely accepted
USDA Code: EUES
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:

- Flowers are yellowish-green and have a pair of heart shaped yellow-green bracts below each inconspicious flower.
- The entire plant contains white, milky latex.

Identification

Growth form: Perennial forb.
Flower: Flowers are yellowish-green, small, arranged in numerous small clusters and subtended by paired heart-shaped yellow-green bracts.
Seeds/Fruit: Seeds are oblong, grayish to purple, contained in a 3-celled capsule.
Leaves: Leaves are alternate, narrow, 1-4 inches long.
Stems: Mature plants are up to 3 feet tall. Stems are thickly clustered.
Roots: Extensive lateral root system.
Seedling: Seed leaves (cotyledons) are linear to lanceolate, with entire margins.
Other: The entire plant contains white, milky latex. Foliage of the plant is smooth and hairless.

Similar Species

Exotics: None known.
Natives: Leafy spurge is distinguished from native spurges such as *Euphorbia brachycera* by its long linear leaves.

Impacts

Agricultural: Leafy spurge can invade rangeland that is in excellent condition, making it worthless for cattle and horse grazing and reducing land values (Lajeunesse et al. 1999).
Ecological: Leafy spurge is an aggressive, long-lived, perennial weed that tends to displace all other vegetation in rangeland, pasture, and native habitats (Biesboer 1998). Leafy spurge decreases rangeland diversity, threatens native plants and degrades wildlife habitat (Lajeunesse et al. 1999). It produces a large number of seeds and underground shoot buds. These two reproductive techniques allow it to rapidly displace native species, and form a leafy spurge monoculture. Rapid re-establishment of treated stands often occurs after an apparently successful management effort because of the large nutrient reserve stored in the roots of leafy spurge plants. Also, leafy spurge produces an allelopathic compound that inhibits the growth of other plants (Butterfield et al. 1996).
Human: The milky latex associated with leafy spurge can cause irritation, blotching, blisters, and swelling in sensitive individuals.

Habitat and Distribution

General requirements: Leafy spurge grows in a wide range of habitats.

It is most aggressive in semi-arid areas, but can be found in xeric to subhumid and subtropic to subarctic habitats (Butterfield et al. 1996). Leafy spurge occurs most commonly on untilled, non-crop areas such as rangeland, pastureland, woodland, prairies, roadsides, stream and ditches, and waste sites. It grows on all kinds of soils, but is most abundant in coarse-textured soils and least abundant on clayey soils (Butterfield et al. 1996).
Distribution: In Colorado, leafy spurge is common on disturbed soils between 5,000 to 6,500 feet (Rutledge and McLendon 1998), but can be found up to 9,000 feet.
Historical: No information available.

Biology/Ecology
Life cycle: Leafy spurge is one of the earliest plants to emerge in the spring, usually in mid-April to late May (Butterfield et al. 1996). The development of terminal flower clusters begins 1 to 2 weeks after stem emergence. Flower clusters have 8 to 16 branches. Each branchlet forms a greenish yellow bract in May. Flowering generally ends in late June to mid-July as the plants do not usually flower, and growth is reduced, during the hotter portion of the summer. However, if conditions are favorable, leafy spurge may produce a few lateral flowers throughout the summer and in the fall. Thus, it is possible for the plant to produce seed until frost. Seeds mature about 30 days following pollination. Peak germination occurs from late-May to early June. If adequate moisture is present, germination can occur throughout the growing season.
Mode of reproduction: Despite being a successful seed producer, leafy spurge primarily reproduces vegetatively through its extensive lateral root system. Long roots have the capability to produce shoots and can reach nearly 15 feet laterally, and about 30 feet in depth. As many as 300 buds have been counted on these long roots (Butterfield et al. 1996).
Seed production: Each flowering stem produces from 10-50 capsules with a seed yield range of 200-250 seeds per flowering shoot (Best et al. 1980). A large plant may produce up to 130,000 seeds (Rutledge and McLendon 1998).
Seed bank: Seeds can remain viable in the soil for 5-8 years although 99% of the viable seeds will germinate in the first two years (Butterfield et al. 1996).
Dispersal: The three-sided capsules explode when ripe, sending the enclosed seeds up to 15 feet from the parent plant. Seeds float on water, and can be transported and deposited by flood water.
Hybridization: No information available.

Control
Biocontrol: Currently, there is extensive research on biological control agents for leafy spurge with over 15 insects being studied (Biesboer 1998). However, control of leafy spurge by insects is often limited by the thick milky latex, which tends to clog the mouth or sucking parts of most insects (Butterfield et al. 1996). Successful biological control will most likely require a combination of insects and a long-term management program to establish them. The Division of Plant Industry's Biological Pest Control Section has released eight species in an effort to control leafy spurge. Three of these species, *Aphthona nigriscutis*, *A. cyparissiae*, and *A. czwalinae*/*lacertosa*, have become established and may be available for distribution from the Insectary. The most effective biological control agents seem to be six species of root- and foliage-feeding beetles in the genus *Aphthona*, and a stem- and root-boring beetle *Obera erythrocephala* (Lajeunesse et al. 1999).

Keys to Control:
- Develop a management scheme that uses several control methods that are compatible with your site.
- Persistently monitor your area and quickly control new infestations.

Grazing sheep on infested areas has been used successfully to control spurge on ranches in Montana, but ranchers agree that once the sheep were removed the spurge would quickly return (Biesboer 1998). Sheep grazing is likely to be most effective in the spring and summer when the spurge plants are succulent and when sheep tend to prefer forbs over grasses, rather than in fall when sheep forage more on grasses (Lajeunesse et al. 1999). Two grazing periods during the spring-summer with a recovery period (for the grasses) between are recommended rather than season-long grazing. Fall grazing by goats followed by application of picloram and 2,4-D (each 1 qt./ac) can provide good control (Lajeunesse et al. 1999). A recent study near Denver found that sheep grazing for a short period in early July every year for 5 years reduced leafy spurge density by 90%. This study also produce excellent results by combining sheep with *Apthona* beetles (Beck and Rittenhous, 2000).
Mechanical: Tillage is not generally a practical control method for areas where leafy spurge grows. Mowing can actually increase the density of leafy spurge, and may not be effective even when combined with herbicide (K.G. Beck, pers. comm.). Pulling leafy spurge is ineffective, even for small infestations because of the deep root system and the presence of numerous root buds.

Fire: Burning alone will not likely provide adequate control of leafy spurge due to regeneration from the root system. However, combinations of burning and herbicide application 5 weeks later might provide adequate control (Biesboer 1998). In one study, plots of leafy spurge were sprayed with a mix of 2,4-D and picloram in September and burned the following April. The plots were sprayed again in June and burned again in October (Biesboer 1998). This process is designed to exhaust the nutrient reserves in the root system of the plant and hinder its ability to compete with other species. Therefore, reseeding desirable species is also necessary.
Herbicides: Herbicides can provide some control of leafy spurge. However, due to its extensive root system and general hardiness, follow up applications are necessary for herbicides to be effective. Picloram is recommended for eradication of small infestations, with herbicide application extending for 10-15 feet beyond the leafy spurge patches (Lajeunesse et al. 1999). A combination of picloram and 2,4-D (1-1.5 pints of picloram with 1-1.5 quarts of 2,4-D) was shown to provide the best control when applied in the spring when flowers emerge (Beck 1996). Research in North Dakota has shown that a tank mix of picloram (1 pt./ac) and 2,4-D (1 qt./ac) (based on concentrate of 4 pounds active ingredient / gallon) applied 2 weeks after the yellow bracts appear and applied annually is a cost effective treatment for leafy spurge (Lym et al. 1993). Picloram at 1 qt./ac for 2-3 consectutive years is also effective, but more expensive. An annual combination of dicamba plus 2,4-D (4-8 oz + 0.5-1 quart/acre) also provided good control (Beck 1996). Glyphosate is most effective when applied sequentially at 1 quart/acre at one-month intervals, coupled with fall grass seeding (Beck 1996).
Cultural/Preventive: Long-term control of leafy spurge requires, among other things, a competitive plant community dominated by desirable species. For reseeding, select a mixture of grass species with early-, mid-, and late-season growth, and with shallow-, intermediate-, and deep-rooting depths. The resulting plant community will maximize the use of water and nutrients by the desirable species and will effectively compete with leafy spurge. After reseeding, it is imperative to manage grazing animals carefully so as to invigorate and not harm perennial grasses. Consider grazing sheep or goats with cattle so the former can graze spurge plants.

Note of Caution: The milky latex associated with leafy spurge can cause irritation, blotching, blisters, and swelling in sensitive individuals. The eyes should never be rubbed until after the hands are thoroughly washed. Gloves should be worn while pulling or coming into contact with this plant.

Integrated Management Summary

Persistent monitoring of areas with known or potential infestations is crucial to managing leafy spurge. New infestations are much more easily controlled than established infestations. 100% eradication of leafy spurge is rarely achieved, but infestations can be reduced to manageable levels. Herbicides are most commonly used to control leafy spurge. However, damage to non-target species is always a concern. Sheep and goats can be used to control leafy spurge. Leafy spurge is extremely difficult to control by chemical means and is almost impossible to control by cultural or physical methods. Therefore a management scheme that combines control methods over four to five years is recommended (Beck 1996). Lym (1998) recommends combinations of re-seeding with competitive grasses, biological control insects, sheep or goat grazing and herbicide (2,4-D + picloram) treatment. Grazing animals and biological agents are generally appropriate only for larger infestations. Although leafy spurge can be poisonous to cattle, sheep can be taught to feed on it and goats will seek it out. For an example of one rancher's integrated approach to leafy spurge control, see page 61.

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Dalmatian toadflax

Linaria dalmatica (L.) Miller;
Linaria genistifolia ssp. ***dalmatica*** (L.) Marie and Petitmengin

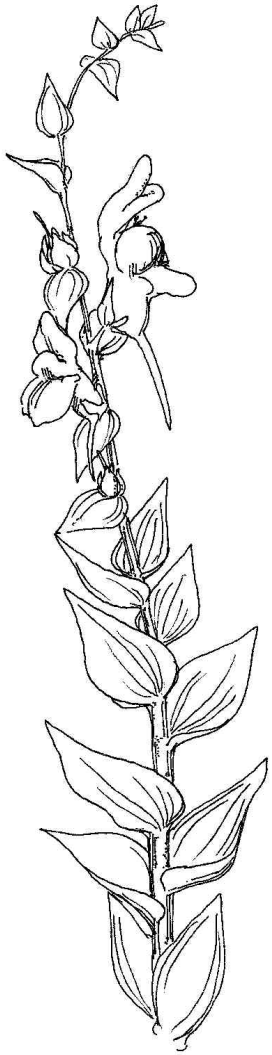
Family: ***Scrophulariaceae*** (Figwort)
Other Names: broad-leaved toadflax, wild snapdragon
USDA Code: LIDAM
Legal Status: Colorado Noxious List B (top 10 worst)

Keys to Identification:

- Dalmatian toadflax can be easily identified by its bright-yellow, snapdragon-shaped flowers.
- Dalmatian toadflax can be distinguished from yellow toadflax by its larger flowers and more ovate leaves (rather than the linear, somewhat pointed leaves that are characteristic of yellow toadflax).

Identification

Growth form: Perennial forb.
Flower: Flowers are borne in loose, elongate, terminal racemes. Flowers are bright yellow and resemble snapdragons.
Seeds/Fruit: Fruits are egg-shaped to nearly round capsules. Seeds are sharply angular, and slightly winged.
Leaves: Leaves are broad, ovate to ovate-lanceolate, and are alternate, generally clasping but crowded.
Stems: Mature plants are up to three feet tall. A single toadflax plant contains from 1-25 vertical floral stems. which are thick-walled and somewhat woody.
Roots: The taproot may penetrate one meter into the soil. Horizontal roots may grow to be several meters long, and can develop adventitious buds that may form independent plants.
Seedling: No information available.



Similar Species

Exotics: Yellow toadflax *(Linaria vulgaris)* is similar in appearance, but has more linear pointed leaves, and is generally a smaller plant.
Natives: None known.

Impacts

Agricultural: Low-till cultivation practices have contributed to the resurgence of toadflax populations on agricultural lands (McClay 1992). Dalmatian toadflax contains a glucoside, a quinoline alkaloid, and peganine which make it toxic to livestock (Rees et al. 1996). However, Dalmatian toadflax is generally considered unpalatable, and reports of livestock poisonings are rare.
Ecological: Dalmatian toadflax is a persistent, aggressive invader and capable of forming colonies through adventitious buds from creeping root systems. These colonies can push out native grasses and other perennials, thereby altering the species composition of natural communities. New infestations of Dalmatian toadflax can occur in naturally occurring disturbances or in small openings in pristine or excellent-condition rangeland (Lajeunesse 1999). Dalmatian toadflax can rapidly colonize open sites. It is most commonly found along roadsides, fences, rangelands, croplands, clear cuts, and pastures. Disturbed or cultivated ground is a prime candidate for colonization. Toadflax can significantly reduce crop yields and stress native communities. In one study, toadflax-free plots produced 2.5 times more grass than plots where toadflax was present (Robocker 1974). The seedlings of toadflax are considered ineffective competitors for soil moisture with established perennials and winter annuals (Morishita 1991). However, once established both species of toadflax suppress other vegetation mainly by intense competition for limited soil water. Mature plants are

particularly competitive with winter annuals and shallow-rooted perennials (Robocker 1974).
Human: No information available.

Habitat and Distribution

General requirements: Dalmatian toadflax can adapt its growth to fit a wide range of environmental conditions, and is tolerant of low temperatures and coarse-textured soils.
Distribution: In Colorado, Dalmatian toadflax is commonly found between 5,000 to 6,500 feet in oak, aspen, sagebrush, mountain brush, and riparian communities. It can be found growing up to 9,000 feet (A. Green, pers. comm.).
Historical: Native to Mediterranean region.

Biology/Ecology

Life cycle: Spring emergence occurs about mid-April and depends primarily on temperature. During the first year the plant forms a rosette and develops a deep root system. Prostrate stems emerge in September and produce ovate leaves. Prostrate stems are tolerant to freezing and are associated with floral stem production the following year (Robocker 1974). The strong upright floral stems that characterize mature toadflax plants develop after a winter's dormancy, and emerge about the same time as new seedlings in mid-April. A single plant will produce from 1-25 floral stems. Flowering occurs from May-August and seeds mature from July-September. Dalmatian toadflax can also reproduce vegetatively. Stems develop from adventitious buds on primary and lateral roots. Vegetative reproduction from root buds can occur as early as 2-3 weeks after germination, and is possible from root fragments as short as 1 cm in length (Zimmerman 1996). These buds can grow their own root and shoot systems, and become independent plants the next year. In addition to promoting growth, the large, deep, root systems of Dalmatian toadflax exploit water efficiently. The taproot may penetrate 3-4 feet into the soil and lateral roots may be 6-12 feet long.
Mode of reproduction: By seeds and vegetatively
Seed production: A mature Dalmatian toadflax can produce up to 500,000 seeds annually (Morishita 1991).
Seed bank: Seeds may remain viable in the soil for up to ten years.
Dispersal: Seeds are winged, and wind-dispersed.
Hybridization: No information available.

Control

Biocontrol: The Division of Plant Industry's Biological Pest Control Section currently has one species, *Calophasia lunula*, that may be available for redistribution on Dalmatian toadflax infestations. *C. lunula* larvae feed extensively on leaves and flowers of toadflax, severely damaging the plants.
Mechanical: Cutting or removal of the above ground portion of toadflax plants reduces the current year growth, but it will not kill the plant. Cutting toadflax stands in spring or early summer is an effective way to eliminate plant reproduction through seed production and dispersal. However, the long dormancy of toadflax seeds requires that the process be repeated annually for up to ten years. Hand pulling toadflax before seed set each year can be an effective control method. The hand pulling experiment on The Nature Conservancy's Magnusson Butte Preserve in Washington showed that toadflax can be significantly reduced by pulling once a year as long as new seed is eliminated. Again, this method must be repeated annually for up to ten years to completely remove a stand. Sheep can help suppress Dalmatian toadflax infestations and reduce seed production. The sheep showed no ill effects from eating toadflax and showed good weight gain (Lajeunesse 1999).
Fire: No information available.
Herbicides: Herbicides have highly variable effects on Dalmatian toadflax, probably due to its high genetic variability. Fall applications of picloram 0.5-1.0 lb. ai/acre has provided excellent control for one year. However, the higher concentrations of picloram may be injurious to desirable plants, plus picloram has been ineffective on some sites. A tank mix of picloram + 2,4-D controlled over 90% of Dalmatian toadflax when applied pre-bloom or in the fall. A six-year study found that phenoxypropionic herbicides such as diclorprop were more effective at controlling toadflax than phenoxyacetic herbicides such as 2,4-D (Robocker 1968). 2,4-D, MCPA, MCPB, and mecoprop used alone do not control toadflax.

Keys to Control:

- Maintain a dense cover of vigorous perennial plants.
- Picloram, dicamba, and glyphosate are effective when applied during flowering.
- Hand pulling is effective for small areas, especially in sandy soils.

Cultural/Preventive: Intensive clean cultivation techniques are recommended for successful toadflax control on agricultural land. Discing can be an effective method of toadflax control on agricultural lands. This method requires at least two years with eight to ten cultivations in the first year, and four to five cultivations the second year (Morishita 1991). Weed control should be accompanied by reseeding with a variety of plant species to occupy the site so as to prevent re-establishment of toadflax. An ideal mix of species would include cool- and warm-season plants as well as plants that root at a variety of depths. For example, shallow rooted, cool-season species such as Sandberg bluegrass (*Poa secunda*) compete with toadflax seedlings.

Integrated Management Summary

Management of Dalmatian toadflax must focus on both reducing the rate of vegetative spread and reducing seed production (Lajeunesse 1999). Successful management requires integrating as many control tactics as possible. Dalmatian toadflax has high genetic variability, and local populations can respond differently to control actions, especially herbicide treatments. Successful control can be obtained by pulling, or killing the plants with herbicide before toadflax seed production begins (Carpenter and Murray 1998). Since the plant also spreads through vegetative propagation, and the seeds can remain dormant for up to ten years, this process must be repeated every year for at least ten years to completely remove a stand. Competitive perennial grasses and forbs should be planted to utilize water and nutrients that would otherwise be readily available to toadflax.

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Yellow toadflax

Linaria vulgaris P. Miller

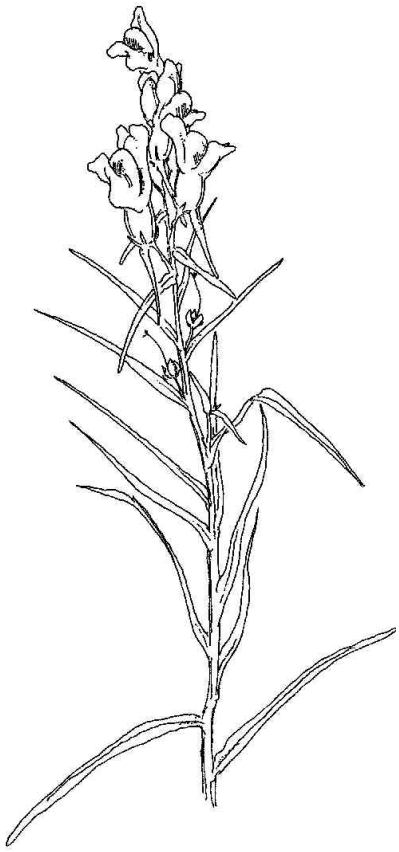
Family: *Scrophulariaceae* (Figwort)
Other Names: butter and eggs, wild snapdragon, common toadflax
USDA Code: LIVU2
Legal Status: Colorado Noxious List B (top ten worst)

Keys to Identification:

- Yellow toadflax can be identified by its yellow, snapdragon-like, flowers and disagreeable turpentine-like scent.
- It can be distinguished from dalmation toadflax by its leaves. The leaves of yellow toadflax are narrow, lance-shaped, and pointed at both ends. The leaves of dalmation toadflax are shorter, wider, and broad-based.

Identification

Growth form: Perennial forb
Flower: Flowers are bright yellow and resemble snapdragons. Flowers are arranged in a raceme at the ends of the branches.
Seeds/Fruit: Seed capsules are round-ovate, 0.3-0.5 inches long, and two-celled. Seeds are brown or black, circular, and surrounded by a notched wing.
Leaves: Leaves are soft, lance-shaped, and pale green. Leaves are mainly alternate but lower leaves appear to be opposite due to crowding.
Stems: Mature yellow toadflax plants are 1-3 feet tall with 1-25 smooth erect floral stems.
Roots: Taproots may be up to a meter in length. Horizontal roots may grow to be several meters long, and can develop adventitious buds that may form independent plants.
Seedling: No information available.
Other: Closely related to Dalmatian toadflax *(Linaria dalmatica).*



Similar Species

Exotics: Leaves of Dalmatian toadflax *(Linaria dalmatica)* are shorter, wider, and broadbased, clasping the stem.
Natives: None known.

Impacts

Agricultural: Yellow toadflax contains a poisonous glucoside that is reported to be mildly poisonous to cattle (Morishita 1991). However, the plant is considered unpalatable and reports of livestock poisonings are rare.
Ecological: Yellow toadflax is quick to establish in open sites and is capable of adapting growth to a wide range of environmental conditions. Yellow toadflax aggressively forms colonies through adventitious buds from creeping root systems. These colonies can push out native grasses and other perennials, thereby altering and simplifying the species composition of natural communities and reducing forage production for livestock and wildlife.
Human: No information available.

Habitat and Distribution

General requirements: Yellow toadflax has a highly variable habitat that depends on environmental factors such as shading, grazing, and soil type (Saner et al. 1995).

Distribution: Yellow toadflax now occurs throughout the continental United States and in every Canadian province and territory (Saner et al. 1995). In Colorado, yellow toadflax is abundant on the Western Slope, but can be found on the Front Range as well. It is typically found from 6,000 to 8,500 feet, but can be found up to 10,000 feet.
Historical: Yellow toadflax was introduced from Eurasia as an ornamental.

Biology/Ecology

Life cycle: Spring emergence occurs around mid-April and depends primarily on temperature. A smaller flush of seedlings can occur in the fall. Prostrate stems emerge in September and produce leaves that are ovate, 0.9-1.5 inches in size. Prostrate stems are tolerant to freezing and are associated with floral stem production the following year (Robocker 1974). The strong, upright floral stems that are characteristic of mature toadflax plants develop after a winter's dormancy, and emerge about the same time as seedlings in mid-April. Flowering occurs from May through August and seeds mature from July through October (Saner et al. 1995). Yellow toadflax is self-incompatible and relies on insects for pollination. The two most important pollinators are bumblebees and halictid bees (Zimmerman 1996).
Mode of reproduction: Yellow toadflax can reproduce both by seeds and vegetatively. Vegetative reproduction enables a stand of toadflax to spread rapidly. Stems develop from adventitious buds on primary and lateral roots. These buds can grow their own root and shoot system, and become independent plants the next year. Yellow toadflax colonies persist mostly via vegetation means while those of Dalmatian toadflax persist both by vegetative and seed reproduction (Lajeunesse 1999).
Seed production: A mature plant can produce up to 30,000 seeds annually. A single stem has been reported to contain over 5,000 seeds (Saner et al. 1995).
Seed bank: Seeds can remain dormant for up to ten years.
Dispersal: Winged seeds aid wind dispersal. Seeds may also be dispersed by water and ants (Rutledge, 1998).
Hybridization: No information available.

Control

Keys to Control:
- Limit vegetative spread of colonies.
- Destroy seedlings that emerge from the soil seed bank.
- Maintain a cover of native perennial plants to discourage infestation elsewhere.

Biocontrol: The Division of Plant Industry's Biological Pest Control Section currently has one species, *Calophasia lunula*, that may be available for redistribution on yellow toadflax infestations. *C. lunula* larvae feed extensively on leaves and flowers of toadflax, severely damaging the plants.
Mechanical: Hand pulling toadflax before seed set each year can be an effective control method especially in coarse-textured soils where large portions of the roots can be pulled. However, this method must be repeated as long as there are viable seeds in the soil (up to 10 years). Cutting or mowing yellow toadflax reduces the current year growth and possibly seed dispersal, but will not kill the plant. These techniques are not recommended to control any toadflax species (Lajeunesse 1999).
Fire: Burning is not a recommended control method for yellow toadflax (Saner et al. 1995). The large, deep root system protects the plant from burning. In fact, areas that have been recently disturbed by fire are susceptible to increased toadflax infestation.
Herbicides: Effectiveness of herbicides on both toadflax species is highly variable, reflecting in part their high genetic variability (Lajeunesse 1999). Yellow toadflax is difficult to control with herbicides. Herbicides should be applied during flowering when carbohydrate reserves in the root of the plants are at their lowest. Picloram or dicamba at 1 lb. ai/acre, or glyphosate at 1.5 lb. ai/acre, will kill yellow toadflax plants in some situations. 2,4-D, MCPA, 2,4-DB, MCPB and mecoprop are ineffective on yellow toadflax (Lajeunesse 1999). Picloram+2,4-D at 0.5+1.0 lb. ai/acre (as Grazon P+D®) controlled 95-100% of yellow toadflax when applied for 1-3 consecutive years (Sebastian and Beck 1999).
Cultural/Preventive: In agricultural areas, miminum-till cultivation practices have contributed to the resurgence of toadflax populations (McClay 1992). By not tilling the soil, and subsequently damaging the root system of toadflax plants, toadflax colonies have been able to flourish. Intensive clean cultivation techniques are recommended for successful toadflax control on agricultural land. This requires at least two years with 8-10 cultivations in the first year and 4-5 cultivations in the second year (Morishita 1991).

Integrated Management Summary

Yellow toadflax rapidly colonizes open sites. It is most commonly found along roadsides, fences, rangelands, croplands, clear cuts, and pastures. Disturbed or cultivated ground is a prime candidate for colonization. The seedlings of yellow toadflax are considered ineffective competitors for soil moisture with established perennials and winter annuals (Morishita 1991). However, once established, yellow toadflax suppresses other vegetation mainly by intense competition for limited soil water. Mature plants are particularly competitive with winter annuals and shallow-rooted perennials.

The key to controlling yellow toadflax is to limit vegetative spread of established colonies (by cutting, pulling, or spraying seed stalks prior to seed set, or by using insects to destroy flowers, seeds, or damage plants). Once current seed production has been controlled, toadflax seedlings that emerge from the soil seed bank must be destroyed every year until the seed bank is diminished.

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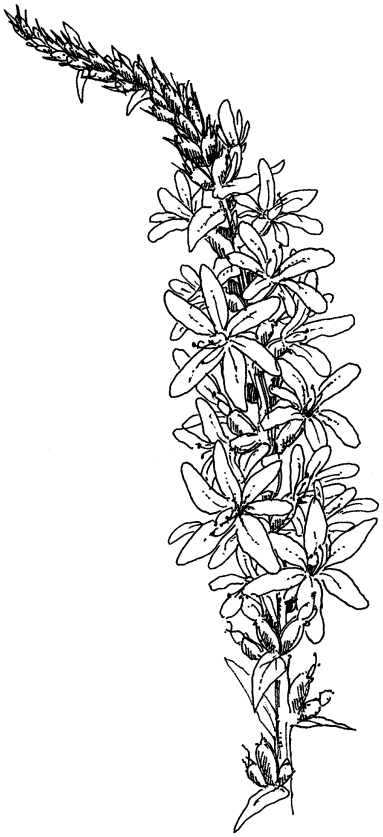
Purple loosestrife

Lythrum salicaria L.

Family: *Lythraceae* (Loosestrife)
Other Names: purple lythrum
USDA Code: LYSA2
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:
- Showy rose-purple flowers bloom in long vertical racemes.
- Lance-shaped leaves have smooth edges.

Identification
Growth form: Perennial forb or woody sub-shrub.
Flower: Flowers are purple with 5-7 petals arranged in long vertical racemes.
Seeds/Fruit: Fruits are many-seeded capsules, seeds are small and ovoid.
Leaves: Leaves are simple, entire, and opposite or whorled (Whitson et al. 1996).
Stems: Annual stems arise from a perennial rootstock (Mal et al. 1992). Stems are erect, and often grow 6-8 feet tall. Plants become taller and bushier over the years as the rootstock matures.
Roots: Short rhizomes and taproot.
Seedling: No information available.



Similar Species
Exotics: Sometimes confused with Dame's rocket *(Hesperis matronalis)*, an exotic mustard.
Natives: Sometimes confused with fireweed (*Epilobium* spp.), which has 4-petaled flowers.

Impacts
Agricultural: No information available.
Ecological: Purple loosestrife is an ornamental species that often escapes to sites such as streambanks or shallow ponds. The invasion of purple loosestrife leads to a loss of plant diversity, which also leads to a loss of wildlife diversity (Bender and Randall 1987). Purple loosestrife germinates at such high densities that it outcompetes native seedlings. Dense infestations can impede water flow in canals and ditches. When placed under moisture stress, purple loosestrife may produce additional roots, which may give it a competitive advantage over other species. It is an aggressive invader of wetlands. Once it is established, it often displaces native wetland species and degrades wildlife habitat. If purple loosestrife is left unchecked, the wetland eventually becomes a monoculture of loosestrife (Bender and Randall 1987). Where purple loosestrife is competing with cattails, it is favored by fluctuating water levels because marsh drawdown aids in seedling establishment (FEIS 1996). However, where water levels remain constant and relatively deep, cattails may be able to outcompete purple loosestrife (FEIS 1996).
Human: No information available.

Habitat and Distribution

General requirements: Purple loosestrife usually occurs in marshes, wet meadows, stream margins, shores of lakes and wetlands. A few of its most common associates include cattail, reed canarygrass (*Phalaris arundinacea*), sedge (*Carex* spp.), bulrush (*Scirpus* spp.), rush (*Juncus* spp.), and willow (*Salix* spp.). Purple loosestrife can tolerate a wide range of conditions (up to 50% shade), can grow on calcareous and acidic soils (Rutledge and McLendon) and will even grow in standing water.
Distribution: In Colorado, purple loosestrife is known to occur in the Denver/Boulder area and along the South Platte River, in Mesa County along the Colorado River, in Montrose County near Nucla, in Otero County near the Arkansas River, and in Colorado Springs. It is not known if purple loosestrife has upper elevational limits, but since it grows successfully in Canada, it should be considered a threat at higher elevations in Colorado.
Historical: Purple loosestrife is a native of Eurasia and was first recorded in America in 1814 (Bender and Randall 1987).

Biology/Ecology

Life cycle: Purple loosestrife begins its growth about a week to 10 days after cattail and reed canarygrass. Spring established seedlings grow rapidly and produce flowers 8 to 10 weeks after germination. After flowering, each stem supports a dense spiraling row of dark-brown seed capsules.
Mode of reproduction: Purple loosestrife is a perennial that reproduces by seeds and rhizomes. The rootstalk of purple loosestrife is the main organ of local propagation; therefore, wide vegetative spread is unlikely. However, detached root or stem fragments can take root and develop into flowering stems (FEIS 1996).
Seed production: A single flowering stalk can produce 300,000 seeds, and densities as high as 80,000 stalks per acre have been recorded (FEIS 1996).
Seed bank: Purple loosestrife seeds may remain viable for up to 20 years.
Dispersal: Seeds are mainly distributed by water, but can also be dispersed by animals and humans. Seeds do not drop from capsules until the air temperature becomes cold in the early fall.
Hybridization: No information available.

Control

Keys to Control:
- Prevent new seeds from being added to the seed bank.
- Maintain a healthy cover of perennial plants.
- Any control effort should be followed up the same growing season and for several years afterwards.

Biocontrol: There are several biological control agents that show potential for controlling purple loosestrife (Rutledge and McLendon). The root-boring weevil (*Hylobius transversovittatus*), can seriously damage the root system of purple loosestrife, stunt growth, and reduce seed production (Rutledge and McLendon). This species is being reared at the Division of Plant Industry's Insectary, but is currently unavailable for general redistribution. Two leaf-eating weevils *Galerucella calmariensis* and *G. pusilla* also show potential as biological control agents (Rutledge and McLendon). Experimental releases of *Galerucella* in the Denver area by the Bureau of Reclamation have become established and appear to be providing effective control of purple loosestrife (D. Weber, pers. comm.). These two species may be available for redistribution upon request.
Mechanical: Hand removal of isolated individuals can be effective on a small scale. Pulling should be conducted prior to seed set. It is important to remove the entire rootstalk of the plant to avoid regrowth from root fragments.
Fire: No information available.
Herbicides: Purple loosestrife is found in very wet soils, thus great care should be used when using herbicides as these may endanger other water plants (Rutledge and McLendon). Glyphosate (in an aquatic formulation such as Rodeo) is commonly used to control purple loosestrife (Rutledge and McLendon). A non-ionic surfactant must be mixed with the Rodeo prior to spray application. The safest method is to cut off all stems about 6 inches from the bottom of the plant and then spray or drip glyphosate (20-30% solution) onto the cut surface (Rutledge and McLendon), however, it is more effective to spray individual plants using a backpack sprayer (D. Weber, pers. comm.). Colorado research by the Bureau of Reclamation has shown that loosestrife plants sprayed with glyphosate will still produce viable seeds if the flowers are 50% or more developed on the stalk when spraying occurs. Therefore, flower heads must be cut and hauled away to prevent seed spread if they are mature when sprayed (D. Weber, pers. comm.).

Broadleaf herbicides (2,4-D based) can be effective on loosestrife if applied to young plants in late May or early June (Bender and Randall 1987). The herbicide Garlon 3A is effective on purple loosestrife and like 2,4-D is specific to broadleaved plants. It is currently only approved in Colorado for experimental use, but may soon be approved for general use (D. Weber, pers. comm.).
Cultural/Preventive: Prevent the establishment of new infestations by minimizing disturbance and seed dispersal.

Integrated Management Summary

Loosestrife populations which extend over three acres are difficult to eradicate and may be a better target for containment rather than control (Rutledge and McLendon). The key to effective control is early detection when infestations are small. It is fairly easy to control small numbers of loosestrife plants when the seed bank in the soil is small. Eradicating large populations with huge populations is much more difficult. Biological control should primarily be considered when populations of loosestrife have become large or are inaccessible. Small loosestrife infestations should be eradicated by hand-pulling or herbicide application. For an example of purple loosestrife control efforts, see page 64.

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Scotch thistle

Onopordum acanthium L. and ***O. tauricum*** L.

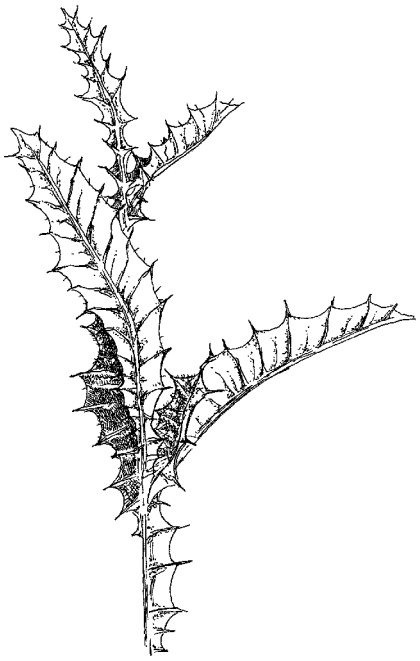
Family: *Asteraceae* (Sunflower)
Other Names: cotton thistle, winged thistle
USDA Code: ONAC, ONTA
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:

- Scotch thistle can be distinguished from other thistles by its large size, and by the spiny wings attached to the stems and the dense, fine hair that give it a characteristic grayish-blue or blue-green color.
- Rosettes often have huge, broad leaves.

Identification

Growth form: Perennial forb.
Flower: Flower heads are numerous, 1-2 inches in diameter, with spine-tipped bracts. Flowers are violet to reddish.
Seeds/Fruit: One-seeded fruit (achene) is wrinkled, brown to grayish-black, tipped with a plume (pappus) of slender bristles (Stubbendieck et al. 1995).
Leaves: Leaves are alternate, very large, irregularly lobed, and have sharp yellow spikes. Rosette leaves may be up to 2 feet long and 1 foot wide (Whitson et al. 1996). Upper and lower leaf surfaces of *O. acanthium* are covered with a thick mat of cotton-like or woolly hairs, giving the foliage a gray-green color (Dewey 1991).
Stems: Mature plants can grow up to 12 feet tall, and have a large, fleshy taproot. Stems are numerous, branched, and have broad spiny wings.
Roots: Thick fleshy taproot.
Seedling: No information available.



Leaves

Similar Species

Exotics: *Onopordum acanthium* is the predominant Scotch thistle species in the western United States and is characterized by its hairy leaves (Beck 1991). A hairless species, *Onopordum tauricum*, also occurs but much less frequently, mostly in the Arkansas River drainage in Colorado (Beck 1991).
Natives: There are many native thistle species (in the genus *Cirsium*). The natives generally do not have leaves clasping the stem all the way from node to node (strongly decurrent leaves), and many have hairy upper and lower leaf surfaces and are blue-green or gray in color.

Impacts

Agricultural: Scotch thistle is an aggressive plant that is competitive with desirable native forage species. It can form dense stands that are impenetrable to livestock.
Ecological: No information available.
Human: No information available.

Habitat and Distribution

General requirements: Scotch thistle is often found along roadsides, irrigation ditches, waste areas and on rangelands. The seeds contain a water-soluable germination inhibitor, so Scotch thistle is particularly successful in moist areas that are adjacent to riparian or sub-irrigated deeper soils along stream courses, lower alluvial slopes and bottomlands.
Distribution: Occurs sparsely over much of the United States. It is increasing throughout Colorado.

Scotch thistle *(Onopordum acanthium)*

Historical: Native to Eurasia.

Biology/Ecology

Life cycle: Scotch thistle is a biennial that produces a large, ground level rosette the first year, and a tall, spiny plant the second. Flowering occurs from mid-June to September.
Mode of reproduction: Scotch thistle reproduces by seed.
Seed production: One plant produces70-100 flowering heads containing 100-140 seeds per head (Young and Evans 1969).
Seed bank: Seeds may remain viable in the soil for over 30 years.
Dispersal: Plumed seeds can be dispersed by attaching to clothing and animal fur. Seeds may be transported in hay and machinery, and seed heads may be carried by wind and water.
Hybridization: No information available.

Control

Biocontrol: None known.
Mechanical: As with other perennial forbs, mechanical controls such as mowing or hand cutting are most effective in combination with other methods. Plants can regrow from severed roots, and cut stems may still produce viable seed.
Fire: No information available.
Herbicides: Picloram at 0.25 lb., dicamba at 0.5 lb., or 2,4-D at 1 lb., clopyralid at 0.2 lb. ai/acre, or a combination of dicamba+2,4-D, or clopyralid+2,4-D are commonly used to control Scotch thistle. Herbicides should be applied in spring before Scotch thistle bolts or in the fall to rosettes (Beck 1991). Metsulfuron or chlorsulfuron are effective on Scotch thistle after bolting begins (Beck 1999). Herbicide rates will vary depending upon stand density and environmental conditions (Beck 1991).
Cultural/Preventive: No information available.

Keys to Control:

- Scotch thistle is best controlled in the rosette stage.
- Sever the taproot of Scotch thistle 1-2 inches below the ground.

Integrated Management Summary

Scotch thistle is best controlled in the rosette stage. Scotch thistle can be controlled by severing its taproot 1-2 inches below the ground. Control can be enhanced by a follow-up application of herbicides to the surviving rosettes. One integrated approach to Scotch thistle management involves 1) managing livestock grazing to increase grass vigor and reduce bare ground; 2) spray rosettes with clopyralid or 2,4-D; 3) re-seed treated ground with competitive desirable plants in the fall after spraying; 4) follow-up with spot cutting of entire plants when first flowers appear annually for several years to deplete the seed bank in the soil.

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Saltcedar

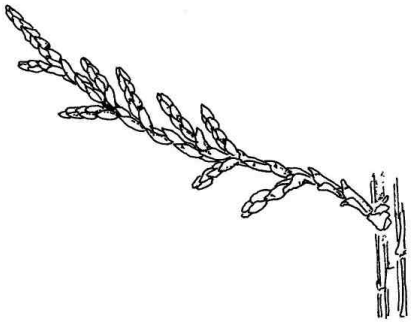
Tamarix ramosissima Ledeb. and ***Tamarix parviflora*** DC.

Family: ***Tamaricaceae*** (Tamarisk)
Other Names: tamarisk, salt cedar
USDA Code: TARA, TAPA4
Legal Status: Colorado Noxious List A (general weeds)

Keys to Identification:

- Saltcedar is a tall shrub or small tree that has large sprays of small whitish or pinkish flowers that are born in finger-like clusters.
- Leaves are very small and scaly.

Identification
Growth form: Deciduous, loosely branched shrubs or small trees.
Flower: Flowers are whitish or pinkish and borne on slender racemes 2-5 cm long on the current year's branches and are grouped together in terminal panicles. Petals are usually retained on the fruit.
Seeds/Fruit: The seeds are borne in a lance-ovoid capsule.
Leaves: Leaves are minute, appressed scaly leaves, alternately arranged.
Stems: Branchlets are slender; plants may reach heights of 15 feet or more.
Roots: The primary root can grow to a depth of up to 30 meters or more (Baum 1978). Plants can develop spreading horizontal roots after reaching the water table. These can spread up to 50 meters and are capable of producing adventitious buds (DiTomaso 1996).
Seedling: No information available.



Branch

Similar Species
Exotics: None known.
Natives: None known.

Impacts
Agricultural: No information available.
Ecological: Saltcedar is an aggressive, woody invasive plant species that has become established over as much as a million acres of the western United States (Carpenter 1998). Saltcedar crowds out native stands of riparian and wetland vegetation. It increases the salinity of surface soil, rendering the soil inhospitable to native plant species. Saltcedar provides generally lower wildlife habitat value than native vegetation. It uses more water than comparable native plant communities and dries up springs, wetlands, riparian areas and small streams by lowering surface water tables. However, in places where beaver dams or other structures have raised the water table, saltcedar can be outcompeted by *Salix exigua* (R. Roberts, pers. comm.) Saltcedar widens floodplains by clogging stream channels and increases sediment deposition due to the abundance of saltcedar stems in dense stands.
Human: No information available.

Close up of leaves

Habitat and Distribution
General requirements: Saltcedar grows well on moist sandy, sandy loam, loamy, and clayey soil textures (FEIS 1996). Saltcedar is tolerant of highly saline habitats, and it concentrates salts in its leaves. Over time, as leaf litter accumulates under saltcedar plants, the surface soil can become highly saline, thus impeding future colonization by many native plant species. Saltcedar is not tolerant of shading. Shaded plants have altered leaf morphology and

reduced reproduction (FEIS 1996). Saltcedar commonly occurs along floodplains, riverbanks, stream courses, saltflats, marshes, and irrigation ditches in arid regions of the Southwest and the Southern Great Plains (FEIS 1996).
Distribution in Colorado: In Colorado, saltcedar is most commonly found between 3,400 to 7,000 feet (FEIS 1996), but can be found up to 8,000 feet (A. Green, pers. comm.). It is widespread in riparian areas throughout the western United States.
Historical: Introduced to North America for use as ornamental, windbreak, and erosion control.

Biology/Ecology
Life cycle: Saltcedar generally flowers in its third year of growth or later, but may flower during the first year (FEIS 1996). Saltcedar buds generally break dormancy in February or March. The flowers are most abundant between April and August, but may be found any time of the year in desert areas. Saltcedar flowers continuously under favorable environmental conditions but the flowers require insect pollination to set seed. Seedlings grow slowly and require saturated soils throughout the first 2-4 weeks of growth (FEIS 1996). Ideal conditions for first-year survival are saturated soil during the first few weeks of life, a high water table, and open sunny ground with little competition from other plants.
Mode of reproduction: Reproduces by seeds as well as vegetatively. Saltcedar sprouts from the root crown and rhizomes, and adventitious roots sprout from submerged or buried stems (FEIS 1996). This allows saltcedar to produce new plants vegetatively following floods from stems torn from the parent plants and buried by sediment.
Seed production: A mature saltcedar plant can produce 600,000 minute seeds annually (FEIS 1996).
Seed bank: Seeds are viable for up to 45 days under ideal conditions during summer, and can complete germination within 24 hours following contact with water (Carpenter 1998). Saltcedar seeds had no dormancy or after-ripening requirements.
Dispersal: The seeds are readily dispersed by wind and water.
Hybridization: No information available.

Control
Biocontrol: The USDA has permitted the release of two species of insects for saltcedar biocontrol but widespread releases have not yet been permitted (A.T. Carpenter, pers. comm.).
Mechanical: As an alternative to herbicides, a bulldozer or prescribed fire can be used to open up large stands of saltcedar. Once opened, the resprouts can be sprayed when they are 1 to 2 m tall using imazapyr, or imazapyr plus glyphosate, or triclopyr.
Fire: See above.
Herbicides: For larger areas (> 2 hectares) that are essentially monotypic stands of saltcedar, the best methods would likely be foliar application of imazapyr herbicide to the intact plants or burning or cutting plants followed by foliar application of imazapyr or triclopyr to the resprouted stems. Foliar application of imazapyr or imazapyr in combination with glyphosate can be effective at killing large, established plants. Over 95% control has been achieved in field trials during the late summer or early fall (Carpenter 1998). The herbicide can be applied from the ground using hand-held or truck-mounted equipment or from the air using fixed-wing aircraft. Foliar application of herbicide works especially well in monotypic stands of saltcedar, although experienced persons using ground equipment can spray around native trees and shrubs such as cottonwood and willow.

Keys to Control:
- Select the appropriate control method based on the size of the area and other environmental or cultural considerations.
- Re-seed controlled areas with desirable species to protect the soil resource and to prevent or retard saltcedar reinvasion.

Saltcedar eradication in areas that contain significant numbers of interspersed, desirable shrubs and trees is problematic. Depending upon site conditions, it may not be possible to rapidly kill saltcedar plants without also killing desirable shrubs and trees. It such situations, it may be necessary to cut and treat saltcedar stumps with herbicide, as outlined in the next paragraph. While this method is relatively slow and labor-intensive, it will spare desirable woody plants. Alternatively, it may be more cost-effective to kill all woody plants at a site and replant desirable species afterward.

For modest-sized areas (< 2 hectares), cutting the stem and applying herbicide (known as the cut-stump method) is most often employed. The cut-stump method is used in stands where woody native plants are present and where their continued existence is desired. Individual saltcedar plants are cut as close to the ground as possible with chainsaws, loppers or axes, and herbicide is applied immediately thereafter to the perimeters of the cut stems. Herbicides must be applied immediately to the cut because wound healing ocurrs very quickly and decreases herbicide penetration. The herbicides triclopyr and imazapyr can be very effective when used in this fashion. This treatment appears to be most effective in the fall when plants are translocating materials to their roots. The efficacy

of treatments is enhanced by cutting the stems within 5 cm of the soil surface, applying herbicide within one minute of cutting, applying herbicide all around the perimeter of the cut stems, and retreating any resprouts 4 to 12 months following initial treatment.

Cultural/Preventive: No matter how effective initial treatment of saltcedar might be, it is important to re-treat saltcedar that is not killed by initial treatment. After saltcedars are killed, other vegetation must be established to protect the soil resource and to prevent or retard saltcedar re-invasion (Frasier and Johnsen 1991). Establishing a canopy cover on treated areas with seeded grasses and planted cottonwood cuttings could reduce the chances of saltcedar successfully re-invading an area (Frasier and Johnsen 1991).

Integrated Management Summary

Saltcedar is native of Eurasia that was introduced as an ornamental and stream bank stabilizer. It is a pioneer species that establishes on freshly exposed alluvium, sand and gravel bars, and streambanks or floodplains after disturbance (FEIS 1996). Once established it often occurs in pure stands, persisting indefinitely in the absence of disturbance (FEIS 1996). It can replace or displace native woody species, such as cottonwood, willow and mesquite, which occupy similar habitats, especially when timing and amount of peak water discharge, salinity, temperature, and substrate texture have been altered by human activities. Saltcedar produces massive quantities of small seeds and can propagate from buried or submerged stems.

Saltcedar can be controlled by five principal methods: 1) applying herbicide to foliage of intact plants; 2) removing aboveground stems by burning or mechanical means followed by foliar application of herbicide to resprouts; 3) cutting stems close to the ground followed by application of triclopyr (Garlon™) to the cut stems; 4) spraying basal bark with triclopyr; and 5) digging or pulling plants (Carpenter 1998).

Selecting an appropriate control method involves considering the size of the area where saltcedar is to be controlled, restrictions on the use of particular herbicides or herbicides generally, the presence or absence of desirable vegetation where saltcedar is growing, the presence or absence of open water, adjacent land uses that might restrict prescribed burning, and the availability and cost of labor (Carpenter 1998).

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Appendix E
Preliminary Seed Mixes for Restoration

Appendix E contains preliminary seed mixes for consideration in restoration efforts on the Open Space.

One of the following general mixes, depending on soil type can be used for shortgrass prairie restoration.

Clayey Plains

Species	Variety	Percent of Mix	Pounds PLS/acre
western wheatgrass	Arriba	35	5.6
green needlegrass	Lodorm	25	2.5
sideoats grama	Vaughn	20	1.8
blue grama	Pastura	15	0.5
purple prairie clover		5	0.3
four wing saltbush	Wytana		0.5
winterfat			0.5
Total		100	11.7

Loamy Plains

Species	Variety	Percent of Mix	Pounds PLS/acre
western wheatgrass	Arriba	40	6.4
green needlegrass	Lodorm	20	2.0
blue grama	Hachita	20	0.6
sideoats grama	Vaughn	10	0.9
little bluestem	Pastura	10	0.7
Total		100	10.6

The following seed mix is an adaptable combination of species that will grow in a variety for changing moisture regimes. These species are not recommended for constantly saturated conditions.

Species	Variety	Percent of Mix	Pounds PLS/acre
switchgrass	Nebraska 28	20	0.9
prairie cordgrass		20	1.4
big bluestem	Kaw	20	2.2
western wheatgrass	Arriba	15	2.4
yellow indiangrass	Llano	15	1.5
slender wheatgrass		10	1.1
Total		100	9.5

The following seed mix can be used in areas of streamside forest:

Species	Variety	Percent of Mix	Pounds PLS/acre
western wheatgrass	Arriba	30	4.8
green needlegrass	Lodorm	20	2.0
switchgrass	Nebraska 28	15	0.7
big bluestem	Kaw	15	1.7
yellow indiangrass	Llano	10	1.0
blue grama	Pastura	10	0.3
Total		100	10.5

Appendix F
Weed Management Plan Worksheet

Appendix F consists of an electronic copy of the Weed Management Plan Worksheet created in MSExcel