STATE OF COLORADO

Eschberger - DNR, Amy <amy.eschberger@state.co.us>

YRR M-2021-009 - Weed Management and Wildlife Plans

Katie Todt <katie@lewicki.biz> Thu, Feb 17, 2022 at 3:19 PM
To: "Eschberger - DNR, Amy" <amy.eschberger@state.co.us>
Cc: Robert Young <youngranchresource@gmail.com>

Good afternoon, Amy:

Per our phone discussion early today, please see the attached Weed Management Plan and Wildlife Mitigation Plans for the Young Ranch Resource Quarry. These items are mentioned in our December 20, 2021 dated Preliminary Adequacy Response questions #45 and #63, respectively.

Kindly let me know when you've received both files. We look forward to receiving your second adequacy review and hope these plans can be included in that process. Thanks for taking my call today and I hope you have a lovely weekend.

Note – this is 1/2 emails as the files together are too large to send via email.

Cheers,

Katie Todt

Senior Consultant

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Young Ranch Resource Weed Mgmt 2-1-22.pdf
20611K

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WEED MANAGEMENT PLAN

FOR

YOUNG RANCH RESOURCE

CLEAR CREEK AND GILPIN COUNTIES, COLORADO

Prepared For:
Bob Young
Young Ranch, LLC

ERC Project #1290-2105

CONTENTS

ATTACHMENT A

Weed Monitoring Form

ATTACHMENT B

Weed Management Map

ATTACHMENT C

Colorado Listed Noxious Weeds Fact Sheets

1.0 INTRODUCTION

The proposed Young Ranch Resource (Project), located on the north side of I-70 and east of Idaho Springs in the counties of Clear Creek and Gilpin, Colorado encompasses approximately 469.7 acres that has been slated for an aggregate mine. The mine, with an approximate 100-year lifespan, will be used to supply the Denver metro area and surrounding Colorado and regional markets with crushed stone and other aggregate products. With the current anticipated upward trend in economic activity and increasing population of Colorado, the Project will be a necessary resource to supply the region with a variety of aggregate products that are in high demand now and in the future. The mine will be developed in 5 phases. Phase 1 will expose 15 acres, Phase 2 will expose 61 acres, Phase 3 will expose 123 acres, Phase 4 will expose 63 acres and the 5th and final Phase will expose 59 acres. Significant ground disturbances associated with mining activities provide ideal conditions for the establishment and spread of noxious weeds. This weed management plan (Plan) has been developed specifically for the Project to identify and control noxious weeds during the life of the Project.

2.0 PURPOSE

The purpose of this Plan is to implement early detection protocols, define containment strategies and put into practices control measures and monitoring to minimize the spread of noxious weeds during Project operations and reclamation activities. The Plan will follow an integrated management approach which entails planning and implementation of a coordinated program utilizing a variety of methods for management of noxious weeds. This Plan will inventory and provide a summary of the location, type and density of noxious weeds identified within the Project Area as well as control measures employed. The Plan is to serve as an on-site reference manual and documentation of weed conditions and control measures throughout the life of the Project.

Earth-moving/disturbance activities are anticipated throughout the life of the Project and include the construction of mining facilities, access roads, stormwater drainage systems, restoration of mining phases, and the overall aggregate mining processes. These main activities have potential to spread weeds throughout the Project Area. The method by which weeds spread must first be understood before control measures can be implemented. Weeds can generally spread through the following four pathways.

1. **Soil disturbance** - when soil and existing vegetation is disturbed it creates an opportunity for weeds to move into an area left open or for seeds in the soil to be exposed and germinate.
2. **Contaminated materials** - Weeds often are introduced unintentionally as contaminants in seed, soil, hay, or revegetation materials. This includes weed seeds and plant fragments that can become lodged in or on vehicles and equipment. Seeds also move easily by becoming attached to clothing, shoes, and other personal gear.
3. **Animals** - Pets, domestic livestock and wildlife may spread weeds when seeds attach to their coats or through their droppings.
4. **Environmental** - Wind, water, and soil can move seeds and plant fragments.

3.0 COLORADO NOXIOUS WEED LAW

Per the Colorado Secretary of State Administrative Rules 2 CCR 407-1 Rule 3.1.10 (6) "methods of weed control shall be employed for all prohibited noxious weed species, and whenever invasion of a reclaimed area by other weed species seriously threatens the continued development of the desired vegetation". This Plan will assist the Project to adhere to the 2003 Colorado Noxious Weed Act and local ordinances.

The Colorado Noxious Weed Program (Title 35, Article 5.5) requires control of 76 plant species designated as noxious weeds. The Department of Agriculture defines noxious weeds as "an alien plant that has 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":

- Aggressively invades or is detrimental to economic crops or native plant communities
- Is poisonous to livestock
- Is a carrier of detrimental insects, diseases, or parasites
- The direct or indirect effect of the presence of this plant is detrimental to the environmentally sound management of natural or agricultural ecosystems

Any weed on the Colorado Noxious Weed "A List" should be promptly and aggressively treated. Similarly, areas with infestations of Colorado Noxious "B or C List" species with more than 10% cover should be promptly addressed; however, a tolerable range of what species can be present and/or cover of an individual species can vary by state or local jurisdiction and by specific permitting requires for an individual project.

The state of Colorado has divided the 76 plant species into three groups: List A, List B, and List C (Colorado Department of Agriculture 2022).

- "List A" contains 25 species designated as high priority weeds and must be eradicated. However, these species have very limited distribution throughout Colorado (**Table 1**).
- "List B" contains 35 species which are more common throughout Colorado but can be managed in a way that stops the continued spreading of the species (suppression). Controlling these species can be done with chemical controls, mechanical controls, or cultural controls (**Table 2**).
- "List C" contains 16 species that are widespread throughout Colorado and should be managed to stop the spread (contained). These species are used to provide additional education, research, and biological control approaches (**Table 3**).

The Colorado Department of Agriculture website should be checked annually to obtain the most current and updated species list. 2022 listed species can be found in (**Attachment C**). Per CO 35-5.5-105, the state of Colorado has mandated that all counties must implement a noxious weed plan for all unincorporated land in each respective county. Gilpin County Ordinance No. 06-02 – *Weed Management Plan 2011*, is mandated through the Gilpin County Weed Advisory Board. The *Gilpin County Weed Management Plan* is consistent with the "Colorado Noxious Weed Act" 35-5.5-101 and the "Permanent Rules Pertaining to the Administration and Enforcement of the Colorado Weed Management Act" 8 C.C.R. 1203-19.

Clear Creek County Ordinance #11-A – Clear Creek County Noxious Weed Management Plan is mandated through the Counties Board of County Commissioners. The ordinance is consistent with the state noxious weed management plan pursuant to 35-5.5-108.

Table 1. CO Noxious Weed List A

Designated for eradication	
Scientific Name	**Common Name**
Peganum harmala	African rue
Fallopia bohemicum	Bohemian knotweed
Alhagi pseudalhagi	Camelthorn
Crupina vulgaris	Common crupina
Euphoriba cyparissias	Cypress spurge
Isatis tinctoria	Dyer's woad
Brassica elongata	Elongated mustard
Butomus umbellatus	Flowering rush
Fallopia sachalinensis	Giant knotweed
Arundo donax	Giant reed
Salvinia molesta	Giant Salvinia
Epilobium hirsutum	Hairy willow-herb
Hydrilla verticillate	Hydrilla
Fallopia japonica	Japanese knotweed
Centaurea x moncktonii	Meadow knapweed
Salvia aethiopis	Mediterranean sage
Taeniatherum caput-medusae	Medusahead
Euphoriba myrsinites	Myrtle spurge
Hieracium aurantiacum	Orange hawkweed
Myriophyllum aquaticum	Parrotfeather
Lythrum salicaria	Purple loosestrife
Chondrilla juncea	Rush skeletonweed
Centaurea virgata	Squarrose knapweed
Senecio jacobaea	Tansy ragwort
Centaurea solstitialis	Yellow starthistle

Fact sheets provided by the Colorado Department of Agriculture are provided in **Attachment C.**

Table 2. CO Noxious Weed List B

Develop and implement Weed Management Plan	
Scientific Name	**Common Name**
Artemisia absinthium	Absinth wormwood
Hyoscayamus niger	Black henbane
Saponaria officinalis	Bouncingbet
Cirsium vulgare	Bull thistle
Cirsium arvense	Canada thistle
Clematis orientalis	Chinese clematis
Tanacetum vulgare	Common tansy
Dipsacus fullonum	Common teasel
Dipsacus lacinatus	Cutleaf teasel
Linaria dalmatica & genistifolia	Dalmatian toadflax
Hesperis matronalis	Dame's rocket
Centaurea diffusa	Diffuse knapweed
Myriophyllum spicatum	Eurasion watermilfoil
Lepidium draba	Hoary cress
Cynoglossum officinale	Houndstongue
Centaurea x psammogena	Hybrid knapweed
Linaria vulgaris	Hybrid toadflax
Aegilops cylindrica	Jointed goatgrass
Euphorbia esula	Leafy spurge
Anthemis cotula	Mayweed chamomile
Verbascum blattaria	Moth mullein
Carduus nutans	Musk thistle
Leucanthemum vulgare	Oxeye daisy
Lepidium latifolium	Perennial
Carduus acanthoides	Plumeless thistle
Acroptilon repens	Russian knapweed
Elaeagnus angustifolia	Russian olive
Tamarix chinensis	Salt cedar
Tripleurospermum inodorum	Scentless chamomile
Onopordum acanthium	Scotch thistle
Centaurea stoebe	Spotted knapweed
Potentilla recta	Sulfur cinquefoil
Carum carvi	Wild caraway
Cyperus esculentus	Yellow nutsedge
Linaria vulgaris	Yellow toadflax

Fact sheets provided by the Colorado Department of Agriculture are provided in **Attachment C.**

Table 1. CO Noxious Weed List C

Develop and implement weed management plan with focus on education, research and biological control	
Scientific Name	**Common Name**
Poa bulbosa	Bulbous bluegrass
Cichorium intybus	Chicory
Arctium minus	Common burdock
Verbascum Thapsus	Common mullein
Hypericum perforatum	Common St. Johnswort
Bromus tectorum	Downy brome
Convolvulus arvensis	Field bindweed
Halogeton glomeratus	Halogeton
Sorghum halepense	Johnsongrass
Sonchus arvensis	Perennial sowthistle
Conium maculatum	Poison hemlock
Tribulus terrestris	Puncturevine
Elymus repens	Quackgrass
Erodium cicutarium	Redstem filaree
Abutilon theophrasti	Velvetleaf
Panicum miliaceum	Wild-proso millet

Fact sheets provided by the Colorado Department of Agriculture are provided in **Attachment C.**

4.0 METHODS

While land clearing, earth moving and mining activities progress throughout the life of the Project, maintaining weed control throughout the Project Area during each phase will reduce potential weed concerns. Ideally, weed control measures should be considered twice a year or, prior to any new land clearing, earth moving activity or disturbance.

To maintain the effectiveness of this Plan, the following recommendations are provided:

1. Weed Manager – Mine operations shall designate a weed manager. The weed manager will have the responsibility of implementing the Plan, and ensuring correct identification of weed species, maintaining data collection, and safely and effectively implementing control measures. The weed manager may also wish to employ professional experienced contractors. The weed manager will ensure that all State declared weeds are identified and controlled as required by the Plan and by State regulations. The weed manager will maintain a copy of the Plan and keep in on site at all times.
2. Monitoring – Prior to any land clearing, earth moving and mining activities, a Project-wide monitoring event will be performed across the entire Project Area which will identify noxious weed populations. Noxious weed populations will be flagged, mapped, and access prevented (land disturbance) until control measures have been implemented. Project-wide monitoring will be completed bi-annually, in the spring and fall. Evaluation in the spring will target rosettes and bolting plants. Implementing an early treatment protocol will suppress the root system and the seed bank. Fall monitoring will focus on locations where spring monitoring depicted problematic areas. Flowering plants and seeds need to be removed (if present) before the seeds germinate. Bi-annual monitoring will aid the weed manager in determining the proper weed control methods help control the weed population.
3. Mechanical decontamination – If using machines and/or mechanical methods to treat or within a weed population area, ensure that all personnel and equipment are inspected for seed and soil contaminates before entering and exiting Phase boundaries. Implement wash-down areas and ensure that all equipment is clean prior to entering or leaving the Project area.
4. Operations – During a mining Phase contractors and workers must stay within the designated Phase boundary and out of vegetated areas.
5. Reclamation Areas – Revegetate disturbed lands as soon as possible using appropriate techniques of site preparation, such as soil conditioning by discing, ripping, mulching, soil amendments, appropriate seeding, fertilizer and soil erosion control measures. Weed control measures shall continue to be employed for all noxious weeds within reclamation areas until determined complete by the Colorado Division of Reclamation, Mining and Safety or others.
6. All monitoring and weed populations will be mapped using GIS/GPS equipment (or other adequate methods) and plotted onto a Project overview map and compared on a year-to-year basis to document control measure success and weed populations over time.

5.0 CONTROL MEASURES

This Plan is intended to follow an integrated management approach which entails planning and implementation of a coordinated program utilizing a variety of methods for management of noxious weeds. Generally, weed control measures can include mechanical or chemical methods. Mechanical methods can include, but are not limited to; mowing, digging, hand pulling, tilling, and controlled burns. These methods rely on personnel labor or on heavy equipment such as mowers, excavators, or disking implements to severe the root and physically disrupt the growth of noxious weeds.

Chemical methods include the application of selective and/or non-selective herbicides at a species-specific rate and time which will ensure successful control and eradication. The use of herbicides would primarily be used in the early spring prior to germination and again in the fall to eliminate any remaining seed.

Low density infestations can be controlled through mechanical methods such as hand pulling, digging, mowing or spot treatment using chemical methods. Larger infestations may require methods such as an early season-controlled burn or by targeting species with a large-scale chemical treatment. During the monitoring periods, density will be calculated based on the number of plants per square yard (sq/yd). The density of each weed population will be based on the following criteria:

- Weed free – Single weed in a sq/yd
- Scattered – $\leq$2 weeds sq/yd
- Light – 2-5 weeds sq/yd
- Moderate – 6-9 weeds sq/yd
- High – 10+ weeds sq/yd

When a weed population exceeds light infestation (2-5 plants per sq/yd) control measures will be implemented and coordinated by the weed manager. Control measures must be selected based on the specific weed species and the known, most-effective way to control or eradicate the species. Special consideration needs to be taken when assessing weed control including but not limited to; timing, special habitat, presence of rare plants and/or animals, and potential species that may replace targeted noxious weeds following treatment. **Attachment C** contains fact sheets provided by the Colorado Department of Agriculture which outline common noxious weed control measures for state listed noxious weeds.

Following implemented control measures, whether mechanical or chemical, follow-up monitoring should be completed to determine if noxious weeds remain in the area during the following bi-annual monitoring event. Mechanical and/or chemical control measures will continue, as necessary, to control noxious weeds in the Project area for the life of the Project.

6.0 REPORTING

Data collected during the spring and fall will be recorded on the **Weed Monitoring Form** (**Attachment A**). The weed monitoring form includes information such as time of year, type of weed, size of infestation, and methods used for control. Using the Weed Monitoring Form, the weed manager will update the **Weed Management Map** (**Attachment B**) and target weed control areas within the Project. The Weed Management Map will be used in a qualitative manner and should show the weed species, location,

general extent and density of noxious weed populations. The appropriate control measures of species listed within this Plan will be coordinated by the weed manager.

Over time, these field forms and maps will be used to compare Project-wide trends and document detailed timelines used for control, record of treatments, and plans for follow up monitoring. These records will ultimately show the success rate of the weed control practices that are being implemented throughout the Project area and determine if different control measures are needed.

This weed management plan has been prepared by:

ECOLOGICAL RESOURCE CONSULTANTS, INC.

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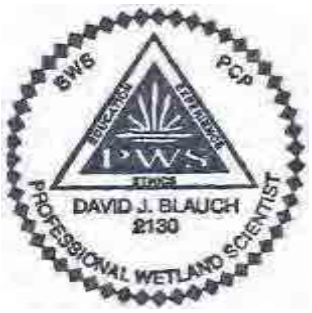
Reviewed and approved by:

Dave Blauch, V.P., Senior Ecologist/ (PWS # 2130)



ATTACHMENT A
Weed Monitoring Form

Weed Monitoring Form

Date: _____ Inspector Name: _____

Inspector Afilliation: _____

Weather: _____

1. Was GPS data collect for the infestation? If yes, provide file name: _____
2. Photo name and direction: _____
3. Monitoring timeframe: Spring Summer Fall

Cover Frequency data:

Weed Species	Infestation size (# weeds sq/yd)	Treated (Mech. Or Herbicide?)	Notes

Treatment			
Method	**Type**		**Amount and Rate/Site (file name)/Acres**
Mechanical	Equipment:		
Herbicide	Chemical:		
	Equipment:		

Description of area infested, limitations, or any other relavent information. Update Monitoring Map.

ATTACHMENT B
Weed Management Map


N
W
E
S
Feet
0
500
1,000
2,000

ATTACHMENT C
Colorado Noxious Weed Fact Sheets

African rue

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

African rue Identification and Management

Key ID Points

1. Flowers are white with 5 petals and 5 sepals.
2. Bushy, succulent herb growing 1-2 feet tall with a branched taproot.

Identification and Impacts

African rue (*Peganum harmala*) is a bright green, succulent, shrubby, perennial herb that grows 1-2 feet tall with a tap root and lateral root system that can extend 20 feet or more into the soil. The stems are multi-branched, stiff, erect and hairless. The leaves are alternate and fleshy, and are irregularly dissected three times or more into linear segments. The flowers are white with five petals and are present from April to September. Seeds are produced in a three – chambered capsule, with many small seeds in each chamber.

African rue is native to northern Africa and the Middle East. African rue spreads by seeds, but can also resprout from roots or root fragments. It can be found growing in; dry, disturbed areas, open sites, fields, pastures, rangeland, roadsides, cropland and semi-arid desserts. It can grow in sandy or clay soils and is also tolerant of saline and alkaline conditions. Infestations can begin in small disturbed sites, and then spread to rangeland and wildlife habitats that are in excellent condition. Due to its deep root system, African rue is extremely drought tolerant and out-competes native rangeland shrubs and grasses. The soil seed reserve for African rue is unknown and site monitoring should be carried out for at least 10 years after the last flowering adult plants have been eliminated.

African rue contains at least four toxic alkaloids and is allelopathic. It is extremely poisonous to cattle, sheep, horses, and humans. Animal toxicity symptoms include tremors, weakness, excitability, salivation, diarrhea, stupor, and hemorrhages in the heart and/or liver resulting in death. The seeds, fruit, and young leaves are the most poisonous plant parts. Although toxicity is high, livestock will rarely graze due to the bitter taste and smell unless they are severely malnourished.

The key to effective control of African rue is to prevent it from establishing through proper land management. Maintain healthy pastures and rangeland and continually monitor your property for new infestations. The following page provides management recommendations for African rue.

African rue is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For More information visit: www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division at 303-239-4100.

Photos courtesy of Kelly Uhing, Colorado Department of Agriculture.

Peganum harmala

Updated on: 7/2015

African rue

CULTURAL
Preventing African rue from establishing by maintaining healthy, native vegetation is the first step in any cultural control effort. Complete removal of any seedlings or newly established plants by continual hand pulling is possible.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A species. Eradication is the management objective of all List A's. No biocontrol agent for African rue is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
NOT recommended as an eradication treatment for established plants due to the lateral root system and extremely deep tap root which is often 20 feet deep. Burning is not recommended because the plant sprouts following disturbance.

Integrated Weed Management:

Preventing the establishment of this plant in Colorado is crucial since it exists in only one area of the state. Monitoring your land for infestations, especially lands in southern Colorado where African rue is present can significantly aid in detecting the species early and eradicating it quickly.

Herbicide timing is very important in controlling this species. Follow timing guidelines closely.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Imazapyr* (Arsenal)	0.5-1 qt./acre + 1% v/v methylated seed oil	Apply when plants are actively growing.
Note: *Imazapyr products are nonselective and will kill any vegetation contacted. Imazapyr is NOT recommended for use in ornamental or turf settings.		
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Top photo, © Kelly Uhing, Colorado Department of Agriculture. University of Idaho Archive, University of Idaho, Bugwood.org, and Kelly Uhing.

Camelthorn

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Camelthorn Identification and Management

Identification and Impacts

Camelthorn *(Alhagi pseudalhagi)* is an erect perennial shrub that grows from 1 1/2 to 4 feet tall. The stems are hairy when the plant is young and as it matures they become smooth and branched with sharp yellow tipped spines up to 1 3/4 inches long. Leaves are blue-green in color with smooth edges and are lance-shaped. They are more apparent on lower branches. Flowers are found towards the ends of the branches on short stalks of spines or small branches. Flowers are pea-shaped in clusters of one to eight with a brown to reddish-purple color.

Camelthorn is native from India to Asia minor and southern Russia. It grows well on dry and moist sites and can be found along roadsides, overgrazed pastures, irrigation canals, rivers, and disturbed areas. It can grow up through asphalt and housing structures. Camelthorn has a deep and extensive creeping root system. Small pieces of roots can grow into new plants. The plant is not yet identified to be in Colorado, yet it has been known to establish between 100 and 5000 feet in elevation. Due to camelthorn's rapid rhizomatous growth habit, quickly formed dense stands can be impenetrable due to the spiny stems. Camelthorn out-competes native species and crowds out desirable wildlife and livestock forage.

The key to effective control of camelthorn is prevention as it is very difficult to control once established. Preventative measures include using certified weed-free hay, preventing overgrazing, and stopping activities that result in significant ground disturbances. Because of the deep rooted system and limited success of eradication, mechanical control is not recommended. Herbicides provide the best means of control and eradication. When using herbicides, be sure to use different chemicals each year to prevent the establishment of a herbicide-resistant population. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Camelthorn is designated as a "List A" species on the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos: Middle left photograph courtesy of Arizona Department of Transportation; above by Steve Dewey, Utah State University; all others from the Washington Noxious Weed Control Board.

Key ID Points

1. Flowers are brown to reddish-purple in clusters of 1 to 8.
2. Perennial shrub that grows 1 1/2 to 4 feet tall.
3. Long stem with spines.

Updated on: 7/2015

Alhagi pseudalhagi

Cameltheorn

CULTURAL
Preventing the establishment of the camelthorn is crucial, so maintaining healthy native plant communities is a priority. Contact your local Natural Resources Conservation Service for seed mix recommendations. Bare ground is prime habitat for weed invasion, so prevent bare spots caused by overgrazing.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A Species. Eradication is the management objective of all List A's. No biocontrol agent for camelthorn is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL

Mechanical techniques such as hand pulling, digging, or tilling are **not** recommended as an eradication treatment because of the deep and extensive creeping root system of camelthorn. Mowing is not an effective method for control because plants flower and seed all the way down to the base of the plant.

Integrated Weed Management:

Preventing the establishment of this plant in Colorado is crucial since it is not yet known to exist in the state. Monitoring your land for infestations is key to early detection. Eradication requires intensive and persistent control efforts to effectively eliminate weed infestations and soil seed reserves. The soil seed reserve for camelthorn is unknown.

The site must be monitored for at least 10 years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

HERBICIDES

The following are recommendations for herbicides that can be applied to range and pasturelands. Always read, understand, and follow the label directions. *Rates are approximate and based on equipment with an output of 30 gallons per acre. Please read label for exact rates.* **The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Metsulfuron (Escort XP)	1 oz./acre + 0.25% v/v non-ionic surfactant	Apply during bolting to early flower growth stages.
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Common crupina

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Ranges from 1-3 ft. tall.
2. Pinkish-purple flowers surrounded by stiff bracts.
3. Stiff spines on leaf edges.

Updated on: 7/2015

Common crupina Identification and Management

Identification and Impacts

Common crupina (*Crupina vulgaris*) is an erect winter annual growing one to three feet in height. The leaves are alternate, finely dissected, and develop short, stiff spines along the edges. Flowers are pink to purple in color and grow one to two on a branch with each plant having several branches and up to 40 flowering heads per plant. Flowers protrude through a whorl of stiff bracts. Seeds are 1/8 to 1/4 inch long with barbed hairs at one end. Common crupina spreads by seed by attaching itself to livestock, wildlife, and people and floating down rivers and streams.

Common crupina is adapted to a wide range of soil and growing conditions. It is a common invader of disturbed grasslands, rangeland and open forest lands and has not yet been identified in Colorado. Common crupina impacts wildlife and plant communities by outcompeting native plants and reducing biodiversity. It invades hay fields and grass seed fields and its seed can contaminate forage crops (such as hay), thus reducing their value.

The key to effective control of common crupina is preventing infestations from occurring. Once establishment of the plant has occurred, there are various control methods to consider for eradication. Hand pulling or hoeing of plants prior to flower and seed production can be an effective control method for small populations. Use of certain herbicides as a control method can be effective as well depending on site ecology. Details on the back of this sheet can help to create a management plan compatible with your site ecology. The soil seed longevity of common crupina is three years. The site must be monitored for at least four years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

Common crupina is designated as a "List A" species on the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Clockwise from lower left, photos © Utah State University Archives; Steve Dewey, Utah State University; Utah State University Archives; Steve Dewey, Utah State University; and USDA APHIS PPQ Archive.

Crupina vulgaris

Common crupina

Management Recommendations

CULTURAL
Establishment of selected grasses can be an effective cultural control of common crupina. Contact your local Natural Resources Conservation Service for seed mix recommendations. Maintain healthy pastures and prevent bare spots caused by overgrazing. Healthy plant communities can deter common crupina from establishing.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A species. Eradication is the management objective of all List A's. No biocontrol agent for common crupina is available. For information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL

Hand pull or dig when soil is moist and be certain to pull all the roots, only when infestations are small. It is important to bag specimens carefully so as to not scatter seeds if the plant is flowering. Seeds are small and can adhere to clothing and tools and these must be cleaned before using again.

Integrated Weed Management:

Preventing the establishment of this plant in Colorado is crucial since it is not yet known to exist in the state. Eradication requires intensive and persistent control efforts to effectively eliminate weed infestations and soil seed reserves. Using an integrated weed management approach if infestations occur can be effective in eradicating common crupina.

HERBICIDES

The following are recommendations for herbicides that can be applied to range and pasturelands. Always read, understand, and follow the label directions. *Rates are approximate and based on equipment with an output of 30 gallons per acre. Please read label for exact rates.* **The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Picloram (Tordon/Picloram 22K - Restricted use pesticide)	1 pint/acre + 0.25% v/v non-ionic surfactant	Apply at rosette growth stage or when adequate soil moisture and plants are actively growing. (Early spring to late summer depending on conditions) DO NOT use near trees, desirable shrubs, water, or high water table.
Metsulfuron methyl + Chlorsulfuron (Cimarron X-tra)	2 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at rosette to bolting growth stages. (Early spring to early summer)
Metsulfuron (Escort XP)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at rosette to bolting growth stages. (Early spring to early summer)

Additional herbicide recommendations for other species can be found at:
https://goo.gl/VFPCUv

Top two photos, © Kelly Uhing, Colorado Department of Agriculture, bottom photo: USDA APHIS PPQ Archive, USDA APHIS PPQ, Bugwood.org.

Cypress Spurge

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Flowers are yellowish-green in color.
2. There are many branched stems that are covered with numerous narrow leaves.

Updated on: 7/2015

Cypress spurge Identification and Management

Identification and Impacts

Cypress spurge *(Euphorbia cyparissias)* is a low growing perennial that overwinters as root and crown tissue. Cypress spurge reproduces by seed and lateral root buds. Leaves are linear, approximately 1/2 to 1 1/4 inches long and 1 to 2 mm wide. Upper stem leaves that occur near the inflorescence are yellow or yellowish-green in color. Leaves are stalkless, alternate, narrow and linear to lance-shaped. Stems are 4 to 32 inches high, hairless, green to yellowish green in color and branch in the upper portions. The leaves and stems emit a milky, toxic sap when broken. Flowers are yellowish-green usually turning reddish green towards maturity and are clustered in bunches at the ends of stems.

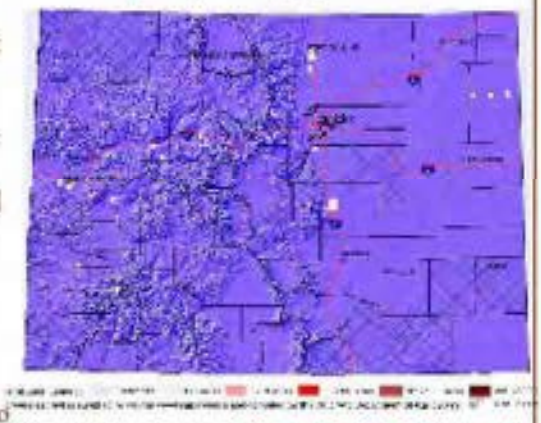
The plants milky sap is an irritant and may cause dermatitis or rashes. Although sheep may eat it, the plant is toxic to horses and cattle. Animals should not be pastured where spurges grow. Humans should be careful and avoid contacting the plant with bare skin as it can cause skin irritation for some people.

Cypress spurge is an invasive ornamental plant that is native to Eurasia. It prefers direct sunlight, but is tolerant to the shade. It commonly occurs in dry to moderately moist meadows, pastures, forest edges, roadsides, Rights-of-Way, cemeteries, and gardens. Cypress spurge is popular in xeriscaping and rock gardens and generally does not occur on intensively cultivated soils. The soil seed reserve is estimated to be at least eight years.

The key to effective control of cypress spurge is preventing the establishment of viable plant communities. When establishment has occurred, there are different control methods to consider. Like most perennial plants, exhausting the nutrient reserves in the root system is important in controlling cypress spurge. Using a combination of mechanical and herbicide treatments in combination can achieve eradication over time.

Cypress spurge is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program link. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Map of cypress spurge infestation.



Clockwise, from lower left, photos: Unknown, Richard Casagrande, University of Rhode Island; Stacey Leicht, University of Connecticut; Steve Dewey, Utah State University; and Kelly Uhing, Colorado Department of Agriculture.. Map by Crystal Andrews, CDA.

Euphorbia cyparissias

Management Recommendations

Cypress spurge

CULTURAL
Keeping desirable vegetation healthy and thick will help keep invaders out. Prevent the establishment of new infestations by minimizing disturbance and seed dispersal. Survey your land regularly to detect new invaders and eradicate any new populations quickly.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A Species. Eradication is the management objective of all List A's. No biocontrol agent for Cypress spurge is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pulling or digging is a viable option when managing new, small cypress spurge infestations. Tillage may simply encourage its spread. Be sure soil is moist and extract the entire root system. When handling plants wear rubber gloves and eye protection to protect yourself from the irritating milky sap.

Integrated Weed Management:

Since Cypress spurge has been identified in small quantities around Colorado, preventing the populations from spreading is important in management of the weed. Using a combination of control methods proves to be the most effective way to control populations. Using mechanical and herbicide control methods together proves to be key in eradicating established infestations.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands unless otherwise noted. Not all products listed are for use near homes. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Quinclorac (Paramount - non-crop)	16 oz. product/acre + 2 pint/acre methylated seed oil or crop oil concentrate	Apply at the flowering stage. (Spring time)
2,4-D + Dicamba (Range star)	2 qt. 2,4-D/acre (2.0 lb/active ingredient) + 1 qt. dicamba/acre (1 lb active ingredient)	Apply at the flowering stage. (Spring time)

Additional herbicide recommendations for other species can be found at:
https://goo.gl/VFPCUv

Top photo, © Kelly Uhing, Colorado Department of Agriculture; Bottom photo Todd Pfieffer Klamath County.

Dyer's woad

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Dyer's woad Identification and Management

Identification and Impacts

Dyer's woad (*Isatis tinctoria*) ranges from 1 to 4 feet tall with a deep taproot. The plant acts as winter annual, biennial, or short-lived perennial. The basal rosette produces stalked, bluish-green leaves covered with a fine hair. Leaves have a white mid-rib on the upper surface of the leaf. The flowers are numerous, yellow and very small. Flowers are clustered on the upper portion of multi-branched stems, which typically occurs in April to early June. Fruit or seed pods are winged, slightly pear shaped and change from light green to a shiny purplish-black color as they mature. The seeds contained in the fruit are cylinder-shaped and brownish-yellow. The seeds usually form in June and July.

The typical habitat for Dyer's woad includes rangelands, pastures, forests, roadsides, fields, disturbed sites and railroad Rights-of-Way. The plant thrives in light sandy and gravelly soils and will establish in rocky soil with minimum water holding capacity. Dyer's woad impacts the natural plant communities by outcompeting native plants. It causes a loss of wildlife and livestock forage by displacing native grasses and other native species.

Dyer's woad is a prolific seeder and the soil seed reserve is unknown. Managed sites must be monitored for at least 10 years after the last flowering adult plants have been eliminated and treatments need repeated when necessary.

The key to effective control of dyer's woad is prevention and early detection. Eradicating populations of dyer's woad can be achieved through different control methods. When populations are small, handpulling is an effective approach. Herbicide applications can be effective also. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Dyer's woad is designated as a "List A" species on the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

All photos courtesy of Steve Dewey, Utah State University, bugwood.org

Key ID Points

1. Ranges from 1-4 ft. tall
2. Numerous flowers that are yellow and very small
3. Seed pods turn dark purple to black

Isatis tinctoria

Updated on: 7/2015

Management Recommendations

CULTURAL
Keeping desirable vegetation healthy and thick will help keep invaders out. Survey your land regularly to detect new invaders and eradicate any new populations quickly.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A Species. Eradication is the management objective of all List A's. No biocontrol agent for dyer's woad is available. For information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL

Hand pulling or digging are effective control methods when dealing with dyer's woad. Hand pulling should occur when soil is moist and be certain to pull all the roots. It is important to bag specimens carefully so as to not scatter seeds if the plant is flowering.

Integrated Weed Management:

Since dyer's woad has been identified in very small quantities around Colorado, preventing the populations from spreading is important in management of the weed. Eradication requires intensive and persistent control efforts to effectively eliminate weed infestations and soil seed reserves. If populations occur hand pulling and herbicide control methods are effective in eradication.

HERBICIDES

The following are recommendations for herbicides that can be applied to range and pasturelands. Always read, understand, and follow the label directions. *Rates are approximate and based on equipment with an output of 30 gallons per acre. Please read label for exact rates.* **The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Metsulfuron (Escort)	0.5-1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at the rosette to bloom growth stages. (Late winter to early spring)
Chlorsulfuron* (Telar)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at the rosette to early bolt growth stage. (Late winter to early spring)
Note: *This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.		
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Dyer's woad

Colorado State University

CDA CO

Elongated mustard

Colorado Department of Agriculture

305 Interlocken Pkwy
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(303) 869-9030
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Basal rosette: leaves are slightly lobed to shallowly toothed & lance shaped.

Flowers are yellow with 4 petals and 6 sepals.

Elongated mustard can inhabit steep, rocky, and semi-arid environmnets.

Top and bottom photos by Larry Walker, Chaffee County Weed Department; middle photo by Rachel Winston, MIA Consulting

Key ID Points

1. Flowers are yellow with 4 petals and 6 sepals.
2. Lance-shaped and weakly-lobed leaves do not clasp the stem.

Updated on: 7/2015

Elongated mustard Identification and Management

Elongated mustard near Salida, Colorado. Photo courtesy of Larry Walker, Chaffee County Weed Department.

Please contact the Colorado Department of Agriculture to report a sighting.

Identification and Impacts

Elongated mustard (*Brassica elongata)* is a biennial, short-live perennial, or sometimes winter annual herb with erect, branched stems up to 3 ft tall. The leaves on elongated mustard help distinguish the species from other mustards. Basal leaves are slightly lobed to shallowly toothed and lance shaped. Upper leaves are much smaller and do not clasp the stem. The small yellow flowers have four petals and six stamen and are present from June through July. The plant has a sweet fragrance when in bloom. Fruits are 0.4 to 0.6 in long with a stalk-like base and a seedless, narrow tip.

Elongated mustard is native to southeastern Europe and Asia where it inhabits semi-arid environments. It spreads by wind-dispersed seeds in the late summer and early fall. In the U.S., it can be found growing in disturbed soils, along roadsides, and in woodland and desert environments. It can tolerate a variety of climatic conditions including extreme temperatures, varied elevations, and saline soils, but cold temperatures in the seed bed restrict germination rates. The soil seed reserve for Elongated mustard is unknown, and site monitoring should be carried out for at least 10 years after the last flowering adult plants have been eliminated.

The key to effective control of Elongated mustard is to prevent it from establishing through proper land management. Maintain healthy roadsides, pastures, and rangeland, and continually monitor your property for new infestations. The following page provides management recommendations for Elongated mustard.

Elongated mustard is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the state. For More information visit: www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division at 303-239-4100.

Treating elongated mustard with herbicide on the steep slopes near Salida, Colorado. Photos courtesy of Crystal Andrews, CDA.

Brassica elongata

Management Recommendations

Elongated mustard

CULTURAL
Cultural controls include management practices that favor the growth of desirable species over noxious weeds. These typse of control are possible in theory but can be very time consuming and expensive. Complete removal of any seedlings or newly established plants by continual hand pulling is also possible.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State. Eradication is the management objective of all List A's. No biocontrol agent for elongated mustard is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Burning is not recommended because this and other types of disturbance often result in an increase of mustard establishment. Yearly manual removal of plants prior to seed set can be used as an effective way to eventually deplete the seedbank.

Integrated Weed Management:

Preventing the further establishment of this plant in Colorado is crucial since only one population is known in the state. Monitoring your land for infestations, especially lands in south central Colorado, where elongated mustard is present, can significantly aid in detecting the species early and eradicating it quickly.

Herbicide timing is important in controlling this species. Follow timing guidelines.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands, including grazed areas. Rates are approximate and based on equipment with an output of 30 gal/acre. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Metsulfuron (Escort XP)	0.5-1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at the rosette to bloom growth stages. (Spring to mid-summer)
Chlorsulfuron* (Telar XP)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at the rosette to bolting growth stages when plants are actively growing. (Spring to mid-summer)
Note: *This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.		
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Top photo, © Kelly Uhing, Colorado Department of Agriculture. University of Idaho Archive, University of Idaho, Bugwood.org, and Larry Walker, Chaffee County Weed Department.

Flowering rush Identification and Management

List A

Flowering rush (Butomus umbellatus) is an herbaceous aquatic perennial also known by the names "grassy rush" and "water gladiolus." The plant can grow in either an emergent or submerged form. In shallow water (up to 10 feet deep), flowering rush grows as an emergent plant with foliage standing upright, up to 5 feet. In its submerged form (10 to 20 feet deep), leaves are flexible, suspended in the water column. Emergent leaves are triangular in form, resembling a sedge, and flowering stems are round, resembling a rush, but this species is neither a true sedge nor rush. It is in its own botanical family, Butomaceae.

Reproduction of flowering rush can be by seed, but most is vegetative through rhizomes and vegetative bulbils. Emergent plants have two flowering forms: one that flowers regularly and produces viable seed, and one that flowers only occasionally and is sterile. When flowers do occur, they are light pink to rose-colored and arranged in umbels of 20-50 flowers each. Individual flowers are 3/4 to 1 inch across, with six petals. The three outer petals are actually sepals, and they are smaller and may be slightly green in color. Bulbils form on both the flowers and rhizomes and can break off and form new plants. Rhizomes form structurally weak constrictions between buds, which allow minor disturbances to break them. Rhizome pieces are buoyant, giving them the ability to disperse long distances.

Flowering rush is native to Eurasia and was likely introduced in the late 1800s through the ornamental trade. The plant grows along lake shores, irrigation ditches, and in slow-moving waters including wetlands. It is most often found in shallow waters but can grow at greater depths by modifying its growth to a submergent form. Infestations can impact irrigation, recreation, and native species. Infested irrigation ditches suffer reduced water flow and availability. Recreational impacts include interference with boat propellers, swimming and fishing, and stands of the plant create ideal habitat for the snail that hosts parasites that cause swimmer's itch.

The key to effective control of flowering rush is to prevent establishment through proper land management. Maintain healthy riparian corridors, wetlands and rights-of-way, and continually monitor your property for new infestations.

Flowering rush s a designated "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the state. The following page provides management recommendations. For more information please visit: www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, at 303-869-9034.

Key ID Points

1. Showy pink and white flowers arranged in an umbel form, when present.
2. Leaves triangular in cross-section.
3. Flowering stems are round.
4. Reproductive units known as "bulbils" form on both the flowers and rhizomes.

Flowering rush

Butomus umbellatus

List A

Integrated Weed Management Recommendations

Flowering rush

Butomus umbellatus

Prevention is the best control for flowering rush. It is not yet known to exist in Colorado, and locations where it is present have struggled to control the infestations. Once established, it is difficult to eliminate because herbicides don't effectively kill the plant.

CULTURAL
Prevent the introduction and establishment of new infestations by conducting regular inspections of recreational and commercial boats and waterways. Remove all plant parts from boats and prevent transportation of propagules into uninfested waters. Maintaining healthy, biodiverse, abundant native communities in slow-moving streams, ponds, reservoirs, and wetlands to help prevent establishment.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State since eradication is the management objective for all List A species. No biocontrol agents for flowering rush is available. For more information on the use of biocontrol agents to control weeds in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Small infestations can possibly be dug out by hand, especially if water levels are low, but follow-up treatment for the next several years will likely be required. Raking is NOT recommended since it will break up rhizomes which can create a bigger problem. All plant parts must be collected so that the infestation doesn't reestablish from remaining fragments and roots. Makes sure you can access all plant parts before attempting mechanical treatment, as ineffective removal can make the infestation worse.

CHEMICAL
While studies are ongoing, there is no clearly effective chemical control option for flowering rush. The following are recommendations for herbicides that can be applied in aquatic environments to treat flowering rush, although results may vary. Rates are approximate and based on smaller infestation, spot-spraying techniques. Please reference the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Imazapyr (Habitat: pre-emergence on mud flats, or post-emergence with 2+ feet above water)	2-3 pints/acre. Plus non-ionic, aquatic surfactant at 0.06-0.5% v/v (0.5-4 pints per 100 gals)	Make a pre-emergence application on mud flats in late winter or early spring. If at least 2 feet of leaves exist above water, a post-emergence application can be made (summer to fall).
Diquat	0.5 to 2 gal per surface acre (per 4-foot water depth).	For under-water treatment of submerged vegetation. Repeat applications at 14- to 21-day intervals are necessary.

Colorado Department of Agriculture - Conservation Services
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Broomfield, CO 80021
(303) 869-9030
www.colorado.gov/ag/weeds

Rev. 10/14

Giant reed

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

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weeds@state.co.us

Leaves have heart-shaped bases and grasp the stem.

Stems are cane-like and spread through rhizomes.

Seed heads can be 3 ft long but seeds are rarely viable.

Photos from top: Amy Ferriter, State of Idaho; Bonnie Million, National Park Service; and Chris Evans, River to River CWMA (www.invasive.org)

Key ID Points

1. Large bamboo-like grass that can grow over 20 ft tall.
2. Seed heads can reach 3 ft in length but rarely produce viable seeds.

Updated on: 7/2015

Giant reed Identification and Management

Giant reed in a Denver neighborhood. Photo by Cindy Lair, CDA.

Please contact the Colorado Department of Agriculture to report a sighting.

Identification and Impacts

Giant reed (*Arundo donax)* is a robust perennial grass that can grow over 20 ft tall. Each plant has many stiff and hollow stems that form cane-like clumps and spread vegetatively through rhizomes. The stems resemble corn stalks and have long, flat leaves up to 1.5 ft long that can appear variegated. The alternate leaves are pale green to blue-green and clasp the stem with a heart-shaped base. Flowers form in dense plumes at the top of the stalks from late summer to early fall. The flower plumes themselves can reach 3 ft in length.

Giant reed is native to India and spreads primarily through underground rhizomes. It can be found growing in wetland areas such as ditches, stream banks and lake shores and has the ability to reduce wildlife habitat, increase fire risk, and interfere with flood control. It can quickly suppress and out-compete native vegetation due to its rapid growth rate and lateral root system, but it does not appear to tolerate high-elevations or continental environments where regular freezing occurs. It prefers well-drained soils where abundant moisture is available. Seeds are mostly infertile, but stem and root fragments less than 2 in long that contain a single node can easily sprout. Therefore, monitoring of sites where giant reed has been treated should continue for at least 5 years after treatment to ensure that re-growth has not occurred.

The key to effective control of giant reed is to prevent it from establishing through proper land management. Maintain healthy wetlands, streams, and ditches, and continually monitor your property for new infestations. The following page provides management recommendations for Giant reed.

Giant reed is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the state. For More information visit: www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division at 303-239-4100.

Vegetative reproduction from stem fragment. Photo: Joseph M. DiTomaso, University of California at Davis.

Arundo donax

Management Recommendations

Giant reed

CULTURAL
Cultural controls include management practices that favor the growth of desirable species over noxious weeds. These types of control are possible in theory but can be time consuming and expensive. Complete removal of any seedlings or newly established plants by continual hand pulling is also possible.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State. Eradication is the management objective of all List A's. No biocontrol agent for giant reed is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Physically digging up adult plants can be done but is not recommended due to giant reed's ability to reestablish from root fragments. Giant reed is highly flammable, and controlled burning followed by herbicide treatment has been shown to be an effective control technique. However, burning of giant reed for control is not currently recommended in Colorado.

Integrated Weed Management:

Preventing the further establishment of this plant in Colorado is crucial since only a few populations are known in the state. Monitoring your land for infestations, especially lands along the Front Range of Colorado, where giant reed is present, can significantly aid in detecting the species early and eradicating it quickly.

Herbicide timing is important in controlling this species. Follow timing guidelines.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be used to treat giant reed. Please note the specific area where each recommendation applies. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Glyphosate* (Rodeo, AquaMaster, AquaNeat: all safe for aquatic use)	2-4 qt./acre + 0.25% v/v non-ionic surfactant OR 2% v/v product + 0.25% v/v non-ionic surfactant for spot spraying	Apply foliar application when plants are actively growing (late summer to fall). May require several years of treatment.
Imazapyr** (Arsenal*, Stalker*, Habitat*)	1-2 qt./acre	Apply to foliage until wet (but not dripping) while plants are actively growing (late summer to fall).
Note: *These herbicide products are nonselective and will kill any vegetation contacted. **Imazapyr is NOT recommended for use in ornamental or turf settings.		
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Photos, top to bottom: Kelly Uhing, Colorado Department of Agriculture: University of Idaho Archive, Bugwood.org; and Barbara Tokarska-Guzik, University of Silesia, Poland.

Giant salvinia

Colorado Department of Agriculture

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Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Giant salvinia Identification and Management

Identification and Impacts

Giant salvinia (*Salvinia molesta*) is a submersed aquatic freshwater perennial species that is native to South America. It starts as free floating pieces with leaves. The plant consists of horizontal stems that float just below the water surface. At each node it produces a pair of floating or emergent leaves that are green in color with rows of white, bristly hairs. The leaves are ovate to oblong in shape. The upper surface of the floating leaves are densely covered in eggbeater-shaped hairs. Plants bear a third leaf that is brown, highly divided and dangles underwater. Submersed leaves are commonly mistaken as roots and as they grow to great lengths they act as a stabilizer to the plant by creating drag. Stems typically fragment easily, and dried pieces can survive for long periods. Under optimal conditions it can double its size in 2-3 days. Individual leaves can range from a few millimeters to 4 centimeters in length.

The typical habitat for giant salvinia is quiet water of lakes and ponds, oxbows, ditches; slow flowing streams and rivers, backwater swamps, marshes and rice fields. Giant salvinia will withstand periods of stress, both low temperature and dewatering, through latent buds. Although it demonstrates tolerance to freezing air temperatures, it cannot withstand ice formation on the water surface.

Giant salvinia effectively reproduces through vegetative means. Stems fragment spontaneously as plants mature. New branches develop from apical and lateral buds. Each node harbors up to five serial lateral buds (Lemon and Posluszny 1997), adding to the high potential for growth and dormancy. Rapidly expanding populations can overgrow and replace native plants. The result is a dense surface cover that prevents atmospheric oxygen and light from entering the water. Its decomposing pieces drop to the bottom and consumes fish and other aquatic life's dissolved oxygen.

The key to effective control of giant salvinia is prevention. Control options are limited when managing giant salvinia due to its aggressive nature in freshwater ways. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Giant salvinia is designated as a "List A" species on the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Key ID Points

1. Floating leaves are densely covered in eggbeater-shaped hairs and are green.
2. Free floating aquatic plant with potentially long submersed leaves that appear like roots.

Clockwise from lower left, photos © USGS C. Jacono 1999; Scott Bauer, USDA Agricultural Research Service; Mic Julien, Commonwealth Scientific and Industrial Research Organization, Australia; Troy Evans, , United States; Kenneth Calcote, Mississippi Department of Agriculture and Commerce

Updated on: 7/2015

Salvinia molesta

CULTURAL
Cultural prevention is the only effective way to control Giant salvinia. Removing all plant parts from recreational boats is the easiest way to prevent the plant's establishment.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A species. Eradication is the management objective of all List A's. No biocontrol agent for giant salvinia is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pulling is an option when populations are small, but only offers short-term effectiveness. Repeated treatments throughout the growing season has to occur. Other mechanical options are available but are cost prohibitive. Make certain to pull all the plant parts and bag specimens carefully so as to not scatter plant parts or seeds. Dispose of in a land fill where runoff can not threaten other waterways.

Integrated Weed Management:

Giant salvinia is extremely difficult to control once it has become established: prevention of infestations and early detection of this very aggressive aquatic weed is essential in stopping the plant from becoming a widespread problem in suitable water bodies. No combination of control methods has proven effective in eradicating populations, once it has been established.

Giant salvinia

HERBICIDES

The following are recommendations for herbicides that can be applied to bodies of water. Recommendations are unique with aquatic weed species, and need to be based on water body type and water volume. **Please read label for exact rates. The Label is the LAW!**

Herbicide	Rate	Application Timing
Diquat (Reward - general use)	Refer to label.	Refer to label.
Glyphosate (Rodeo, Aqua Master, etc. - general use)	Refer to label.	Refer to label.
Fluridone (Sonar - general use)	Refer to label.	Refer to label.
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Mechanical photo above © Kenneth Calcote, Mississippi Department of Agriculture and Commerce.

Hairy willow-herb Identification and Management

List A

Hairy willow-herb (Epilobium hirsutum) is a perennial, semi-aquatic plant also known by the names "codlins and cream" and "European fireweed." The plant grows up to 6 feet tall and can reproduce via seeds or rhizomes. Each mature plant can produce up to 70,000 seeds, which can be wind-dispersed thanks to a tuft of long white hairs on the oblong and flattened seeds. The entire plant is covered with fine, soft hairs. Leaves are mostly opposite, lanceolate to oblong-lanceolate in shape, with sharply serrated margins. Leaves attach directly to the stem, are often clasping at the base, and grow from 2-5 inches long and 1/2-1 inch wide. The showy pink flowers are 3/4 inch across with four notched petals, four sepals, and eight stamens. Flowers occur in racemes in the upper leaf axils and are present in July and August.

Hairy willow-herb is native to Eurasia and North Africa and was likely introduced to the U.S. as an ornamental. Some reports suggest it may have also arrived in ship ballast. The plant is typically found in water-logged soils and easily tolerates inundation. It does not tolerate shaded areas during seedling establishment, but once established can be somewhat shade-tolerant. Infestations can clog small waterways and displace native vegetation, increasing bank erosion and degrading wildlife habitat. Hairy willow-herb spreads easily into undisturbed areas and can form monotypic stands in wetland areas. Seeds require a soil pH for 5.5 or higher for germination and are thought to remain viable for several years in the soil. Site monitoring should be carried out for at least ten years after the last flowering adult plants have been eliminated.

The key to effective control of hairy willow-herb is to prevent establishment through proper land management. Maintain healthy riparian corridors, wetlands and rights-of-way, and continually monitor your property for new infestations. Be aware that there are several native species of Epilobium in Colorado. Make sure to identify plants correctly before taking action to control them.

Front Range infestation in a golf course wetland.

Hairy willow-herb is a designated "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the state. The following page provides management recommendations. For more information please visit: www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, at 303-869-9034.

Key ID Points

1. Bright pink flowers have 4 notched petals, 4 sepal, & 8 stamens.
2. Leaves mostly opposite & sessile on the stem.
3. Seeds have white, silky tuft in long seedpod.
4. Entire plant covered with soft hairs.

Hairy willow-herb

Epilobium hirsutum

List A

Integrated Weed Management Recommendations

Hairy willow-herb

Epilobium hirsutum

Preventing the spread of this plant in Colorado is crucial since it is known to exist only in a few locations, mostly in the Denver Metropolitan area. Monitoring your land for infestations, especially lands near water and downstream of known sites, can significantly aid in detecting the species early and eradicating it quickly. Herbicide timing is important in controlling this species. Follow timing recommendations closely.

CULTURAL

Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production, and maintaining healthy native communities. Survey regularly for noxious weeds on your property. Be sure to completely remove any seedlings or newly established plants by hand pulling the plants as early as possible in their development.

BIOLOGICAL

Biocontrol agents are not included in the prescribed management plans by the State. Eradication is the management objective for all List A's. No biocontrol agents for hairy willow-herb is available. For more information on the use of biocontrol agents to control weeds in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

© King County, Washington, Noxious Weed Program

MECHANICAL

Small infestations can be dug by hand and should be performed prior to seed set. It is very important to remove the entire rootstalk and any existing rhizomes of the plant to avoid regrowth from root fragments. Composting of this species is not advised, and vegetation should be destroyed on site or contained in heavy-duty trash bags and disposed of in a landfill.

CHEMICAL

NOTE: The following are recommendations for herbicides that can be applied along riparian and wetland areas to treat hairy willow-herb. Rates are approximate and based on smaller infestation, spot-spraying techniques. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Imazapyr* (Habitat**, Arsenal** for aquatic use)	0.5-1% v/v (0.6-1.3 oz. imazapyr/gal water) + 0.25% v/v non-ionic surfactant	Apply evenly over leaf surface "to wet," not dripping. Treat in the pre-bud to flowering stage. (June to August).
Glyphosate (Rodeo**, AquaMaster**, Aqua-Neat** for aquatic	Up to 5% v/v (Up to 6.4 oz. glyphosate/gal	Apply evenly over leaf surface "to wet," not dripping. Treat in the pre-bud to flowering stage. (June to August; at least half of foliage should still be green).
Note: * Imazapyr is NOT for use in ornamental or turf settings. **These herbicide products are non-selective and will kill any vegetation contacted.		
Other species herbicide recommendations: https://goo.gl/VFPCUv		

Colorado Department of Agriculture - Conservation Services
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Rev. 2/15

Hydrilla

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Hydrilla
Identification and Management

Identification and Impacts

Hydrilla *(Hydrilla verticillata)* is a submersed invasive aquatic plant. It can grow to the surface and form dense mats. It may be found in all types of water bodies. The stems are slender, branched, and up to 25 feet long. Hydrilla's small leaves are strap-like and pointed. They grow in whorls of four to eight around the stem and below the growing tips are straight or curved. The leaf margins are distinctly saw-toothed. Hydrilla often has one or more sharp teeth along the length of the leaf mid-rib. Hydrilla produces tiny white flowers on long stalks from June to October. Stems typically grow rooted but fragment easily. The plant also produces 1/4 inch turions, or overwintering buds, at the leaf axils and potato-like tubers attached to the roots in the mud. The flowers are wind pollinated.

Hydrilla is very small in its initial stages of life and can therefore go undetected until it quickly fills a lake or river that it infests. The plant can grow one inch per day. Hydrilla produces thick mats and outcompetes, shades out or simply eliminates ecologically important native submersed plants. It greatly slows water flow and clogs irrigation and flood-control canals. Hydrilla seriously interferes with boating-both recreational and commercial, prevents swimming and fishing, and alters water chemistry and oxygen levels.

Habitats for hydrilla include virtually all types of freshwater: springs, lakes, marshes, ditches, rivers, and tidal zones. The plant can grow in water as shallow as a few inches deep, to water more than 20 feet deep. It can thrive in oligotrophic (low nutrient) to eutrophic (high nutrient) conditions and can grow in 7% salinity of seawater. Low light compensation and saturation points and low CO_2 compensation point make it a competitive plant because it can start growing in low light before other plants do.

The key to effective control of hydrilla is preventing establishment of uncontrolled monocultures. Mechanical and herbicide controls give short-term to medium-term effectiveness and need to be repeated at least annually. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Hydrilla is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos clockwise, from lower left: © USDA APHIS PPQ Archives; Alison Fox; Vic Ramey, Univ.of Florida; Chris Evans, CWMA River to River; Leslie J. Mehrhoff, University of Connecticut.

Key ID Points

1. Stems are slender, branched and up to 25 feet long.
2. Tiny white flowers on long stalks.

Updated on: 7/2015

Hydrilla verticillata

Management Recommendations

Hydrilla

CULTURAL
Cultural prevention is the only effective way to control hydrilla. Removing all plants parts from recreational boats and preventing transport to unaffected waters is the easiest way to prevent the plant's establishment.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A species. Eradication is the management objective of all List A's. No biocontrol agent for Hydrilla is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pulling is an option when populations are small, but only offers short-term effectiveness. Dredging is effective and available, but is cost prohibitive. Make sure to pull all the tubers and bag specimens carefully so as not to scatter plant parts or seeds. Dispose of in an land fill where runoff can not threaten other waterways.

Integrated Weed Management:

Hydrilla is extremely difficult to control once it has become established. Prevention of infestations and early detection of this very aggressive aquatic weed is essential in stopping the plant from becoming a widespread problem in suitable water bodies. An integrated approach using cultural, mechanical, biological and chemical can achieve some long-term effectiveness.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to bodies of water. Recommendations are unique with aquatic weed species and need to be based on water body type, and water volume. Please read label for exact rates. **Always read, understand, and follow the label directions. The label is the LAW!**

Herbicide	Rate	Application Timing
Fluridone (Sonar - genearal use)	Refer to label.	Refer to label.
Endothall + Diquat (Aquathal K + Reward - general use)	Refer to label.	Refer to label.
Endothall (Aquathal K - general use)	Refer to label.	Refer to label.
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Top to bottom photos, © A. Murray, Univ. of Florida; USDA ARS Archive; and J.Schardt, Florida D.E.P.

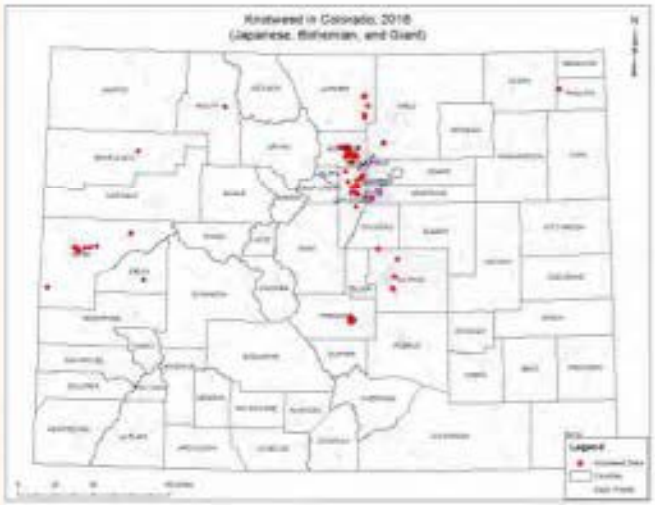
Knotweeds Identification and Management

List A

Japanese knotweed (*Fallopia japonica*), giant knotweed (*Fallopia sachalinensis*), and their hybrid, Bohemian knotweed (*Fallopia x bohemica*) are bright green, bamboo-like perennial plants that grow 5-16 feet tall and spread through lateral root systems (rhizomes). Stems are hollow between nodes, and often reddish-brown and swollen at the nodes. The base of the stem above each joint is surrounded by a membranous sheath. Leaves are alternate and large. Japanese knotweed leaves are broadly ovate or spade-shaped with low, bump-like scabers on the underside instead of hairs. Giant knotweed leaves are heart-shaped with long hairs underneath, and Bohemian plants typically have both leaf forms. The small, showy, greenish-white flowers develop on branched clusters and are present in late summer. Seeds are three-sided, black and shiny, and they develop in a papery-winged fruit.

Japanese and giant knotweed are native to Asia and were introduced to the U.S. as ornamentals and for erosion control and landscape screening. All three species spread and resprout from roots or root fragments. They can be found growing near water sources, in disturbed areas, and along rights-of-way. All three species can tolerate many environmental conditions such as full shade, high temperatures, salinity, and drought. Infestations can clog small waterways and displace native vegetation, increasing bank erosion and degrading wildlife habitat. Like other species in the genus Polygonum, the soil seed reserve is likely long-lived, and site monitoring should be carried out for at least ten years after the last flowering adult plants have been eliminated.

The key to effective control of Japanese, giant, and Bohemian knotweed is to prevent establishment through proper land management. Maintain healthy riparian cooridors, wetlands and rights-of-way, and continually monitor your property for new infestations. The following page provides management recommendations.



All three knotweeds are designated as "List A" species in the Colorado Noxious Weed Act. They are required to be eradicated wherever found in the state. For more information please visit: www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division at 303-869-9030.

Key ID Points

1. Stems are hollow
2. Stem nodes are raised with a membranous sheath
3. Leaves are spade- to heart-shaped
4. Flowers are showy and form clusters in late summer

Knotweeds: Japanese, giant, & Bohemian

Fallopia japonica, F. sachalinensis, F.x bohemica

List A

Integrated Weed Management Recommendations

Knotweeds: Japanese, giant, & Bohemian

Fallopia japonica, F. sachalinensis, F. x bohemica

Preventing the spread of this plant in Colorado is crucial since it is known to exist only in a few locations. Monitoring your land for infestations, especially lands near water and downstream of known sites, can significantly aid in detecting the species early and eradicating it quickly. Herbicide timing is important in controlling this species. Follow timing recommendations closely.

CULTURAL

Cultural control may be possible with persistence. Heavy blackplastic should entirely cover the infestation but be loose enough toallow growth underneath. Some plants will likely survive, so followup treatment and monitoring will be necessary.

BIOLOGICAL

Biocontrol agents are not included in the prescribed managementplans for List A species by the State; eradication is the management objective. No biocontrol agents for the knotweeds are available. Formore information on the use of biocontrol agents in Colorado, please contact the Palisade Insectary at 970-464-7916.

MECHANICAL

NOT recommended as an eradication treatment due to theextensive and complex lateral root system. If plants are removedmechanically, all plant parts should be removed and then burnt or carefully baggedand disposed of in the landfill. Burning the plant as a controlmethod is ineffective and not recommended.

CHEMICAL

The following are recommendations for herbicides that can be applied along riparian and wetland areas to treat knotweeds. Rates are approximate and based on smaller infestation, spot-spraying techniques. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Glyphosate (Rodeo*, AquaMaster*, AquaNeat* are all safe for aquatic use)	2.5% to 3% solution (3.2 to 3.8 oz/gal water) + 0.32 oz/gal water non-ionic surfactant. OR 5 to 6 ml undiluted herbicide per individual stem for injections	Apply evenly over leaf surface "to wet," not so dripping occurs. Treat when plants are actively growing, pre-bud to flowering stage: June to July (at least half of foliage should still be green).** Use a calibrated injection gun to inject just below the third node from July to September. (gun can be bought online) (total treatment must not exceed 8 quarts per acre or approximately 1,000-1,500 stems per acre for suggested rates).
Triclopyr (Garlon 3A for aquatic sites) OR Imazapyr*** (Habitat* OR Arsenal* for aquatic use)	1% solution (1.3 oz/gal water) + 0.32 oz/gal water non-ionic surfactant.	Apply evenly over leaf surface "to wet," not so dripping occurs. Treat when plants are actively growing, pre-bud to flowering stage: June to July.** Injection method is not allowed for these herbicides.

***All starred herbicide products are nonselective and will kill any vegetation contacted.**
****If leaves are above one's head, plants can be bent down to allow better foliar spray coverage.**
*****Imazapyr is NOT recommended for use in ornamental or turf settings.**

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Rev. 3/19

Meadow Knapweed Identification and Management

List A

Meadow knapweed (*Centaurea x moncktonii*) is a perennial that grows from a woody crown. The upright stems, grow from 20 to 40 inches tall and branch near the middle. Flower heads are solitary at tips of the branches, pink to purple in color, and 3/4 of an inch in size. Bracts are light to dark brown with papery-fringed margins. Lower leaves are lobed and upper leaves are linear. The leaves grow up to 6 inches long and more than 1 inch wide.

Meadow knapweed primarily reproduces by seed, but root and crown fragments re-sprout when disturbed by heavy equipment or cultivation. Meadow knapweed seeds are carried in rivers, streams, or irrigation water, in hay or by vehicles along roadsides. It is an attractive plant which some people plant as a garden ornamental. The seed viability for meadow knapweed is unknown. The site must be monitored for at least 10 years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

Habitat for meadow knapweed include moist sites, irrigated pastures, moist meadows, river banks, streams, irrigation ditches, roadsides, and openings in forested areas. The plant is native to Europe where originally it was introduced (cross between black and brown knapweed) as a potential forage species, but it has low palatability to grazing animals. Meadow knapweed outcompetes native plants and pasture species and reduces available forage for wildlife and livestock. It is not palatable or nutritionally sufficient for livestock and disrupts wetland habitat by displacing native plant species.

The key to effective control of meadow knapweed is preventing the establishment of plant communities by maintaining healthy native plant populations. If meadow knapweed is present, using a combination of control methods, mechanical and herbicides, to eradicate populations is effective.

Meadow knapweed is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-869-9030.

Key ID Points

1. Flowers are pink to purple and are about the size of a nickel.
2. Leaves are up to 6 inches long and an inch wide.
3. Bracts have papery-fringed margins.

Meadow Knapweed

Centaurea x moncktonii

List A

Integrated Weed Management Recommendations

Meadow Knapweed

Centaurea x moncktonii

Since meadow knapweed has been identified in small quantities around Colorado, preventing the populations from spreading is important in management of the weed. Eradication requires intensive and persistent control efforts to effectively eliminate weed infestations and soil seed reserves. If populations occur hand pulling and herbicide control methods are effective in eradication.

CULTURAL

Preventing the establishment of the Meadow knapweed is crucial, so maintaining healthy native plant communities is a priority. Contact your local Natural Resources Conservation Service for seed mix recommendations. Bare ground is prime habitat for weed invasion, so prevent bare spots caused by overgrazing.

BIOLOGICAL

Biocontrol agents are not included in the prescribed management plans by the State for List A Species. Eradication is the management objective of all List A's. No biocontrol agent for Meadow knapweed is available. For more information about biological control agents, visit the Colorado Department of Agiculture's Palisade Insectary website at www.colorado.gov/ag/biocontrol.

MECHANICAL

Hand pulling or digging is an effective control method when populations are small. Hand pulling should occur when soil is moist and be certain to pull all the roots. It is important to bag specimens carefully so as to not scatter seeds if the plant is flowering.

CHEMICAL

NOTE: The following are recommendations for herbicides that can be applied to pastures and rangeland. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Aminopyralid (Milestone - general use)	7 fl. oz. product/acre plus 0.25% v/v ionic surfactant.	Apply in spring to early summer during bolting to bud growth stages or in fall
Cloypyralid (Transline - general use)	1 pint product/acre plus 0.25% v/v ionic surfactant.	Apply in spring to early summer during bolting to bud growth stages or in fall
Picloram (Tordon- Restricted use or Picloram 22K))	1 qt.product/acre plus 0.25% v/v ionic surfactant.	Apply in spring to early summer during bolting to bud growth stages or in fall

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Rev. 3/19

Mediterranean sage

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Mediterranean sage Identification and Management

Identification and Impacts

Mediterranean sage *(Salvia aethiopis)* is a biennial that is an erect, coarse biennial or short-lived perennial, with a stout taproot. First year rosettes are blue-green, and are covered with woolly white hairs. Second year plants produce more leaves with a flowering stem. Leaves have a pungent odor when crushed. The flower stem can grow 2 to 3 feet tall and branch 2 to 3 feet wide resembling a candalabra. The stem breaks off in the fall and forms a tumbleweed dispersing thousands of seeds. Mature plants can produce 100,000 seeds each. The flowers are white to yellowish-white and appear in clusters.

Mediterranean sage is native to the Mediterranean region and northern Africa. Mediterranean sage invades primarily rangeland, but will easily invade riparian areas, forests, roadsides, and dry pastures. This invasive ornamental plant prefers south-facing slopes in loose, gravelly, well drained soils. Mediterranean sage initially invades disturbed sites, but quickly spreads to non-disturbed and natural sites. It adapts to a wide variety of environmental conditions and quickly displaces native vegetation. The plant is unpalatable to most grazing animals and is capable of forming dense monocultures. The seed viability for Mediterranean sage is unknown. The site must be monitored for at least 10 years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

The key to effective control of Mediterranean sage is preventing the establishment of plant communities through the use of sound land management practices. Maintain healthy pastures and rangeland and continually monitor your property for new infestations, especially near current known infestations since tumbleweed mobility of this plant can spread the seeds far and wide. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Mediterranean sage is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Map of Mediterranean sage infestation.

Key ID Points

1. Leaves have a pungent odor when crushed.
2. Leaves are very hairy.
3. White to yellowish-white flower clusters.

Updated on: 7/2015

Salvia aethiopis

Management Recommendations

CULTURAL
Preventing overgrazing and promoting healthy plant communities is crucial. Disturbed, bare ground areas are prime habitat for weed invasions. Contact your local Natural Resource Conservation District for seed mix recommendations for your area.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A Species. Eradication is the management objective of all List A's. For information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pull or shovel when soil is moist. Make certain to pull up all the roots or sever at least 2 to 3 inches of taproot with a shovel. Shake excess soil from specimens and turn over to dry out. Bag specimens carefully so as to not scatter seeds if flowering.

Integrated Weed Management:

Since Mediterranean sage reproduces solely by seed, it is imperative to prevent seeds from producing as well as depleting the soil seed bank. Combining mechanical and herbicide treatments to rosettes or bolting plants can be very effective. If flowering, mechanically remove plants and bag them. Survey properties on the perimeter of known infestations to detect new infestations early.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminopyralid (Milestone)	7 oz. product/acre + 1% v/v methylated seed oil	Apply in spring during rosette to bolting (early flowering) growth stages.
Metsulfuron (Escort or Cimarron) + 2,4-D	1 oz. product/acre (metsulfuron) + 1 qt./acre (2,4-D) + 0.25% v/v non-ionic surfactant	Apply in spring during rosette to bolting (early flowering) growth stages.
Picloram (Tordon/Picloram 22K - Restricted use pesticide) + Chlorsulfuron (Telar)	1 qt. product/acre (Tordon) + 1 oz. product/ acre (Telar) + 0.25% v/v non-ionic surfactant	Apply in spring during rosette to bolting (early flowering) growth stages. DO NOT use near trees, desirable shrubs, water, or high water table.

Additional herbicide recommendations for other species can be found at:
https://goo.gl/VFPCUv

Top to bottom photos. © A. Murray, Univ. of Florida; USDA ARS Archives.

Mediterranean sage

Medusahead

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Medusahead
Identification and Management

Identification and Impacts

Medusahead *(Taeniatherum caput-medusae)* is a winter annual grass. The plant is native to Europe and Asia. It can grow to heights of 6 to 24 inches. Stems are wiry and slender containing a few short leaves. The leaf blades are narrow and rolled in the stalk. The yellowish-green sheen of dense stands are highly visible after other annual grasses turn brown. The flower is a long-awned spike and it has a fibrous root system that is quickly developed allowing it to extract soil moisture deep in the soil profile before most perennials. The seed longevity for medusahead is at least two years. The site must be monitored for at least four years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

Habitats for medusahead include disturbed sites and grasslands. It grows best on clay soils where deep soil moisture is available late in the season. Medusahead infestations displace native vegetation and can greatly reduce carrying capacity of rangelands for domestic livestock of up to 75%. The barbs or awns on the seed head can cause puncture wounds to grazing animals, as well as cling to the feet and fur of animals or hikers socks. Tissues have high silica content which decrease palatability and makes the litter of dead stems slow to decompose.

The key to effective control of medusahead is preventing the establishment of plant communities. Medusahead outcompetes desirable plants when overgrazing of the site occurs. An aggressive management approach, combining several control methods (mechanical, herbicides, and burning) has proven to be the most effective dealing with medusahead plant populations. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Medusahead is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Key ID Points

1. Stems are wiry and slender with a few short leaves.
2. Grows 6 to 24 inches tall.
3. Awns are long and twisted.

Above © Steve Dewey, Utah State University

Taeniatherum caput-medusae

Updated on: 7/2015

Management Recommendations

CULTURAL
Preventing the establishment of the medusahead is crucial, so maintaining healthy native plant communities is a priority. Contact your local Natural Resources Conservation Service for seed mix recommendations. Bare ground is prime habitat for weed invasions, so prevent bare spots caused by overgrazing.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A Species. Eradication is the management objective of all List A's. No biocontrol agent for medusahead is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pull or dig from moist soil in spring before emerging from boot. Make certain to pull all roots and bad specimens carefully so as not to scatter seeds if seed heads are present. Disking and plowing or a slow hot fire before seed set can reduce medusahead by 90% or more.

Integrated Weed Management:

Preventing the establishment of this plant in Colorado is crucial since it is not yet known to exist in the state. Knowing how to identify Medusahead is important for early detection. Eradication requires intensive and persistent control efforts to effectively eliminate weed infestations and soil seed reserves. Using an integrated weed management approach if infestations occur can be effective in eradicating Medusahead.

Medusahead

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Sulfometuron + Metsulfuron (Oust Extra)	3 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply in fall either preemergence or very early postemergence

Additional herbicide recommendations for other species can be found at:
https://goo.gl/VFPCUv

Colorado State University

CDA CO

Myrtle spurge

Euphorbia myrsinites

Colorado Department of Agriculture

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Myrtle spurge Identification and Management

Identification and Impacts

Myrtle spurge *(Euphorbia myrsinites)* is a low growing perennial with trailing fleshy stems. The leaves are fleshy, blue-green and alternate. Flowers are inconspicuous with yellow-green, petal-like bracts that appear from March to May. Myrtle spurge spreads by seed and plants are capable of projecting seeds up to 15 feet. The plant grows from a taproot, with new stems emerging in early spring and dying back in the winter. Plants can grow up to 8-12 inches high and 12-18 inches in width.

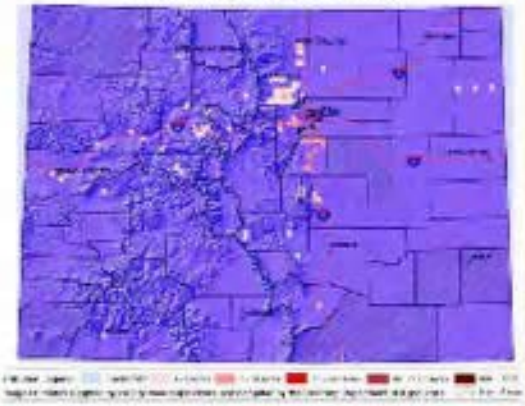
Myrtle spurge contains a toxic, milky sap which can cause severe skin irritations, including blistering. This plant is poisonous if ingested; causing nausea, vomiting and diarrhea. Wearing gloves, long sleeves, shoes, and eye protection is highly recommended when in contact with myrtle spurge, as all plant parts are considered poisonous.

Myrtle spurge is an invasive ornamental that is native to Eurasia. It is popular with xeriscapes and rock gardens, preferring sunny to partly sunny areas and well drained soils. Myrtle spurge rapidly escapes gardens and invades sensitive ecosystems, out competing native vegetation and reducing wildlife forage. Alternatives to planting myrtle spurge include native plants such as sulphur flower (*Erigonum umbellatum*), Kinnikinnick *(arctostaphylos uvursi)*, or creeping mahonia (*Mahonia repens*). The soil seed reserve of myrtle spurge is estimated to be eight years. The site must be monitored for at least nine years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

The key to effective control of myrtle spurge is to remove plants prior to seed set and to detect and remove new populations in natural areas early on. Small areas can be easily removed by mechanical means but should be done early to prevent triggering seed launching. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Myrtle spurge is designated as a "List A" species in the Colorado Noxious Weed Act. It is designated for statewide eradication. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Map of myrtle spurge infestation.



Key ID Points

1. Low growing plant with blue-green, waxy leaves.
2. Flowers are yellow-green petal like bracts that appear from March to May.

Photos © Kelly Uhing, Colorado Department of Agriculture and (above) Crystal Andrews, Colorado Department of Agriculture.

Updated on: 7/2015

Management Recommendations

CULTURAL
Keeping desirable vegetation healthy and thick will help keep invaders out. Prevent the establishment of new infestations by minimizing disturbance and seed dispersal. Survey your land regularly to detect new invaders and eradicate any new populations quickly.

BIOLOGICAL
Biocontrol is not an approved method of contol for State List A species. Eradication as the management objective for all List A species. For more information on insect biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916

MECHANICAL
Hand pull or dig when soil is moist. Make certain to pull all the roots and wear rubber gloves and eye protection to protect yourself from the toxic milky sap. Treatment follow up is important to check root fragment resprouts that will occure when the tap root is severed too shallow.

Integrated Weed Management:

Since Myrtle spurge spreads mainly by seed, it is very important to prevent seed production and deplete the seed bank. Remove mature plants prior to setting seed and seedlings whenever present.

Populations can be managed mechanically and by spot treatment of herbicides. It is important to be persistent with follow up treatments for many years.

Myrtle spurge

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
2,4-D ester	2 qt./acre + 1% v/v methylated seed oil	Use a 2,4-D ester formulation that has a 4.0 lbs. active ingredient/acre. Apply during spring or during fall regrowth.
Dicamba + 2,4-D	1 pint/acre dicamba + 2-3 pints/acre 2,4-D (amine or ester)	Use a 2,4-D formulation that has a 4 lbs. active ingredient/gallon. Apply during spring or during fall regrowth.
Picloram (Tordon/Picloram 22K - Restricted use pesticide) + 2,4-D	20 oz./acre + 2-3 pints/acre 2,4-D (amine or ester)	Apply at flowering growth stage during spring or to fall regrowth. DO NOT use near trees, desirable shrubs, water, or high water table.

Additional herbicide recommendations for other species can be found at:
https://goo.gl/VFPCUv

Top to bottom photos © Unknown, A. Murray, Univ. of Florida; USDA ARS Archive; and unknown.

Orange hawkweed

Hieracium aurantiacum

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Orange hawkweed Identification and Management

Identification and Impacts

Orange hawkweed *(Hieracium aurantiacum)* is a perennial plant originating from Europe. It reproduces from runners, rhizomes, sporadic root buds, and seed. Leaves are basal with one or two small leaves occasionally occurring on the bristly stem. Rosette leaves are four to six inches in length, spatula shaped and have finely toothed margins. The plant grows 10 to 20 inches in height. Flowers have 5 to 35 red-orange-yellow heads with petals that are strap-shaped with notched tips. The flowers generally grow in clusters, and look similar to dandelions. They range from 1/2 to 3/4 inches in size. The plant also contains a milky juice.

Habitat for orange hawkweed include disturbed areas, ski-fields, grasslands, pastures, rangelands, woodlands, alpine meadows and yards. It grows in temperate and mountain regions and can tolerate a variety of conditions.

Orange hawkweed displaces native vegetation and reduces livestock and wildlife forage. The plants quickly form dense infestations which dominate the site with a solid mat of rosettes or seedlings. Orange hawkweed readily escapes gardens and becomes a serious problem in natural areas. The seed viability of orange hawkweed is seven years. The site must be monitored for at least eight years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

The key to effective control of orange hawkweed is preventing the establishment of plant communities through sound land management practices. Maintain healthy pastures and rangeland and continually monitor your property for new infestations. If plant populations of orange hawkweed exist, combining herbicides and cultural control methods can be effective. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Orange hawkweed is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Map of orange hawkweed infestation.

Photos © Bottom 2 lower left: Kelly Uhing, Colorado Department of Agriculture; Top Left and Top Center: Michael Shephard, USDA Forest Service; Above map: Crystal Andrews, Colorado Dept.of Ag

Key ID Points

1. Basal leaves with 1 or 2 small leaves.
2. Red-orange flower heads with petals that are strap-shaped with notched tips.
3. Hairy leaves and stems.

Updated on: 7/2015

Hieracium aurantiacum

Orange hawkweed

Management Recommendations

CULTURAL
When native forbs and grasses are already present, assisting plant competitiveness by supplementing fertilizers can be an effective cultural control method. This proves to be most successful on pasture and rangelands where soil nitrogen levels may be depleted.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A Species. Eradication is the management objective of all List A's. No biocontrol agent for Orange hawkweed is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
NOT recommended because of the weed's ability to reproduce by stolons, rhizomes and root fragments. This often renders mechanical control obsolete.

Integrated Weed Management:

Since orange hawkweed has been identified in small quantities around Colorado, preventing the populations from spreading is important in management of the weed. Using a combination of control methods proves to be the most effective way to control populations. Using cultural and herbicide control methods together proves to be key in eradicating established infestations.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminopyralid (Milestone)	6-7 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply when plants are in rosette to bolting stage. (Spring to early summer)*
Clopyralid (Transline)	1.33 pint product/acre + 0.25% v/v non-ionic surfactant	Apply when plants are in the rosette growth stage. (Spring to early summer)*
Clopyralid + 2,4-D (Curtail)	2 qt. product/acre + 0.25% v/v non-ionic surfactant	Apply when plants are in the rosette growth stage. (Spring to early summer)*
Note: *Ideally treat in the reproductive stage, which is bolting to flowering. Fall treatments are ineffective.		
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Photos, © Top: Tom Heutte, USDA Forest Service; Others: Kelly Uhing, Colorado Department of Agriculture.

Parrotfeather Identification and Management

List A

Parrotfeather (Myriophyllum aquaticum) is an aquatic to semi-terrestrial perennial plant also known by the names "Brazilian watermilfoil" and "thread-of-life." The plant is colony-forming, creating large, emersed mats of vegetation. Adventitious roots form at the nodes, and plant parts break off easily and form new infestations. This species is dioecious, meaning that there are both female and male plants. However, only female plants occur in the plant's non-native range, so reproduction is exclusively vegetative. Seeds have not been observed outside of the native range.

The finely-dissected, feather-like leaves of the plant are arranged around the stem in whorls of four to six. Emergent leaves are 2-5 centimeters long with 6-18 divisions per leaf, and the submerged leaves are 1.5-3.5 centimeters long with 20-30 divisions per leaf. Emergent vegetation stands upright, up to a foot high above the water, and looks like miniature fir trees. The emergent leaves are stiffer and darker in color. Stems can become woody, and the plant is unpalatable to most grazers. Flowers are very small, translucent to white in color, and develop in the axils of middle to upper submersed and emersed leaves from April to July.

Parrotfeather is native to the Amazon River in South America and was introduced in the late 1800s as an aquarium plant and pond ornamental. Parrotfeather has naturalized worldwide, especially in warmer climates. It grows along the shorelines of lakes, canals, reservoirs, and other bodies of water, and it tends to colonize slow-moving or still water rather than high-flow areas. Colonies can become detached and form floating mats, and the plant can also live in a semi-terrestrial form on mud flats. Infestations can clog waterways, impeding recreational and commercial boating activities. Dense monocultures also disrupt the native aquatic plant community.

The key to effective control of parrotfeather is to prevent establishment through proper land management. Maintain healthy riparian corridors, wetlands and irrigation canals, and continually monitor your property for new infestations. Parrotfeather is related to and can highly resemble a List B noxious weed known as Eurasian watermilfoil. Be sure to identify species correctly so that appropriate treatment can be applied.

Parrotfeather is a designated "List A" species in the Colorado Noxious Weed Act. It is not known in the state but is required to be eradicated if found. The following page provides management recommendations. For more information please visit: www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, at 303-869-9034.

Key ID Points

1. Aquatic plant with submersed AND emergent leaves.
2. Feather-like leaves in whorls of 4-6.
3. Emergent growth up to 1 foot above water surface, resembling tiny fir trees.
4. Reproduction is vegetative only in non-native range.

Parrotfeather

Myriophyllum aquaticum

List A

Integrated Weed Management Recommendations

Parrotfeather

Myriophyllum aquaticum

Prevention is the best control for parrotfeather. Its tough rhizomes can be transported long distances on boat trailers. Avoid introduction through boating activities. Once established, it is difficult to fully eliminate parrotfeather, due to its thick waxy cuticle and aquatic environment.

CULTURAL

Prevent the introduction and establishment of new infestations by conducting regular inspections of recreational and commercial boats and waterways. Remove all plant parts from boats and prevent transportation of propagules into uninfested waters. Maintaining healthy native communities in slow-moving streams, ponds, reservoirs, and wetlands to help prevent establishment.

BIOLOGICAL

Biocontrol agents are not included in the prescribed management plans by the State since eradication is the management objective for all List A species. No biocontrol agents for parrotfeather is available. For more information on the use of biocontrol agents to control weeds in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL

Small infestations can be raked or seined out of the water, but caution should be used since mechanical efforts while the plant is still invading may enhance its rate of spread. In addition, all plant parts must be collected so that the infestation doesn't reestablish from remaining fragments and roots. Rhizomes can be very dense and tough, and the plant regrows quickly. Makes sure you can access all plant parts before attempting mechanical treatment.

CHEMICAL

Parrotfeather is difficult to control chemically due to its thick waxy cuticle. The following are recommendations for herbicides that can be applied in aquatic environments to treat parrotfeather. Rates are approximate and based on smaller infestation, spot-spraying techniques. Please reference the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
2,4-D liquid (Hardball, Weedar 64, etc.) or 2,4-D granules (Sculpin, Navigate)	2.3 gal/acre with 5-gal min. mix/acre for emerged plants 2.5-6.2 gal/acre-ft. for submerged	Treat emerged plants when vegetation has at least 1 foot above water. Must include an aquatic-safe surfactant for effective absorption. Submerged treatments are limited to 2 per year. **Coordination and approval from local entities may be necessary for all aquatic treatments.**
Endothall (Aquathol)	1.9-3.2 gal/acre-ft. for spot or lake margin treatment	Spot treat on emerged and submerged plants. If treating an entire waterbody, rates will be lower. Be sure to follow label.
Imazapyr (Habitat: apply to emerged vegetation only)	2-3 pints/acre. Plus aquatic surfactant	Use only on emerged plant parts. Must include an aquatic-safe surfactant for effective absorption. Treat when emergent vegetation has at least 1 foot above water.

Colorado Department of Agriculture - Conservation Services
305 Interlocken Parkway
Broomfield, CO 80021
(303) 869-9030
www.colorado.gov/ag/weeds

Rev. 10/14

Purple loosestrife

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Purple loosestrife Identification and Management

Identification and Impacts

Purple loosestrife *(Lythrum salicaria)* is a non-native, tap-rooted, perennial forb. It is native to Europe and was introduced to North America as an ornamental plant for gardens. It has escaped into natural areas such as streambanks and shallow ponds. Purple loosestrife reproduces primarily by seed. A single, mature plant can produce up to three million seeds per year. The seeds can remain viable in the soil for 5 to 20 years. Pieces of roots or stems also can produce new plants. Purple loosestrife produces multiple four-sided stems that can grow two to eight feet tall. Leaves are two to five inches long, lance-shaped and whorled on the stems. Flowers are tightly grouped in long, vertical heads; they bloom from the bottom up. They are reddish-purple in color, about one inch long, and have five to seven petals. Flowers appear from late June through September.

Key ID Points

1. Showy rose-purple flowers bloom in long vertical racemes.
2. Lance-shaped leaves have smooth edges.

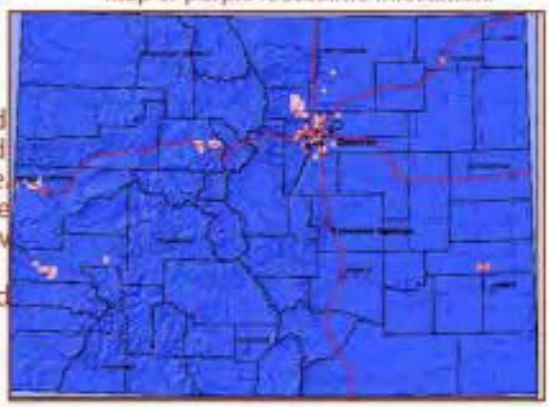
Purple loosestrife can be found along riverbanks, ditches, and wet meadows throughout the state. Infestations rapidly replace native vegetation, can impede water flow in canals and ditches, and have little wildlife habitat value. Infested wetlands eventually become a monoculture of loosestrife.

If purple loosestrife is growing in your garden, remove plants immediately and consider a substitute. There are many planting alternatives that are better suited to Colorado and beneficial to wildlife. Alternatives include spotted gayfeather, Rocky Mountain Penstemon, beebalm, purple coneflower, and Colorado Columbine. For more information refer to Colorado Native Plant Society's website, www.conps.org.

The key to effective control of purple loosestrife 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 low. Eradicating large populations is much more difficult. Persistent management and monitoring of site is a long-term program to ensure eradication. Small loosestrife infestations should be eradicated by hand-pulling/cutting in combination with herbicide application. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Purple loosestrife is designated as "List A" species on the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/csd and click on the Noxious Weed Program link or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Map of purple loosestrife infestation.



All photos © Kelly Uhing. Infestation map above, Crystal Andrews, Colorado Department of Agriculture.

Updated on: 7/2015

Lythrum salicaria

Management Recommendations

CULTURAL
Prevent the establishment of new infestations by minimizing disturbance and seed dispersal.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A Species. Eradication is the management objective of all List A's. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand removal of isolated individuals can be effective on small infestations. Hand removal should be performed prior to seed set. It is important to remove the entire rootstalk of the plant to avoid regrowth from root fragments. During the flowering stage, flowerheads must be cut and disposed of properly before a herbicide is applied. This will prevent or reduce seed production.

Integrated Weed Management:

Since purple loosestrife has been identified in Colorado, preventing the populations from spreading is important in management of the weed. Prevent new seeds from being added to the seed bank by managing purple loosestrife before it flowers or by clipping and disposing of the flowerheads prior to seed set and using herbicides to control plants.

Follow up control efforts the same growing season and for several years afterwards. Maintain a healthy cover of perennial plants.

HERBICIDES

The following are recommendations for herbicides that can be applied to range and pasturelands. Always read, understand, and follow the label directions. Rates are approximate and based on equipment with an output of 30 gallons per acre. Please read label for exact rates. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Triclopyr (Garlon 3A)	6-8 qt./acre OR 1.3-1.9 oz./gal water + 0.25% v/v non-ionic surfactant	Apply in summer. If plants are flowering, cut and properly dispose of flowerheads before applying Garlon 3A.
Glyphosate (Rodeo*, Habitat* - aquatic safe)	4 qt./acre OR 1.3-1.9 oz./gal water + 0.25% v/v non-ionic surfactant	Apply in summer during the flowering stage. Cut and properly dispose of flowerheads before applying Rodeo.
Aquatic 2,4-D Amine	1-2 qt./acre or 1.3-2.5 oz./gal water + 0.25% v/v non-ionic surfactant	Early spring - prevents seed formation only. Retreatment will be necessary. DO NOT apply when outside temperatures will exceed 85 degrees.
Note: *These herbicide products are nonselective and will kill any vegetation contacted.		
Additional herbicide recommendations for other species can be found at: **https://goo.gl/VFPCUv**		

Purple loosestrife

Colorado State University

CDA CO

Rush skeletonweed

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. 1-4 ft. in height.
2. Stems and leaves contain milky latex.
3. Leaves are sharply toothed.
4. Brown hairs on first 4" to 6" of stem.

Updated on: 7/2015

Rush skeletonweed Identification and Management

Identification and Impacts

Rush skeletonweed *(Chondrilla juncea)* is a native to Asia and the Mediterranean region. It is a herbaceous perennial that reproduces by seed and by an extensive root system. The wiry stems of the plant can grow from 1 to 4 feet tall. Stems are hairy from the ground up to 4 to 6 inches high with smooth stems above. These brown hairs are a distinguishing characteristic. Stems and leaves contain a milky latex if cut. The leaves on stems are sharply toothed. The hairless basal leaves are 2 to 5 inches long and 1/2 to 2 inches wide. Flowers are yellow and occur from mid-July to when frost occurs. Flower heads are less than 1 inch in diameter and consist of 9 to 12 flowers, although they may appear to be one. A vigorous mature plant can produce up to 1,500 flowers capable of distributing 20,000 seeds. Plants usually overwinter as rosettes which closely resemble common dandelion.

Habitat for rush skeletonweed include roadsides, rangelands, grain fields, and pastures. The plant prefers well drained soils and disturbance aids establishment. This weed thrives on well-drained and rocky or sandy textured soil, but can flourish in both very wet and very dry environments. The plant can regenerate if the root system is damaged by mechanical or cultivation practices. When damage occurs and root fragments sprout they can reduce crop yields and wildlife forage and habitat. The soil seed longevity is at least three years.

The key to effective control of rush skeletonweed is preventing the establishment of plant communities through sound land management practices. Maintain healthy pastures and rangeland and continually monitor your property for new infestations. If rush skeletonweed populations exist, an integrated weed management strategy is the only way to control and eradicate populations. There is no one control method that works. Details on the back of this sheet can help to create a management plan comparible with your site ecology.

Rush skeletonweed is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photo clockwise, from lower left © Idaho Weed Awareness Campaign; Utah State University Archives; Richard Old; Idaho Weed Awareness Campaign and above, Steve Dewey, Utah State University, Bugwood.org.

Chondrilla juncea

Management Recommendations

CULTURAL
Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities. Contact your local Natural Resources Conservation Service for seed mix recommendations. Maintain healthy pastures and prevent bare spots caused by overgrazing.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A species. Eradication is the management objective of all List A's. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Diligent hand-pulling or digging can be effective for very small infestations only. New plants can arise from root fragments so check site often, removing any new growth. Hand-pull or dig when soil is moist and try to remove all roots. Be sure to bag removed specimens carefully as to not scatter seeds if plant is flowering. Mowing and cultivation are ineffective. Cultivation spreads root fragments increasing infestations.

Integrated Weed Management:

Preventing the establishment of this plant in Colorado is crucial since it is not yet known to exist in the state. Monitoring your land for infestations is key to early detection. Eradication requires intensive and persistent control efforts to effectively eliminate weed infestations and soil seed reserves.

The site must be monitored for at least 10 years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

Rush skeletonweed

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminopyralid (Milestone)	5-7 oz./acre (start with 7 oz.) + 0.25% v/v non-ionic surfactant	Apply at rosette growth stage. (Spring to Early Summer)
Aminocyclopyrachlor + chlorsulfuron (Perspective)	4.75-8 oz. product/acre + 0.25% v/v non-ionic surfactant	Post-emergence in spring until flowering, or to fall rosettes. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not permitted for use in the San Luis Valley.
Additional herbicide recommendations for this and other species can be found at: **https://goo.gl/VFPCUv**		

Top to bottom photos, © Utah State University Archive, Utah State University, Bugwood.org; Eric Coombs, Oregon Department of Agriculture; Gary L. Piper, Washington State University, Bugwood.org;

Squarrose knapweed

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Squarrose knapweed Identification and Management

Identification and Impacts

Squarrose knapweed *(Centaurea virgata Lam. Var. squarrosa)* is a taprooted long-lived perennial that reaches 1 to 3 feet in height. It has bract tips that are recurved or spreading with terminal spine longer than lateral spines. Flowers are borne in singles or pairs at the tip of each branch. The flowers are rose to pink colored and usually the plant only produces 3 to 4 seeds per head. The flower heads appear more slender than other species of knapweeds. Deciduous seed heads fall off the stems after seeds mature. Seeds are bur-like and are dispersed by animal movement. Stems are branched with deeply dissected lower leaves and bract-like upper leaves.

Squarrose knapweed can be found on rangeland sites as well as disturbed sites like roadsides and waste areas. Squarrose knapweed is extremely drought and temperature tolerant. It is found in pockets of Utah, Oregon and California. Squarrose knapweed is native to the eastern Mediterranean region.

Squarrose knapweed outcompetes native plant species and reduces available forage for livestock and wildlife. It disrupts native plant communities and forms monocultures. The plant is not palatable or nutritionally sufficient for livestock and is allelopathic, preventing desirable plants from growing around it. The seed longevity is at least 3 years so the site must be monitored for at least 4 years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

The key to effective control of squarrose knapweed is preventing the establishment of plant communities, by maintaining healthy native plant populations, and by surveying your land for any new infestations. If squarrose knapweed is present, using a combination of control methods such as mechanical and herbicides to eradicate populations is effective. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Squarrose knapweed is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © All except top center: Steve Dewey, Utah State University; Top center: Sara Rosenthal, USDA Agricultural Research Service, Bugwood.org

Key ID Points

1. Flowers are pink or rose colored.
2. Recurved bract tips
3. Stems are branched with deeply dissected lower leaves and bract like upper leaves.

Centaurea virgata Lam. Var. squarrosa

Updated on: 7/2015

Management Recommendations

Squarrose knapweed

CULTURAL
Preventing the establishment of the squarrose knapweed is crucial, so maintaining healthy native plant communities is a priority. Contact your local Natural Resources Conservation Service for seed mix recommendations. Bare ground is prime habitat for weed invasions, so prevent bare spots caused by overgrazing.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A species. Eradication is the management objective of all List A's. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Digging the entire taproot from the ground will eradicate Squarrose knapweed. Be sure to properly dispose of the plants, since seeds can mature and become viable after the plant has been dug out. Monitoring the site for regrowth from rootstalks is needed if entire taproot is not removed.

Integrated Weed Management:

Preventing the establishment of this plant in Colorado is crucial since it is not yet known to exist in the state. Monitoring your land for infestations is key to early detection.

Since squarrose knapweed looks similar to diffuse knapweed, it may go undetected. Knowing the key characteristics can help with proper identification.

Do not allow squarrose knapweed to go to seed.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminopyralid (Milestone)	7 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply in spring to early summer during bolting to bud growth stages or in fall. Add 1 qt./acre 2,4-D when plants are treated in the bolt to flowering phase.
Aminocyclopyrachlor + chlorsulfuron (Perspective)	4.75-8 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply from the seedling to the rosette growth stages. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not permitted for use in the San Luis Valley.

Additional herbicide recommendations for this and other species can be found at:
https://goo.gl/VFPCUv

Top two photos, © Steve Dewey, Utah State University. Bottom photo, Dale Swenarton.

Tansy ragwort

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Yellow ray and disk flowers.
2. Reaches 1-6 feet in height.
3. Leaves are 2-8 inches long.
4. Rank odor from crushed leaves.

Updated on: 7/2015

Tansy ragwort Identification and Management

Identification and Impacts

Tansy ragwort *(Senecio jacobaea)* is a non-indigenous, poisonous weed native to Europe and Asia minor, that is responsible for the deaths of thousands of livestock. It is a taprooted biennial or short lived perennial reaching 1 to 6 feet in height. The stems are stout and erect, with slightly branching characteristics. The leaves are 2 to 8 inches long, alternate and equally distributed mostly pinnately lobed, with the terminal lobe generally larger than the lateral ones. When the leaves are crushed, they give off a rank odor. The flowers form in clusters at the end of erect branches. The flowering heads are numerous and contain ray and disk flowers that are yellow in color. The flowers have 10 to 13 petals and are 1/4 to 1/2 inch long. The stems may be solitary or multiple up to the inflorescence. The seeds are pappus and are carried by the wind, each plant can produce up to 150,000 seeds.

Habitat for tansy ragwort include roadsides, pasture land, rangeland sites and disturbed forest habitats after logging. It currently effects millions of acres in the Pacific Northwest. The viability of the seeds can be up to 15 years. Monitoring a site after eradication, is imperative with seed dormancy being so long. The crown and root system can reproduce vegetatively and produce rosettes. This occurs when plants are disturbed by mechanical and pulling control methods.

Tansy ragwort outcompetes native plant species and reduces available forage for livestock and wildlife. It is toxic to cattle and horses causing irreversible liver damage. The plant is not palatable or nutritionally sufficient for livestock and disrupts native plant communities and forms monocultures. The soil seed reserve is at least 16 years.

The key to effective control of tansy ragwort is preventing the establishment of plant communities through sound land management practices. Maintain healthy pastures and rangeland and continually monitor your property for new infestations. If plant populations of tansy ragwort exist, combining herbicides, cultural and mechanical control methods can be effective in eradication. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Tansy ragwort is designated as a "List A" species in the Colorado Noxious Weed Act. It is required to be eradicated wherever found in the State. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Senecio jacobaea

Tansy ragwort

Management Recommendations

CULTURAL
When native forbs and grasses are already present, assisting plant competitiveness by supplementing fertilizers can be an effective cultural control method. This proves to be most successful on pasture and rangelands where soil nitrogen levels may be depleted.

BIOLOGICAL
Biocontrol agents are not included in the prescribed management plans by the State for List A species. Eradication is the management objective of all List A's. No biocontrol agent for Tansy ragwort is available. For more information on biocontrol in Colorado, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pulling or digging is an effective control method when populations are small. Hand pulling should occur when soil is moist and be certain to pull all the roots, since Tansy ragwort has a tendacy to grow from root fragments. It is important to bag specimens carefully so as to not scatter seeds if the plant is flowering.

Integrated Weed Management:

Preventing the establishment of this plant in Colorado is crucial since it is not yet known to exist in the state. Monitoring your land for infestations is key to early detection. Eradication requires intensive and persistent control effores to effectively eliminate weed infestations and soil seed reserves.

Once seed reserves have been established Tansy ragwort is very persistent and tough to manage.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminopyralid (Milestone)	4 to 5 fl oz./acre	Apply at the rosette growth stage. (During first year of growth or Spring)
Picloram (Tordon/Picloram 22K - Restricted use pesticide)	2 to 4 pint/acre + 0.25% v/v non-ionic surfactant	Apply at the rosette growth stage. (During first year of growth or Spring) DO NOT use near trees, desirable shrubs, water, or high water table.
Metsulfuron (Escort XP)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at the bud growth stage. (Spring)

Additional herbicide recommendations for this and other species can be found at:
https://goo.gl/VFPCUv

Photos, top to bottom © King County, Washington; Leslie J. Mehrhoff, University of Connecticut, Bugwood.org; and Michael Shephard, USDA Forest Service, Bugwood.org.

Yellow starthistle

Colorado Department of Agriculture

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Yellow starthistle Identification and Management

Identification and Impacts

Yellow starthistle *(Centaurea solstitialis)* originated from Northern Spain. It is a winter annual that is blue-green in color, has a vigorous taproot, and produces bright yellow flowers with sharp, stiff spines surrounding the base of the flower that extend up to ¾ of an inch long. Yellow starthistle grows from 1 inch tall to 4 feet tall. Basal leaves are 1-3 inches long and deeply lobed while upper leaves are smaller and narrower. Stems appear winged and both stem and leaves have a slight whitish nap covering them. Yellow starthistle spreads by seed with a single large plant producing up to 100,000 seeds. Plumed and plumeless seeds disperse at different times.

Yellow starthistle typically germinates in the fall with increased moisture, overwinters as a seedling, and forms its rosette beginning in March through May. It can however, germinate extremely fast with optimal conditions throughout the entire summer (16 hours or less with ~ 70 degrees F and ample moisture). Flowering generally occurs from June to September and often later.

Habitats for yellow starthistle include rangelands, pastures, roadsides, wastelands, and lower elevations. Over utilized grasslands are particularly susceptible to invasion.

Yellow starthistle is fatally poisonous to horses (causing chewing disease) and is considered poor forage for all livestock and wildlife. It also destroys native plant communities. The seed bank of yellow starthistle is not completely understood. The site must be monitored for at least 15 years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

The key to effective control of yellow starthistle is to prevent seed set from occurring in existing populations, monitoring your land for new infestations frequently, treating newly detected invasions rapidly, and preventing new introductions from occurring. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Yellow starthistle is designated as a "List A" species in the Colorado Noxious Weed Act. It is designated for statewide eradication. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Map of yellow starthistle infestation.

Key ID Points

1. Bright yellow ray and disk flowers.
2. Winged stems.
3. Stiff spines at flower base
4. Plant has a unique blue-green color.

Photos clockwise from lower left © (3 on left side) Kelly Uhing, Colorado Department of Agriculture, Steve Dewey, Utah State University, Bugwood.org; and map by Crystal Andrews, Colorado Department of Agriculture.

Updated on: 7/2015

Centaurea solstitialis

Yellow starthistle

Management Recommendations

CULTURAL
Following initial control, establishment of selected grasses can be an effective cultural control of yellow starthistle. Contact your local Natural Resource Conservation Service for seed mix recommendations. Maintain healthy pastures and prevent bare spots caused by overgrazing. Bare ground is prime habitat for weed invasions.

BIOLOGICAL
Insect biocontrol agents exist but are not included in the state prescribed management plan. Eradication is the management objective for all List A species. For more information on biocontrol in Colorado, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pull when soil is moist and make certain to pull all the roots. Bag specimens carefully so as to not scatter seeds if flowering. Plants vary greatly in size so be sure to look for plants that are only a few inches tall, as well as plants that are several feet tall. Include dried skeletons as they may still contain seed. Mowing is not advisable and may extend life of the plant and stimulate additional flowering.

Integrated Weed Management:

The sheer number of seeds, high seed viability, and fast growth of yellow starthistle requires a persistent control program. Using herbicides and mechanical techniques to control the invasion followed by establishing a desirable plant community can be effective.

Management must be persistent to deplete the seed bank in the soil.

It is imperative to prevent seed production. Do not allow yellow starthistle plants to go to seed.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminopyralid (Milestone)	7 oz. product/acre	Apply during rosette growth and bolting growth stages. (Early spring to early summer)
Aminocyclopyrachlor + chlorsulfuron (Perspective)	3-5 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply during rosette growth and bolting growth stage; most effective at the seedling to the rosette stages. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not permitted for use in the San Luis Valley.
Clopyralid (Transline)	1.33 pints product/acre	Apply during rosette growth and bolting growth stages. (Early spring to early summer)

Additional herbicide recommendations for this and other species can be found at:
https://goo.gl/VFPCUv

Photos, top to bottom © Stephen Ausmus, USDA Agricultural Research Service, Bugwood.org; University of Idaho Archive, University of Idaho, Bugwood.org; and Jerry Asher, USDI Bureau of Land Management, Bugwood.org.

Absinth wormwood

Colorado Department of Agriculture

305 Interlocken Pkwy
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(303) 869-9030
weeds@state.co.us

Absinth wormwood Identification and Management

Key ID Points

1. Absinth is well branched and gets 3 feet tall and 2 feet across.
2. Silver-grey leaves and small yellow flowers.

Identification and Impacts

Absinth wormwood *(Artemisia absinthium)* is native to Eurasia, the Middle East and North Africa. It was introduced to North America in the early 19th century to be cultivated for medicinal use. It was first reported outside cultivated gardens in 1841, along roadsides and waste grounds.

Absinth wormwood is a long-lived perennial that possesses a strong sage odor and bitter taste. Plants grow 2 to 4 feet in height and are prolific seed producers. It has a taproot that can reach 2 inches in diameter and shallow lateral fibrous root branches that can extend up to 6 feet long in all given directions. Plants are woody at the base and regrow from the soil level each spring. The stems are numerous and are covered with fine, gray hairs while the leaves area blue-olive green, alternate and highly divided. Flowers are small, yellowish and arranged in large, spike-like panicles. The seed viability is estimated to be 3 to 4 years and are easily scattered by wind, water, animals, and in hay. The seeds are less than 1/6 inch long, smooth, flattened and light gray.

Habitats for Absinth wormwood include disturbed sites, moist soils, and is also shade tolerant. It can occur in 5,000 to 7,000 feet elevation and is considered a weed in pastureland, cropland, and rangeland. Absinth wormwood is listed as poor palatability in horses, but good for sheep.

The key to effective control of Absinth wormwood is a combination of control methods. Compared to most perennials, it is fairly easy to control with chemicals in combination with mechanical control. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Absinth wormwood is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/csd and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © Kelly Uhing, Colorado Department of Agriculture; and map above by Crystal Andrews, Colorado Department of Agriculture.

Artemisia absinthium L.

Updated on: 07/2015

Absinth wormwood

Management Recommendations

CULTURAL
Cultural controls are possible in theory, but are very time consuming and expensive. Complete removal of any seedlings or newly established plants by continual hand pulling is also possible.

BIOLOGICAL
There is no biological control available for Absinth wormwood. Since biological control agents take years to research, develop and release, no releases are expected in the foreseeable future. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pull or dig when soil is moist. Make certain to pull all the roots, including short horizontal roots. Bag specimens carefully so as to not scatter seeds if removed during or after flowering. Multiple mowings prior to seed generation can cause stress and may provide a control option.

Integrated Weed Management:

Absinth Wormwood is easily controlled using a combination of methods such as chemical and mechanical.

Compared to most perennials, it is fairly easy to control.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminopyralid* (Milestone)	7 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply late spring into summer though the flowering growth stage.
Aminopyralid* + Metsulfuron (Opensight)	3.3 oz. product/acre	Apply late spring into summer though the flowering growth stage.
Aminopyralid* + 2,4-D (Forefront HL)	2 pints product/acre	Apply late spring into summer though the flowering growth stage.
Clopyralid (Transline)	0.66 pint/acre	Apply late spring into summer though the flowering growth stage. Provides greater selectivity when applying near trees and shrubs.
Picloram* + 2,4-D (Tordon/Picloram 22K - Restricted use pesticide)	1 pint product/acre + 1 qt./acre 2,4-D	Apply late spring into summer though the flowering growth stage. DO NOT use near trees, desirable shrubs, water, or high water table.
*Product not permitted for use in the San Luis Valley.		
Additional herbicide recommendations for other species can be found at: goo.gl/TvWnv9		

Top to bottom photos, © Chris Evans, River to River CWMA, Bugwood.org; Mary Ellen (Mel) Harte, , Bugwood.org; and Richard Old, XID Services, Inc., Bugwood.org.

Black henbane

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Black henbane Identification and Management

Key ID Points

1. Shallow lobed leaves that have sticky hairs.
2. Flowers have purple centers and veins.

Identification and Impacts

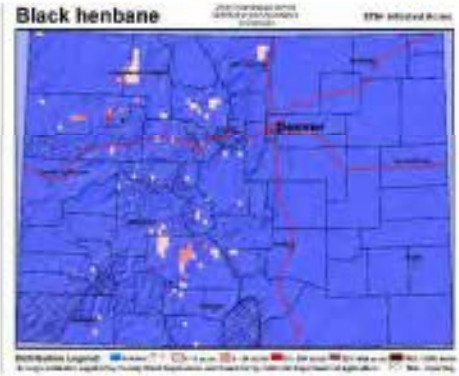
Black henbane *(Hyoscyamus niger)* was introduced from Europe as an ornamental and medicinal herb. In Colorado it is mostly found on the western slope. The plant blooms June through September and may be an annual or biennial. A mature plant reaches 1 to 3 feet in height with foliage that has a fowl odor. Leaves are shallowly lobed to coarsely toothed with sticky hairs. The outer part of the flower is brownish yellow in color with a purple center and veins. Fruits are approximately 1 inch long with 5 lobes.

All parts of Black henbane are poisonous to both livestock and humans when ingested. However; the plant is usually avoided by livestock due to the foul odor. The plant is a strong competitor for moisture and nutrients and produces a persistent litter effecting germination and growth of native plants. Black henbane invades disturbed and overgrazed sites. A good preventable measure is to guard against overuse.

Habitats for Black henbane included disturbed open spaces, roadsides, fields, waste places and abandoned gardens. It grows in most soil types but likes sandy or well drained loam soils. The seed viability or longevity is considered to be 1 to 5 years.

The key to effective control of Black henbane is guarding against disturbance and overuse, this can prove to be a good preventative measure against black henbane. Mechanical control and chemicals are the most commonly recommended method. Controlling plants in the spring or early summer prior to seed production is most effective, follow-up treatments are recommended to pick up missed or late bolting plants. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Black henbane is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/csd and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.



Photos © (2 on bottom, left): Steve Dewey, Utah State University; (Top left and top center): Mary Ellen Harte, forestryimages.com and Map above by Crystal Andrews, Colorado Department of Agriculture.

Hyoscyamus niger

Updated on: 07/2015

Management Recommendations

CULTURAL
Cultural controls are possible in theory, but are very time consuming and expensive. Complete removal of any seedlings or newly established plants by continual hand pulling is also possible.

BIOLOGICAL
There is no biological control available for Black henbane. Since biological control agents take years to research, develop and release, no releases are expected in the foreseeable future. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pull or dig from moist soil, so the entire tap root system can be removed. Tillage will control henbane, but is usually not recommended due to the land it occupies: rangeland, roadsides and pastures. Be sure to bag specimens carefully if removed during or after flowering.

Integrated Weed Management:

Controlling plants in the spring or early summer prior to seed production is most effective, follow-up treatments are recommended to pick up missed or late bolting plants.

Constant monitoring of site after last adult flowering plant is removed is suggested since seed viability can be up to 5 years.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Metsulfuron (Escort XP)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Surfactant absolutely necessary. Apply late bolt to early flower. (Summer to Early Fall)
Chlorsulfuron* (Telar)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply late bolt to early flower. (Summer to Early Fall)
Chlorsulfuron + Metsulfuron (Cimarron Plus)	0.625-1.25 oz./acre + 0.25% v/v non-ionic surfactant	Apply late bolt to early flower. (Summer to Early Fall)
Note: *This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.		
Additional herbicide recommendations for other species can be found at: **goo.gl/TvWnv9**		

Top to bottom photos, © (Top 2 photos) Stevens County (Washington State) Noxious Weed Control Board; and bottom photo David Hallinan, Bannock County Weed Superintendent, Idaho Weed Awareness Campaign.

Black henbane

Bouncingbet Identification and Management

List B

© Mike LaValley

Bouncingbet (*Saponaria officinalis L.*) is a perennial forb in the Caryophyllaceae family, also known as soapwart or sweet William.

Mature plants grow up to three feet tall. Like other plants in the Carnation family, the leaves are opposite and smooth, about 2 to 4 inches long, and have an ovate to elliptic shape. Leaves have three very distinct deeply cleft parallel veins, with smaller lateral faint veins. They are fused at the base around the stem, which forms swollen nodes, similar to carnations. Like the leaves, the stems are smooth and erect. They are sparingly branched.

Showy bouncingbet flowers form at the end of an upright stem to form a cyme. Flowers are usually in pairs. Each flower has five petals per corolla; cultivare petals vary. The petals have a distinct notch on the petal margin, making it bi-lobed. Petals are usually pink to white and are recurved to reflexed, which makes the stamens exposed and the two styles centrally protruding. Within one season, flowers transition from a smaller paler staminate-phase to a larger pinker pistillate-phase, likely to avoid self-pollination (Davis et al. 2014). The five sepals are fused at the base to form a tube-like calyx. In Colorado, bouncingbet greens up in April, flowers emerge starting in June, and sets seed through October. Bees and wasps pollinate bouncingbet flowers (Davis et al. 2014). The fruits are capsules with dull black roundish to kidney-shaped seeds. Seed longevity is unknown. Bouncingbet forms densely thick taproot and rhizomes. With its robust root structure, bouncingbet can form dense colonies. It spreads by root and seed.

Originally, bouncingbet was introduced from Europe as a garden ornamental. In Colorado, bouncingbet occurs mainly municipal areas as a cultivated ornamental and escapee, such as in residential gardens, abandoned lots, exurban areas, and other sites that offer moist, well-drained soil, full to partial sun, such as roadsides and wetlands (EDDMapS 2018).

Bouncingbet contains saponin, which when wet produces lather, and thus was cultivated for this purpose (Challinor and De Voss 2012). Other chemical compounds in bouncingbet are investigated for "cytotoxic activity against human cancer cell lines" and other pharmacological or homeopathic uses (Challinor and De Voss 2012). While generally unpalatable to livestock, in large doses bouncingbet can be poisonous to livestock. The sapogenic glycosides can cause gastrointestinal irritation and destroy red blood cells when absorbed in the blood streams of grazing animals. In humans, it can be toxic when overdosed, however may be a culinary additive in some cultures (Wikipedia 2018).

© Ellen Rathbone

© Davis et al. 2014

Key ID Points

1. Five petals with notched margins
2. Pale staminate flowers and pinker pistillate flowers
3. Three parallel veins in leaves
4. Opposite leaves fused at the base with swollen nodes

Bouncingbet

Saponaria officinalis L.

List B

Integrated Weed Management Recommendations

Bouncingbet

Saponaria officinalis L.

Effective integrated management means using a variety of eradication methods in the same site along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seed dispersal, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, including land use practices.

CULTURAL

Most bouncingbet seeds remain close to parent plants; spread is mainly by root or ornamental introductions. Cultural methods should follow other methods. Maintain or restore a competitive assemblage of shrubs, forbs, cool and warm season grasses that form large root biomass to crowd out bouncingbet roots. Implement whole site restoration of soils, plants and water regimes where dense colonies exist. Use locally adapted species that are ecologically appropriate for the site to improve competitiveness, including annual and perennial species. Incorporate soil amendments, soil microbes and mycorrhizal fungi in restoration efforts for natives. Minimize soil compaction and disturbance, especially in wetlands and moist soil.

MECHANICAL

Mechanical methods are best for residential areas or small infestations, and best applied in early season or newly established plants. Completely remove all roots and root fragments in addition to above ground biomass. Repeat through the season. Mowing, chopping and deadheading leaves roots behind, stimulates more flower production; these methods require consecutive years of season-long treatments and only control but not eradicate it. Mowing when plants are flowering or producing seed disperses flowers and seeds, which expands the size of the infested area. Collect, bag, and dispose of or destroy flowers; seeds could mature and germinate if left on the ground. Low severity prescribed fires may damage above ground vegetation, leaving roots and seeds unaffected. High severity prescribed fire may not damage native plant roots; pile slash on bouncingbet to increase fire temps.

BIOLOGICAL

Bouncingbet is not palatable to sheep, cattle or horses because of its saponin chemical content. If grazed, bouncingbet may resprout. Properly managed grazing can improve vigor of desired species and indirectly prevent bouncingbet. There are no biological control agents for bouncingbet authorized in Colorado that would effectively control it. For more information about biological control agents, visit the CDA Palisade Insectary website at: www.colorado.gov/ag/biocontrol

CHEMICAL

NOTE: Herbicide recommendations to control bouncingbet in pastures and rangeland are found at: https://goo.gl/TvWnv9 Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for herbicides appropriate for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Colorado Department of Agriculture Conservation Services
305 Interlocken Parkway
Broomfield, CO 80021
(303) 869-9030
www.colorado.gov/ag/weeds

Rev. 2/19

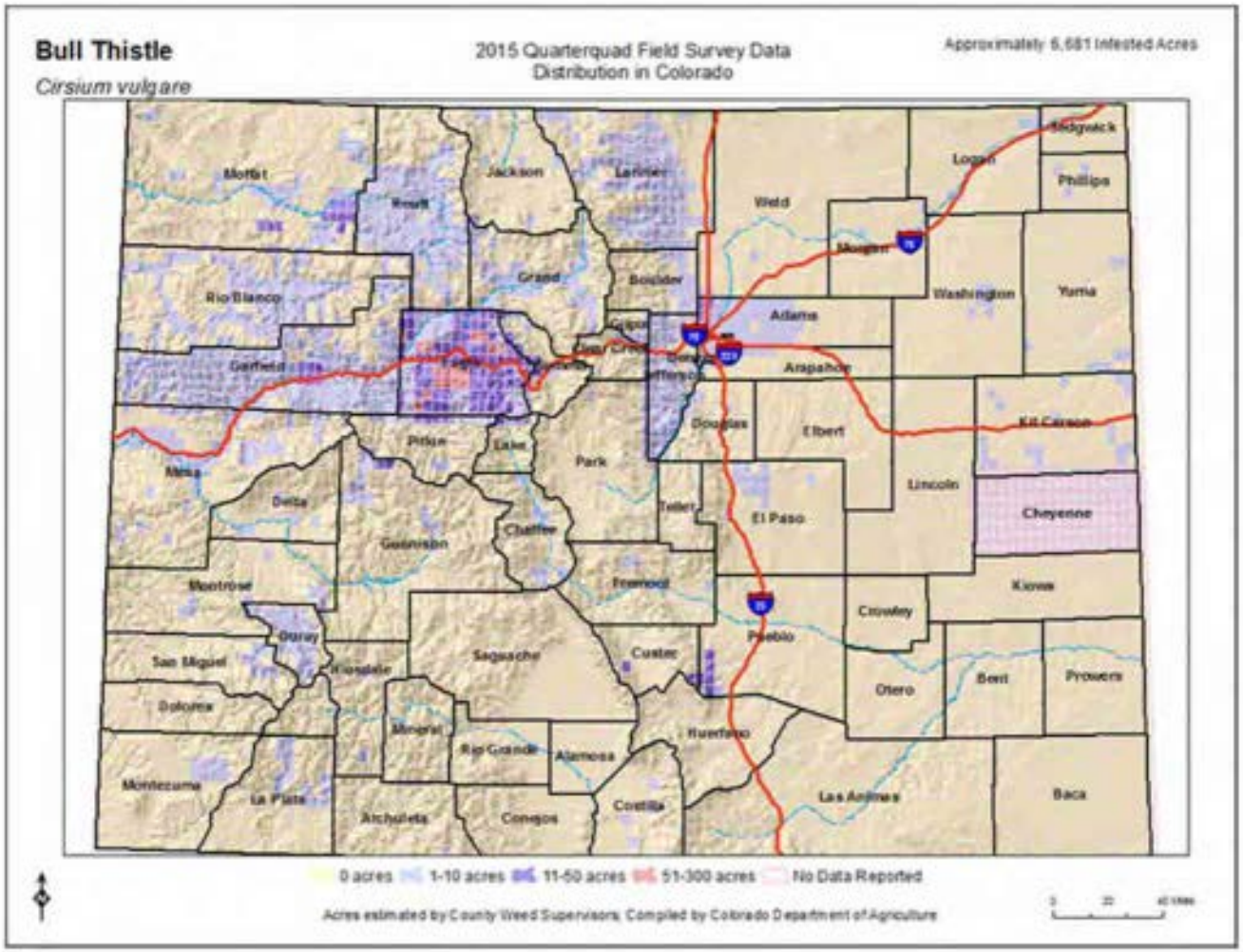
COLORADO
Department of Agriculture (/)

Home (/) Conservation (/conservation) Noxious Weeds (/conservation/noxious-weeds)
Noxious Weed Species ID (/conservation/noxious-weeds/species-id) Bull thistle

Bull thistle

(Cirsium vulgare)

Bull thistle is a biennial forb that was introduced to North America as a seed contaminant and is now widespread. Gumdrop-shaped flowers are pinkish to dark purple in color and 1 ½ to 2 inches in diameter. The flower bracts are somewhat tapered and covered with spines. Seeds are capped with a circle of plume-like white hairs. Leaves are alternate. In Colorado, Bull thistles are the only species that are prickly hairy on the top and are cottony-hairy on the undersides of the leaves. In mature plants the leaves extend down, clasping the stem, and are divided into segments. The plant has a short, fleshy taproot with several primary roots extending from the root crown. Seed leaves are round to spatulate, and smooth. Mature plants can produce up to 4,000 seeds per plant.


Bull Thistle
Cirsium vulgare
2015 Quarterquad Field Survey Data
Distribution in Colorado
Approximately 6,681 Infested Acres
Moffat
Routt
Jackson
Larimer
Weld
Logan
Sedgwick
Phillips
Rio Blanco
Grand
Boulder
Morgan
Washington
Yuma
Garfield
Eagle
Adams
Arapahoe
Douglas
Elbert
Kit Carson
Pitkin
Lake
Park
Mesa
Delta
Teller
El Paso
Lincoln
Cheyenne
Gunnison
Chaffee
Montrose
Fremont
Crowley
Kiowa
Ouray
Pueblo
San Miguel
Hinsdale
Saguache
Custer
Otero
Bent
Prowers
Dolores
Mineral
Rio Grande
Alamosa
Huerfano
Montezuma
La Plata
Archuleta
Conejos
Costilla
Las Animas
Baca
0 acres
1-10 acres
11-50 acres
51-300 acres
No Data Reported
Acres estimated by County Weed Supervisors. Compiled by Colorado Department of Agriculture

Canada Thistle Identification and Management

List B

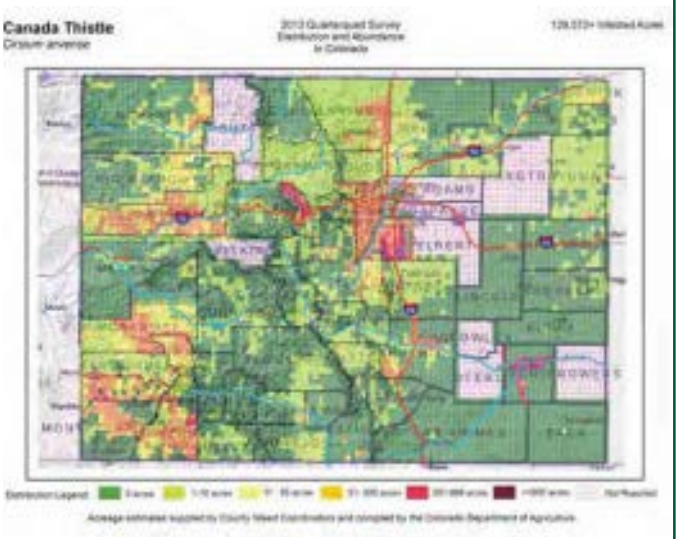
Canada thistle (*Cirsium arvense*) is a non-native, deep-rooted perennial that spreads by seeds and aggressive creeping, horizontal roots called rhizomes. Canada thistle can grow 2 to 4 feet in height. The leaves are oblong, spiny, bright green, and slightly hairy on the undersurface. Unlike other noxious biennial thistles which have a solitary flower at the end of each stem, Canada thistle flowers occur in small clusters of 1 to 5 flowers. They are about 1 cm in diameter, tubular shaped, and vary from white to purple in color.

Canada thistle emerges from its root system from late April through May. It flowers in late spring and throughout the summer. It produces about 1,000 to 1,500 seeds per plant that can be wind dispersed. Seeds survive in the soil for up to 20 years. Additionally, Canada thistle reproduces vegetatively through its root system, and quickly form dense stands. Each fragmented piece of root, 0.25 inch or larger, is capable of forming new plants. The key to controlling Canada thistle is to eliminate seed production and to reduce the plant's nutrient reserves in its root system through persistent, long-term management.

Canada thistle is one of the most troublesome noxious weeds in the U.S. It can infest diverse land types, ranging from roadsides, ditch banks, riparian zones, meadows, pastures, irrigated cropland, to the most productive dryland cropland. Large infestations significantly reduce crop and cattle forage production and native plant species. It is a host plant to several agricultural pests and diseases. Canada thistle prefers moist soils, but it can be found in a variety of soil types. It has been found at elevations up to 12,000 feet.

Effective Canada thistle control requires a combination of methods. Prevention is the most important strategy. Maintain healthy pastures and rangelands, and continually monitor your property for new infestations. Established plants need to be continually stressed. Management options become limited once plants begin to produce seeds. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

2013 Quarter Quad Survey



Canada thistle is designated as a "List B" species as described in the Colorado Noxious Weed Act. It is required to be either eliminated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Program link or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, (303) 869-9030.

Key ID Points

1. Cluster of 1-5 white to purple flowers on a stem.
2. Floral bracts are spineless.
3. Small flowers that are 1 cm in diameter.
4. Perennial, rhizomatous plant with spiny, oblong, green leaves.

Canada thistle

Cirsium arvense

List B

Canada thistle

Cirsium arvense

Integrated Weed Management Recommendations

Integrated weed management is imperative for effective Canada thistle control. This weed needs to be continually stressed, forcing it to exhaust root nutrient stores, and eventually die. Mowing or grazing can be followed up with herbicide application. Avoid hand-pulling and tilling which can stimulate the growth of new plants.

CULTURAL

Prevention is the best control strategy. Maintain healthy pastures , riparian areas, and rangelands. Prevent bare ground caused by overgrazing, and continually monitor your property for new infestations. Establishment of select grasses can be an effective control.

BIOLOGICAL

Cattle, goats, and sheep will graze on Canada thistle when plants are young and succulent in the spring. Follow up grazing with a fall herbicide application. Insects are available, and provide limited control. Currently, collection and distribution methods for Canada thistle rust (*Puccinia punctiformis*) are being refined. For more information on Canada thistle biocontrol, contact the Colorado Department of Agriculture - Palisade Insectary at (970) 464-7916.

MECHANICAL

Due to Canada thistle's extensive root system, hand-pulling and tilling create root fragments and stimulate the growth of new plants. Mowing can be effective if done every 10 to 21 days throughout the growing season. Combining mowing with herbicides will further enhance Canada thistle control.

CHEMICAL

The table below includes recommendations for herbicides that can be applied to rangeland and some pastures. Treatments may be necessary for an additional 1 to 3 years because of root nutrient stores. Always read, understand, and follow the label directions.

Herbicide	Rate	Application Timing
Aminopyralid* (Milestone)	5-7 oz. product/acre + 0.25% v/v non-ionic surfactant OR 1 teaspoon product/gal water + 0.32 oz./gal water	Apply in spring at the pre-bud growth stage until flowering and/or to fall regrowth. Can also add chlorsulfuron (Telar) at 1 oz./acre to the mix.
Clopyralid + Triclopyr (Prescott; Redeem; others)	3 pints product/acre + 0.25% v/v non-ionic surfactant OR 1.25 oz. product/gal water + 0.32 oz./gal water	Apply until flowering and/or fall regrowth.
Aminocyclopyrachlor + chlorsulfuron (Perspective)*	5.5 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply to spring rosette to flower bud growth stage; or fall. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage.
Note: *Product not permitted for use in the San Luis Valley.		
Additional herbicide recommendations for this and other species can be found at: **goo.gl/TvWnv9**		

Colorado Department of Agriculture - Conservation Services
305 Interlocken Parkway
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www.colorado.gov/ag/weeds

Updated 07/2015

Chinese clematis

Colorado Department of Agriculture

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Chinese clematis
Identification and Management

The key to effective control of Chinese clematis is preventing the plants from going to seed. Pulling the woody stem prior to flowering can be an effective control. Chemical treatments are also effective when dealing with Chinese clematis. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

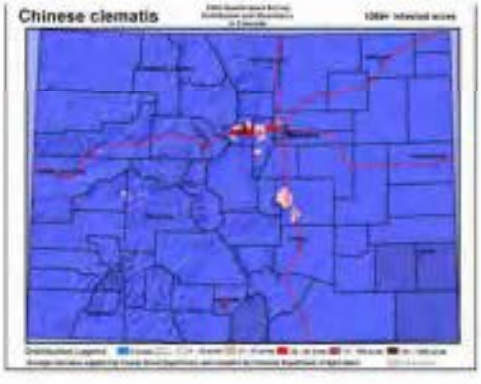
Chinese clematis is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Identification and Impacts

Chinese clematis *(Clematis orientalis)* is a herbaceous to woody vined perennial that is native to Eurasia. It is an escaped ornamental species that is a deciduous climber growing up to 12 feet. Solitary flowers have four yellow sepals (petal-like structures) that are often nodding. Each flower produces numerous feathery, long-tailed fruits which are conspicuous all winter. The plant flowers from August to September.

Habitats for Chinese clematis include roadsides, riparian corridors and rocky slopes. It is sometimes found in open woods. Plants prefer sunny areas but have shown to be somewhat shade tolerant. Chinese clematis prefers well-drained soils.

Chinese clematis can cause death to young trees and brush. It outcompetes native shrubs and herbaceous species. Plants will completely cover; rock walls, trees, bushes and fences. The juice of freshly crushed leaves and stems have blister causing agents.



Key ID Points

1. Solitary flowers with four yellow sepals.
2. A herbaceous to woody vine climbing perennial.

Updated on: 07/2015

Photos and Map © Colorado Department of Agriculture.

Clematis orientalis

Chinese clematis

Management Recommendations

CULTURAL
Cultural controls are possible in theory, but are very time consuming and expensive. Complete removal of any seedlings or newly established plants by continual hand pulling is also possible.

BIOLOGICAL
There is no biological control available for Chinese clematis. Since biological control agents take years to research, develop and release, no releases are expected in the foreseeable future. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pull or dig when soil is moist. Make certain to pull all the roots and bag specimens carefully so as to not scatter seeds if flowering.

Integrated Weed Management:

The most effective control method for dealing with Chinese clematis is preventing the plant from going to seed. Pulling the plant from the ground, by the woody stem, prior to the plant flowering is the most effective control. Chinese clematis also responds well to chemical treatments.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
2,4-D amine	2 qts. product/acre at 4.0 lb active ingredient/gallon of product + 0.25% v/v non-ionic surfactant	Apply anytime when the plant if actively growing. Will damage neighboring brush species, if present.
Imazapic (Plateau, Panoramic)	12 oz. product/acre + 1 qt./acre methylated seed oil	Apply in the fall at flowering growth stage.
Aminopyralid (Milestone)	4 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at flowering growth stage in the fall.
Additional herbicide recommendations for other species can be found at: **goo.gl/TvWnv9**		

Top to bottom photos, © (Top 2 photos) Stevens County (Washington State) Noxious Weed Control Board; and bottom photo David Hallinan, Bannock County Weed Superintendent, Idaho Weed Awareness Campaign.

Common Tansy Identification and Management

List B

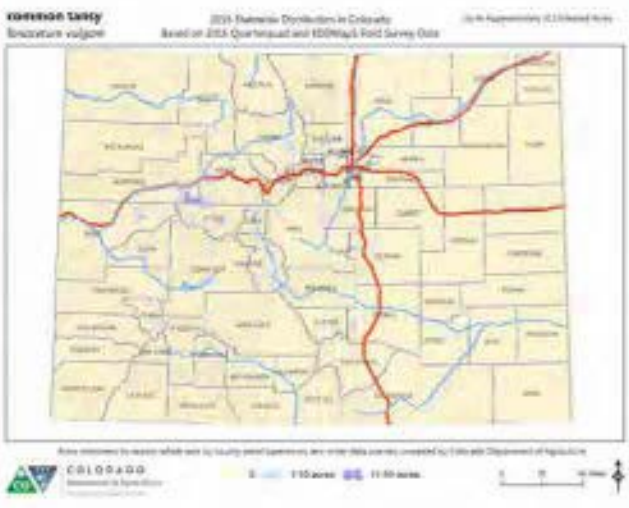
Common tansy (*Tanacetum vulgare* L.) is a perennial plant in the Asteraceae family, also known as golden buttons and garden tansy.

Mature plants range from 1.5 to seven feet tall. The stem leaves are alternate and oblong. Leaves are deeply divided with four to ten pairs of leaflets. Glands appear on the leaf surface. The leaf margins are dentate. From afar, leaves have a fern-like appearance and have a strong odor when crushed. Stems are stiff, upright, ribbed often purplish-red to green in color, and hairless. Common tansy has only button-like perfect disc flowers; it lacks ray flowers. Yellow disc flowers are numerous and arranged as a flattened dense cluster at the terminal end of the stems. The outer ring of disc flowers are pistillate. Ovate shaped phyllaries that surround the head are arranged in series. Phyllary margins are lighter in color than the center.

In Colorado, flowering typically starts in June lasting to September. Seeds are yellowish brown achenes with short, five-toothed crowns. One plant can produce up to about 50,000 seeds. Seeds is well adapted to cold environments with germination rates as high as 70% (Gucker 2009). Seed longevity is at least two years, and most seeds remain near the parent plant since they lack wind-dispersed structures (Gucker 2009). Roots are robust, often with rhizomes that can be woody, coiled and at least 51 inches below the soil surface (Gucker 2009). Rhizomatous spread occurs, but reproduction is primarily by seed (Gucker 2009).

Common tansy is often confused with *Achillea millefolium* ('Moonshine' yarrow), which is a similar height, leaf structure, and has yellow terminal flowers. When common tansy is not in flower, it can also be confused with *Conium maculatum* (poison hemlock) because of its leaf structure, the stiff ribbed stems and corymbiform flower head.

In Colorado, common tansy is mostly found along the banks of irrigation ditches, streams, seeps and roads (EDDMapS 2018). It is also found in residential areas as an ornamental, and occasionally on semi-arid rangelands and pastures (EDDMapS 2018). It survives cold, prefers wet environments and full sun but can tolerate partial shade (Gucker 2009). Common tansy is reported predominantly in the northern portion of the United States (EDDMapS 2018).



With adequate moisture common tansy can outcompete and displace native and desirable species; allelopathy may be a factor (Gucker 2009). When stands get robust, it can reduce irrigation water flow (Gucker 2009). Its seeds float, so water can be a vector and downstream riparian corridors and irrigation channels can become infested. It tends to be fairly aggressive and difficult to control.

Key ID Points

1. Yellow button-like composite flower heads that lack ray flowers
2. Fern-like pinnately divided alternate leaves, foul smell
3. Ribbed stiff tall stems
4. Dense woody-like root mass

Common tansy

Tanacetum vulgare L.

List B

Integrated Weed Management Recommendations

Common tansy

Tanacetum vulgare L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seeds from dispersing, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, other plants present and land uses.

CULTURAL

Common tansy prefers bare mineral soil, high light and few competitors to germinate, so maintain deep mulch and litter cover and select shade producing species. Since common tansy forms robust rhizomatous roots, select plants that will have equally or more competitive below ground root structures that includes an assemblage of shrubs, forbs, cool and warm season grasses, annuals and perrenials. Use locally adapted species that are ecologically appropriate for the site and ecoregion to improve competitiveness. Implement whole site restoration, where needed. Common tansy prefers frequent disturbance and flooding, so where possible, modify the hydrology and disturbance regimes until control is established, especially where dense colonies exist.

MECHANICAL

Because of common tansy's robust roots and prolific seed production, mechanical methods are best for residential areas and small infestations. Remove all root biomass or sever roots below the soil surface early in the season to reduce energy storage and before seed production. Mowing, chopping, hand-pulling, and deadheading leaves roots behind and stimulates flower production, requiring consecutive years of season-long treatments. Mowing disperses seeds and expands the infested area. Collect, bag, and dispose of or destroy all flowers; seeds could mature and germinate if left on the ground. Its large size may increase fire hazard. High intensity prescribed fire may top kill plants but leave roots mildly affected (Gucker 2009). Combine prescribed fire with other methods to improve treatment efficacy (Gucker 2009).

BIOLOGICAL

Common tansy is toxic to cattle, not recommended for horses, however confined domestic sheep and goats eat it during early flower (Gucker 2009). Targeted grazing can be effective, but opens the canopy for new seeding or shoot growth; repeat integrated entries with chemical (Gucker 2009). Non-targeted grazing should be light, with less than 60% defoliation to maintain competitiveness against common tansy (Gucker 2009). There are no biological control agents authorized in Colorado that would effectively control this species.

CHEMICAL

NOTE: Herbicide recommendations to control common tansy in pastures and rangeland are found at: https://goo.gl/TvWnv9. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for herbicides appropriate for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

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www.colorado.gov/ag/weeds

Rev. 2/19

Common Teasel Identification and Management

List B

Common teasel, *Dipsacus fullonum* L., is a biennial or sometimes short-lived perennial forb. Mature plants can grow up to or over six feet tall and have a taproot. Common teasel has simple lanceolate to oblanceolate basal and stem leaves. Both leaves are conspicuously veined, wrinkled and have rough surface. Leaf margins are crenate. Stems leaves are lined with stiff prickles along the midrib. Stem leaves are opposite, net-veined, stalkless, and clasp the stem. The stem is rigid and also lined with several rows of downward turned prickles.

Flowers are range from white to violet. The flower head is generally egg-shaped, with a square base. The long thin stiff floral bracts at the base of the inflorescence are generally longer than the flower head; these also have prickles. It flowers from April to September. This species reproduces by seed. In a Canadian study, common teasel resprouted 50% of the time after mechanically removing above ground vegetation. Common teasel can produce more than 2,000 seeds per plant. Plants die after production of seed has occurred. Seeds can stay viable for up to 14 years. Seeds germinate and establish readily, however, seeds don't generally disperse far form the parent plant. The fruits are a four-angled achene, each containing a single seed.

Common teasel is native to Europe where historically it had many uses. Common teasel is spreading rapidly in America. It is common along major travel corridors and previously disturbed areas. It is invasive in moist soils, such as wetlands, fens and riparian corridors. This includes roadsides, swales, irrigation ditches. Upland dry sites are also vulnerable. These include open, sunny habitats such as abandoned fields, pastures, meadows and woodlands.

Restoration of infested and degraded sites is one of the keys to eradicating common teasel. Wetlands are important but very sensitive environments. Methods and techniques used in infested wetlands should follow best managment practices, such as those available at https://www.colorado.gov/pacific/ag-conservation/noxious-weed-publications. Preventing seed production is necessary to curtail the spread of this forb. Eradication efforts will need to continue for multiple consecutive seasons until the seed bank is depleted. Once eradication is complete, monitoring will be needed.

Common teasel is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be eradicated; some populations may be contained or suppressed depending on state regulations. For state regulations described for each county, refer to the most recent Rule, or visit www.colorado.gov/ag/co-weedcontacts for details.

2015 Quarter Quad Survey

Key ID Points

1. Long slender floral bracts extend beyond the top of the flower head.
2. Leaves are crinkled and have prickles.
3. Stems are stiff and have rows of prickles.

Common teasel

Dipsacus fullonum L.

List B

Integrated Weed Management Recommendations

Common teasel

Dipsacus fullonum L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production in the first and second year. Prevent seed from dispersing, e.g. contaminated equipment. Rest sites until restored. Change land use practices. Use methods appropriate for the site; disturbing wetlands, fens and riparian areas is generally not advised without proper training.

CULTURAL CONTROL METHODS

Maintain or restore a competitive assemblage of forbs, cool and warm season grasses. Implement whole site restoration of soils, plants and water regimes where stands of common teasel exist. Use locally adapted species that are ecologically appropriate for the site to improve competitiveness (e.g. wetland plants or upland plants). Include annual as well as perennial species. Incorporate soil amendments, soil microbes and mycorrhizal fungi in restoration efforts. Minimize soil compaction and disturbance, especially in wetlands and moist soil. Acquire permits for wetland restoration, if required.

BIOLOGICAL CONTROL METHODS

Common teasel is not palatable to domestic livestock in part because of the abundance of prickles. Properly managed grazing can improve vigor of desired species and indirectly reduce common teasel. There are no biological control agents for common teasel authorized in Colorado that would effectively control common teasel. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at https://www.colorado.gov/pacific/agconservation/biocontrol

MECHANICAL CONTROL METHODS

Mechanical methods are best for infestations smaller than 0.5 acres; weigh this against other plants present, ecology and site condition. Sever roots below the soil surface during the first year before the plant stores energy, and in the second year before seed production. Mowing, chopping and deadheading stimulates more flower production; these methods require consecutive years of season-long treatments. Flower heads must be collected, bagged, and disposed of or destroyed; seeds will mature and germinate if left on the ground. Fire effects are unknown. Vegetation may not carry fire. Low severity prescribed fires may only kill the above ground vegetation, leaving roots and seeds unaffected. High severity prescribed fire may kill common teasel, but could damage native species and is not recommended.

CHEMICAL CONTROL METHODS

NOTE: The following are recommendations for herbicides that can be applied to pastures and rangeland. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Metsulfuron (Escort XP)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply when in rosette or bolting growth stage. (Spring or fall rosettes, or early summer bolting)
Aminopyralid (Milestone)*	4-7 oz. product/acre (start with 7 oz.) + 0.25% v/v non-ionic surfactant	Apply when in rosette or bolting growth stage. Best choice of herbicide to use in riparian areas. (Spring or fall rosettes, or early summer bolting) *Not permitted for use in the San Luis Valley.
Imazapic (Plateau)	8-12 oz. product/acre + 2 pints/ acre methylated seed oil	Apply when in rosette or bolting growth stage. Good choice of herbicide to use in riparian areas. (Spring or fall rosettes, or early summer bolting)
Aminocyclopyrachlor + chlorsulfuron (Perspective)*	4.75-8 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply from the seedling to the bolting stage. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage. *Product not permitted for use in the San Luis Valley.

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www.colorado.gov/ag/weeds

Colorado State University

Rev. 11/16

Cutleaf Teasel Identification and Management

List B

Cutleaf teasel, *Dipsacus laciniatus* L., is a biennial forb, but under ideal growing conditions it may act as a short-lived perennial. Mature plants can grow over six feet tall. Cutleaf teasel has basal rosette leaves and stem leaves. First year basal leaves are conspicuously veined. Stem leaves are opposite but distinctly clasp the stem at the point of attachment to form a cup. Leaves have a lanceolate shape and a prominent white mid-rib that is lined with prickles. Leaf marins are deeply divided into narrow irregular segments. Stems are four-angled and have rows of prickles down the length of the stem. Flower heads are cream to white and bloom from the center of the head first. Individual flowers have a short four-lobed calyx and 4-lobed corolla. The green floral bracts are fused at the base, forming a cup. These bracts are linear to lanceolate shaped. They curve upward and are spine-tipped. In comparision to common teasel, the bracts on cutleaf teasel are wider and generally shorter than the entire length of the flower head. Cutleaf teasel blooms from April through September and is cross-pollinated by hoverflies, bumblebees and about 40 other insects. Fruits are oblong, four-angled achenes. Each achene contains a single seed. A single teasel plant can produce over 2,000 seeds. Seeds remain viable for up to 14 years but generally are believed to germinate within a few seasons after seeds set. This species reproduces only by seed. Generally seeds remain close to the parent plant,however seeds have the ability to disperse in water, such as creeks, by animals such as birds or small mammals, or by humans. New plants tend to reoccupy the vacancy that parent plants left after dying.

Cutleaf teasel is an aggressive exotic species that can out-compete native species. It can become a monoculture, and take over prairies and savannas once established. This species prefers moist soil conditions, such as fens, wetlands, riparian corridors, ditches, swales and roadsides that receive direct sun. It can also invade sunny dry upland sites, such as dryland pastures, abandoned fields, meadows and woodlands.

Restoration of infested and degraded sites and preventing seed production for consecutive multiple seasons are critical to eradicating cutleaf teasel. Monitoring sites post-treatment will be needed.

2015 Quarter Quad Survey

Cutleaf teasel is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be eradicated; some populations may be contained or suppressed depending on state regulations. For management directions for each county, refer to the most recent Rule, or visit www.colorado.gov/ag/coweed-contacts for details.

Key ID Points

1. Opposite stem leaves surround the stem and form a cup.
2. Leaves have a white mid-rib, are lined with prickles and deeply but irregularly lobed.
3. Floral bracts are wide, spine-tipped and shorter than the flower head.

Cutleaf teasel

Dipsacus laciniatus L.

List B

Integrated Weed Management Recommendations

Cutleaf teasel

Dipsacus laciniatus L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy pastures and native landscapes. Restore degraded sites. Avoid soil disturbance. As with most biennials, prevent seed production in the first and second year of growth. Prevent seed from dispersing, such as on contaminated equipment. Rest sites until they are effectively restored. Change land use practices. Use methods appropriate for the site.

CULTURAL CONTROL METHODS

Maintain or restore a competitive assemblage of forbs, cool and warm season grasses. Implement whole site restoration of soils, plants and water regimes where stands of cutleaf teasel exist. Use locally adapted species that are ecologically appropriate for the site to improve competitiveness (e.g. wetland plants or upland plants). Include annual as well as perennial species. Incorporate soil amendments, soil microbes and mycorrhizal fungi in restoration efforts. Minimize soil compaction and disturbance, especially in wetlands and moist soil. Acquire permits for wetland restoration, if required.

BIOLOGICAL CONTROL METHODS

Cutleaf teasel is not palatable to domestic livestock in part because of the abundance of prickles. Properly managed grazing can increase vigor of desirable species and indirectly reduce cutleaf teasel. There are no biological control agents for cutleaf teasel authorized in Colorado that would effectively control cutleaf teasel. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at https://www.colorado.gov/pacific/agconservation/biocontrol

MECHANICAL CONTROL METHODS

Mechanical methods are best for infestations smaller than 0.5 acres; weigh this against other plants present, ecology and site condition. Sever roots below the soil surface during the first year before the plant stores energy and in the second year before seed production. Mowing, chopping and deadheading stimulates more flower production; these methods require consecutive years of season-long treatments. Flower heads must be collected, bagged, and disposed of or destroyed; seeds will mature and germinate if left on the ground. Fire effects are unknown. Vegetation may not carry fire. Low severity prescribed fires may only kill the above ground vegetation, leaving roots and seeds unaffected. High severity prescribed fire may kill cutleaf teasel, but could damage native species and is not recommended.

CHEMICAL

NOTE: The following are recommendations for herbicides that can be applied to pastures and rangeland. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Metsulfuron (Escort XP)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply when in rosette or bolting growth stage. (Spring or fall rosettes, or early summer bolting)
Aminopyralid (Milestone)*	4-7 oz. product/acre (start with 7 oz.) + 0.25% v/v non-ionic surfactant	Apply when in rosette or bolting growth stage. Best choice of herbicide to use in riparian areas. (Spring or fall rosettes, or early summer bolting) *Not permitted for use in the San Luis Valley.
Imazapic (Plateau)	8-12 oz. product/acre + 2 pints/acre methylated seed oil	Apply when in rosette or bolting growth stage. Good choice of herbicide to use in riparian areas. (Spring or fall rosettes, or early summer bolting)
Aminocyclopyrachlor + chlorsulfuron (Perspective)*	4.75-8 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply from the seedling to the bolting stage. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage. *Product not permitted for use in the San Luis Valley.

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Colorado State University

Rev. 11/16

Dalmatian toadflax

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Showy yellow snapdragon-like flowers with an orange throat on elongated racemes.
2. Thick, waxy, bluish heart-shaped leaves that wrap the stem.

Updated on: 07/2015

Dalmatian toadflax Identification and Management

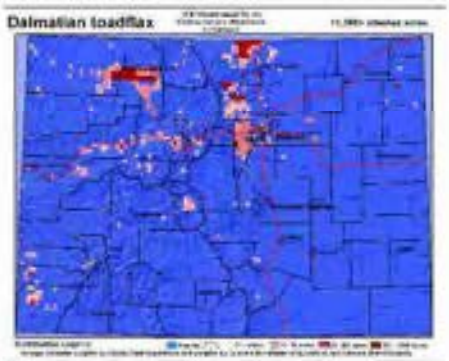
Identification and Impacts

Dalmatian toadflax (*Linaria dalmatica*) is a non-native, perennial forb introduced from the Mediterranean region as a folk remedy, fabric dye and ornamental. It reproduces both by seed and by extensive, creeping rhizomes. A single plant produces 500,000 seeds, most of which fall within 18 inches of the parent plant. Seeds can remain viable for at least 10 years. Dalmatian toadflax grows to 3 feet, and has bright yellow snapdragon-like flowers with an orange throat on elongated racemes. The alternate leaves are broad, with a thick, waxy cuticle and a bluish cast. Each leaf is heart-shaped and wraps the stem.

Habitats for Dalmatian toadflax include disturbed open sites, fields, pastures, rangeland, roadsides, cropland and forest clearings. Infestations can begin in small disturbed sites, then spread even to rangeland and wildlife habitats in excellent condition. Dalmatian toadflax is a highly aggressive plant that can genetically adapt to varied environmental conditions and herbicide controls. Its extreme competitiveness is due to early spring regeneration from vegetative buds on roots that are not dependent on soil moisture or native plant competition. Once established, toadflax quickly overruns native plants and becomes a monoculture that severely reduces forage, productivity, biodiversity and wildlife habitat.

The key to effective control of Dalmatian toadflax is prevention and integrating as many management strategies as possible. Prevention is always desirable when dealing with Dalmatian toadflax. Early detection and eradication can keep populations from exploding, making more management options available. With the plants varying genetically using many different approaches is important such as; chemical, mechanical, cultural and biological methods. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Dalmatian toadflax is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/csd and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.



Clockwise, from lower left, photos © John M. Randall of The Nature Conservancy; and Linda Wilson and Susan Turner of Invasive.org. Infestation map by Crystal Andrews, Colorado Department of Agriculture.

Linaria dalmatica

Management Recommendations

CULTURAL
It is imperative to seed managed areas with competitive grasses such as thickspike wheatgrass and streambank wheatgrass. The combination of herbicide spraying and seeding competitive grasses controls Dalmatian toadflax better than spraying alone. (K.G. Beck, CSU)

BIOLOGICAL
Calophasia lunula, a predatory noctuid moth, feeds on leaves and flowers of Dalmatian toadflax. Eteobalea intermediella, a root boring moth, and Mecinus janthinus, a stem boring weevil, are also available. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
For small infestations, pulling toadflax by hand can be effective. Pull every year for 5 to 6 years to deplete the reserves of the root system. Monitor the site for 10 - 15 years to remove seedlings produced from dormant seeds.

Integrated Weed Management:

Because of the high genetic variability of the toadflax species, it is critical to integrate as many management strategies as possible into the control program. Two local populations may respond differently to the same herbicides.

Keys to management are to prevent seed formation and vegetative spread by roots. Controlling toadflaxes is expensive and difficult, prevention is the best option.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminocyclopyrachlor + chlorsulfuron (Perspective)*	4 oz. product/acre + 1% v/v methylated seed oil	Apply when flowering in spring and/or in the fall regrowth. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage.
Picloram* (Tordon/Picloram 22K - Restricted use pesticide)	1-2 qts./acre + 1% v/v methylated seed oil	Apply when flowering in spring and/or in the fall regrowth. DO NOT use near trees, desirable shrubs, water, or high water table.
Chlorsulfuron** (Telar)	1.5-2 oz./acre + 1% v/v methylated seed oil	Apply when flowering in spring and/or in the fall regrowth.
Note: *Not permitted for use in the San Luis Valley. **This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.		
Additional herbicide recommendations for this and other species can be found at: **goo.gl/TvWnv9**		

Top photo, © Kelly Uhing, Colorado Department of Agriculture. *Calophasia lunula* larva photo © Bob Richard, USDA APHIS, Invasive.org. Handpulling toadflax photo © Lake Tahoe Environmental Education Coalition.

Dalmatian toadflax

Colorado State University

CDA CO

Dame's Rocket Identification and Management

List B

© Melissa McCormick, City of Colorado Springs

Dame's rocket (*Hesperis matronalis* L.) is a perennial plant in the Brassicaceae family, also known as dame's violet, mother-of-the-evening.

Mature plants range from one to three feet tall. The erect stems are sparingly branched with simple or forked hairs, but sometimes glabrous (Francis et al. 2009). Basal rosette leaves range from entire to dentate. Alternate stem leaves range from lanceolate with a narrowly acute apex and acute base on the upper stem, to ovate-lanceolate with a broad apex and a long petiolate base on the lower stem. Stem leaves have toothed margins and the leaf surface is pubescent. Its fiborous lateral roots are usually shallow, especially in compacted soil, such as roadsides (Franci 2009).

Like all mustards, the bisexual flowers have four separate petals symmetrically arranged. Petals range in color from white to fucsia, and are lollipop in shape- oval on top with long linear tail that creates the appearance of a tubular type arrangement. Four tall stamens and two short stamens surround a superior ovary with two united carpels. Similar to the petals, there are four sepals and they look tubular, though they are separate. Sepals are pubescent with perpendicular hairs. The inflorescence is arranged in a loose to corymbiform raceme, that in total, can be up to 30 cm long and erect. In Colorado, flowers bloom from mid May to mid July. Like all plants in the Brassicaceae family, seeds are the key to confirm the species' identity. The silique seed pods are narrow and from 6 to 14 cm long with one row of 20 to 35 seeds in each silique (Francis et al. 2009). Wingless seeds range from 3 to 4 mm long to 1 to 1.5 mm wide. The seedbank likely does not persist, but there are no empirical studies about seed longevity (Francis 2009). Reproduction is only by seed (Francis et al. 2009).

Although the flower is pollinated by a variety of day and night pollinators, the strong dusk-time fragrance of flowers most successfully allures syrphid fly pollinators (Majetic et al. 2009). However it appears that daytime pollination doubles seed production compared to nighttime pollination (Francis et al. 2009).

From a distance, dame's rocket is often confused with garden phlox *(Phlox paniculata)* and fireweed (*Chamaenerion angustifolium*) due to flower color and similar gestalt. Common garden phlox has five fused petals that form a tubular corolla, five sepals, five stamens, one pistil with a superior ovary and opposite narrowly elliptic leaves that are hairless. Fireweed's flower has four broad fucsia petals and four linear sepals of a similar color and stamens with red anthers and white vein.

In Colorado, it is found mainly in urban and suburban, disturbed areas, wet and alkaline soils.

© Minnesota Wildflowers

© Minnesota Wildflowers

© Selvet Acad. Sci. of Philadelphia

Key ID Points

1. Four petals, four sepals, four tall and two stamens
2. Alternate lanceolate leaves, some petiolate, hairy stems & leaves
3. Silique with single row of seeds
4. Fiborous lateral roots

Dame's rocket

Hesperis matronalis L.

List B

Integrated Weed Management Recommendations

Dame's rocket

Hesperis matronalis L.

Effective integrated management means using a variety of eradication methods in the same site along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seeds from dispersing, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site and land uses.

CULTURAL

Dame's rocket has the uncanny ability to maximize use of nitrogen and especially high water availability to outcomplete and suppress native plants (Hwang and Laurenroth 2008). This remains even if one plant is present, if it is a seedling, or if natives are adults (Hwang and Laurenroth 2008). Thus, cultural methods should follow after integrating other methods. Implement whole site restoration of soils, plants and water regimes where dense colonies of dame's rocket exist. Use locally adapted species that are ecologically appropriate for the site, including annuals, perennials, shrubs, forbs, cool and warm season grasses. Do not add nitrogen or water. Give natives soil microbes and mycorrhizal fungi. Minimize disturbance. Choose garden phlox or the native fireweed for gardens and ornamental settings instead.

MECHANICAL

When dame's rocket density is high, it will bolt and reproduce early (Rothfels et al. 2002). So timing mechanical methods should be based on density-dependent behaviors. Mechanical methods are best for residential areas, small infestations or seedlings. Remove as much of the lateral root mass as possible early in the season before the plant stores energy and produces seed. Mowing, chopping and deadheading leaves roots and chlorophyll structures behind, stimulates more flower production and allows energy storage; these methods require consecutive years of season-long treatments. Mowing disperses flowers and seeds, and expands the infested area. Collect and bag flowers; seeds germinate if left. Low severity prescribed fire may damage above ground vegetation, leaving roots and seeds unaffected. High severity prescribed fire may top kill plants and seeds.

BIOLOGICAL

Dame's rocket is palatable to domestic goats. No information is available about targeted grazing using other livestock. Target grazing early in growing season and repeat entries through the season and years as control. There are no biological control agents for dame's rocket authorized in Colorado that would effectively control it. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at: www.colorado.gov/ag/biocontrol

CHEMICAL

NOTE: Herbicide recommendations to control dame's rocket in pastures and rangeland are found at: https://goo.gl/TvWnv9 Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for herbicides appropriate for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Colorado Department of Agriculture - Conservation Services
305 Interlocken Parkway
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(303) 869-9030
www.colorado.gov/ag/weeds

Rev. 2/19

Diffuse knapweed

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Floral bracts have yellow spines with teeth appearing as a comb and a distrinct terminal spinte.
2. Flowers are white or lavender.
3. Seedlings have finely divided leaves

Updated on: 07/2015

Diffuse knapweed Identification and Management

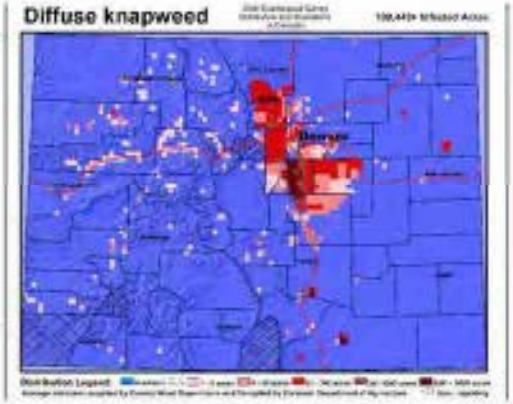
Identification and Impacts

Diffuse knapweed *(Centaurea diffusa)* is a non-native biennial forb that reproduces solely by seed. A biennial is a plant that completes its lifecycle within two years. During the first year of growth, diffuse knapweed appears as a rosette in spring or fall. During the second year in mid to late spring – the stem bolts, flowers, sets seed, and the plant dies. Once the plant dries up, it breaks off at ground level and becomes a tumbleweed which disperses the still viable seeds over long distances. A prolific seed producer, diffuse knapweed can produce up to 18,000 seeds per plant. Therefore, the key to managing this plant is to prevent seed production. Diffuse knapweed can grow 1 to 3 feet tall, and is diffusely branched above ground. This gives the plant a ball-shaped appearance and tumble-weed mobility when broken off. Leaves are small, and are reduced in size near the flowering heads. Flowers are mostly white, sometimes purple, urn-shaped, and are located on each branch tip. Bracts that enclose the flowerheads are divided like the teeth of a comb, and are tipped with a distinct slender spine. Upon drying, the bracts become rough, rendering them injurious to the touch. Flowers bloom July through August. Seed set usually occurs by mid-August.

Diffuse knapweed tends to invade disturbed, overgrazed areas. Other habitats may also include rangeland, roadsides, riparian areas, and trails. It is a tough competitor on dry sites and rapidly invades and dominates disturbed areas. Once established, diffuse knapweed outcompetes and reduces the quantity of desirable native species such as perennial grasses. As a result, biodiversity and land values are reduced, and soil erosion is increased.

The key to effective control of Diffuse knapweed is to prevent the plant from flowering and going to seed. An integrated weed management approach dealing with Diffuse knapweed is highly recommended. There are many options of mechanical, chemical, and biological controls, available. Details on the back of this sheer can help to create a management plan compatible with your site ecology.

Diffuse knapweed is designated as a "List B" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information, visit www.colorado.gov/ag/csd and click on the Noxious Weed Program link or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division at 303-239-4100.

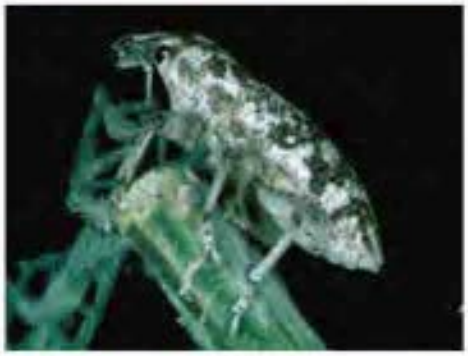


Plant photo, top © Kelly Uhing. Infestation map above, Crystal Andrews. Flower photo © Cindy Roche. Rosette and leaf photos © Dale Swenarton.

Centaurea diffusa

Management Recomendations

CULTURAL
Establishment of selected grasses can be an effective cultural control of diffuse knapweed. Contact your local Natural Resources Conservation Service for seed mix recommendations. Maintain healthy pastures and prevent bare spots caused by overgrazing. Bareground is prime habitat for weed invasions.



BIOLOGICAL
The seedhead weevil (*Larinus minutus*) and the root weevil fly (*Cyphocleonus achates*) provide fair to good control when used in combination with each other. Expect to wait at least 3 to 5 years for the insects to establish and achieve optimum results. This is an option for large infestations. To obtain the insects, contact the Colorado Department of Agriculture, 970-464-7916.

MECHANICAL
Any mechanical or physical method that severs the root below the soil surface will kill diffuse knapweed. Mowing or chopping is most effective when diffuse knapweed plants are at full-bloom. Be sure to properly dispose of the flowering cut plants, since seeds can mature and become viable after the plant has been cut down.

Integrated Weed Management:

Diffuse knapweed is best controlled in the rosette stage. It is imperative to prevent seed production. Do not allow diffuse knapweed flowers to appear. Management must be persistent in order to deplete the seed bank in the soil.

HERBICIDES : The following are recommendations for herbicides that can be applied to range and pasturelands. Always read, understand, and follow the label directions. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminocyclopyrachlor + chlorsulfuron (Perspective)*	4.75-8 oz. product/acre + 0.25% non-ionic surfactant	Pre-emergence or from seedling to mid-rosette stage. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage.
Aminopyralid* (Milestone)	5-7 oz./acre + 0.25% non-ionic surfactant	Spring at rosette to early bolt stage and/or in the fall to rosettes. Add 1 qt./acre 2,4-D or 3 oz. Perspective when treating in the bolting to flowering growth stages.
Clopyralid (Transline)	0.67-1.33 pints/acre + 0.25% non-ionic surfactant	Apply to spring/fall rosettes before flowering stalk lengthens. Add 1 qt./acre 2,4-D when treating in the bolting to flowering growth stages.
Note: *Not permitted for use in the San Luis Valley.		
Additional herbicide recommendations for this and other species can be found at: **goo.gl/TvWnv9**		

Weevil photo © J. Johnson, Univ. Idaho, bugwood.org. All other photos © Kelly Uhing.

http://www.colorado.gov/ag/csd

Diffuse knapweed

Colorado State University

CO CDA

Eurasian Watermilfoil Identification and Management

List B

Eurasian watermilfoil, *Myriophyllum spicatum* L., is a perennial highly invasive aquatic species. Its stems are about 4 mm long, entirely submerged, and range in color from pinkish white, green to brown. Stems can be as long as 9 feet. Leaves are whorled around a round stem, usually four total, but can have three to five leaves per whorl. Leaves are opposite; when dissected in a cross-section they are at right angles. Leaves are pinnately compound, divided into linear leaf segments or leaflets. Leaflets are usually paired but can range from alternate to opposite; there are usually 12 or more leaflet pairs per leaf. The leaf margins are smooth; under high magnifications leaf margins may be finely toothed. Turions are absent. The overall leaf architecture gives it a feather-like appearance. Long slender roots are able to grow at leaf nodes. The plant roots on soil at the bottom of water bodies, and can survive free-floating. Pinkish flowers are whorled around the round stem as a spike. Male flowers have four petals and four sepals which are entire; both male and female flowers are on the same plant. Flowers are minute and sepals are reduced. Flowers are emergent and upright. Fruits are 4 ribbed or grooved and ultimately break apart into four, one-seeded nutlets. Seeds are viable; seed longevity is unknown. Stems and leaves senesce in fall. It forms very dense mats on the upper portions of water. Roots, delicate stems, leaves and leaflets easily fragment; the smallest of fragments easily disperse, root at the nodes, and colonize new sites. Autofragmentation occurs after each flowering period, which occurs twice: mid-June and mid-July. Vegetative reproduction is the main means of spread.

Native to Northern Europe and Asia, it is cold-water adapted and overwinters in Colorado. It also has the advantage of green-up and growth in the spring earlier than native aquatic species, allowing it to outcompete natives for sun and space. It colonizes a wide spectrum of aquatic conditions: depths 1-30 ft., pH 5.4 to 11, alkaline water, disturbed water, nutrient rich, abundant recreation activities, fresh and brackish water, slow and fast currents, lentic and lotic systems. It looks similar to and can hybridize with its native sister species, *Myriophyllum sibiricum*, which is wide spread throughout Colorado, from 4870 to 11,590 feet in elevation. Hybrids have intermediate number of leaflets. *M. spicatum* can also be confused with another native aquatic, *M. verticillatum*.

Eurasian watermilfoil is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be eradicated; some populations may be contained or suppressed depending on state regulations. For state regulations described for each county, refer to the most recent Rule, or visit www.colorado.gov/ag/coweedcontacts for details.

2015 Quarter Quad Survey

Key ID Points

1. 12 or more leaflet pairs are present.
2. Turions are absent.
3. Male flower bracts are entire.
4. Delicate stems, leaves and leaflets.

Eurasian Watermilfoil

Myriophyllum spicatum L.

List B

Integrated Weed Management Recommendations

Eurasian Watermilfoil

Myriophyllum spicatum L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of dispersal, and monitoring. Maintain healthy native waters. Prevent vegetative fragmentation and dispersal, such as on boats, swimming attire, equipment, etc. Infested water bodies can become very dangerous to humans, clog water infrastructure and equipment. Use methods appropriate for the site and with a full understanding of the species' biology.

CULTURAL CONTROL METHODS

Cultural methods, such as seeding, revegetation, fertilization, and irrigation are not applicable to aquatic environments such as lakes, rivers and streams. There are no known cultural control methods that would be effective against Eurasian watermilfoil, especially since this species hybridizes with native watermilfoil species.

BIOLOGICAL CONTROL METHODS

There are known biological control agents for Eurasian watermilfoil that were considered elsewhere in the USA, but issues preclude their use. For instance, grass carp, *Ctenopharyngodon idella*, is not host specific and feeds on native watermilfoils. The fungus, *Mycoleptodiscus terrestris*, is difficult to obtain. A weevil, *Euhrychiopsis lecontei*, is a native species that is not host specific and feeds on native watermilfoils. There are no known host specific biological control agents available or authorized in Colorado. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at at www.colorado.gov/ag/biocontrol.

MECHANICAL CONTROL METHODS

Use of mechanical methods such as cutting, rotovation, hand pulling, raking, harvesting come with a high risk of spreading infestations since Eurasian watermilfoil fragments and roots easily. Such methods should be used only in closed systems, such as ponds, with no outlet, or in limited situations. If this method is used, all plant fragments need to be removed and dried. Equipment needs to be thoroughly cleaned and dried before its used in another water body. Physical water level manipulation that allow roots to freeze or plants to dry out for several weeks can be effective. Burn, compost or bag and throw away plants.

CHEMICAL

NOTE: The following are recommendations for herbicides that can be applied to aquatic systems. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
2-4-D (Aqua-Kleen, Navigate, DMA 4 IVM; Use only aquatic approved products)	Determined by herbicide concentration within the water column.	Actively growing plants or manufactors specified recommendations.
Fluridone (Sonar or Avast)	Determined by herbicide concentration within the water column.	Actively growing plants or manufactors specified recommendations.
Imazamox (Clearcast)	Determined by herbicide concentration within the water column.	Actively growing plants or manufactors specified recommendations.
Triclopyr (Renovate 3)	Determined by herbicide concentration within the water column.	Actively growing plants or manufactors specified recommendations.

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Rev. 11/16

Hoary cress

Colorado Department of Agriculture

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(303) 869-9030
weeds@state.co.us

Key ID Points

1. White flowers.
2. Grows erect 10-24" in height.
3. Leaf is 3/4-4" long with blunt end and fine white hairs.

Updated on: 07/2015

Hoary cress Identification and Management

Identification and Impacts

Hoary cress *(Lepidium draba)* commonly known as whitetop, is a creeping perennial that is a member of the mustard family and native to Europe. The stems, in the rosette stage, may grow up to 2 inches in height and produce grayish-green leaves that are lance shaped. The leaves are alternate and 3/4 to 4 inches long. The upper leaves have 2 lobes that clasp the stem. The plant has numerous small, white flowers with 4 petals on stalks radiating from a stem. Seed capsules are heart-shaped with two small, flat, reddish brown seeds. One plant can produce from 1,200 to 4,800 seeds. The plants emerge in early spring with stems emerging from the center of each rosette in late April. Hoary cress flowers from May to June and plants set seed by mid-summer.

Habitats for Hoary Cress include: fields, waste places, meadows, pastures, croplands and along roadsides. It is typically found on unshaded, generally open areas of disturbed ground. It generally does better with moderate amounts of precipitation and grows well on alkaline soils.

The key to effective control of Hoary cress is prevention. Preventing the encroachment of these weeds is the most cost-effective management. Preventing invasions by limiting seed dispersal, monitoring and using weed free hay, and quarantine animals that may have grazed in infested areas. Beyond prevention, the key is early detection when infestations are small, and aggressive management. Integrated Weed Management is required for proper control. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Hoary cress is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division.

Photos © Kelly Uhing, Colorado Department of Agriculture; Mark Schwarzlander, University of Idaho, Above map: Crystal Andrews, Colorado Department of Agriculture,

Lepidium draba

Hoary cress

Management Recommendations

CULTURAL
Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities. Contact your local Natural Resources Conservation Service for seed mix recommendations. Planting competitive legumes, such as alfalfa, can reduce Hoary cress in crop rotations.

BIOLOGICAL
There is no biological control avaiable for Hoary cress. Since biological control agents take years to research, develop and release, no releases are expected in the foreseeable future. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Mowing several times before the plants bolt stresses Hoary cress and forces the plant to use nutrient reserves stored in the root system. Combining mowing with herbicides will further enhance control of this weed. Mow repeatedly during the summer, then apply a herbicide in the fall.

Integrated Weed Management:

No single treatment provides effective, long term control. The best and first defense is always prevention. Once established, integrate a variety of combinations of competitive planting, crop rotations, and herbicides. This can reduce Hoary cress to manageable levels.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Chlorsulfuron* (Telar)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at flowering. (Early spring to early summer)
Metsulfuron (Escort XP)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply at flowering. (Early spring to early summer)
Imazapic (Plateau, Panoramic)	12 oz./acre + 2 pints/acre methylated seed oil or crop oil concentrate	Apply at late flower to post-flower growth stage. (Late spring to mid-summer)

Note: *This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.

Additional herbicide recommendations for other species can be found at:
goo.gl/TvWnv9

Top to bottom photos, © R. Old, XID Servisces; A. Sparks Jr., University of Georgia; and Kelly Uhing

Colorado State University

CO CDA

Houndstongue

Colorado Department of Agriculture

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weeds@state.co.us

Houndstongue Identification and Management

Key ID Points

1. Panicles of reddish-purple flowers with 5 petals and 5 soft, hairy sepals.
2. Velcro-like seeds with 4 nutlets.

Identification and Impacts

Houndstongue (*Cynoglossum officianale)* is a short lived perennial or biennial forb. It produces rosettes in the first year, and bolts a stout, erect stem that is 1 to 4 feet tall, by mid-summer of the second year. Then it flowers and produces fruit. Flowers are reddish-purple (occasionally white) and droop slightly from densely clustered panicles. The five rounded petals are cupped by five sepals covered with long, soft white hairs. Flowering occurs May to July. The simple leaves are lance or oblong shaped, with a smooth edge and no teeth or lobes. Leaves are alternate, 1 to 12 inches long and 1 to 3 inches wide. The leaf tip is sharply pointed, like a hound's tongue, yet are covered with long-soft white hairs. Leaves often appear dusty and insect-ridden. A thick, dark, woody taproot can reach 3 to 4 feet deep.

Reproduction is solely by seeds. Seeds are 4 prickly teardrop-shaped nutlets, which are packed in a pyramid-shaped receptacle. Most seeds fall close to the parent plant, but the seeds can travel great distances. The seeds have barbs like Velcro, with a hooked tip that clings to animals, clothing and machinery. A mature plant can produce 2,000 seeds. Seed viability is 1 to 3 years. Houndstongue is poisonous. Toxic pyrrolizidine alkaloids in Houndstongue stop liver cells from reproducing. Livestock and wildlife may live up to six months after ingesting a lethal dose. Though the plant has a distinctive odor that repels animals, it is more palatable when dried. Animals rarely eat it unless it is dried and mixed with hay. Houndstongue's toxicity effects horses and cattle more severely, sheep seem more resistant. Burs will reduce the value of sheep wool if present.

Habitats for Houndstongue are open to shady, moist, disturbed areas, along trails, roadsides, fields, pasture, rangeland, along the edge of forests, sand dunes and ditch banks. Houndstongue prefers moist areas, but often grows on sandy or gravelly alkaline soil up to 9,000 feet elevation. Areas with more than 10% bare ground are particularly vulnerable to Houndstongue invasions.

The key to effective control of Houndstongue is preventing establishment and to prevent seed production. Planting competing and desirable grasses and forbs can be effective. Helping with reestablishment of disturbed sites. An integrated weed management approach can also be successful. Chemical, mechanical, and biological controls can be effective when dealing with Houndstongue. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Houndstongue is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/csd and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos: top left Aspen County, CO; all other Kelly Uhing , Colorado Department of Agriculture.

Cynoglossum officianale

Updated on: 07/2015

Houndstongue

Management Recommendations

CULTURAL
Prevent the establishment of new infestations by minimizing disturbance and seed dispersal, eliminating seed production and maintaining healthy native communities. Contact your local Natural Resources Conservation Service for seed mix recommendations. Maintain healthy pastures and prevent bare spots caused by overgrazing.

BIOLOGICAL
A root weevil, *Mogulones cruciger,* has been successful in Canada and introduced in Montana, but has not yet been approved for use in Colorado. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Cut or pull plants, and remove entire root crown when plants are in the rosette stage. Remove dense litter layer (up to 4 inches) to stimulate germination of desired plants. To reduce seed production, mow or cut flowering stems before seed nutlets develop, this can significantly reduce seed production.

Integrated Weed Management:

Prevention is the best option when dealing with Houndstongue. Use only certified weed-free hay. If an infestations does occur, reducing the seed production is key in controlling Houndstongue. Chemical, mechanical and the developing biological controls can also be effective management techniques.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to specific areas. Rates are approximate and based on equipment with an output of 30 gal./acre. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Metsulfuron (Escort XP) + 2,4-D	1 oz. product/acre + 1 qt 2,4-D/acre +0.25% v/v non-ionic surfactant	Apply in spring rosette to early flower growth stages.
Chlorsulfuron* (Telar) + 2,4-D	1-1.5 oz. product/acre + 1 qt 2,4-D/acre +0.25% v/v non-ionic surfactant	Apply in spring rosette to early flower growth stages.
Metsulfuron + Chlorsulfuron (Cimarron X-tra)	2.0 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply in spring rosette to early flower growth stages.

Additional herbicide recommendations for other species can be found at:
goo.gl/TvWnv9

Top photo, © Kelly Uhing, Colorado Department of Agriculture. *Mogulones cruciger* photo ©H. Goulet. Mechanical management by Kelly Uhing.

Jointed Goatgrass Identification and Management

List B

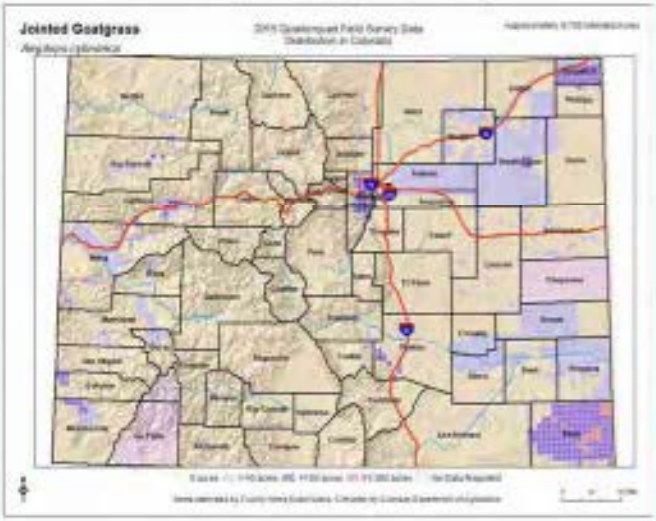
Jointed goatgrass, *Aegilops cylindrica* Host, is a winter annual, which greens up in late summer or fall and remains active through winter. The plants can grow as a single or multiple stems or tillers. Mature plants can reach 15 to 30 inches tall. Leaves are simple and alternate. Leaf blades are between 1/8 to 1/4 of an inch wide. Leaf blades have stiff short hairs on the leaf margins that are perpendicular to the blade and evenly spaced. Hairs can also be found on the auricles, ligules and leaf sheaths; these hairs are evenly spaced too. The cylindrical inflorescence is uniquely arranged into spikelets, which appear as zigzag joints. Each spikelet is cylindrically shaped and fit into the contour of the rachis. Spikelets are about 1/2 inch long. On top of each spikelet, the glumes will have long awns. Spikelets turn hard, change color from orange to red to purple, and shatter at the joint margins when mature. Each spikelet contains 1 to 3 viable seeds which develop quickly after pollination. Seeds germinate in fall and throughout cool months. Seeds remain viable for up to nine years. Often, spikelets will still be attached to the roots when plants are seedlings. In the seedling stage, Jointed goatgrass looks similar to winter wheat. The hairs on the jointed goatgrass will be the key diagnostic feature; winter wheat does not have these hairs.

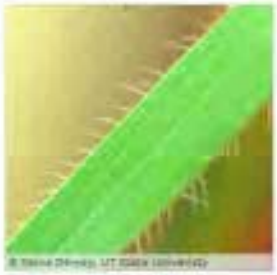
Jointed goatgrass looks very similar to winter wheat in the younger stages of growth and hybridizes with winter wheat. The presence of the hairs on the leaf margin, sheath, ligules and auricles is key to identifying it apart from winter wheat. Mature hybrid spikelets closely resemble the zigzag structure of jointed goatgrass. A 2000 study found that hybrids do have a limited ability to produce viable seeds that can germinate and produce plants (Synder et al. 2006). The seeds of both species are also similar in terms of size and weight and so its assumed that hybrid seeds would be similar. It has a longer flowering season than winter wheat.

Jointed goatgrass is native to the temperate regions of central Asia, Russia and the Mediterranean. Long growing seasons, precipitation and cool weather favor jointed goatgrass. It invades a wide variety of sites, including grasslands, wheat fields, fence rows, waste places, roadsides, alfalfa fields, and pastures. Winter wheat fields infested with jointed goatgrass cause long-term economic loss and wheat certification issues for the agricultural industry for years.

Jointed goatgrass is designated as a "List B" species on the Colorado Noxious Weed Act. It is required to be eradicated; some populations may be contained or suppressed depending on state regulations. For state regulations described for each county, refer to the most recent Rule, or visit www.colorado.gov/ag/coweedcontacts for details.

2015 Quarter Quad Survey





Key ID Points

1. Stiff short hairs evenly spaced on the margins of leaf blades.
2. Evenly spaced hairs are on auricles, leaf sheath and ligules.
3. Spikelets fit in a zig-zag pattern in a cylindrical shape.

Jointed goatgrass

Aegilops cylindrica Host

List B

Integrated Weed Management Recommendations

Jointed goatgrass

Aegilops cylindrica Host

Effective integrated management means using a variety of eradication methods that also includes restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes and restore degraded sites. Avoid soil disturbance. As with most annuals, prevent seed production. Prevent seed from dispersing, such as on contaminated equipment. Rest sites until they are effectively restored. Control jointed goatgrass before March for the most effective results. Implementation and choice of method must consider the plant's life cycle.

CULTURAL CONTROL METHODS

Rotate crops for three seasons or longer before winter wheat is recultivated. Alternate crop selection is important: winter wheat/sunflower/fallow and winter wheat/corn/fallow decrease jointed goatgrass seed density. Early spring crops may not be effective as rotation crops. Band nitrogen fertilizer with desired species' seeds and irrigate; avoid broad nitrogen fertilizer applications. Select cultivars that result in early fall or spring growth, taller plants, and high till capacity to outcompete jointed goatgrass. Increase seed rates and reduce row space of crops and seeded sites. Isolate and harvest jointed goatgrass patches separately from other crops.

BIOLOGICAL CONTROL METHODS

The long awns and hard seeds make jointed goatgrass unpalatable to domestic livestock and can cause injury and may even be fatal. Grazing before flower production is believed to stimulate growth and plant density; properly timed grazing may increase the vigor of desired plants. Avoid high intensity-short duration and heavy grazing. There are no known biological control agents effective against jointed goatgrass authorized in Colorado. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at www.colorado.gov/ag/biocontrol.

MECHANICAL CONTROL METHODS

Mowing and weed whacking should be done before flower production; these methods can induce more tiller and flower production and disperse seeds. Ensure that all methods do not cause spikelets to shatter and disperse seeds. Tilling may bring buried seeds back to the soil surface and could increase germination. Till "in the fall when primary dormancy is lost, but before secondary dormancy is imposed" (Fandrich and Mallory-Smith 2006). Mechanical methods have limited success. Prescribed fire can kill seeds if there is enough vegetation (> 7,000 lbs/acre) on the soil surface to carry fire and increase heat generated. Consecutive fire applications will be needed.

CHEMICAL CONTROL METHODS

NOTE: The following are recommendations for herbicides that can be applied to pastures and rangeland. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Glyphosate* (Roundup, and others)	16 oz./acre + 0.25% v/v non-ionic surfactant	Apply before first spikelets begin to emerge from the boot; usually weeds are < 6" in height. (Late winter to early spring). *These herbicide products are non-selective and will kill any vegetation contacted.
Imazapic + Glyphosate* (Journey)	6 oz./acre + 0.25% v/v non-ionic surfactant	Apply before first spikelets begin to emerge from the boot; usually weeds are < 6" in height. (Late winter to early spring). Note: *These herbicide products are non-selective and will kill any vegetation contacted.
Imazapic (Plateau, Panoramic)	6 oz./acre + 1% v/v methylated seed oil	Apply pre-emergance in late summer or fall, or early postemergence in late winter before tiller
Aminocyclopyrachlor plus chlorsulfuron (Perspective)*	4.75-8 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply from the seedling to the bolting stage. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage. *Product not permitted for use in the San Luis Valley.

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(303) 869-9030
www.colorado.gov/ag/weeds

Colorado State University

Rev. 11/16

Leafy spurge

Euphorbia esula

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Leafy spurge Identification and Management

Key ID Points

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

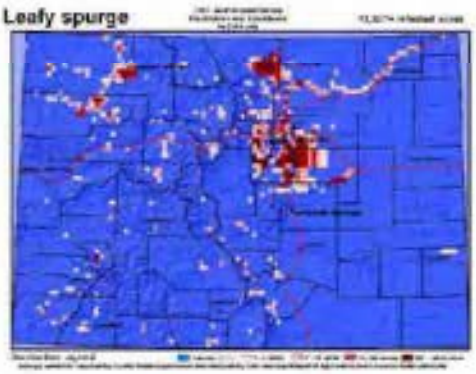
Identification and Impacts

Leafy spurge (*Euphorbia esula*) is a non-native deep-rooted perennial that spreads by seed and extensive, creeping roots. The roots can extend as deep as 30 feet into the soil and are extremely wide-spreading. The roots are brown and contain numerous pink buds that generally produce new shoots or roots. Leafy spurge can grow from 1 to 3 feet in height. The stems are smooth, pale green, and thickly clustered. Leaves are alternate, narrow, linear, and 1 to 4 inches long. The flowers are very small and yellowish-green. They are enclosed by very visible yellowish-green, heart-shaped bracts. The entire plant contains white, milky sap that exudes readily upon stem or leaf breakage. This sap can damage eyes and sensitive skin. Leafy spurge is one of the earliest plants to emerge in the spring. Flower clusters develop 1 to 2 weeks after stem emergence which is from mid-April to late May. One large leafy spurge plant can produce up to 130,000 seeds. Three-sided seed capsules explode when ripe and project the seeds up to 15 feet away from the parent plant.

Leafy spurge has adapted to a wide variety of habitats in the state and is very competitive with other plant species. Where it becomes established in rangeland, pasture, and riparian sites, it crowds out practically all other vegetation. The competitive, rapidly growing, and extensive root system makes leafy spurge very difficult to manage. Develop a management plan that uses several control methods that are compatible with your site.

The most effective method of control for Leafy spurge is to prevent its establishment through proper land management. Maintain healthy pastures and rangeland and continually monitor your property for new infestations. New infestations are much more easily controlled than established infestations. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Leafy spurge is designated as a "List B" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. On the back of this sheet are leafy spurge management recommendations. For more information, please visit www.colorado.gov/ag/csd and click on the Noxious Weed Program link. Or contact the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.



Flower photo, top, © Norman Rees, USDA, APHIS, Invasive.org. All other photos © Kelly Uhing.

Updated on: 07/2015

Management Recomendations

CULTURAL
Establishment of selected grasses can be an effective cultural control of leafy spurge. Contact your local Natural Resources Conservation Service for seed mix recommendations. Maintain healthy pastures and prevent bare spots caused by overgrazing. Bareground is prime habitat for weed invasions.

BIOLOGICAL
Both sheep and goats can be effective grazers of leafy spurge. The flea beetles *Apthona nigriscutis, A. lacertosa,* and *A. cyparissiae,* are effective especially when combined with grazing and/or herbicides. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture, 970-464-7916.

Photo © USDA.

MECHANICAL
Due to the extensive root system, hand-pulling this plant is not a viable option. Mowing will reduce seed production if repeated every 2 to 4 weeks during the growing season, but will provide little long-term control.

Integrated Weed Management:

Persistent monitoring of areas with known or potential infestations is crucial to managing leafy spurge. A combination of management methods in a long-term management plan is imperative. The management objective is to exhaust the root system and deplete the soil seed bank.

Leafy spurge

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gallons per acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminocyclopyrachlor + chlorsulfuron (Perspective)* + Diflufenzopyr + dicamba (Overdrive, Distinct)	3-4 oz. Perspective/acre + 4 oz. Overdrive/acre + 1% v/v methylated seed oil	At flowering in the spring and/or fall.
Quinclorac (Paramount, Facel-L, Quinstar) + Diflufenzopyr + dicamba (Overdrive, Distinct)	12-24 oz. Quinstar/acre + 4 oz. Overdrive/acre + 1% v/v methylated seed oil	At flowering in the spring and/or fall.
Aminocyclopyrachlor + chlorsulfuron (Perspective)*	4.75-8 oz. product/acre + 1% v/v methylated seed oil	Post-emergence in spring until flowering, or to fall rosettes.
Note: *IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not permitted for use in the San Luis Valley. Perspective is not for use on grazed or feed forage.		
Additional herbicide recommendations for this and other species can be found at: **goo.gl/TvWnv9**		

Mayweed Chamomile Identification and Management

List B

© Anne Parsons, Naturalist

Mayweed chamomile (*Anthemis cotula L.*) is an annual forb in the Asteraceae family, also known as stinking chamomile, dog fennel, mayweed, and mayweed dogfennel. Distinguishing mayweed chamomile from similar looking species is difficult. Hybridization with scentless chamomile is reported (Kay 1971). It is believed to be phenotypically plastic, making visible traits inconsistent; traits overlap with other *Anthemis* species (Ali 2019, Kay 1971).

The most obvious diagnostic feature is its pungent odor. It may irritate skin of mammals upon contact (iNaturalist 2019). Mature plants range from 3 to 26 inches tall. Its leaves are alternate and deeply divided pinnately, each lobe is pinnately divided again two to three times (bi- to tripinnatifid), giving it a feather-like appearance. Each segment is short and narrow. Soft hairs are on the leaf upper surface. Stems have many branches, sometimes stems have red hue, hairs or glands. It has a fibrous taproot. White ray flowers have shallow three-lobed margin. It has ten to 15 ray flowers. Once the yellow disc flowers are developed, they form a cone shape that causes the white ray flowers to subtend. When vertically sliced, the receptacle is diagnostically narrowly cone-shaped, solid in the center, and has chaff- a few long shaggy soft hairs restricted to the center, and sometimes glands, all are observable with a hand lens. The imbricate phyllaries are oval, in a series of two or more and have soft hairs. The achenes are wrinkled with ten ridges and small glands that give it a bumpy surface. It spreads only by seed and like other Asteraceae plants, it is a prolific seed producer. Seeds lack anatomical dispersal structures so they remain close to parent plants.

Other Asteraceae species are easily confused with this species from a distance. These include two other List B species, scentless chamomile (*Tripleurospermum inodorum*) and oxeye daisy (*Leucanthemum vulgare*), as well as German chamomile (*Matricaria chamomilla*), sea mayweed (*Tripleurospermum maritimum*), chamomile (*Chamaemelum nobile*), pineapple weed (*Matricaria discoidea*), native annual fleabane (*Erigeron annuus*) and whiplash daisy (*Erigeron flagellaris*) (iNaturalist 2018).

Mayweed chamomile is native to the arid Mediterranean and Middle Eastern areas and spread from there worldwide through trade and agriculture (Invasive Species Compendium 2019). Its status is unknown in Colorado; this species is likely both under-reported and incorrectly identified. Mayweed chamomile is ruderal, found mainly in Colorado's disturbed sites and the sides of impermeable surfaces, such as roads, sidewalks, trails, as well as gravely or well-drained soils.

© Anne Parsons, Naturalist

© CC Carr, Boise Herbarium

© tswans, iNaturalist

© JK Nelson, Rocky Flats Herb., SCINet

Key ID Points

1. Three lobed ray flowers; pungent odor
2. Narrow cone-shaped receptacle with chaff- few long hairs; imbricate phyllaries with hairs
3. Alternate leaves are bi- to tripinnatifid
4. Fibrous taproot

mayweed chamomile

Anthemis cotula L.

List B

Integrated Weed Management Recommendations

mayweed chamomile

Anthemis cotula L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seeds from dispersing, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, other plants present and land uses.

© Colorado State University

CULTURAL

Since mayweed chamomile is not a strong competitor and is ruderal, minimizing soil disturbance and maintaining high native canopy cover of drought tolerant plants is key. It prefers moist soil, so implement modify water regimes where dense colonies exist. Since mayweed chamomile can modify its life history to take advantage of conditions, tilling during shoulder seasons, hot temperatures or before bolting, exposes the shallow roots to drying (Allaie et al. 2005). Till frequently and seed cover plants. Maintain or restore a competitive assemblage of shrubs, forbs, cool and warm season grasses, annuals and perennials. In restoration efforts, select locally adapted species, soil amendments, soil microbes and mycorrhizal fungi that are ecologically appropriate for the site to improve competitiveness of other species.

MECHANICAL

Mayweed chamomile has shallow roots, so mechanical methods can be effective in residential areas and moderate sized infestations. In loose soil, dig to remove the fibrous taproot. In spring, sever roots below the soil surface before the plant stores energy. Mowing, chopping and deadheading leaves roots behind, stimulates more flower production and are not recommended. Mowing, especially when timed near flowering or seeding phases, often disperses flowers and seeds, which expands the size of the infested area. Collect, bag, and dispose of or destroy flowers; seeds could mature and germinate if left on the ground. Prescribed fire may be an effective tool to control mayweed chamomile but since it prefers roadsides and developed sites, it may not be possible to generate the heat needed to damage the root, greens and seeds. Little information exists on fire effects on this plant.

© Getty Images

BIOLOGICAL

Mayweed chamomile is not palatable to domestic livestock and irritates the skin of mammals (Woo et al. 1999, Kay 1971). Properly managed grazing can improve vigor of desired species and indirectly reduce infestations. At present, there are no biological control agents authorized in Colorado that would effectively control it. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at: www.colorado.gov/ag/biocontrol.

© Mountain Spraying Company

CHEMICAL

NOTE: Herbicide recommendations to control mayweed chamomile in pastures and rangeland are found at: https://goo.gl/TvWnv9. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for herbicides appropriate for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

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Broomfield, CO 80021
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www.colorado.gov/ag/weeds

Colorado State University

Rev. 2/19

Moth mullein Identification and Management

List B

Moth mullein (*Verbascum blattaria* L.) is generally biennial, but in suitable sites it can be a short-lived perennial. Although recent genetic analyses split the family, this plant remains in the Scrophulariaceae family.

The stem is stiff, reaches up to 1.5 m tall and appears slender compared to common mullein. The upper stem, especially near the flowers, glistens in the sun from glandular-tipped hairs. Leaf shape varies. Initially they develop a basal rosette and are oval with slightly wavy margins. Leaves on mature plants alternate along the stem and are upright. Mature leaves are oblong in shape, have toothed margins but are not hairy, and are 8 to 45 cm long and 3 to 15 cm wide. The fibrous taproot is reportedly large (New Jersey Agricultural College Experimental Station 1892).

Solitary perfect flowers are five-parted, loosely arranged in a raceme. Sepals have glandular hairs. Lobed petals are 2 to 3 cm in diameter, ranging from off-white to yellow. Petals are slightly recurved, exposing faint guidelines towards the five stamens, which are densely lined with magenta knobby hairs, and single pistil that sits on a superior ovary with two chambers. Fruits are rounded bilobed capsules, about 8.5 mm in diameter and have conspicuous glandular hairs. Upon maturity, fruits split in two, revealing dark brown seeds whose surface has ridges and grooves. Seed is the primary reproductive method, but they lack dispersal anatomy so fall close to parent plants (Gros and Werner 1978). Viable seed longevity is at least 120 years (Telewski and Zeevaart 2002).

Moth mullein is well adapted to upland semi arid or Mediterranean climates found in its Northern Africa and European origin (Bretzel et al. 2009, Plants of the World Online 2018). It is adapted to serpentine soils, including high levels of heavy metals such as lead, nickle, cobalt, chromium, and magnesium, but can also grow in fertile soils (Gross and Werner 1978, Shallari et al. 1998). As recently as 2009, moth mullein was recognized for its adaptations to infertile, nutrient poor and unproductive soils, attractiveness to pollinators, low maintenance, the quantity and duration of flowering, and promoted as an ornamental in its native Mediterranean range (Bretzel et al. 2009). It appears confined to elevations below 6500 feet in the USA and its native range (Ackerfield 2015, eFloras 2018).

Currently its distribution in Colorado is limited to the northern front range (EDDMapS 2018). However, it is a prolific seeder and appears to be spreading south, so it is imperative to implement EDRR strategies before the infestation worsens. *V. blattaria* can hybridize with *V. thapus* (Flora of North America 2012, Gross and Werner 1978).

Key ID Points

1. Five-parted flowers (petal, sepal, stamen); magenta stamens densely lined with hairs
2. Oblong alternate leaves
3. Fibrous taproot
4. Conspicuous glandular hairs on stem and immature fruit

Moth mullein

Verbascum blattaria L.

List B

Integrated Weed Management Recommendations

Moth mullein

Verbascum blattaria L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seeds from dispersing, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, other plants present and land uses.

© Colorado Natural Heritage Program

CULTURAL

Very little information is available on cultural control methods effective against moth mullein; this remains a significant research gap. It does appear to prefer disturbed areas, so minimize soil disturbance especially near infested areas. In wildland settings, maintain or restore a competitive assemblage of shrubs, forbs, cool and warm season grasses, annuals and perennials. Use locally adapted species that are ecologically appropriate for the site to improve competitiveness. Incorporate soil amendments, soil microbes and mycorrhizal fungi to boost native species when appropriate. Aim to reduce above and below ground space and nutrients to make them unavailable to moth mullein.

© The Nature Conservancy

MECHANICAL

Since moth mullein has a short life cycle, mechanical methods can be effective, especially in residential areas and small infestations. The key is to sever roots below the soil surface in the first year or early in the second season before the plant flowers. Mowing, chopping and deadheading is not effective; these methods leave roots behind, stimulate more flower production, disperse flowers and seeds, which expand the size of the infested area. Collect, bag, and dispose of all flowers and fruits; seeds will germinate if left on the ground. Since seed longevity is so long, consecutive years of treatment are necessary. Time prescribed fires before flowering to top kill above ground biomass. Low intensity prescribed fire would leave roots unaffected; spring burns increased cover by 0.2% so multiple entries are necessary (Denver Botanic Gardens 2002).

© Cynthia Vita, NRCS

BIOLOGICAL

Moth mullein appears to be unpalatable to domestic livestock based on anecdotal reports. Properly managed grazing can improve vigor of desired species and indirectly reduce moth mullein. The biological control agent *Rhinusa tetra* attacks moth mullein, but its primary target is common mullein (Winston et al. 2014). Currently there are no biological control agents for moth mullein authorized in Colorado. For more biocontrol information, visit the Colorado Department of Agriculture's Palisade Insectary website at: www.colorado.gov/ag/biocontrol

© Celestine Duncan, Techline Invasive Plant Series

CHEMICAL

NOTE: Herbicide recommendations to control moth mullein in pastures and rangeland are found at: https://goo.gl/TvWnv9. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for herbicides appropriate for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

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Rev. 2/19

Musk Thistle Identification and Management

List B

Musk thistle *Carduus nutans* L. is a non-native biennial forb that reproduces solely by seed. During the first year of growth, a rosette forms in spring or fall. During the second year in mid to late spring, the stem bolts, flowers, sets seed, and the plant dies.

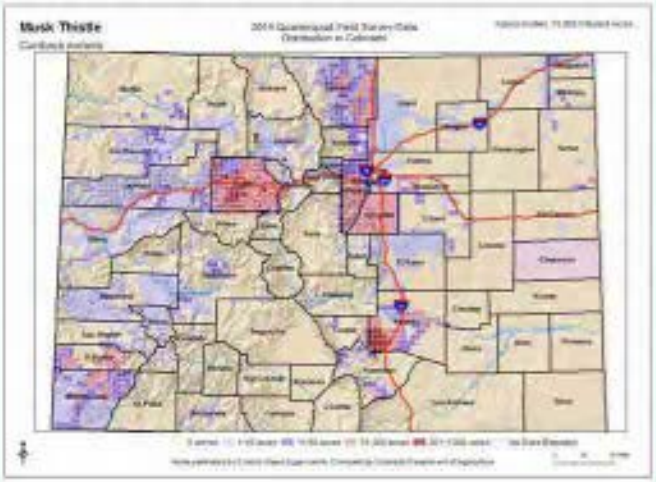
Musk thistle can grow up to 6 feet tall. The leaves have spines, are waxy, and dark green in color with a prominent light green to white midrib that can be seen from a distance. Leaves are dentately lobed; leaf bases sometimes extend down below the point of attachment. The terminal flower heads are purple, large in size (1.5 to 3 inches in diameter) and bend over as if nodding. These flower heads are made up of only disk flowers. They are surrounded by numerous, wide and stout lance-shaped, spine-tipped bracts that resemble an open pineapple. The pappus has plumose bristles that appear barbed under magnification. Musk thistle produces many flower heads. The tallest shoots flower first; lateral shoots develop in leaf axils. A robust plant may produce 100 or more flowering heads. Reproduction is usually via out-crossing through insect pollination, but self-pollination also occurs. Flowers emerge in May through September. Seeds develop shortly after flowers emerge. Flower buds can contain viable seeds from self-pollination. Seeds can mature on severed bud and flowerheads. Seeds remain viable in the soil for up to about 14 years. Seeds can germinate and emerge from spring through fall.

Musk thistle habitat is found in a variety of environments extending from shortgrass prairie to alpine. It is strongly associated with heavily disturbed sites, where over-use occurs or where site conditions are poor due to land management practices. This includes over-grazed areas, large fires, trails, ditches and roadsides. Infested livestock pasturs suffer from significantly decreased carrying capacity.

Because musk thistle reproduces solely from seed, the key for successful management is to prevent seed production. Once flowers emerge and start to produce seed, effective management options will become limited. Once sites are infested, musk thistle can form dense stands. Prevention, adjusting land management practices, a robust integrated treatment plan and restoration are critical to eliminating this species.

Musk thistle is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be eradicated; some populations may be contained or suppressed depending on state regulations. For management directions for each county, refer to the most recent Rule, or visit www.colorado.gov/ag/coweedcontacts for details.

2015 Quarter Quad Survey



Key ID Points

1. Leaf with white midrib and leaf margins with spines.
2. Pappus with plumose barbed bristles.
3. Wide, stout lance-shaped bracts with spiny tips.

Musk thistle

Carduus nutans L.

List B

Integrated Weed Management Recommendations

Musk thistle

Carduus nutans L.

Effective integrated management means using a variety of eradication methods that also includes restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes and restore degraded sites. Avoid soil disturbance. As with most biennials, prevent seed production in the first and second year of musk thistle growth. Prevent seed from dispersing, such as on contaminated equipment. Rest sites until they are effectively restored. Change land use practices. Use methods appropriate for the site.

CULTURAL CONTROL METHODS

Musk thistle is not tolerant of competition and needs light to germinate seeds. Cultural methods should aim to maintain or restore a competitive assemblage of forbs, cool and warm season grasses. Implement whole site restoration of soils, plants and water regimes where stands of musk thistle exist where needed. Use locally adapted species that are ecologically appropriate for the site to improve competitiveness. Include annual as well as perennial species. Incorporate soil amendments, soil microbes and mycorrhizal fungi in restoration and land management efforts. Minimize soil compaction and disturbance, especially in wetlands and moist soil. Irrigation can increase competitive species.

BIOLOGICAL CONTROL METHODS

Although horses, cattle, goats and sheep may eat flower heads on a few plants, seeds pass through their digestive tracks unaltered and spread. The leaf and stalk spines can cause domestic livestock to avoid mature musk thistle. Thus, musk thistle can become an "increaser" in over-grazed systems. Properly managed grazing can improve vigor of desired species and indirectly reduce musk thistle. *Trichosirocalus horridus* is the only biological control agent available for musk thistle in Colorado. The other species, *Rhinocyllus conicus*, is not host specific and will damage native thistles, and therefore cannot be released as an agent in Colorado. For more information, visit the Colorado Department of Agriculture's Palisade Insectary website at www.colorado.gov/ag/biocontrol.

MECHANICAL CONTROL METHODS

Methods, such as tilling, hoeing and digging, are best for infestations smaller than 0.5 acres; weigh this against other plants present, ecology and site condition. Sever roots below the soil surface during the first year before the plant stores energy, and in the second year before flower production. Mowing, chopping and deadheading stimulates more flower production; these methods require consecutive years of season-long treatments. All flowerbuds and heads must be collected, bagged, and disposed of or destroyed; seeds will mature and germinate if left on the ground. Prescribed fire that results in high soil burn severity damage roots and above ground biomass, but is not recommended due to impacts on desired plants. Fire generally favors musk thistle germination.

CHEMICAL

NOTE: The following are recommendations for herbicides that can be applied to pastures and rangeland. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Aminopyralid* (Milestone)	6 oz./acre + 0.25% v/v non-ionic surfactant	Apply in spring rosette to early bolting growth stages or in fall to rosettes. *Product not permitted for use in the San Luis Valley.
Chlorsulfuron** (Telar)	1-2.6 oz. product/ acre + 0.25% v/v non-ionic surfactant	Apply in spring from rosette through very early flower growth stages. (Can prevent viable seed formation if applied no later than the first viable flowers begin to open.) **This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.
Clopyralid (Transline)	0.67-1.33 pints product/acre + 0.25% v/v non-ionic surfactant	Apply to rosettes through flower bud stage in spring, or to fall rosettes.

Colorado Department of Agriculture - Conservation Services
305 Interlocken Parkway
Broomfield, CO 80021
(303) 869-9030
www.colorado.gov/ag/weeds

Colorado State University

Rev. 11/16

Oxeye Daisy Identification and Management

List B

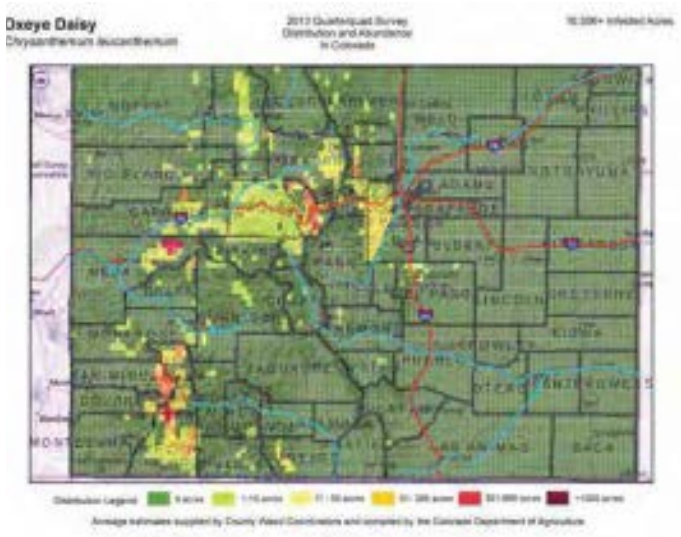
Oxeye daisy (*Leucanthemum vulgare*) was introduced from Europe as a seed contaminant and as an ornamental. It is a rhizomatous, creeping, short-lived perennial that grows 10 inches to 2 feet tall. The basal and lower leaves are spoon-shaped, toothed, and with long petioles (leaf stem). The upper leaves are narrow, toothed, and clasp the stem. Flowers bloom between June and August. The flowers are 1 to 3 inches in diameter, with 15 to 30 white ray flowers, and mostly solitary. The phyllaries beneath the flower head are green with a dark brown margin. One flower head can produce up to 200 seeds. Oxeye daisy spread vegetatively from roots, root fragments, or by seed. Seeds may be viable up to 38 years or more. Infestation sites needs to be monitored for at least 10 years after the last flowering plant has been eliminated and treatments repeated when necessary. Ornamental Shasta daisy (*Leucantheum x superbum*) is not an aggressive invader and looks similar to oxeye daisy, but it is 6 to 12 inches taller and has larger flowers.

Oxeye daisy is an strong competitor. It forms dense stands that reduce native plant diversity. It degrades pastures and natural areas because cattle and wildlife avoid feeding on oxeye daisy. Heavy infestations may reduce nutrient cycling due to a shallow root system and create areas of bare soil, thus increasing soil erosion.

Habitats for oxeye daisy included mountain meadows, grasslands, pastures, streams, gardens, waste grounds, railway, and roadsides. Oxeye daisy typically grows in high elevations, up to 11,000 feet in Colorado.

The key to effective control of oxeye daisy is education and prevention. Oxeye daisy has been included in many different seed mixes, thus consumers should carefully read the label prior to planting so-called "native wildflower" mixes. Homeowners and land managers often overlook the impacts and the need to manage this weed because of the plant's attractiveness. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

2013 Quarter Quad Survey



Oxeye daisy is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eliminated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, (303) 869-9030.

Key ID Points

1. 15-30 white ray flowers on flowerheads that are 1-3 inches in diameter.
2. Rosette and lower leaves are spoon-shaped and toothed.
3. Upper leaves on the stem are narrow, toothed, and clasp the stem.

Oxeye daisy

Leucanthemum vulgare

List B

Integrated Weed Management Recommendations

Oxeye daisy

Leucanthemum vulgare

Oxeye daisy has been included in many different seed mixes, thus consumers should carefully read the label prior to planting so-called "native wildflower" mixes. Repeated hand pulling can eliminate small infestations. Mowing or grazing by sheep or goats can be effective, in addition with a chemical approach.

CULTURAL
Generate awareness for this noxious weed. Carefully inspect "wildflower" seed mixes; do not plant mixes that include *Leucanthemum vulgare*. Avoid overgrazing, disturbance, and seed dispersal. Bare ground is prime habitat for weed invasions. Tall perennial grasses that shade oxeye daisy are good competitors.

BIOLOGICAL
Goats or sheep can be effective in the control of oxeye daisy. There are no insect biological controls available for oxeye daisy. For more information on biocontrols, contact the Colorado Department of Agriculture-Palisade Insectary at 970-464-7916.

MECHANICAL
Repeated hand pulling or digging when soil is moist and infestations are small. Oxeye daisy is fairly shallow rooted; pull up as much of the root as possible. If removed during or after flowering, bag specimens carefully so as to not scatter seeds. Mowing before flowering or when flower buds are present can limit dispersal; do not mow during or after flowering. Tilling at 6 inches or deeper, and repeated shallowly as necessary, can control patches.

CHEMICAL
The table below includes recommendations for herbicides that can be applied to rangeland and pastures. 0.25% v/v non-ionic surfactant is equivalent to 0.32 oz/gal of water or 1 pt/100 gal of water. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Aminopyralid (Milestone)	4-6 oz./acre + 0.25% v/v non-ionic surfactant	Optimum control when applied at the pre-flower bud growth stage.
Metsulfuron (Escort XP)	1 oz. product/acre + 0.25% v/v non-ionic surfactant	Surfactant is absolutely necessary. Optimum control when applied at flowering growth stage. 1 oz. product is the minimum eradication rate based on best treatment observed in several CSU

Additional herbicide recommendations for this and other species can be found at:
goo.gl/TvWnv9

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Broomfield, CO 80021
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www.colorado.gov/ag/weeds

Updated
07/2015

Perennial pepperweed

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Perennial pepperweed Identification and Management

Identification and Impacts

Perennial pepperweed (*Lepidium latifolium*) is an extremely invasive perennial forb introduced from Europe and Asia in 1900 as a containment in sugar beet seed. Pepperweed reproduces both by seed and vegetatively by roots and shoots. Root fragments as small as 0.5 inch can grow into new plants. A serious threat, pepperweed alters ecosystems by acting as a "salt pump" absorbing salts from deep in the soil. The plant then excretes the salt through the leaves and deposits it on the surface soil. Since most desirable plants do not tolerate high saline concentrated soils, the entire plant composition and diversity of the area changes.

Growing 1 to 5 feet high, pepperweed has tiny white flowers. The flowers have four spoon-shaped petals in dense, rounded clusters on branch tips of erect stems. Stems emerge from deep, thick, woody root stocks that can penetrate 10 feet into the soil. Leaves of the mature plant are alternate, and lance or oblong in shape with serrated edges that are slightly wavy. They are glabrous (not hairy) and green to gray-green in color, with a distinctive white midrib. Upper leaves are smaller than basal leaves and have no stalks.

Perennial pepperweed invades a wide variety of habitats, from intermountain, mountainous areas and marshes. It is frequently found in riparian areas, wetlands, marshes, irrigation ditches, canals, and floodplains. If introduced, it can also invade roadsides, hay and alfalfa fields and rangeland. It readily invades disturbed and bareground areas. It can thrive in either low or high-saline soils. Large monocultures and dense litter layers prevent native plants from regenerating. Pepperweed displaces native plants and wildlife habitats, reduces food quality for wildlife and reduces agricultural and pasture production.

Perennial pepperweed rarely produces seedlings in the field, even with extensive seed crops. Research is underway, but the lack of seedlings may be due to seeds rapidly losing viability in the field (but not in the laboratory). Reproduction is primarily from deep, perennial roots and root pieces which break off and sprout new plants. However, preventing seed production is still recommended until further research is done.

The key to effective control of Perennial pepperweed is preventing establishment of large populations. Early detection and removal of plants if found, is the key to prevention. Planting desirable and competing grasses and forbs can aid in limiting the spread of Perennial pepperweed. Herbicide treatments are a good option if used during the bud to flowering stage of the plant. Once established, containment is key. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Perennial pepperweed is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/csd and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos courtesy of Kelly Uhing, Colorado Department of Agriculture.

Key ID Points

1. White flowers in dense round clusters at branch tips.
2. Leaves are waxy with a white midrib.

Updated on: 07/2015

Lepidium latifolium

Management Recommendations

CULTURAL
Prolonged spring flooding of new growth will kill pepperweed. Grazing is not recommended because the plant may be toxic. Reestablishing the native or desired plants can take years, so repeat plantings must be repeated, but it can aid in controlling populations. Contact your local Natural Resources Conservation Service for seed mix recommendations.

BIOLOGICAL
Biological control is not a viable option because 11 other species of native Lepidium are on the Endangered species list, and the risk to these species as well as agricultural species is too great. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Due to the deep, brittle root, most mechanical methods are not recommend, and can actually propagate, spread and increase the density of pepperweed. Hand pulling can also bring seeds to the soil surface, and spread pieces of root, which will sprout. However, spring mowing combined with chemical treatments can be effective.

Integrated Weed Management:

Because of the deep roots and persistence of pepperweed, it is critical to combine repeated herbicide application with monitoring and revegation of the area. Control of Perennial pepperweed can be difficult, so prevention is the best option. Early detection, eradication and containment of small populations and their source are vital.

Perennial pepperweed

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to specific areas. Rates are approximate and based on equipment with an output of 30 gal./acre. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Chlorsulfuron* (Telar)	1 oz. product/acre + 0.25 v/v non-ionic surfactant	Apply when plant is in the early flower to flowering growth stages. (Early spring to early summer)
Metsulfuron (Escort XP)	1 oz. product/acre + 0.25 v/v non-ionic surfactant	Apply when plant is in the early flower to flowering growth stages. (Early spring to early summer)
Imazapic (Plateau, Panoramic)	12 oz./acre + 2 pints/acre methylated seed oil or crop oil concentrate	Apply when plant is in the early flower to flowering growth stages. (Early spring to early summer)
Note: *This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.		
Additional herbicide recommendations for other species can be found at: **goo.gl/TvWnv9**		

NOTE: Herbicides, when applied at the flower bud stage, are extremely effective to control pepperweed. **Repeat applications for up to five years. However, the waxy leaf surface and the dense growth of this weed can make it difficult to obtain adequate coverage with the herbicide, so apply the chemical carefully and thoroughly for effective control.**

Top photo, © Kelly Uhing, Colorado Department of Agriculture. *Calophasia lunula* larva photo © Bob Richard, USDA APHIS, Invasive.org. Root system, Nature Conservancy.

Plumeless thistle

Colorado Department of Agriculture

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(303) 869-9030
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Plumeless thistle Identification and Management

Key ID Points

1. Flower heads cluster 2-5 and are purple to dark red in color.
2. Leaves are alternate, stalk-less and hairy underneath.

Identification and Impacts

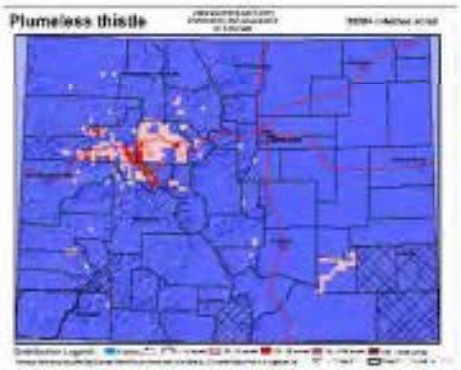
Plumeless thistle *(Carduus acanthoides)* is a winter annual or biennial that is native to Europe and Asia. Plumeless thistle rosettes have wavy leaves with yellow spines along the white-colored leaf margins. The stems are covered with leaf-like, winged spines that extend up to the flowering heads. The flower heads, in clusters of 2 to 5, are alone at the end of the branches. They are purple to dark red in color and are 1/2 to 1 inch in diameter. Leaves are alternate, stalk-less, hairy underneath and blend into the stem. Mature plants can grow taller than 5 feet and can produce upwards of 9,000 seeds.

Habitats for Plumeless thistle include pastures, fields, disturbed lands, logged-over areas, river valleys, along roadsides and in native grasslands. Plumeless thistle out competes native species and forage crops. It is one of the most aggressive thistles, due to its high seed production. Plumeless thistle is unpalatable to livestock and it may accumulate nitrates.

Plants over winter and grow from seeds and rosettes. The seed viability for Plumeless thistle is unknown. The site must be monitored for at least 10 years after the last flowering adult plants have been eliminated and treatments repeated when necessary.

The key to effective control of Plumeless thistle is very similar to Musk thistle. Preventing Plumeless thistle seed production and planting desirable grasses and forbs to out compete plumeless thistle is effective. An integrated weed management approach is an effective tool when dealing with plumeless thistle; using herbicide, biological and cultural control methods. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Plumeless thistle is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/csd and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.



Photos © Map above: Crystal Andrews, Colorado Department of Agriculture; All other photos: Kelly Uhing, Colorado Department of Agriculture.

Updated on: 07/2015

Carduus acanthoides

Management Recommendations

CULTURAL
Establishment of selected grasses can be an effective cultural control of Musk thistle. Contact your local Natural Resources Conservation Service for seed mix recommendations. Maintain healthy pastures and prevent bare spots caused by overgrazing. Bareground is prime habitat for weed invasions.

BIOLOGICAL
Biological control insects, such as the seed head weevil and the crown weevil are effective on large infestations. When used together, these insects provide fair to good control. These insects have been known to threaten native thistle populations. Contact the Insectary of Colorado Department of Agriculture to get complete information at 970-464-7916. Or visit www.colorado.gov/ag/csd.

MECHANICAL
Any mechanical or physical method that severs the root below the soil surface will kill Plumeless thistle. Mowing or chopping is most effective when Plumeless thistle plants are at full bloom. Be sure to properly dispose of the flowering cut plants since seeds can mature and become viable after the plant has been cut down.

Integrated Weed Management:

The key to managing Plumeless thistle is to prevent seed production. Dense Plumeless thistle stands can be treated by spot use of herbicide programs. Due to the unknown seed viability of plumeless thistle, monitoring up to 10 years, and repeating control methods may need to occur for many years to completely eliminate an infestation.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Aminopyralid* (Milestone)	5 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply in spring rosette to early bolting growth stages or in fall to rosettes.
Chlorsulfuron** (Telar)	1-2.6 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply in spring from rosette through very early flower growth stages. (Can prevent viable seed formation if applied no later than the first viable flowers begin to
Clopyralid (Transline)	0.67-1.33 pints product/acre + 0.25% v/v non-ionic surfactant	Apply to rosettes through flower bud stage in spring, or to fall rosettes.

Note: *Product not permitted for use in the San Luis Valley. **This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.

Additional herbicide recommendations for this and other species can be found at:
goo.gl/TvWnv9

Photos Top to bottom © Loke T. Kok, Virginia Polytechnic Institute and State University, Bugwood.org; Richard Old, XID Services, Inc., Bugwood.org; and Kelly Uhing, Colorado Department of Agriculture.

Plumeless thistle

Colorado State University

CO CDA

Russian Knapweed Identification and Management

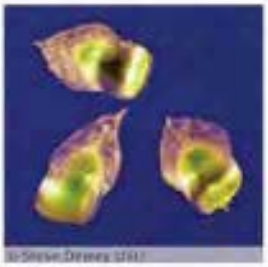
List B

Russian knapweed (*Acroptilon repens*) is a non-native, deep-rooted perennial that spreads by aggressive, creeping, horizontal roots (rhizomes) and seeds. The roots are brown to black with a scaly appearance. Russian knapweed can grow up to 3 feet in height. The stems and leaves are covered with short gray hairs. The flowers are urn-shaped, pink to purple in color, and are solitary at the tips of the upper branches. Russian knapweed can be distinguished from other knapweeds by the smooth, papery, rounded bracts that surround the flowers. Russian knapweed emerges in early spring after soil temperatures remain above freezing. It produces flowers from June to August and sets seed in late summer to early fall. The seeds are viable for two to three years. Russian knapweed reproduces primarily from its root system. Buds on the horizontal roots can form adventitious shoots, August through the winter, that can grow to become independent plants. Once rosettes emerge in the spring, remaining root buds slough-off until they develop again in late summer. Additionally, root fragments can develop into new plants.

Russian knapweed is allelopathic, which means it contains a toxic substance that inhibits the growth of competing plants. This weed may also be toxic to horses resulting in serious injury or possibly death of the animal. Russian knapweed displaces native vegetation and reduces forage values on range and pasturelands.

Habitat for Russian knapweed includes roadsides, ditch banks, riparian zones, pastures, rangeland, saline soils, clear cuts, and cropland. It typically invades degraded areas and sites with full sun.

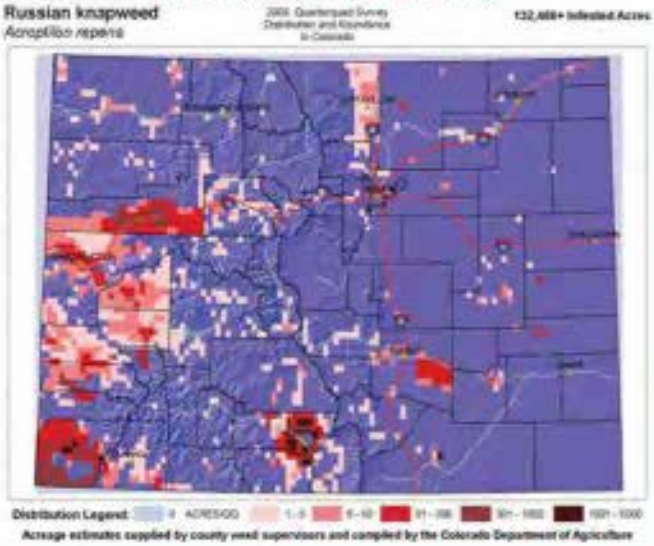
The most effective method of control for Russian knapweed is to prevent its establishment through proper land management. Maintain healthy pastures and rangeland and continually monitor your property for new infestations. If Russian knapweed is already established, using an integrated weed management approach proves to be effective. Russian knapweed can be managed with herbicides or biocontrol insects, but long-term control must include planting competitive plant species to occupy bare ground once infested by the weed. Details on the back of this sheet can help to create a management plan compatible with your site ecology.



Key ID Points

1. Distinguished from other knapweeds by the flower's smooth, papery bracts.
2. Roots are brown to black with scaly appearance.
3. Rosettes and lower leaves deeply lobed.
4. Upper leaves are smaller, smooth margined, and not lobed.

2008 Quarter Quad Survey



Russian knapweed is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eliminated, contained, or suppressed depending on the local infestations. For more information, visit www.colorado.gov/ag/weeds and click on the Noxious Weed Program link or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-869-9030.

Russian knapweed

Acroptilon repens

List B

Integrated Weed Management Recommendations

The most effective control for Russian knapweed is to prevent its establishment through proper land management. An integrated weed management approach can be effective when dealing with Russian knapweed. It can be managed with herbicides or insects, but long-term control must include planting competitive plant species to occupy bare ground once infested by the weed.

Russian knapweed

Acroptilon repens

CULTURAL

Maintain healthy pastures and prevent bare spots caused by overgrazing. Bare ground is prime habitat for weed invasions. Establishing sod-forming grasses or vegetation with dense shade can be an effective cultural control of Russian knapweed. Contact your local Natural Resources Conservation Service for seed mix recommendations.

BIOLOGICAL

The gall midge, *Jaapiella ivannikovi*, is a fly that lays eggs in the shoot tips of Russian knapweed. It forms galls that reduce flowering, seed production, and stunts the plants' growth. This biocontrol will stress the stand of Russian knapweed but will not likely eliminate it. The Colorado Department of Agriculture - Palisade Insectary, 970-464-7916, is currently establishing this biocontrol . It is not yet available to the public.

MECHANICAL

Mowing several times before the plants bolt stresses Russian knapweed and forces it to use nutrient reserves stored in the root system. However, mowing alone will not eliminate the infestation and it can stimulate shoot sprouting the following year. Mowing combined with a fall herbicide application will enhance control. Tilling and disking can create root fragments that can sprout. However, repeated deep tillage (1 feet) over 3 years can kill much of the root system.

CHEMICAL

The following are recommendations for herbicides that can be applied to range and pasturelands. Always read, understand, and follow the label directions. Please read label for exact rates. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Aminopyralid* (Milestone)	7 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply in the fall when above-ground stems die back and root buds are highly susceptible. Can also apply in the bud to senescence stages or in the spring during early bolt before flower buds form.
Aminocyclopyrachlor + Chlorsulfuron (Perspective)*	4-5 oz. product/acre + 1% v/v methylated seed oil	Apply in the fall when above-ground stems die back and root buds are highly susceptible. Can also apply in the bud to senescence stages or in the spring during early bolt before flower buds form. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage. Not for use on grazed or feed forage.

Note: *Product not permitted for use in the San Luis Valley. **This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.

Additional herbicide recommendations for this and other species can be found at:
goo.gl/TvWnv9

Colorado Department of Agriculture - Conservation Services
305 Interlocken Parkway
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(303) 869-9030
www.colorado.gov/ag/weeds

Updated: 07/2015

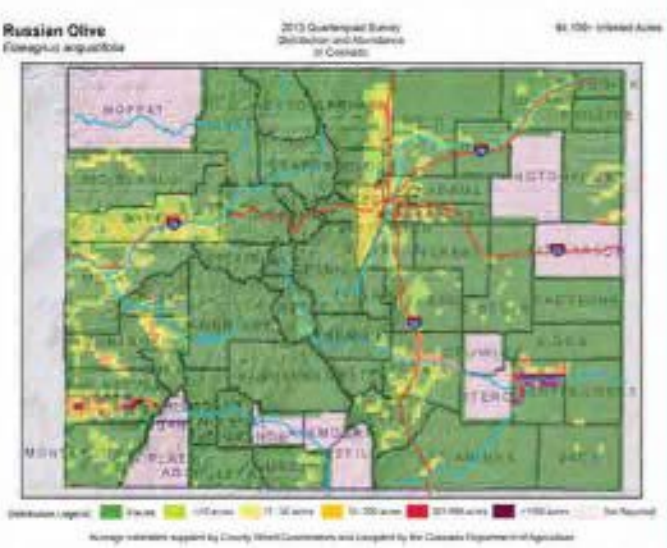
Russian Olive Identification and Management

List B

Russian olive (*Elaeagnus angustifoilia*) is a perennial tree or shrub that is native in Europe and Asia. The plant has olive-shaped fruits, silver color at first then becoming yellow-red when mature. Russian olive can reproduce by seed or root suckers. Seeds are readily spread by birds and can remain viable for up to 3 years. Spring moisture and slightly alkaline soil tend to favor seedling growth. The plant's extensive root system sprouts root suckers frequently. The tree can reach up to 30 feet in height with branches that have 1 to 2 inch thorns. Leaves are 2 to 3 inches long, alternate, narrow, and have simple blades with smooth edges. The leaf's lower surface is silvery white, while the upper surface is light green in color. Flowers are 4 small sepals in light yellow clusters, fragrant, and appear May through June. Fruits mature from September to November. Russian olive twigs are flexible, reddish, and have surfaces coated with gray and scaly pubescence, becoming smooth.

Once thought to be a beneficial windbreak tree, it since has been deemed detrimental to the environment. Russian olive can grow in a variety of soil and moisture conditions, but prefers open, moist, riparian zones. It is shade tolerant and can be found along streams, floodplains, fields and open areas up to approximately 8,000 feet in elevation. Russian-olive can outcompete native plants, interfere with natural plant succession and nutrient cycling, and tax water reserves. Because Russian olive is capable of fixing nitrogen in its roots, it can grow on bare, mineral substrates and dominate riparian vegetation. Although Russian olive provides a plentiful source of edible fruits for birds, ecologists have found that bird species richness is actually higher in riparian areas dominated by native vegetation.

The key to effective control of Russian olive is preventing establishment of the trees or shrubs. If plants are already present, control options include cut-stump treatments and mechanical mowing. These treatments depend on size and location of the plant. Details on the back of this sheet can help you create a management plan compatible with your site ecology.



Russian olive is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Key ID Points

1. Leaves are silvery white.
2. Branches have 1 to 2 inch thorns.
3. Yellow-red fruits on mature plants.
4. Mature trees have shedding, reddish-brown bark.

Russian olive

Elaeagnus angustifoilia

List B

Integrated Weed Management Recommendations

Russian olive

Elaeagnus angustifolia

Integrated weed management offers the most effective combination of control efforts through the "cut stump" treatment. Trees are cut down with a hatchet or chainsaw, then immediately treated with an approved herbicide on the surface of the cut stump. The most effective timing is late summer/early fall for herbicide transfer into the roots.

© John Randall, TNC

CULTURAL

Replace Russian olives with native trees. Prevent establishment of new trees by removing seedlings and saplings before they mature. Contact your local Natural Resources Conservation Service for recommendations of other possible trees or shrubs.

© James Miller, USFS

BIOLOGICAL

Tubercularia canker is an unapproved biocontrol. However, it overwinters on infected stems and spreads via rain-splash, animals, or pruning implements to open wounds in the bark. Infected tissue becomes discolored or sunken. Entire stems may be girdled and killed, and the disease can deform or kill stressed plants over time.

© Chris Nova, Adams County

MECHANICAL

Saplings can be pulled with a weed-wrench or cut with brush-cutters. Trees can be girdled or cut with chainsaws. However, stump sprouting commonly occurs after cutting down the tree; and stump excavation without removing all parts of the roots can result in root sprouting. Treating cut-stumps with an herbicide can eliminate sprouting. Stump burning is practical when conditions support a long, hot fire and most effective in summer or early fall. Saplings are most sensitive to mechanical treatment.

© Scott Peterson, USDA

CHEMICAL

The table below includes recommendations for herbicides that can be applied to range and pasturelands. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Triclopyr (Garlon 4, Remedy)	20-30% solution in basal bark oil. The herbicide Pathfinder comes pre-mixed in oil and does not require dilution.	Cut-Stump Treatment: Apply to the cambial layer of the tree immediately after the cut-stump treatment and to roots above soil surface. (Summer to fall; fall treatments showed fewer re-growth) Basal Bark Treatment: Spray till wet but not dripping; the roots above soil surface, root collar, and lower trunk to a height of 12-15 inches above ground (Late summer to fall)
Glyphosate* (Rodeo - approved aquatic label)	Undiluted (100% solution) or 50% solution in basil bark oil	Cut-Stump Treatment: Apply to the cambial layer of the tree immediately after the cut-stump treatment and to roots above soil surface. Diluted solutions requires regular agitation. Treat summer to fall; fall treatments showed fewer re-growth.
Note: *These products are non-selective and will kill any vegetation contacted.		
Additional herbicide recommendations for this and other species can be found at: **goo.gl/TvWnv9**		

Updated: 07/2015

Colorado Department of Agriculture - Conservation Services
305 Interlocken Parkway
Broomfield, CO 80021
303-869-9030
www.colorado.gov/ag/weeds

Saltcedar

Tamarix spp.

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Saltcedar is a tall shrub or small tree that has white to pink flowers in clusters called racimes.
2. Leaves are small and scaly.

Updated on: 07/2015

Saltcedar Identification and Management

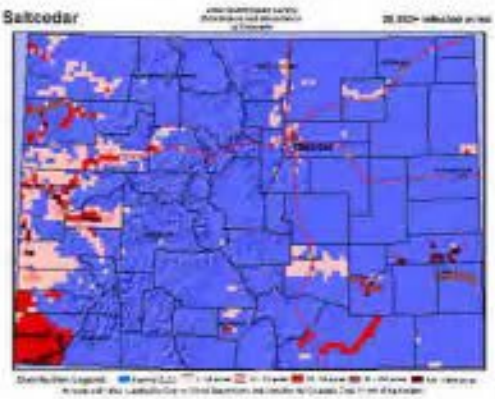
Identification and Impacts

Saltcedar, or tamarisk (*Tamarix spp.*), is a non-native deciduous evergreen shrub or small tree that grows from 5 to 20 feet tall. The bark on saplings and stems is reddish-brown. The leaves are small, scale-like and bluish-green in color. Tiny pink to white flowers have five petals and grow on slender racemes. Saltcedar reproduces by seeds as well as vegetatively. A mature plant can produce up to 600,000 seeds per year. Seeds are viable for up to 45 days under ideal conditions. Saltcedar buds break dormancy in February or March. Flowering occurs anytime between April and August. Ideal conditions for saltcedar seedling 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.

Saltcedar was introduced from central Asia, northern Africa, and southern Europe for ornamental purposes and for stream bank stabilization. It is now widespread in the United States. Saltcedar crowds out native stands of riparian and wetland vegetation. Saltcedar increases salinity of surface soil, rendering the soil inhospitable to native plant species. Saltcedar can be found along floodplains, riverbanks, streambanks, marshes, and irrigation ditches. It's heavy use of water has contributed to the intensity of the drought.

The most effective method of control for saltcedar is to prevent its establishment through proper land management. Monitor susceptible areas for new infestations. An integrated weed management approach has proven to be an effective control when dealing with saltcedar. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Saltcedar is designated as a "List B" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information, please visit www.colorado.gov/ag/csd and click on the Noxious Weed Program link. Or call the State Weed Coordinator of the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.



Management Recomendations

Saltcedar

CULTURAL
After a saltcedar infestation is managed, revegetation is necessary in order to protect the soil resource and reduce the threat of reinvasion. Seeded grasses, willow stakes, and cottonwood cuttings can reduce the chances of saltcedar reinvading managed sites.

BIOLOGICAL
The saltcedar leaf beetle (*Diorhabda elongata*) larvae and adults feed on foliage. This causes stem dieback and potential death of the plant if defoliation is consistent. The leaf beetle should be available for limited distribution. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture, 970-464-7916.

MECHANICAL
A bulldozer or prescribed fire can be used to open up large stands of saltcedar. These methods must be followed up with a herbicide treatment of the resprouts when they are 1 to 2 meters tall. Chainsaws, or loppers for smaller plants, are effective for cut-stump treatments to smaller infestations or in environmentally-sensitive management areas.

Integrated Weed Management:

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 slow saltcedar reinvasion. Follow up control efforts the same growing season and for several years afterwards.

HERBICIDES: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on hand-held equipment with an output of 30 gallons per acre. Always read, understand, and follow the label directions. **The herbicide label is the LAW!**

Herbicide	Rate	Application Timing
Triclopyr (Garlon 4, Remedy)	20-30% solution in basal bark oil. The herbicide Pathfinder comes pre-mixed in oil and does not require dilution.	Cut-Stump Treatment: Apply to the cambial layer of the tree immediately after the cut-stump treatment and to roots above soil surface. (Summer to fall) Basal Bark Treatment: Spray till wet but not dripping; the roots above soil surface, root collar, and lower trunk to a height of 12-15 inches above ground (Summer to fall)
Glyphosate* (Rodeo - approved aquatic label)	Undiluted (100% solution) or 50% solution in basil bark oil	Cut-Stump Treatment: Apply to the cambial layer of the tree immediately after the cut-stump treatment and to roots above soil surface. Diluted solutions requires regular agitation. (Summer to fall)
Triclopyr (Garlon 4, Remedy) + Aminopyralid (Milestone)	3 qts. Garlon 4/acre + 7 oz. Milestone/acre + 0.25% v/v non-ionic surfactant	Broadcast foliar treatment: Apply when plants are growing rapidly. (May to September)
Note: *These products are non-selective and will kill any vegetation contacted.		
Additional herbicide recommendations for other species can be found at: **goo.gl/TvWnv9**		

Scentless Chamomile Identification and Management

List B

Scentless chamomile (*Tripleurospermum inodorum L.*) is an annual forb in the Asteraceae family, also known as scentless false mayweed, scentless mayweed, and false chamomile, not to be confused with the tea producing German chamomile (*Matricaria chamomilla*).

Distinguishing scentless chamomile from similar looking species is difficult. The lack of odor is one clue; lack of hairs is another. Mature plants are about 1 to 1.5 feet tall. Its alternate leaves are 2 to 8 cm long, divided pinnately, and each lobe is pinnately divided again (bipinnatifid), giving a fern-like appearance. It has more than two stem leaves. Its roots are shallow and fibrous. White ray flowers have shallow five-lobed margin, which sometimes are asymmetrical. It has ten to 24 ray flowers. Fully developed yellow disc flowers form a dome shape that causes the white ray flowers to subtend. When vertically sliced, the receptacle is diagnostically cone-shaped, solid in the center, and lacks chaff. The phyllaries are oblong, in a series of two to five, are green in the middle, dried and thin on margins. The achenes diagnostically have three deep ribs that are well-separated, rounded oil-glands. It spreads only by seed; like other Asteraceae, it is a prolific seed producer. Seeds lack anatomical dispersal structures so remain close to parent plants.

Identification of this species is difficult and underwent numerous past taxonomic changes. There are several Asteraceae species that are easily confused with scentless chamomile from a distance. These include two other List B species, stinking chamomile (*Anthemis cotula*) and oxeye daisy (*Leucanthemum vulgare*), as well as German chamomile, sea mayweed (*Tripleurospermum maritimum*), chamomile (*Chamaemelum nobile*), pineapple weed (*Matricaria discoidea*), native annual fleabane (*Erigeron annuus*) and whiplash daisy (*Erigeron flagellaris*) (iNaturalist 2018).

It is native to mountains and river valleys in the Caucus region, Russia, Uzbekistan, Kazakstan, parts of China (eFloras 2019,). It was introduced into European prairies and spread through agriculture (Kay 1969, Woo et al. 1999). Diploid plants (two chromosome sets), which are more common, come from western Europe; tetraploid plants (four chromosome sets) come from marginal edges of its range in eastern and central Europe. Tetraploidy may indicate sympatric speciation, hybridization, genetic modifications, climatic changes or different introduction pathways (Kay 1969).

Scentless chamomile is ruderal, found mainly in Colorado's disturbed sites in upper montane and subalpine, where soil water content is slightly higher. This is usually on the sides of impermeable surfaces, such as roads, sidewalks, trails, and gravely areas.

Key ID Points

1. Receptacle is solid in the center, cone-shaped & naked
2. Phyllaries are oblong, green in center & dried on margins
3. Alternate leaves are bipinnatifid into filiform segments
4. Fibrous roots

Scentless chamomile

Tripleurospermum inodorum L.

List B

Integrated Weed Management Recommendations

Scentless chamomile

Tripleurospermum inodorum L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seeds from dispersing, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, other plants present and land uses.

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CULTURAL

Since scentless chamomile is ruderal, and sensitive to drought, minimizing soil disturbance and maintaining high native canopy cover of drought tolerant plants is key. It prefers moist soil, so modify drainage where dense colonies of scentless chamomile exist. Tilling during shoulder seasons or hot temperatures, exposes the shallow roots to drying. Since seed viability is more than 6 years, till frequently and seed cover plants. Maintain or restore a competitive assemblage of shrubs, forbs, cool and warm season grasses, annuals and perennials. In restoration efforts, select locally adapted species, soil amendments, soil microbes and mycorrhizal fungi that are ecologically appropriate for the site to improve competitiveness of other species.

MECHANICAL

Since scentless chamomile has shallow roots, mechanical methods can be effective in residential areas and moderate sized infestations. In loose soil, dig to remove the fibrous roots, especially the caudex. Mowing, chopping and deadheading leaves roots behind, stimulates more flower production and are not recommended. Mowing, especially when timed near flowering or seeding phases, often disperses flowers and seeds, which expands the size of the infested area. Collect, bag, and dispose of or destroy flowers; seeds could mature and germinate if left on the ground. Prescribed fire may be an effective tool to control scentless chamomile, but since it prefers roadsides and developed sites it may not be possible to generate the heat needed to damage the caudex and seeds. Little information exists on fire effects to this plant.

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BIOLOGICAL

Scentless chamomile is not palatable to domestic livestock (Woo et al. 1999). Properly managed grazing can improve vigor of desired species and indirectly reduce infestations. In Canada, two biological control agents were released; only one established (Winston et al. 2014). At present, there are no biological control agents authorized in Colorado that would effectively control it. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at: www.colorado.gov/ag/biocontrol.

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CHEMICAL

NOTE: Herbicide recommendations to control scentless chamomile in pastures and rangeland are found at: https://goo.gl/TvWnv9. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for herbicides appropriate for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

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www.colorado.gov/ag/weeds

Rev. 2/19

Scotch Thistle Identification and Management

List B

Scotch thistle includes two species, *Onopordum acanthium* L. and *O. tauricum* Willd. Both are non-native biennial forbs. During the first year of growth, both species appear as a rosette in spring or fall. During the second year in mid to late spring the stems bolt, the plants flower, set seed, and the plants die. Both Scotch thistle species can grow up to 12 feet tall and basal rosettes can be up to 2 feet in diameter. Stems are numerous and branched. Characteristically, the entire length of stems from both species have broad wings with spiny tips. *O. acanthium* leaves have an overall gray color from dense woolly hairs. *O. tauricum* leaves are glandular and not as hairy as *O. acanthium*. For both, leaves are spiny. Both species have a distinct mid-rib. Flower heads are terminal, violet to reddish in color, 1 to 3 inches in diameter, and arranged in a raceme. One plant can produce up to 100 flower heads. The spine-tipped bracts curve away from the flowering head. The flower receptacle is fleshy and has pits to hold seeds. The plants flower from mid-June to September. Scotch thistle seeds have the ability to mature in flower buds and heads that have been removed from the stalk. Both species can produce up to 14,000 seeds per plant. Seeds remain viable for up to 30 years but germinate readily with moisture in spring and fall.

Scotch thistle invades rangeland, overgrazed pastures, roadsides, and irrigation ditches. Both species prefer moist soil, such as areas adjacent to creeks and rivers. Roadsides appear to be especially vulnerable to invasion likely due to the water runoff from the shoulders. Maintaining healthy pastures and native plants, minimizing soil disturbance, changing land use practices to prevent overuse, and using seed-free equipment are critical measures to preventing infestations. As with most biennials, once established, limiting seed production is critical to effective control. Due to the robust, spiny nature of Scotch thistle, this plant can act as a living barbed wire fence, making areas impassible for wildlife, livestock, and people and unpalatable to cattle.

To control seed production, plants with buds or flowers should be collected, bagged and immediately disposed of or destroyed. Chemical control is most effective when plants are in rosette stage, spring or early fall. Mechanical controls can be used to eliminate small patches or plants in a later growth stage.

Scotch thistle is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be eradicated; some populations may be contained or suppressed depending on state regulations. For state regulations described for each county, refer to the most recent Rule, or visit www.colorado.gov/ag/coweedcontacts for details.

2015 Quarter Quad Survey

Key ID Points

1. Pitted fleshy flower receptacle.
2. Prominent mid-rib.
3. Wide lobed leaves with distinct mid-rib.
4. Wide spiny wings extend the length of the stem.

Scotch thistle

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

List B

Integrated Weed Management Recommendations

Scotch thistle

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

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. As with most biennials, prevent seed production in the first and second year of growth. Prevent seed from dispersing, such as on contaminated equipment. Rest sites until they are effectively restored. Change land use practices. Use methods appropriate for the site.

CULTURAL CONTROL METHODS

Effectiveness begins with maintaining or restoring a competitive native forb and forb assemblage. Continue restoration efforts until native plants are robust and abundant. Use locally adapted native seeds whenever possible to improve competitiveness. Include cool season and warm season, as well as perennial and annual grasses in revegetation efforts. Soil may need to be restored by adding soil amendments, soil microbes, mycorrhizal fungi and nitrogen fixing plants such as legumes. Manage land uses so they do not create bare mineral soil or compact soil. Annual crop cultivation appears to be an effective control measure.

BIOLOGICAL CONTROL METHODS

Domestic livestock are likely to avoid this plant due the large number of spines all over the plant. Goats and sheep may eat flower heads if plants are small. Since most livestock and herbivores avoid the leaves and stems, Scotch thistle can become an "increaser" in over-grazed systems. Properly managed grazing systems can increase desireable plant vigor and indirectly reduce Scotch thistle. There are no known biological control agents effective against scotch thistle or authorized in Colorado. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at www.colorado.gov/ag/biocontrol.

MECHANICAL CONTROL METHODS

Methods, such as tilling, hoeing and digging, are best for infestations smaller than 0.5 acres; weigh this against other plants present, ecology and site condition. Sever roots below the soil surface during the first year before the plant stores energy and in the second year before seed production. Mowing, chopping and deadheading stimulates more flower production; these methods require consecutive years of season-long treatments. Flower heads must be collected, bagged, and disposed of or destroyed; seeds will mature and germinate if left on the ground. Fire gives Scotch thistle a competitive advantage. Large fleshy stems and leaves would not be consumed in a low severity fire and seeds would remain unaffected. High severity fires would likely damage native plants, which favors Scotch thistle if seeds are not killed and this is not recommended.

CHEMICAL

NOTE: The following are recommendations for herbicides that can be applied to pastures and rangeland. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Aminopyralid* (Milestone)	7 oz. product/acre + 0.25-0.5% v/v non-ionic surfactant	Apply in spring rosette to early bolting growth stages or in fall to rosettes. *Product not permitted for use in the San Luis Valley.
Chlorsulfuron** (Telar)	1-2.6 oz. product/acre (0.75 oz. active ingredient/acre)+ 0.25% v/v non-ionic surfactant	Spring from bolting to flower bud stages. **This herbicide has residual soil activity that will affect all broadleaf seedlings germinating after application has occurred.
Metsulfuron + Chlorsulfuron (Cimarron X-tra)	2 oz. product/acre + 0.25-0.5% v/v non-ionic surfactant	Apply during rosette to flower bud stages.
Clopyralid (Transline)	0.67-1.33 pints product/acre + 0.25% v/v non-ionic surfactant	Apply to rosettes in spring or fall.
Aminocyclopyrachlor + chlorsulfuron (Perspective)* *Product not permitted for use in the San Luis Valley.	4.75-8 oz. product/acre + 0.25% v/v non-ionic surfactant	Apply from the seedling to the bolting stage. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage.

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Colorado State University

Rev. 11/16

Spotted Knapweed Identification and Management

List B

Spotted knapweed (*Centaurea stoebe*) is a non-native, short-lived perennial forb that reproduces mainly by seed. A prolific seed producer, spotted knapweed can grow up to 900 seeds per plant annually that are viable for up to 8 years. The key to distinguishing spotted from other knapweeds is the black-tipped, spiny, involucral bracts (phyllaries) at the base of the flower. Unlike diffuse knapweed, it does not have a long, distinct terminal spine at the tip of the bracts. Spotted knapweed can grow up to 3 feet tall on ridged stems that are openly branched on the upper half of the plant. Urn-shaped flowers are solitary on the tip of each branch. Flowers are pink to purple, and rarely white. Leaves on the stem are alternate, deeply lobed, and become smaller and simple near the tips of the stem. Basal rosette leaves are deeply lobed and up to 6 inches long.

Flowers bloom from June to October and seed-set usually occurs by mid-August. Spotted knapweed can also reproduce vegetatively from lateral roots.

Spotted knapweed tends to invade disturbed, overgrazed areas. It also occurs in grasslands, pastures, foothill clearings, logged areas, roadsides, sandy soils, and floodplains. Since it can tolerate both dry conditions and moist areas it is an especially versatile invader. Spotted knapweed and diffuse knapweed infestations often occur together in Colorado and plants can hybridize. Once established, spotted knapweed reduces livestock and wildlife forage by out-competing native and desirable species.

The most effective method of control for spotted knapweed is to prevent seed production and establishment through proper land management. Maintain healthy pastures, rangeland, and forests; and continually monitor for new infestations. If spotted knapweed is already established, applying an integrated weed management approach is effective. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Spotted knapweed is designated as a "List B" species as described in the Colorado Noxious Weed Act. It is required to either be eliminated, contained, or suppressed depending on the local infestations. For more information please visit www.colorado.gov/ag/weeds and click on the Noxious Weed Program link or call the State Weed Coordinator, Colorado Department of Agriculture at 303-869-9030.

2013 Quarter Quad Survey

Key ID Points

1. Floral bracts have black tips, with comb-like spines of equal length.
2. Flowers are pink to purple, and rarely white.
3. Basal and stem leaves are deeply lobed, but become simple and oblong towards the tips of the stem.

Spotted knapweed

Centaurea stoebe

List B

Spotted knapweed

Centaurea stoebe

Integrated Weed Management Recommendations

Spotted knapweed is best controlled at the rosette stage with mechanical or chemical techniques in the spring and fall. A key goal is to prevent seed production. Management must be intense and persistent in order to deplete the seed bank in the soil.

CULTURAL
Bareground is prime habitat for weed invasions. Maintaining healthy pastures and forests, while minimizing disturbance and overgrazing, is crucial. Contact your local Natural Resources Conservation Service for seed mix recommendations.

BIOLOGICAL
Root and seed head weevils (*Cyphocleonus achates* and *Larinus minutus*) attack the roots and reduce seed production in spotted and diffuse knapweeds. This is an option for large infestations, though optimum results take 3-5 years. To obtain the insects, contact the Colorado Department of Agriculture's Insectary in Palisade, Colorado at 970-464-7916.

MECHANICAL
Dig when the soil is moist; remove the root crown, 2-4 inches of taproot, and lateral roots. Digging alone requires several years of multiple treatments within a growing season. Mowing spotted knapweed when flower buds or early flowers are present will stress the plant, but not kill it. Do not mow after seed-set because it can disperse the seeds. Annual cultivation can eliminate spotted knapweed.

CHEMICAL
The table below includes recommendations for herbicides that can be applied to rangeland and some pastures. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Aminocyclopyrachlor + chlorsulfuron (Perspective)*	4.75-8 oz. product/acre + 0.25% non-ionic surfactant	Pre-emergence or from seedling to mid-rosette stage. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage.
Aminopyralid* (Milestone)	5-7 oz./acre + 0.25% non ionic surfactant	Spring at rosette to early bolt stage and/or in the fall to rosettes. Add 1 qt./acre 2,4-D or 3 oz. Perspective when treating in the bolting to flowering growth stages.
Clopyralid (Transline)	0.67-1.33 pints/acre + 0.25% non-ionic surfactant	Apply to spring/fall rosettes before flowering stalk lengthens. Add 1 qt./acre 2,4-D when treating in the bolting to flowering growth stages.
Note: *Product not permitted for use in the San Luis Valley.		
Additional herbicide recommendations for this and other species can be found at: yoo.yl/TvWnv9		

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Colorado State University

Updated 4/2015

Spotted Knapweed Identification and Management

List B

Spotted knapweed (*Centaurea stoebe*) is a non-native, short-lived perennial forb that reproduces mainly by seed. A prolific seed producer, spotted knapweed can grow up to 900 seeds per plant annually that are viable for up to 8 years. The key to distinguishing spotted from other knapweeds is the black-tipped, spiny, involucral bracts (phyllaries) at the base of the flower. Unlike diffuse knapweed, it does not have a long, distinct terminal spine at the tip of the bracts. Spotted knapweed can grow up to 3 feet tall on ridged stems that are openly branched on the upper half of the plant. Urn-shaped flowers are solitary on the tip of each branch. Flowers are pink to purple, and rarely white. Leaves on the stem are alternate, deeply lobed, and become smaller and simple near the tips of the stem. Basal rosette leaves are deeply lobed and up to 6 inches long.

Flowers bloom from June to October and seed-set usually occurs by mid-August. Spotted knapweed can also reproduce vegetatively from lateral roots.

Spotted knapweed tends to invade disturbed, overgrazed areas. It also occurs in grasslands, pastures, foothill clearings, logged areas, roadsides, sandy soils, and floodplains. Since it can tolerate both dry conditions and moist areas it is an especially versatile invader. Spotted knapweed and diffuse knapweed infestations often occur together in Colorado and plants can hybridize. Once established, spotted knapweed reduces livestock and wildlife forage by out-competing native and desirable species.

The most effective method of control for spotted knapweed is to prevent seed production and establishment through proper land management. Maintain healthy pastures, rangeland, and forests; and continually monitor for new infestations. If spotted knapweed is already established, applying an integrated weed management approach is effective. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Spotted knapweed is designated as a "List B" species as described in the Colorado Noxious Weed Act. It is required to either be eliminated, contained, or suppressed depending on the local infestations. For more information please visit www.colorado.gov/ag/weeds and click on the Noxious Weed Program link or call the State Weed Coordinator, Colorado Department of Agriculture at 303-869-9030.

2013 Quarter Quad Survey

Key ID Points

1. Floral bracts have black tips, with comb-like spines of equal length.
2. Flowers are pink to purple, and rarely white.
3. Basal and stem leaves are deeply lobed, but become simple and oblong towards the tips of the stem.

Spotted knapweed

Centaurea stoebe

List B

Spotted knapweed
Centaurea stoebe

Integrated Weed Management Recommendations

Spotted knapweed is best controlled at the rosette stage with mechanical or chemical techniques in the spring and fall. A key goal is to prevent seed production. Management must be intense and persistent in order to deplete the seed bank in the soil.

CULTURAL
Bareground is prime habitat for weed invasions. Maintaining healthy pastures and forests, while minimizing disturbance and overgrazing, is crucial. Contact your local Natural Resources Conservation Service for seed mix recommendations.

BIOLOGICAL
Root and seed head weevils (*Cyphocleonus achates* and *Larinus minutus*) attack the roots and reduce seed production in spotted and diffuse knapweeds. This is an option for large infestations, though optimum results take 3-5 years. To obtain the insects, contact the Colorado Department of Agriculture's Insectary in Palisade, Colorado at 970-464-7916.

MECHANICAL
Dig when the soil is moist; remove the root crown, 2-4 inches of taproot, and lateral roots. Digging alone requires several years of multiple treatments within a growing season. Mowing spotted knapweed when flower buds or early flowers are present will stress the plant, but not kill it. Do not mow after seed-set because it can disperse the seeds. Annual cultivation can eliminate spotted knapweed.

CHEMICAL
The table below includes recommendations for herbicides that can be applied to rangeland and some pastures. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Aminocyclopyrachlor + chlorsulfuron (Perspective)*	4.75-8 oz. product/acre + 0.25% non-ionic surfactant	Pre-emergence or from seedling to mid-rosette stage. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage.
Aminopyralid* (Milestone)	5-7 oz./acre + 0.25% non ionic surfactant	Spring at rosette to early bolt stage and/or in the fall to rosettes. Add 1 qt./acre 2,4-D or 3 oz. Perspective when treating in the bolting to flowering growth stages.
Clopyralid (Transline)	0.67-1.33 pints/acre + 0.25% non-ionic surfactant	Apply to spring/fall rosettes before flowering stalk lengthens. Add 1 qt./acre 2,4-D when treating in the bolting to flowering growth stages.
Note: *Product not permitted for use in the San Luis Valley.		
Additional herbicide recommendations for this and other species can be found at: **goo.gl/TvWnv9**		

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Updated: 07/2013

Sulfur Cinquefoil Identification and Management

List B

Sulfur cinquefoil (*Potentilla recta* L.) is a perennial forb in the Ranunculaceae family, also know as roughfruit or erect cinquefoil. There are 32 *Potentilla* species in Colorado, 32 have compound leaves, 26 of them are hairy, four are introduced, one is a rare endemic, and they hybridize within the Genus. Thus, correct identification is imperative.

The plant overall has a ring-like form, growing from the center outward and its stiff stems give it an upright growth form, up to three feet tall. The stem, petioles, calyx and underside of leaves are hirsuite with long perpendicular hairs, sparse hairs on upper leaf surface. The palmate compound leaves with serrate margins and narrow oblanceolate and generally has five leaflets. The underside of its leaves are green. Leaves are basal, alternate on stem and stipulate.

The perfect flowers are arranged in a loose cyme. Each flower has pale yellow petals and notched margins; flower color is not diagnostic. Like many *Potentilla* species, it has five bracts that subtend flowers, five petals, 25 or 30 stamens, numerous pistils, superior ovary and hypanthium. The style is not plumose or hooked at the top. The achene fruit is slightly winged with a heavily network-like veined surface, holding seeds. It is a prolific seeder (Zouhar 2003). Most seeds fall close to the parent plant. Seed longevity is at least four years (Zouhar 2003). It reproduces mainly vegetatively from the woody base where new shoots sprout as older portions die back, eventually forming new independent plants (Zouhar 2003). The woody taproot and lateral roots grow annual rings that can be used to age the plant up to 6 years (Dietz et al. 2002).

The native slender cinquefoil (*Potentilla gracilis)* is often confused with sulfur cinquefoil. It has palmate compound leaves that are shallowly toothed, broad oblong-elliptical shape, has five leaflets, and the leaf underside is green. It can be sparsely to densely hairy, but the hairs on the stem are appressed; small hair tufts are on leaflet tips. Long yellow petals exceed the length of its sepals. It grows to three feet tall.

Beautiful potentilla (*Potentilla pulcherrima)* is another hirsuit native that has many appressed stem hairs. However the underside of the leaves are gray and hairy. Its leaves are shallowly and obtusely serrate and each leaflet is rounded at the tip.

In Colorado, sulfur cinquefoil is robust in partial to full sun and moist soil found in wet meadows, swales, seeps, ditches, wetlands, riparian areas, and roadsides. However, it can also tolerate slopes and dry sites. Seedlings can be susceptible to drought when faced with interspecific competition (Zouhar 2003).

P. recta *P. pulcherrima*

P. recta *P. pulcherrima*

Key ID Points

1. Hirsuit calyx with perpendicular hairs
2. Leaf underside is green
3. Hirsuit stem, petioles & leaves with perpendicular hairs
4. Caudex & woody taproot with annual rings

Sulfur cinquefoil

Potentilla recta L.

List B

Integrated Weed Management Recommendations

Sulfur cinquefoil

Potentilla recta L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seeds from dispersing, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, other plants present and land uses.

© Douglas County

CULTURAL

Since sulfur cinquefoil is shade-intolerant and seedlings are suseptible to drought, promote species that provide dense shade, high ground cover, or remain robust during drought, providing appropriate site conditions (Zouhar 2003). In cultivated sites, plowing, discing and reseeding to contiguous crop cover, such as grass may be effective as long as the entire root crown is killed (Zouhar 2003). In wildland settings, maintain or restore a competitive assemblage of shrubs, forbs, cool and warm season grasses, annuals and perennials. Use locally adapted species and mycorrhizal fungi that are ecologically appropriate for the site to improve competitiveness. Implement whole site restoration of soils, plants and water regimes where dense colonies of sulfur cinquefoil exist. Minimize soil compaction and disturbance, especially in moist soil.

© Arizona Native Plant Society

MECHANICAL

Since sulfur cinquefoil grows new shoots readily at the caudex, mechanical methods that fragment roots, such as tilling, hand-pulling and mowing are not recommended. Mowing, chopping and deadheading leaves roots behind, stimulates shoot and flower production and disperses flowers and seeds, which expands the infestation. Be sure to remove the entire upper root crown if digging in small infestations. Collect, bag, and dispose of or destroy flowers; seeds could mature and germinate if left. Low severity prescribed fires would leave root caudex unaffected and cause resprouting. Piling slash on infestations can increase temperature transfered to roots during prescribed fire, but resulting high severity effects can damage soils. Spring burns are more effective than fall burns for mature plants; fall burns are best for seedlings (Zouhar 2003).

© G. Eric and Edith Matson, Library of Congress

BIOLOGICAL

Sulfur cinquefoil is not palatable to cattle, sheep or horses likely due to tannins, but may be palatable to goats; when eaten, only buds and flowers are selected (Zouhar 2003). Properly managed grazing can improve vigor of desired species and indirectly reduce sulfur cinquefoil. There are no biological control agents for sulfur cinquefoil authorized in Colorado that would effectively control it. For more information about biological control agents, visit the Colorado Department of Agriculture's Palisade Insectary website at: www.colorado.gov/ag/biocontrol.

© Techline Invasive Plant News

CHEMICAL

NOTE: Herbicide recommendations to control sulfur cinquefoil in pastures and rangeland are found at: https://goo.gl/TvWnv9. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for herbicides appropriate for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

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305 Interlocken Parkway
Broomfield, CO 80021
(303) 869-9030
www.colorado.gov/ag/weeds

Rev. 2/19

Wild Caraway Identification and Management

List B

© Ilene Shonle, Colorado State University Extension

Wild caraway (*Carum carvi* L.) is a biennial to perennial forb in the Apiaceae family, also known as caraway, not to be confused with cumin (*Cuminum cyminum*). It grows up to 70 cm tall.

Leaves are primarily basal, however stem leaves are also present in fewer numbers and smaller in size comparatively. The overall shape of the basal leaves is ovate with a tripinnate form. Stem leaves are fine and filliform; each leaflet is less than 1 mm wide. Stem leaves are opposite. Stems and leaves are glabrous. Tap roots are fusiform, similar to a carrot, and up to 25 cm long. Like other plants in the carrot family,the inflorescence is a compound umbel. Peduncles range from 5 to 13 cm long. On each umbel, there can be 7 to 14 rays, usually an unequal number, each measuring about 2 to 4 cm long in an upright position. The pedicel holding each umbellet is about 1 to 12 mm wide. Usually there are no bracts in the involucre or bractlets in the involucel, or they are tiny. Flowers are usually white to pale pink, and when viewed up close, are very distinct. Each flower is made up of five petals that are obcordate with the center cupped inward forming a hook. Five stamens surround two stylopodia. The fruits are oblong, compressed laterally and prominently ribbed evenly. Their size ranges from 3 to 4.5 mm long and are about half as wide. Even with a slight movement, mature seeds shatter and disperse. In Colorado, wild caraway flowers from May through July, sets fruit through September.

Its origin is distributed from Europe, North Africa, Middle East, Central Asia, Himalayas in India and West Pakistan (eFloras 2018). It is very common in its native range. Worldwide its fruits are used as a culinary spice and explored for medicinal properties due to its aromatic essential oils, carvone and limonene (Solberg et al. 2016).

In 1893, James H. Cowen collected the first Colorado wild caraway specimen from a street in Fort Collins (SEINet 2018). In Utah, wild caraway was likely introduced by Mormon settlers (Pammel 1910). Currently in Colorado, it is found in mountain valleys, and occasionally in the eastern plains. It prefers moist soil, such as irrigated fields and pastures, ditches, riparian corridors, wetlands, wet meadows, swales and roadsides. It can tolerate dry soils, such as montane grasslands, abandoned lands, montane woodlands, subalpine forests and stony fields. Elevation ranges from 1500 to 4300 meters.

From a distance, wild caraway can be confused with Queen Anne's lace (*Daucus carota*) or common yarrow (*Achillea millefolium*). Queen Anne's lace has distinct three-pronged linear bracts subtending the inflorescence and the rays of the inflorescence form a nest-like structure as they curve inward.

© Botanic Gardens in the Netherlands

Key ID Points

1. Flowers compound umbel, 5 white obcordate petals cupped inward, 5 stamens, & 2 stylopodia
2. Tripinnate stem leaves
3. Evenly ribbed seeds 3 mm long
4. Carrot-like brown taproot

Wild caraway

Carum carvi L.

List B

Integrated Weed Management Recommendations

Wild caraway

Carum carvi L.

Effective integrated management means using a variety of eradication methods along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seeds from dispersing, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, other plants present and land uses.

© Brian Randall, Sage-grouse Initiative

CULTURAL

Since wild caraway prefers moist soil, modify irrigation or water regimes if possible to make sites less hospitable. In irrigated fields, switch to grass/monocots until control is established. In wildland settings, maintain or restore a competitive assemblage of shrubs, forbs, cool and warm season grasses, annuals and perennials. Use locally adapted species that are ecologically appropriate for the site to improve competitiveness. Incorporate soil amendments, soil microbes and mycorrhizal fungi to boost desired species when appropriate. Aim to reduce above and below ground space and nutrients to make them unavailable to wild caraway. Minimize soil compaction and disturbance, especially in wetlands and moist soil. Acquire permits for wetland restoration, if required.

MECHANICAL

Mechanical methods are best for residential areas and small infestations. Sever roots below the soil surface early in the season before the plant stores energy, and before seed production. Mowing, chopping and deadheading leaves roots behind, stimulates more flower production; these methods require consecutive years of season-long treatments. Mowing, especially when timed near flowering or seeding phases, often disperses flowers and seeds, which expands the size of the infested area. Collect, bag, and dispose of or destroy flowers; seeds could mature and germinate if left on the ground. Prescribed fire temperatures would need to be very hot to carry in moist soil conditions; this type of fire would smolder for long durations and kill microbes and native plant roots and may leave wild caraway roots moderately damaged.

© Harris and Ewing, Library of Congress

BIOLOGICAL

Wild caraway is toxic to horses but is highly palatable to other livestock in spring before bolting. Its reported as a possible dewormer and source of minerals (Schmit et al. 2012, Walter et al. 2001). Properly managed grazing can improve vigor of desired species and directly reduce wild caraway. Currently there are no biological control agents for wild caraway authorized in Colorado. For more biocontrol information, visit the Colorado Department of Agriculture's Palisade Insectary website at: www.colorado.gov/ag/biocontrol

© Wyoming Bureau of Land Management

CHEMICAL

NOTE: Herbicide recommendations to control wild caraway in pastures and rangeland are found at: https://goo.gl/TvWnv9. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for herbicides appropriate for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

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Rev. 2/19

Yellow toadflax

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Yellow flowers that are like snapdragons with deep orange centers.
2. Stems that are woody at the base and smooth to the top.

Updated on: 07/2015

Yellow toadflax Identification and Management

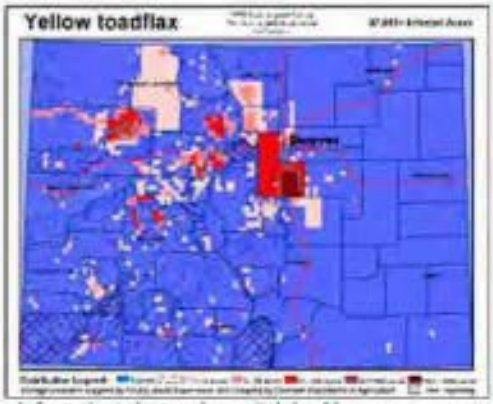
Identification and Impacts

Yellow toadflax (Linaria vulgaris) is a perennial escaped ornamental plant that is native to the Mediterranean region. The leaves are narrow, linear, and 1 to 2 inches long. The stems are woody at the base and smooth toward the top. Sparingly branched and 1 to 3 feet tall. The showy snapdragon-like flowers are bright yellow with a deep orange center and have a spur as long as the entire flower. It develops an extensive root system, making control options varied. Yellow toadflax displaces desirable plant communities reducing ecological diversity and rangeland value. Decreases forage for domestic livestock, some big game species and decreases habitat for associated animal communities. The plant is known to be mildly poisonous to cattle. Goats and sheep have been known to graze the plants with little effect.

Habitats for Yellow toadflax include roadsides, vacant lots, gravel pits, fields, waste areas, other disturbed sites and rangeland. It has adapted to a variety of site conditions, from moist to dry and does well in all types of soil. The plant can even establish in areas of excellent condition in natural disturbances or small openings.

The key to effective control of Yellow toadflax is prevention and integrating as many management strategies as possible. Prevention is always desirable when dealing with Yellow toadflax. Early detection and eradication can keep populations from exploding, making more management options available. With the plants varying genetically using many different approaches is important such as; herbicide, mechanical, cultural and biological methods. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Yellow toadflax is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/weeds and click on the Noxious Weed Management Program. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.



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Linaria vulgaris

Management Recommendations

Yellow toadflax

CULTURAL
Establish select grasses and forbs as an effective cultural control of Yellow toadflax. Contact your local Natural Resources Conservation Service for seed mix recommendations. Bareground is prime habitat for weed invasions, so maintain healthy pastures and prevent bare spots caused by overgrazing.

BIOLOGICAL
Calophasia lunula, a predatory noctuid moth, feeds on leaves and flowers of Yellow toadflax. Eteobalea intermediella, a root boring moth and Mecinus janthinus a stem boring weevil are also available. For more information, contact the Colorado Department of Agriculture's Insectary in Palisade, Colorado at 970-464-7916.

MECHANICAL
Handpulling or digging is not recommended for eradication of Yellow toadflax because it's unlikely that the entire root will be excavated and a new plant is likely to occur. A single new plant might be an exception. Tillage is not recommended due to the creeping root system.

Integrated Weed Management:

Because of the high genetic variability of the toadflax species it is critical to integrate as many management strategies as possible into the control program. Two local populations may respond differently to the same herbicides.

Keys to management are to prevent seed formation and vegetative spread by roots. Controlling is expensive and difficult to treat toadflaxes, prevention is the best option.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasture-lands. *Rates are approximate and based on equipment with an output of 30 gallons per acre.* Always read, understand, and follow the label directions. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Aminocyclopyrachlor + Chlorsulfuron (Perspective)*	4 oz. product/acre + 0.5% v/v methylated seed oil	Apply at flowering through fall post-flower into senescence. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage.
Picloram* (Tordon/Picloram 22K - Restricted use pesticide) + Chlorsulfuron (Telar)	1 qt./acre Tordon + 1.25 oz./acre Telar + 0.25% v/v non-ionic surfactant	Apply at flowering through fall post-flower into senescence. Typically late August through September application timing has shown best results. Re-treatment may be necessary. Refer to label for grazing restrictions on Telar. DO NOT use near trees, desirable shrubs, water, or high water table.
Note: *Product not permitted for use in the San Luis Valley.		
Additional herbicide recommendations for this and other species can be found at: **goo.gl/TvWnv9**		

Yellow Nutsedge Identification and Management

List B

Yellow nutsedge (*Cyperus esculentus*) is a warm season, perennial species that is native to Europe. Plants range from 6 to 30 inches tall. Leaves originate from the base of each stem and are grass-like, smooth, glossy, and folded lengthwise. The stems are pithy and triangular in cross-section. The flower inflorescence is umbrella-shaped, has up to 40 florets per flattened spikelet, and subtended by 3 to 9, long, leaf-like bracts. Flowers are yellowish-brown in color and appear from June to October. The root system on each plant can produce hundreds to thousands of hard, round, brown-black tubers in a season; the tubers can survive 3 to 4 years. Yellow nutsedge is particularly noticeable in July and August when it grows more quickly than native species and stands out visually.

Yellow nutsedge is very damaging to crops like onions, potatoes, beans, and corn. It reduces crop yield and quality by competing for light, water, and nutrients. Yellow nutsedge is a serious invader because it cannot be controlled by common grass herbicides and is extremely difficult to eliminate from cropland sites once it invades. Yellow nutsedge favors moist areas, irrigated croplands, and forms dense colonies. It can also be found on disturbed sites within: pastures, floodplains, dams, ditches, streambanks, roadsides, wet fields, wet prairies, turf, landscaped areas, and around lakes and ponds. It has been sighted in elevations up to 8,200 feet. Once yellow nutsedge establishes, it is drought tolerant.

The key to effective control of yellow nutsedge is prevention. It is especially important to clean dirt and tubers from potentially contaminated farm and construction equipment. It can also be introduced with nursery activities and contaminated transplants. New infestations must be treated early , before tubers form and the plant becomes established.. Hand pulling plants, when they first appear and have less than 6 leaves, help deplete carbohydrates that supply the tubers growth. In the spring, when plants are young, herbicide treatments are an option. Details on the back of this sheet can help you create a management plan compatible with your site ecology.

It is illegal to plant any variety of yellow nutsedge in Colorado, including chufa (*Cyperus esculentus var. sativus*) which is sometimes used to attract wildlife, such as turkeys.

Yellow nutsedge is designated as a "List B" species in the Colorado Noxious Weed Act. It is required to be either eliminated, contained, or suppressed depending on the local infestations. For more information visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, (303) 869-9030.

2013 Quarter Quad Survey

Key ID Points

1. Stout triangular stem with grass-like leaves.
2. Brown to black, round tubers at the ends of slender rhizomes.
3. Yellowish, triangular, flattened, and oblong seeds.
4. Leave-like bracts under the inflorescence.

Yellow nutsedge

Cyperus esculentus

List B

Integrated Weed Management Recommendations

Yellow nutsedge

Cyperus esculentus

Prevention is the best control for yellow nutsedge. Avoid soil disturbances and introduction from contaminated equipment or nursery material. Once established, it is difficult to eliminate because herbicides don't effective kill the plant or tubers. Young plants can be hand pulled before they form tubers and pulling can deplete energy stored in the roots.

CULTURAL

The best control method is preventing the establishment of new infestations by minimizing disturbance, preventing tuber and seed dispersal by cleaning equipment, carefully inspecting plantings from nurseries, eliminating seed production, and maintaining healthy native communities. Yellow nutsedge can penetrate and grow through black polyethylene plastic.

BIOLOGICAL

In cultivated field, pigs and chickens can effectively grub and feed on tubers. However, there are no other biocontrol agents available for yellow nutsedge. Biocontrol takes many years of research and development. For more information on biocontrols, contact the Colorado Department of Agriculture's Insectary in Palisade, Colorado at 970-464-7916.

MECHANICAL

Hand pull small nutsedge plants when they have less than 6 leaves, which is before tubers form. This is approximately every 2 to 3 weeks during the growing season; over time, this will deplete energy reserves in the roots. Tilling can potentially spread tubers.

CHEMICAL

Not many herbicides are effective at controlling yellow nutsedge because they lack selectivity or uptake, and most are not effective on tubers. The table below includes recommendations for herbicides that can be applied to turf, range, and pastures. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Herbicide	Rate	Application Timing
Aminocyclopyrachlor + Chlorsulfuron (Perspective)	4.75-8 oz. product/acre + 0.25% non-ionic surfactant	Apply at bolting to bud growth stages. (Spring to early summer) IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not permitted for use in the San Luis Valley. Not for use on grazed or feed forage.
Aminopyralid + Metsulfuron (Opensight)	2.5-3 oz. product/acre + 0.25% non-ionic surfactant	Apply at bolting to bud growth stages. (Spring to early summer) Not permitted for use in the San Luis Valley. See label regarding grazed or feed forage.
Metsulfuron (Escort XP) + 2,4-D	1 oz. product/acre + 1 qt. 2,4-D/acre + 0.25 % v/v non-ionic surfactant	Apply at bolting to bud growth stages. (Spring to early summer) May stunt grass growth.

Additional herbicide recommendations for this and other species can be found at:
goo.gl/TvWnv9

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Colorado State University

Updated 07/2015

Yellow toadflax

Colorado Department of Agriculture

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Key ID Points

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Updated on: 07/2015

Yellow toadflax Identification and Management

Identification and Impacts

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Habitats for Yellow toadflax include roadsides, vacant lots, gravel pits, fields, waste areas, other disturbed sites and rangeland. It has adapted to a variety of site conditions, from moist to dry and does well in all types of soil. The plant can even establish in areas of excellent condition in natural disturbances or small openings.

The key to effective control of Yellow toadflax is prevention and integrating as many management strategies as possible. Prevention is always desirable when dealing with Yellow toadflax. Early detection and eradication can keep populations from exploding, making more management options available. With the plants varying genetically using many different approaches is important such as; herbicide, mechanical, cultural and biological methods. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

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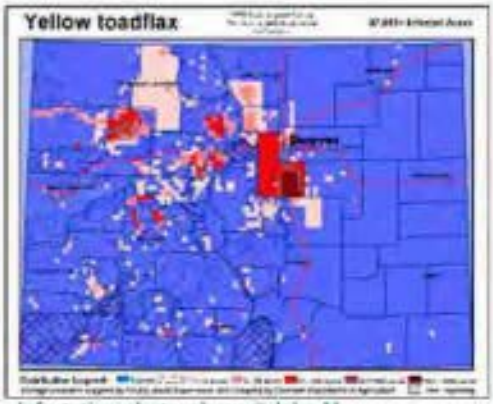

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Linaria vulgaris

Management Recommendations

Yellow toadflax

CULTURAL
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BIOLOGICAL
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MECHANICAL
Handpulling or digging is not recommended for eradication of Yellow toadflax because it's unlikely that the entire root will be excavated and a new plant is likely to occur. A single new plant might be an exception. Tillage is not recommended due to the creeping root system.

Integrated Weed Management:

Because of the high genetic variability of the toadflax species it is critical to integrate as many management strategies as possible into the control program. Two local populations may respond differently to the same herbicides.

Keys to management are to prevent seed formation and vegetative spread by roots. Controlling is expensive and difficult to treat toadflaxes, prevention is the best option.

HERBICIDES

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Herbicide	Rate	Application Timing
Aminocyclopyrachlor + Chlorsulfuron (Perspective)*	4 oz. product/acre + 0.5% v/v methylated seed oil	Apply at flowering through fall post-flower into senescence. IMPORTANT: Applications greater than 5.5 oz. product/acre exceeds the threshold for selectivity. DO NOT treat in the root zone of desirable trees and shrubs. Not for use on grazed or feed forage.
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Note: *Product not permitted for use in the San Luis Valley.		
Additional herbicide recommendations for this and other species can be found at: **goo.gl/TvWnv9**		

COLORADO
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Home (/) Conservation (/conservation) Noxious Weeds (/conservation/noxious-weeds)
Noxious Weed Species ID (/conservation/noxious-weeds/species-id) Bulbous bluegrass

Bulbous bluegrass

(Poa bulbosa l.)

- Poaceae - Grass family
- Short-lived perennial, cool-season, tuft or sod-forming
- 6-24 inches tall
- Flowers modified bulbets with a dark purple base. Panicle has a plume-like appearance from the long, slender bracts attached to each bulblet
- Flowers May-June
- Stems and culms are erect and attached to bulbous bases
- Leaf-blades are narrow, flat or loosely rolled, 2-6 inches tall and 1/4 inch wide
- Reproduces primarily asexually
- Root system consists of a terrestrial bulb with secondary fibrous roots below
- Often the first invading species on disturbed moist shallow soils during the winter and early spring. May sprout vegetatively after fire

- Found in areas with dry summers, mild winters, and winter rainfall. Infestations often begin by bulbets being carried within crop seed, hay, or straw
- Elevation to 5,500 feet

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(http://www.youtube.com/user/ColoradoStateFair?feature=watch)

Chicory Identification and Management

List C

Chicory (*Cichorium intybus* L.) is a perennial forb in the Asteraceae family, also known as coffeeweed, French endive, and succory, not to be confused with curly endive (*Cichorium endivia* L.) (iNaturalist 2019).

Mature plants can be four feet tall. Oblanceolate basal leaves range in size from 5 to 35 cm long and are persistent (SEINet 2019). Their margins are highly variable, sometimes dentate or denticulate like dandelion leaves, sometimes pinnatifid (Plants of the World Online 2019). The rigid ascending stems have stiff short hairs. Branches are widely apart. Stems are hollow, have milky sap and linear ribs (University of Wisconsin-Madison 2019). Its stem leaves are sessile, rigid, oblong to lanceolate, usually with smooth margins, and are narrower than the basal leaves; short stiff hairs are on both surfaces and leaf margins. The base of leaves clasp the stem. Chicory has a very robust, long taproot and rootlets.

The peduncles leading to the flowers are very short, less than 2 mm. The inflorescence is an open panicle. The green stiff phyllaries are in two rows, each series has between five and six sepals; the outer row is reduced in size. The phyllaries are lanceolate and have glandular tipped hairs visible with a hand lens. The inflorescence has only ray flowers which are ligulate with five teeth on the edge (Jepson eFlora 2019). Flower color ranges from cornflower blue to off white. The stamens, style and bilobed stigma are usually blue. The pappus on the achene is nearly absent, consisting of minute toothed scales (Leach 1921). The achene has five ribs and since it lacks a feathery pappus architecture like many other Asteraceae plants, the seeds fall near the parent plants (Leach 1921). Chicory reproduces by seed and its longevity is at least 10 years (Priestley et al. 1985).

Chicory is often confused with blue flax (*Linum lewisii* Pursh) mainly due to their blue flower color and overlapping distributions. Being in a different plant family, upon closer inspection it becomes apparent that it lacks basal leaves, stem leaves are slender, the five petals are bi-lobed.

Chicory is native to Mediterranean areas in Europe, Africa, and Middle East. It has a long cultivation history for pharmacology dating back to ancient Egypt, Greek and Roman eras, 2000 BC. (Bahmani et al. 2015). Modern cultivation is for coffee substitution (roots) and salad (leaves). It has worldwide distribution. It has been in Colorado since at least 1872 when Townshend Stith Brandegee collected a specimen in Fremont County (SEINet 2019). In Colorado its either under-reported or rare. It is ruderal, inhabiting roadsides and disturbed areas at elevations below 8,000 feet.

Key ID Points

1. Ligulate flowers with 5 teeth at ends
2. Blue stamens, style and bilobed stigma
3. Stiff short hairs on stems, leaves and achene
4. Persistent basal leaves resembling dandelion leaves

Chicory

Cichorium intybus L.

List C

Integrated Weed Management Recommendations

Chicory
Cichorium intybus L.

Effective integrated management means using a variety of eradication methods in the same site along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seed dispersal, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, including land use practices.

© Weedtalk, Alaska Bureau of Land Management

CULTURAL

Since chicory is sensitive to competition from grasses, maintain or drill seed bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass (*Poa secunda*) with vesicular-arbuscular mycorrhizae; these are drought tolerant natives that are highly competitive against chicory but require mycorrhizae. Native shrubs with competitive robust root biomass is another option. It is ruderal so minimize soil disturbance, especially near infestations. For cultivated sites, select native plants with blue flowers instead of chicory: *Scutellaria brittonii, Gentiana parryi, Mertensia lanceolata, Penstemon glaber, Eritrichium aretoides,* or *Aconitum columbianum*. Be cautious when purchasing seed as chicory may be in mixes. Use seed pillows to disperse seeds.

© California Department of Transportation

MECHANICAL

Mechanical methods are best for residential areas, small infestations or soils where the entire taproot can be removed. Mowing is not recommended; it leaves roots behind, stimulates flower production, disperses seeds, and expands the size of the infested area. Chopping the inflorescence just below the root crown and bagging the biomass may reduce vigor with consecutively treatment; effectiveness is dependent on cultivare type. Collect, bag, and dispose of or destroy flowers; seeds can mature and germinate if left. Subsoiling must be deeper than 10 inches; use a subsoiler. Fall prescribed fire may kill seeds if hot enough; chicory sets seed through the growing season so timing is important. Fire is unlikely to affect its deep taproot. The effects to chicory from prescribed fire is not tested.

BIOLOGICAL

Chicory provides high quality forage for goats, sheep and cattle. It is sensitive to grazing; fall is best for control (Alemseged et al. 2003, Barry 1998, Li and Kemp 2005, Li et al. 2003). Properly managed grazing can improve vigor of desired species and indirectly reduce chicory. Currently there are no biological control agents for chicory authorized in Colorado. For biocontrol information, visit the Colorado Department of Agriculture's Palisade Insectary website at: www.colorado.gov/ag/biocontrol

© Aspen Public Radio

CHEMICAL

NOTE: Herbicide recommendations to control chicory in pastures and rangeland are found at: https://goo.gl/TvWnv9. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Colorado Department of Agriculture · Conservation Services
305 Interlocken Parkway
Broomfield, CO 80021
(303) 869-9030
www.colorado.gov/ag/weeds

Rev. 2/19

Common burdock

Arctium minus

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Updated on:
08/09

Identification and Management

The key to effective control of minimizing soil disturbance and preventing the establishment of plants. Using an integrated weed management approach combining chemical, cultural, and mechanical methods to control these plants is effective. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Common burdock is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Identification and Impacts

Common burdock (Arctium minus) is a biennial forb that is native to Europe. The first year of growth is a basal rosette, producing large cordate, thickly hairy leaves. The second year of growth, is a coarse, multi-branched, erect stem that will grow to heights of 3 to 10 feet tall. The large, dark green leaves are alternate and appear to have toothed or wavy margins. They are broadest and the base of the leaf and diminish as they approach the tip of the leaf, and have a hairy underside. The flowers appear at the end of the branches, numerous, clustered and are pink to purple in color. At the base of the flower there are many spines that often have a hook on the end. The flower and the spines dry and becomes an easily dispersible bur. Flowering and seed production occur from July to October. The plant grows from a sturdy taproot that is brown and fleshy in color.

Habitats for Common burdock include roadsides, ditch banks, waste places, pastures, and fencerows. Animals will avoid eating the plant in both years of growth, the first year due to the hairy leaves and the second year due to the spines and burs. The burs can easily get entangled into livestock fur, make distribution easy over large areas.

Photos © All Photos from Kelly Uhing, Department of Agriculture

Management Recommendations

Common burdock

CULTURAL
Minimizing soil disturbance and encouraging the establishment of desirable grasses and forbs, can assist in controlling Common burdock. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
Currently there is not any biocontrol available for Common burdock. Biocontrol takes many years of research and development. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916 for more information.

MECHANICAL
Hand pull or dig when soil is moist, but make sure to wear gloves. Bag specimens carefully so as not to scatter seeds. Mowing is also effective, cutting the top growth of the plant. The key to effective control is to prevent seed production and/or spread.

Integrated Weed Management:

Preventing the establishment and minimizing soil disturbance is an effective way to control Common burdock. Combining treatment methods of cultural, mechanical and chemical assist with controlling these plants.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Aminopyralid (Milestone)	4-7 oz/acre or 1 teaspoon/gal water	Apply in rosette stage in spring or fall. Add non-ionic surfactact @ 0.32 oz/gal water or 1 qt/100 gal water.
Clopyralid (Stinger)	1/2-1 1/3 pts/acre	Apply to young to actively growing plants in the spring. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water.
2,4-D Amine	2 pts/acre	Apply to young to actively growing plants in the spring. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water.
2,4-D Dicamba	1 pt/acre	Apply to young to actively growing plants pre-flower stages in spring. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water.

Photos © Top to Bottom; Kelly Uhing, Colorado Department of Agriculture; Whitney Cranshaw, Colorado State University, Bugwood.org; Kelly Uhing, Colorado Department of Agriculture

Common mullein

Verbascum thapsus

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Updated on:
08/09

Identification and Management

Identification and Impacts

Common mullein (*Verbascum thapsus*) is a biennial forb native to Europe and Asia. The first year of the plant it produces a basal rosette. Basal rosettes can grow to 30 inches in diameter. The leaves are light-green in color and are covered in fine soft hairs. The woolly leaves are alternate and overlapping each other and can grow over a foot long. In spring of the second year the plant bolts an erect stem, that grows 2 to 6 feet tall. The flowers of the plant are borne in terminal spikes. These terminal spikes may reach up to 20 inches in length. The flowers are sulfur-yellow in color and have five petals. The flowers range from 3/4 of an inch to 1 1/2 inches in diameter. Numerous two chambered fruits produce 100,000 to 250,000 seeds per plant. Flowering and seed production typical occur from June to August. The plant has a deep taproot along with a fiberous root system.

Habitats for Common mullein are roadsides, waste places, right-of-ways, pastures, hay fields, and abandoned lands. It prefers gravelly soil types, but can grow in other soil types. Livestock will avoid eating Common mullein, due to the hairy leaves of the plants. The plants were originally introduced as a medicinal plant. The Europeans used the flowers for tea, and the leaves for many remedies like burns and rashes. Both the Europeans and the Indians smoked the dried leaves to treat bronchitis.

The key to effective control of Common mullein is preventing the production of seeds. This plant is difficult to control due to the large amount of seed produced and seed bank left in the soil. Mechanical, cultural, biological and chemical treatments can be successful if utilized together in an integrated weed management plan. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Common mullein is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © All Photos from Kelly Uhing, Department of Agriculture; Except Bottom left Mary Ellen (Mel) Harte, United States

Common mullein

Management Recommendations

CULTURAL
Cultural control can be effective in assistance with other treatment options. Once the parent plants have been removed, cultivating the area with desirable grasses and forbs may outcompete Common mullein seedlings. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
Gymnetron tetrum, a seed eating weevil, biological control has been found in eastern Washington State and is currently working on populations there. The weevil has not yet been approved for use in Colorado. Contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916 for more information.

MECHANICAL
Hand pull or dig when soil is moist, prior to flowering and seed production can be effective. If flowers are present, bag specimens carefully so as not to scatter any potential seeds. The key to effective control is to prevent seed production and/or spread.

Integrated Weed Management:

Preventing the establishment and the seed production of Common mullein is key to controlling populations. If the population is established, using a combination of cultural, chemical, biological and mechanical treatments can aid in suppressing population size. Since plants produce thousands of seed treatments need to occur over an extended period of time.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Chlorsulfuron (Telar XP)	1-3 oz/acre	Apply to rosette stages in spring or fall prior to bolting. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water.
2,4-D Picloram (Grazon P+D *this is a Restricted Use Pesticide*)	4 pts/acre	Apply to rosette stages in spring or fall prior to bolting. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water. DO NOT apply near trees/shrubs/high water table.
Picloram (Tordon 22K *this is a Restricted Use Pesticide*)	1-2 qts/acre	Apply to rosette stages to early growth stages in spring or fall. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water. DO NOT Apply near trees/shrubs/high water table.
Metsulfuron (Cimmaron)	1.0 oz/acre	Apply to rosette stages in spring or fall. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water.

Photos © Top to Bottom; Kelly Uhing, Colorado Department of Agriculture; Whitney Cranshaw, Colorado State University, Bugwood.org; Kelly Uhing, Colorado Department of Agriculture

Common St. Johnswort

Hypericum perforatum

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Identification and Management

Identification and Impacts

Common St. Johnswort (*Hypericum perforatum*) is a perennial forb native to Europe and frequently found in the Pacific Northwest. Common St. Johnswort grows to a height of 1 to 3 feet tall, with multiple branched stems. The stems are erect, ridged, rust colored, and woody at the base. The elliptical to oblong shaped leaves are no longer than 1 inch, covered with clear dots, and are opposite of each other on the stems. The flowers are bright yellow and about 3/4 of an inch in diameter. They appear in showy terminal clusters, have five petals and numerous visible stamens. Rust-brown seed pods are formed after flowering. Seed pods are about 1/4 inch in length and contain numerous amounts of seeds. One plant can produce up to 100,000 seeds per year. The root system consist of a large taproot and fiberous roots near the surface. The plant reproduces by seeds or short runners.

Habitats for Common St. Johnswort include disturbed sites, railroad right-of-ways, roadsides, rangeland, meadows, dry pastures, and open woodlands. It prefers sandy, dry soils, and full sun. If not monitored, it will infest healthy plant communities. The weed is toxic to white-haired animals. Animals will exhibit a skin irritation which is associated to sunlight. Animals will not die if the plant is ingested, but will show signs of weight loss.

The key to effective control of Common St. Johnswort is preventing the establishment of plant communities. Using an integrated weed management approach will assist in the control of Common St. Johnswort. Using a combination of mechanical, chemical and biological treatment options proves to be a effective in controlling this plant. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Common St. Johnswort is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © From bottom left; Colorado State University Extension - Adams County; (Next 2) Steven Dewey, Utah State University, Bugwood.org; Kelly Uhing, Colorado Department of Agriculture; Carlos DiSalvo, USDI National Park Servie, Bugwood.org

Updated on: 08/09

Management Recommendations

Common St. Johnswort

CULTURAL
Preventing the establishment of Common St. Johnswort, by planting desirable grasses and forbs will assist in control efforts. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
There are many different forms of biological control available to assist in control of Common St. Johnswort. Currently there is not any available for use in Colorado. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916 for more information.

MECHANICAL
Hand pull or dig when soil is moist, multiple times to remove all of the plants. Bag specimens carefully so as not to scatter seeds and remove from the sight. If left at the sight plants can regenerate vegetatively. The key to effective control is to prevent seed production and/or spread.

Integrated Weed Management:

Preventing the establishment of Common St. Johnswort, is the key method to control plant populations. Using a combination of cultural, biological, chemical, and mechanical treatments will help in control this plants population.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Aminopyralid (Milestone)	5-7 oz/acre or 1 teaspoon/gal water	Spring at actively growing to early growth stage. Add non-ionic surfactant @ 0.32oz/gal water ot 1qt/100 gal water.
Metsufuron (Cimarron)	1.0 oz/acre	Apply in spring to young activeley growing stages. Add non-ionic surfactacnt @ 0.32 oz/ gal water or 1qt/100 gal water.
Picloram (Tordon 22K *this is a Restricted Use Pesticide*)	2-4 pts/acre	Apply to actively growing plants to pre-bud stages. DO NOT apply near trees/shrubs/ high water tables
2,4-D Amine	2-4 pts/acre	Apply in spring to early growth to flower bud stage.

Photos © Top to Bottom; Steven Dewey, Utah State University, Bugwood.org; Whitney Cranshaw, Colorado State University, Bugwood.org; Kelly Uhing, Colorado Department of Agriculture

Cheatgrass Identification and Management

List C

James Bailey, iNaturalist

Cheatgrass (*Bromus tectorum* L.) is a winter annual grass in the Poaceae family, also known as downy brome.

Mature plants reach up to 24 inches tall. The stems are smooth but the leaf blades and sheath are hairy (downy). The ligules are fringed, short and membranous. The culms range from five to 90 cm long, can be prostrate or vertical, and have fine short hairs. Its fibrous roots can be up to 60 inches long, but the majority of root biomass is within first 12 inches of the soil surface. Roots are efficient at absorbing soil moisture, allowing cheatgrass to grow quickly early in season, while other plants are still dormant. Green up can occur twice per season. Cheatgrass has an unique spectral signature during seed set and senescence when it turns reddish purple. During these shoulder growing season events, it is easily detectable from other vegetation with satellite imagery.

The flower is a simple one-sided panicle that characteristically flops over and hangs, branches and is open. Spikelets are usually terminal. Usually there are five to many florets; it has perfect flowers. The upper and lower glumes are usually unequal in length and shorter than florets; the lower glume ranges from 4 to 14 mm in length and is one veined. The upper glume is three-veined. The plant disarticulates above the glumes. The lemmas are usually downy, narrowly lanceolate with sharp tips and about 9 to 12 mm long. Usually there are five to many lemmas. Awns are usually present and range from 10 to 18 mm long. It is a prolific seed producer, capable of two seed crops per season. Seeds need to be buried in soil or litter and have fall moisture to germinate. The fall seed crop has greater reproductive success than spring. Seeds lack dispersal anatomy so fall close to parent plants but transport readily with animals, people and equipment. Seed longevity is about three years. Both inbreeding and cross breeding occur.

Cheatgrass is one of the most competitive non-natives in the Western US. It thrives in arid, semi arid, and cold environments. Colorado's high elevation range is not an issue for cheatgrass; plants were recently detected as high as 9,500 feet. It exhibits phenotypic plasticity and genetic diversity, making it highly adaptable to a variety of conditions, likely due to multiple introductions. Its presence has significant negative impacts throughout the West. Most notably, it alters fire regimes and thus engineers a positive fire feedback loop that favors its growth over other plants. This feedback loop is why cheatgrass forms monocultures throughout the West.

It is often confused with Japanese brome (*Bromus japonicus*), which has denser more compact spikelets, shorter awns, and changes from green to gold through the growing season.

© Priyantha Wijesinghe, iNaturalist

© Veronika Johansson, iNaturalist

© Leslie J. Mehrhoff, University of CT

Key ID Points

1. Downy leaf blades, sheaths, ligules
2. Glumes are unequal size, lemmas are downy
3. One-sided panicle that droops, red-purple during seed set & senescence
4. Fibrous roots

Cheatgrass

Bromus tectorum L.

List C

Integrated Weed Management Recommendations

Cheatgrass

Bromus tectorum L.

Effective integrated management means using a variety of eradication methods in the same site along with restoration, prevention of seed production and dispersal, and monitoring. Maintain robust healthy native landscapes. Restore degraded sites. Avoid soil disturbance. Prevent seed production and seed dispersal, e.g. on contaminated equipment. Rest sites until restored. Modify land use practices. Use methods appropriate for the site, including land use practices.

© Martin Bernetti, Associated Press

CULTURAL

Biological soil crust is a soil health indicator of arid and semi arid sites; crusts inhibit cheatgrass seed germination. Aerial spread and cultivate soil crust where it is absent. Aerial and drill seeding bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass (*Poa secunda*) with vesicular-arbuscular mycorrhizae; these are drought tolerant natives that are highly competitive against cheatgrass but require mycorrhizae. As these grasses establish and cheatgrass wanes slowly introduce additional species such as thickspike wheatgrass (*Elymus lanceolatus*), winterfat (*Krascheninnikovia lanata*), yarrow (*Achillea millefolium*) in the plant interspaces in subsequent years. Be cautious when purchasing seed as cheatgrass is often a contaminate, especially in mixes. Use seed pillows to disperse seeds.

© Stacy Gill, Associated Press

BIOLOGICAL

Sheep and cattle will select green cheatgrass which also affects desired cool-season grasses. Properly managed grazing can improve vigor of desired species and directly reduce cheatgrass. Post-fire grazing management varies depending on site potential and objectives. Currently there are no biological control agents for cheatgrass authorized in Colorado. For more biocontrol information, visit the Colorado Department of Agriculture's Palisade Insectary website at: www.colorado.gov/ag/biocontrol

© Bureau of Land Management

MECHANICAL

Mechanical methods are best for residential areas and small infestations. Mowing and chopping are not recommeded; they leave roots behind, stimulate flower production, disperse seeds, and expand the size of the infested area. Collect, bag, and dispose of or destroy flowers; seeds can mature and germinate if left. Tilling must be deeper than 6 inches to work. Prescribed fire applied before seed maturity, (late spring or early summer), may kill seeds; the trick is to get green cheatgrass and litter to carry fire and at a hot enough temperature to destroy seeds and seedlings. Always combine prescribed fire with cultural methods, timed appropriately, and base it on site conditions and other plants present. Monitoring and adaptive management are critical if prescribed fire is used as a tool for control.

© Helena Wood Control, Rocky Mountain EIA Foundation

CHEMICAL

Pseudomonas fluorescens D7 inhibits cheatgrass and is currently approved by EPA and Colorado. NOTE: Herbicide recommendations to control cheatgrass in pastures and rangeland are found at: https://goo.gl/TvWnv9. Rates are approximate and based on equipment with an output of 30 gal/acre. Follow the label for exact rates. Consult local turf and ornamental experts for residential settings. Always read, understand, and follow the label directions. The herbicide label is the LAW!

Colorado Department of Agriculture - Conservation Services
305 Interlocken Parkway
Broomfield, CO 80021
(303) 869-9030
www.colorado.gov/ag/weeds

Rev. 2/19

Field bindweed

Convulvulus arvensis

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Leaves are shaped like arrowheads.
2. Flowers are funnel-shaped, white to pink, and have two small bracts one inch below the flower base.

Field bindweed Identification and Management

Identification and Impacts

Field bindweed (*Convolvulus arvensis*) is a non-native deep-rooted perennial that reproduces from seed and creeping, horizontal roots (rhizomes). Field bindweed stems are prostrate (grows low to the ground) and twining, and grow up to 6 feet long. Leaves are distinguishable by their arrowhead shape. The flowers are bell or trumpet-shaped, white to pink in color, and are about 1 inch long. Field bindweed seeds can remain viable in the soil for up to 40 years.

Field bindweed emerges from its root system in the spring. Flowering occurs from June to September and until the first fall frost. The number of seeds produced per plant ranges from 25 to 300 and seed production is variable depending on environmental conditions. Field bindweed is an extremely difficult noxious weed to control because, in part, of its taproot that may go 20 feet deep into the soil, and which repeatedly gives rise to numerous long rhizomes.

Field bindweed is a problem throughout Colorado. It is one of the most competitive perennial weeds. It is widespread in cultivated areas, pastures, lawns, gardens, roadsides, and waste areas from 4,000 to 8,000 feet in elevation.

To successfully manage field bindweed, containment and persistence in controlling existing stands are necessary in order to exhaust the root system and deplete the soil seed bank. This weed needs to be continually stressed, forcing it to exhaust root nutrient stores and eventually die. Of all control methods, prevention is most important. Maintain healthy pastures and rangeland and continually monitor your property for new infestations. A healthy cover of desirable perennial plants will assist in discouraging field bindweed establishment.

Field bindweed is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jursidictions managing this species.

On the back of this sheet are field bindweed management recommendations. For more information, visit www.ag.state.co.us/csd/csdhome.html. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

White flower © Mary Ellen Harte, Invasive.org. All other photos © Kelly Uhing.

Management Recomendations

CULTURAL
Establishment of selected grasses can be an effective cultural control of field bindweed. Contact your local Natural Resources Conservation Service for seed mix recommendations. Maintain healthy pastures and prevent bare spots caused by overgrazing. Bareground is prime habitat for **weed invasions.**

Bindweed mite damage

BIOLOGICAL
The bindweed gall mite, *Aceria malherbae*, has proven to be effective in reducing field bindweed infestations. This is an option for large infestations. To obtain a mite release, contact the Colorado Department of Agriculture, 970-464-7916.

MECHANICAL
Cutting, mowing, or pulling has a negligible effect unless the plants are cut below the surface in the early seedling stage. Well-established populations have a large seed bank in the soil that can remain viable for over 40 years.

Integrated Weed Management:

Field bindweed requires active management once it is established because of its potential to regenerate rapidly. Even small infestations should be viewed as a serious threat and managed aggressively.

Contain and persistently control infestations in order to exhaust the root system and deplete the soil seed bank.

Maintain a healthy cover of perennial plants to discourage field bindweed establishment.

Field bindweed

HERBICIDES: The following are recommendations for herbicides that can be applied to range and pasturelands. *Rates are approximate and based on equipment with an output of 30 gallons per acre. Please read label for exact rates.* Always read, understand, and follow the label directions. **The herbicide label is the LAW!**

HERBICIDE	RATE	APPLICATION TIMING
Clarity + 2,4-D Amine	1 qt./acre or 1 oz/gal water	Just after full-bloom and/or fall. DO NOT apply near or under trees/shrubs or where soils have rapid permeability. DO NOT apply when outside temperatures will exceed 85 degrees. Add non-ionic surfactant @ 0.32oz/gal water or 1 qt/100 gal water.
Tordon 22K *this is a Restricted Use Pesticide*	1 qt./acre or 1 oz/gal water	Just after full-bloom and/or fall. DO NOT apply near or under trees/shrubs or where soils have rapid permeability. Add non-ionic surfactant @ 0.32oz/gal water or 1qt/100 gal water.
Roundup Ultra *non-selective herbicide, will kill all vegetation*	4 - 5 qts./acre or 4 - 5 oz/gal water	Apply at full-bloom and/or fall. Add non-ionic surfactant @ 0.32oz/gal water or 1qt/100 gal water. Use caution when applying near grasses or other desirable vegetation.

Halogeton

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Identification and Management

Identification and Impacts

Halogeton (Halogeton glomeratus) is an annual forb native to Asia. The plant ranges in heights of a few inches off the ground to 18 inches tall. Halogeton starts as a low growing multi-branched, spreading plant and then stems become erect with maturity. Plants begin as a blueish-green color in the spring turning redish-yellow later in the summer. Leaves are nearly tubular, small, and fleshy in nature. The ends of the leaf are tipped with a delicate needle-like spine. Flowers are inconspicuous, green and borne at the leaf axils. The root system is fiberous and spreading. Halogeton mainly reproduces by seeds. There are two different types of seeds produced. The seeds that are brown in color, generally will lie dormant and stay viable for many years. The seeds that are black in color will generally reproduce in the same growing season.

Habitats for Halogeton include roadsides, trails, areas where animals congregate, overgrazed sites, and is ideally adapted to the high desert/alkaline soils. The Plant can be toxic to grazing animals and at times it is readily grazed by animals. Sheep seem to be most affected by the toxic oxalates, cows can also be affected. Halogeton is hard to eradicate in plant populations have been present for more than 2 years, since seeds can stay viable up to 10 years.

The key to effective control of Halogeton is preventing the plant to establish viable populations. Halogeton does not outcompete native vegetation, so maintaining and revegetating sites that are overgrazed are effective management tools. Herbicide treatments can also be effective in plant populations are small. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Halogeton is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © Bottom right, Bottom left, and top left; Kelly Uhing, Department of Agriculture; All others Clinton Shock, Oregon State University, Bugwood.org

Halogeton glomeratus

Updated on:
08/09

Halogeton

CULTURAL
Outcompeting Halogeton proves to be the most economical treatment method. Planting desirable grasses and forbs on disturbed sites, and where Halogeton populations are establish will help control populations. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
Currently there is not any biocontrol available for Halogeton. Biocontrol takes many years of research and development. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916 for more information.

MECHANICAL
Hand pull or dig when soil is moist, but make sure to wear gloves. Bag specimens carefully so as not to scatter seeds. The key to effective control is to prevent seed production and/or spread.

Integrated Weed Management:

Using cultural and herbicide treatments in combination can help control Halogeton populations. Halogeton does not outcompete native vegetation, so maintaining healthy plant populations and revegetating areas that have been disturbed, proves to be the most economical method of treatment.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Metsulfuron + Chlorsulfuron (Cimmaron X-tra)	2.0 oz/acre	Applypre-emergancetopost-emergancestages in spring. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water.
Chlorsulfuron (Telar XP)	1/2 - 1 oz/acre	Applypre-emergancetopost-emergancestages in spring. Add non-ionic surfactant @ 0.32 oz/gal water or 1 pt/100 gal water.

Photos © Top to Bottom: (Unknown) Harney County Oregon; Whitney Cranshaw, Colorado State University, Bugwood.org; Kelly Uhing, Colorado Department of Agriculture

Johnsongrass

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Identification and Management

Identification and Impacts

Johnsongrass (Sorghum halpense) is a perennial grass native to the Mediterranean region. The erect stems of this grass grows to be 2 to 8 feet tall and they are generally solid. At the base of the stalks they are reddish pink in color. Leaves of this grass range from 6 to 20 inches long and are 1/2 to 1 inch wide. The blades are flat with a very distinctive white midvein with maturity. The ligules of the plant are membranous and are surrounded with fine hairs. The inflorescence of Johnsongrass are is a large open panicle, reddish to purple in color. The spikelets of the panicle are generally awn-tipped and shiny. Not all spikelets will contain awns, but the awns that are present can be bent and needle-like. Johnsongrass reproduces by seed and a thick fibrous rhizomes.

Habitats for Johnsongrass include; crop fields, hay fields, roadsides, fence rows, and waste areas. Originally introduced as a hay or forage crop, and thought to be a warm season grass, it has adapted in cooler climates. When found in areas that may frost or become moisture stressed, Johnsongrass becomes toxic to livestock. It produces hydrocyanic acid, which can cause livestock's cells to lose the ability to utilize oxygen, similar to cyanide poisoning.

The key to effective control of Johnsongrass is the establishment and to minimize disturbance in areas susceptible to infestation. Using an integrated approach to control population of already established plant infestations can be an effective management tool. Depending on size of the infestation chemical, cultural and mechanical control options are useful. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Johnsongrass is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © (First 2) Chris Evans, River to River CWMA; Steve Dewey, Utah State University; Charles Bryson, USDA Agricultural Research Services; Bonnie Harper-Lore, Federal Highway Administrations; All Bugwood.org

Sorghum halpense

Updated on:
08/09

Johnsongrass

CULTURAL
Maintaining a healthy rangeland or pasture can help prevent the establishment of Johnsongrass. Planting native grasses and forbs to outcompete the grass can assist in control. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
Currently there is not any biocontrol available for Johsnongrass. Biocontrol takes many years of research and development. For more information, please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916 .

MECHANICAL
Hand pulling or hoeing when soil is moist, and infestations are small can be effective. When infestations are larger, mowing, tilling or plowing can assist with control when used in combination with herbicides. The key to effective control is to prevent seed production and/or spread through rhizomes.

Integrated Weed Management:

Preventing the establishment and maintaining healthy pastures by minimizing disturbance of the is most effective in controlling Johnsongrass. Using a combination of control methods can be effective if an infestation is already established. Cultural, chemical and mechanical treatments can be effective if used together.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Glyphosate + Isopropylamine (Glyphomax)	16 oz/acre	Apply in early growth stages before plant reaches 12 inches in height.
Glyphosate + Potassium	22 oz/acre	Apply in early growth stages before plant reaches 6 inches in height.
2,4-D + Glyphosate + Isopropylamine (Recoil)	1.25 -2.5 qts./acre	Apply in pre-seedhead stages of plant.

Photos © Top to Bottom; Steve Dewey, Utah State University, Bugwood.org; Whitney Cranshaw, Colorado State University, Bugwood.org; Kelly Uhing, Colorado Department of Agriculture

Perennial sowthistle

Sonchus arvensis

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Updated on:
08/09

Identification and Management

Identification and Impacts

Perennial sowthistle (Sonchus arvensis) is a perennial forb native to Eurasia. The plants erect stems can grow 2 to 5 feet tall, they are hollow, and have a milky juice that appears when the plant is injured. The plant branches near the top of the stem and will exhibit a showy yellow disc flower about 1 1/2 inches in size, and resembles a dandelion. The flowers are borne out of bracts that are sticky and slightly hairy. Seeds are produces out of the flower bract and are red to brown in color, and have ribs that run lengthwise on the seed. The seeds are connected to a silky, parachute-like tuft of white hair and travel very easily in the wind. Leaves of the plant are alternate and clasping to the stem. The leaves vary in size generally getting smaller the higher up on the stem. Leaves are deeply lobed to whole and have prickly margins. Perennial sowthistle grows from a deep-taproot that exhibits horizontal rizome-like roots that will produce other stems.

Habitats for Perennial sowthistle include roadsides, fertile waste areas, cultivated fields, gardens, woods, lawns, ditches, and rivers.

Perennial sowthistle produces by seeds and the rhizometous root systems. Plants overwinter and begin to appear in early spring, seeds will germinate at this same time. Plants are palatable to grazing animals and can assist in control.

The key to effective control of Perennial sowthistle preventing the establishment of the plant populations. Reducing the production of seeds can assist in the control of Perennial sowthistle. Mechanical, chemical and grazing controls will also assist in control plant populations. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Perennial sowthistle is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © From Bottom left; Steve Dewey, Utah State University; (Next 2) Ohio Weed Lab State Archive, Ohio State University; John Cardina, Ohio State University; Michael Rasy, University of Alaska; (All Bugwood.org)

Perennial sowthistle

Management Recommendations

CULTURAL
Maintaining healthy plant populations and minimizing disturbance is a good way prevent weed populations. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
Currently there is not any biocontrol available for Common burdock. Biocontrol takes many years of research and development. For more information, contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Tilling plant populations where possible can assist with controlling Perennial sowthistle. Smaller root fragments have a harder time producing viable rosettes. The optimum time to treat mechanically is in the leaf rosette stage. Mowing can assist with control in depleting the root reserves for the plants.

Integrated Weed Management:

Combing mechanical and chemical control methods can assist with controlling Perennial sowthistle. Plant are palatable to grazing animals, this can also assist in controlling plant populations.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
2 4-D + Dicamba (Rangestar)	1 to 2 pt/acre	Apply to rosettes or early bolting stage. Add non-ionic surfactant @ 0.32 oz/gal of water or 1 pt/100 gal of water.
Aminopyralid (Milestone)	3 to 5 oz/acre	Apply to rosettes or early growth under favorable growing conditions. Add non-ionic surfactant @ 0.32 oz/gal of water or 1 pt/100 gal of water.
Clopyralid (Stinger)	5 to 11 oz/acre	Apply to rosette to bud stages of plant growth. Add non-ionic surfactant @ 0.32 oz/gal of water or 1 pt/100 gal of water.
Picloram (Tordon 22K *this is a restricted use herbicide*)	4 pt/acre	Apply to rosette to early boting stage. Add non-ionic surfactant @ 0.32 oz/gal of water or 1 pt/100 gal of water.

Photos © Top to Bottom; Theodore Webster, USDA Agricultural Research Service, Bugwood.org; Whitney Cranshaw, Colorado State University, Bugwood.org; Kelly Uhing, Colorado Department of Agriculture

Poison hemlock

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

1. Fern-like shiny green leaves.
2. Smooth, hallow stems that are rigid and have purple spots.

Updated on:
08/09

Poison hemlock Identification and Management

Identification and Impacts

Poison hemlock *(Conium maculatum)* is an erect biennial weed that is native to Europe. The plant typically grows 4 to 8 feet tall and has smooth, hallow stems that are rigid and have distinct purple spots. The plant has shiny green leaves that are pinnately compound, multi-stemmed and have a fern like appearance. The leaves are lacy, resembling parsley and have a musty odor when crushed. The first year the plant usually forms a large rosette. The second year the plant bolts a large stem, flowers and then dies. The flowers have 5 petals, clawed, notched (1 to 1.5 mm long) and are white, umbrella-like clusters at the end of the branch. They appear from June to July. The fruit matures in August-September and is flat, small and grayish-green in color.

Habitats for Poison hemlock include streams, rivers, irrigation and roadside ditches, crop and pasturelands, as well as disturbed sites. All parts of the plant are poisonous, they contain alkaloids. Animals do not eat the plant, unless food is scarce. Ingestion of 0.25-0.30% of an animals body weight is lethal. Poisoning of humans has occurred, the plant can easily be confused with members of the carrot family. Consumption in large quantities can be fatal.

The key to effective control of Poison hemlock is prevention and containment. Identified early enough, pulling the taproot when soil is moist can be an effective control method. When plants are already present, containment using herbicides is crucial. Other herbicide control methods include spraying plants in the rosette stage in early spring or late fall. Mechanical treatments are also effective, depleting root reserves and reducing seed production, with repeat mowings. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Poison hemlock is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © Clockwise from lower left: Ohio State Weed Lab Archive, Ohio State University, Bugwood.org; Unknown; Unknown; Richard Old, XID Services, Inc., Bugwood.org; and Steve Dewey, Utah State University, Bugwood.org.

Conium maculatum

Poison hemlock

CULTURAL
Broadcast seeding or "no-till" drill seeding can be effective by helping out compete hemlock. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
The hemlock moth (Agonopterix alstroemericana) larvae feed on leaves, young stem tissue, flowers, and seeds causing severe defoliation and death of the plant. Contact the Palisade Insectary of the Colorado Department of Agiculture at 970-464-7916 for more information.

MECHANICAL
Hand pull or dig when soil is moist, but make sure to wear gloves. Bag specimens carefully so as not to scatter seeds. The key to effective control is to prevent seed production and/or spread.

Integrated Weed Management:

Integrated management approaches have not been an approved method of control concerning Poison hemlock. Even though it has not been a proven method, does not mean that it is ineffective. Using a combination of biological and herbicide treatments may be successful in combating Poison hemlock. Adding the promotion of desirable plants to help out compete the infestation of Poison hemlock may assist with control as well.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
2,4-D (4 lb ai/gallon)	2 qt/ac. + 0.25% v/v non-ionic surfactant	Apply when plant is in rosette to early bolting growth stages. (36 inches tall or less)
Grazon P+D	2 qt/ac. + 0.25% v/v non-ionic surfactant	Apply when plant is in rosette to early bolting growth stages. (36 inches tall or less)
Escort	1 oz product/ac. + 0.25% v/v non-ionic surfactant	Apply when plant is in rosette to early bolting growth stages.
Telar	1 oz product/ac. + 0.25% v/v non-ionic surfactant	Apply when plant is in rosette to early bolting growth stages.

Photos © (Top to bottom): Steve Dewey, Utah State University, Bugwood.org and bottom two by: Jan Samanek, State Phytosanitary Administration, Bugwood.org.

Puncturevine

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Identification and Management

Identification and Impacts

Puncturevine (*Tribulus terrestris*) in a summer annual forb, and is native to Europe. The plant is prostrate or ascending, spreading into mat forming cover. The stems are trailing and can grow to 1 1/2 to 5 feet long. Leaves are formed into leaflets, with each leaflet containing 5 to 8 oval leaves. The leaves are hairy and opposite. The flowers appear in July through October. They have five petals and are yellow in color. Each flower node will produce a fruit, at maturity the fruit will break into 5 seed capsules. Each seed capsule will produce 2-4 seeds. Each capsule is hard and contains many spines, almost tack like. The shape of the seed capsule has been referred to as a "goathead." The seeds will propagate after the first moisture of the spring and then any wet period following. Seeds can stay viable for 4 to 5 years.

Habitats for Puncturevine include, but are not limited to roadsides, pastures, waste areas, cultivated fields, yards, and disturbed sites. The seed capsules can cause injury to humans, animals, and tires. Seeds can be found in hay, which may cause injury to animals. The capsules can also become entangled in wool, and decrease the quality. Due to the spiny nature of the plant, spreading seed over large areas is fairly easy.

The key to effective control of Puncturevine is preventing the plants to produce seed. Puncturevine can easily be dug up, making sure to get all the roots and to bag any flowering parts. Chemical and biological controls can also be effective as treatment options. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Puncturevine is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds and click on the Noxious Weed Program link. Or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © From Bottom left; Steve Dewey, Utah State University, Bugwood.org; All other Kelly Uhing, Colorado Department of Agriculture

Tribulus terrestris

Updated on: 08/09

Puncturevine

CULTURAL
Cultural control for Puncturevine is a difficult task, since seed reserves can stay viable for 4 to 5 years. Preventing the plants from establishing, by eliminating bareground can assist in the process. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
There are two biological controls available for control of Puncturevine; *Microlarinus lareynii*, a seed feeding weevil, and *Microlarinus lypriformis*, a stem boring weevil. Contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916 for more information.

MECHANICAL
Hand pull or dig when soil is moist, but make sure to wear gloves. Bag specimens carefully so as not to scatter seeds. This is helpful unless infestations are too large. The key to effective control is to prevent seed production and/or spread.

Integrated Weed Management:

Using a combination of control options can be effective in the control of Puncturevine. The plants are hard to eradicate, due to the seed viability of 4 to 5 years in the soil. Constant monitoring and management can be helpful.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Glyphosate (Roundup) *Non-selectiveherbicide*	1.6% solution or 2 oz./gal water	Apply in early plant growth stages, emergance and rosettes.
2,4 D and Dicamba (Outlaw)	1-2 pints/Acre or 0.5-1.0 oz/gal water	Spring at emergence of seedlings continue through growing season. Add non-ionic surfactant 0.32 oz./gal water or 1 qt./100 gal water.
Chlorusulfuron (Telar)	1-3 oz./Acre	Apply pre-emergance or early post-emergance.
Pendimethalin (Pendulum)	2.1-4.2 qts/Acre	A pre-emegance spray.

Photos © Top to Bottom; (middle) Neal Spencer, USDA Agricultural Research Service European Labratory, Bugwood.org; (other 2)Kelly Uhing, Colorado Department of Agriculture

Quackgrass

Colorado Department of Agriculture
Conservation Services

305 Interlocken Pkwy
Broomfield, CO 80021
303-869-9030

Quackgrass Identification and Management

Identification and Impacts

Quackgrass (Elymus repens) is a perennial grass that is native to Europe. It grows from underground rhizomes to an unmowed height of 1 to 4 feet with erect stems. The rhizomes are yellowish-white, sharp pointed and somewhat fleshy. Both the leaf sheath and blade are hairless or sparsely hairy. The seeds germinate in the fall and spring and plants can produce seeds more than 1 time per season. Spikelets are in 2 long rows and borne flatwise to the stem. The florets have short, straight awns or are awnless. The leaves of Quackgrass are constricted near the tips. Leave blades are 0.25 to 0.5 inches wide, flat, pointed, with small ear-like appendages at the junction of the blade and the sheath. Quackgrass's flowers appear from June through August and resemble wheat head in a slender spike. Each Quackgrass plant produces about 25 seeds. These seeds remain viable for 3 to 5 years in the soil.

The habitat of Quackgrass includes: crops, pasture, rangeland, roadsides, ditches, gardens, yards, and any disturbed moist area. It is a rapid invader that does stabilize eroding soils, but take over good areas for other plants. Since it adapts to moist soils the optimal growth temperature is 68-77 degrees Fahrenheit. Quackgrass only moderately tolerates shade.

The key to effective control of Quackgrass is preventing the establishment of dense stands, once it becomes established it is hard to control. Using an integrated weed management approach proves to be the best control. Using a combination of cultural, mechanical and chemical controls can have an effect, with Quackgrass. Herbicide treatments are an option if used when plants are young, generally in the spring. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Quackgrass is designated as a "List C" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-869-9030.

Key ID Points

1. The yellowish-white rhizomes (root systems).
2. The leaves ear-like appedages at the sheath node.

Photos © (Clockwise from lower left): Ohio State Weed Lab, Ohio State University; (Unknown) weeds.hotmeal.net; (Unknown) Shawnee County Kansas; (Next two) Steven Dewey,

Updated on:
08/08

Elymus repens

Management Recommendations

Quackgrass

CULTURAL
Cultural methods for Quackgrass include outcompeting when in crop fields, but preventing the establishment of new infestations by minimizing disturbance, and maintaining healthy native communities proves to be successful. Contact your local Natural Resources Conservation Service for seed mix recommendations.

BIOLOGICAL
Currently, there are no biocontrol agents available for Quackgrass. Biocontrol takes many years of research and development. For more information, contact the Colorado Department of Agriculture's Insectary in Palisade, Colorado at 970-464-7916.

MECHANICAL
Mechanical treatments are tricky when dealing with Quackgrass. Tilling proves to be the best method, but it can also aid in the spread of the rhizometous nature of the plant. If tilling is the only option till towards the center of the infestation, so spreading doesn't occur outward and till when the roots can be exposed to high or freezing temperatures. This will kill the roots and minimize regrowth.

Integrated Weed Management:

Using a combination of control methods proves to be the most effective method when dealing with Quackgrass. Using a mechanical and chemical approach seems to be most effective. Always revegetate with desirable grasses and forbs after treatments. Once infestations of Quackgrass become established control and containment become more difficult.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. *Rates are approximate and based on equipment with an output of 30 gallons per acre.* **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

HERBICIDE	RATE	APPLICATION TIMING
Glyphosate (Roundup)	2 to 3 qt/acre or a 2% solution	Apply when grass is 8 of more inches tall.
Clethodim (Select 2EC)	8 to 16 fl. oz. of product /acre + 1% v/v crop oil concentrate	Apply when grass is 4 to 12 inches tall and repeat, if necessary, when 4 to 12 inches tall. *Select can be used in many crops, including alfalfa, and in non-crop areas.

Above photos © (Top to Bottom): (Unknown) Washington State University; Whitney Cranshaw, Colorado State University, Bugwood.org; and W. S. Curran, Penn State University.

Redstem filaree

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Redstem filaree Identification and Management

Identification and Impacts

Redstem filaree *(Erodium cicutarium)* is a winter annual or biennial forb that has a spreading or erect profile and is native to the Mediterranean or Asia. Part of the Geranium family, Redstem filaree grows generally from a rosette stage, and can grow from the 3 inches to 2 feet tall. The stems are hairy and red in color. The leaves are opposite and finely divided with toothed or lobed margins. They are pubescent, grow on short stems and have a reddish tint. The root system is a shallow taproot with fiberous secondary roots. The five petaled flowers are a purplish-pink in color and are in clusters of 2 or more. Each flower will produce five long lobed fruits. Each fruit will have an awn like tail which will dry and split with maturity. Redstem filaree primarily reproduces by seed and generally germinates in early spring.

Habitats for Redstem filaree include: dry pasturelands, landscapes, turfgrass and it prefers sandy soils. It can easily outcompete desirable vegetation once established. Redstem filaree is drought tolerant and can withstand a heavy stocking rate. The plant is grazed by many different animals especially sheep.

The key to effective control of Redstem filaree is preventing establishment of the plant and seed production. There are many options for control of Redstem filaree depending on site ecology. Both chemical and mechanical control options are effective. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Redstem filaree is designated as a "List C" species in the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local intestations. For more information visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Key ID Points

1. The hairy red colored stems.
2. The opposite leaf pattern in the rosette stage.
3. The long-beak like fruit and seed.

Photos © (Clockwise from lower left): Theodore Webster, USDA, Bugwood.org; (Unknown) Oregon State University; Howard F. Schwartz, Colorado State University, Bugwood.org; Richard Old, XID Services Inc., Bugwood.org; (Unknown) Oregon State University

Updated on: 08/09

Erodium cicutarium

Management Recommendations

CULTURAL
Prevent the establishment of Redstem filaree, in rangeland or pastureland by planting native grasses and forbs. Contact your local Natural Resources Conservation Service for seed mix recommendations that may help. Bareground is prime habitat for weed invasions.

BIOLOGICAL
Currently there is not any biocontrol available for Redstem filaree. Biocontrol takes many years of research and development. For more information, contact the Colorado Department of Agriculture's Insectary in Palisade, Colorado at 970-464-7916.

MECHANICAL
Hand pulling or digging when soil is moist, making sure to get the roots to prevent resprouting is effective. Removing flowers before the plant sets seed will also be effective. Be sure to bag specimens carefully so as not to spread seeds. Any kind of tillage to the area can also be effective.

Integrated Weed Management:

Locate and remove plants immediately before plants set seed to prevent the spread of Redstem filaree. Since the plant reproduces solely by seed, an integrated management effort must include the elimination of seed production and depletion of seed bank. Combing control methods of herbicide and mechanical can be effective.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. *Rates are approximate and based on equipment with an output of 30 gallons per acre.* **Always read, understand, and follow the label directions. The herbicide label is the LAW!**

HERBICIDE	RATE	APPLICATION TIMING
Metsulfuron (Escort XP)	.33 oz of product /acre +.025% v/v non-ionic surfactant	Apply rosette stage through early flower stage.
2,4-D + dicamba (Rangestar)	2 pt. + 1 pt. product / acre	Apply rosette stage of growth.

Redstem filaree

Colorado State

CDA CO

Velvetleaf

Abutilon theophrasti

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Identification and Management

Identification and Impacts

Velvetleaf (*Abutilon theophrasti*) is an annual forb native to Asia. This summer annual's seedling is formed with one heart-shaped and one round cotyledon. These cotyledons are hairy on both the upper and lower surface. As the plant grows, the stems become erect and can range in heights of 2 to 7 feet tall. Fine and soft hairs are present along the unbranched stem. Leaves form alternate from one and another. They range in size from 2 inches to 6 inches in width and length. Both surfaces of the leaves are densely covered in soft, "velvet" hairs. Leaves are heart-shaped with toothed margins and taper to a point. Single flowers are born on individual stalks at the leaf axils. They are yellow-orange in color, and are 1/2 to 1 inch in size. The flowers have 5 petals and the stamens of the flower form a tube. Flowering occurs in late June to October. The seed capsule is round in shape about 1 inch in diameter. The seed capsule has 9 to 15 prickly seed pockets, arranged in a disk. Each seed pocket contains 3 to 9 egg-shaped seeds. Seed viability can last up to 50 years in the soil. The plant has a fibrous taproot.

Habitats for Velvetleaf are cultivated fields, roadsides, gardens, fence rows, and waste areas. Velvetleaf thrives in nutrient rich soils. Velvetleaf is detrimental in croplands, outcompeting the strongest row crops for nutrients and water. It will appear generally after the last cultivation, growing quickly and vigorously.

The key to effective control of Velvetleaf is preventing the establishment of plants by keeping seed production in check. Mechanical, chemical, and cultural control options are effective if used in an integrated weed management approach. Hand pulling is most effective when plants are young, prior to flower production. Once established, control options diminish due to seed longevity. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Velvetleaf is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

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Updated on: 08/09

Management Recommendations

Velvetleaf

CULTURAL
Since Velvetleaf is generally found in cultivated fields, utilizing a proper crop rotation regiment can prove to be effective. Planting competitive grasses and forbs in native pastures can assist in slowing establishment of Velvetleaf. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
There is studies being conducted on proper biological control for Velvetleaf. Currently though there has not been any approved for use in Colorado. For more information please contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916.

MECHANICAL
Hand pull or dig when soil is moist, and before plants flower and go to seed. Bag specimens carefully so as not to scatter seeds. Mowing very close to the ground can also be effective. The key to effective control is to prevent seed production and/or spread.

Integrated Weed Management:

Preventing the establishment of plant populations is the key to effective control of Velvetleaf. If plants are present preventing flower and seed production is the best option for control. Cultural, mechanical and chemical options are effective methods in controlling plant populations. Velvetleaf is hard to eradicate due to seed viability of 50 years once populations become established.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
2,4-D + Dicamba (Banvel+2,4-D)	1 to 2 pts/acre	Apply to early growth stages. Add non-ionic surfactant @ 0.32 oz/gal of water or 1 pt/100 gal of water.
Glyphosate (Roundup) *Non-Selective herbicide*	22 oz/acre if < 6" in height - 1 to 2.7 qt/acre in > 6" in height	Apply to early growth stages.
Quinclorac (Paramount)	5.3 to 8 oz/acre	Apply to early growth stages.
Pendimethalin (Pendulum)	2.4 to 4.8 qts/acre	Apply pre-emergance of weed species.

Photos © Top to Bottom; Jan Samanek, State Phytosanitary Administration, Bugwood.org; Whitney Cranshaw, Colorado State University, Bugwood.org; Kelly Uhing, Colorado Department of Agriculture

Wild proso millet

Colorado Department of Agriculture

305 Interlocken Pkwy
Broomfield, CO 80021

(303) 869-9030
weeds@state.co.us

Key ID Points

Identification and Management

Identification and Impacts

Wild proso millet (*Panicum miliaceum*) is an annual grass that is native to Asia or middle Europe. This grass grows an erect stem, that branches near the base. It can grow 2 to 6 feet tall. Leaf blades are 1/2 to 3/4 inches wide, with stiff hairs on both the upper and lower surfaces of the blade. Leaf sheaths contain and open with long spreading hairs. Fused at the base of the leaf, are the ligules that are a fringe of 1/16 of an inch long dense hairs. The inflorescence grows to be a 4 to 12 inches long spreading panicle that is nodding or erect when mature. The panicle is usually not fully extended from the leaf sheath. Spikelets on the panicle are 1/4 inch to 1/2 inch long and are two-flowered. The upper flower of the spikelet is fertile and the lower spikelet is sterile. The glumes are pointed at the tip, ovate and strongly nerved. At the plants maturity the seeds shed. The seeds are brown to black in color, shiny, and smooth. Plants can be easily identified by the seed coat that stays attached to the fibrous root system.

Habitats for Wild proso millet are cultivated fields, waste places, roadsides, and disturbed sites. Wild proso millet is easily spread through its prolific seed production. Seeds can be spread by harvesting equipment, birds, manure, irrigation water, and small animals.

The key to effective control of Wild proso millet preventing the establishment of plant populations and limiting seed production. Since Wild proso millet likes to grow in cultivated fields, identifying the plant in early growth stages is imperative. Control options include, mechanical, cultural and chemical. Details on the back of this sheet can help to create a management plan compatible with your site ecology.

Wild proso millet is designated as a "List C" species on the Colorado Noxious Weed Act. It is required to be either eradicated, contained, or suppressed depending on the local jurisdictions managing this species. For more information, visit www.colorado.gov/ag/weeds or call the State Weed Coordinator at the Colorado Department of Agriculture, Conservation Services Division, 303-239-4100.

Photos © From Bottom left; All photos, Steve Dewey, Utah State University, Bugwood.org

Panicum miliaceum

Updated on:
08/09

Wild proso millet

Management Recommendations

CULTURAL
Within cultivated fields Wild proso millet can be effectively controlled using a rotational crops system. Minimizing disturbance in native pastures can assist in preventing establishment, and planting native grasses and forbs. For specific seed recommendations contact your local Natural Resources Conservation Services for seed mixes.

BIOLOGICAL
Currently there is not any biocontrol available for Wild proso millet. Biocontrol takes many years of research and development. For more information contact the Palisade Insectary of the Colorado Department of Agriculture at 970-464-7916 .

MECHANICAL
Hand pull or dig when soil is moist, can be an effective control method. Bag specimens carefully so as not to scatter seeds. Mowing and tilling can contribute to the spread of seeds. The key to effective control is to prevent seed production and/or spread.

Integrated Weed Management:

Preventing the establishment and seed production is the key to effectively controlling Wild proso millet. Once the plant is established and depending on site features, an integrated weed management approach can be effective.

HERBICIDES

NOTE: The following are recommendations for herbicides that can be applied to range and pasturelands. Rates are approximate and based on equipment with an output of 30 gal/acre. Please read label for exact rates. Always read, understand, and follow the label directions. The herbicide label is the LAW!

HERBICIDE	RATE	APPLICATION TIMING
Glyphosate (Roundup Promax)	16 - 32 oz/acre	Apply to early growth stages to plant bolting stages.
2,4-D + Glyphosate (Recoil)	1.2 to 1.8 qts/acre	Apply to early growth stages to plant bolting stages. Add non-ionic surfactant @ 0.32 oz/gal of water or 1 pt/100 gal of water.
Pendimethalin (Prowl)	Up to 4.8 pts/acre	Apply to early growth stages. Add non-ionic surfactant @ 0.32 oz/gal of water or 1 pt/100 gal of water.

FULL SUN

[illegible]

Over 12' long, can grow 6" daily

Blooms July to August

Flowers greenish-white, ½" wide, in clusters of 4 - 5

Fruit round, dark-blue to black berry with 2 - 6 oblong seeds

Leaves dark green, simple, triangular, alternate, and broadly toothed with a corkscrew tendril for climbing and small white glands on surfaces

Roots thick, fleshy, and light yellow

Highly toxic to humans and livestock

Referred to as "Kudzu of the West"

[illegible]

Up to 70' tall

Blooms March to May

Flowers greenish, lacking petals, occur in small, drooping clusters of 2 - 5, appear before leaves develop

Fruits flat, circular, ½" wide, each containing a single seed

Crown open and rounded with slender spreading branches

Leaves less than 3" long, alternate, simple, singly-serrate, dark green

Leaf base symmetrical, unlike most elms

Bark light-gray with irregular furrows

[illegible]

3 - 10' tall and 3½' wide

Blooms May to July

Flowers 1" long and pea-like

Flat seedpods burst open in late summer, throwing small black seeds

Leaves alternate, ½ - 1" wide, pinnately compound, dark green above, paler and fuzzy below

Stems slender, green, grooved and up to 2" wide, commonly without leaves and may appear "tangled"

Reproduces by seed

Taproot up to 24" deep

[illegible]

Up to 70' tall, 60' in crown width, and 6" in trunk diameter

Blooms May to June

Plants dioecious, flowers light green in color, arranged in multi-branched inflorescence

Fruits on female plants tan to reddish, single-winged, can be wind or water-dispersed

Leaves pinnately compound, 1 - 3' long with 10 - 41 leaflets, each with a glandular, notched base

Bark pale gray, smooth and thin with pungent odor similar to rancid peanut

DISTURBED, DRY, SANDY SOIL

[illegible]

12 - 18" tall and up to 36" wide

Blooms June to October

Flowers clustered, delicate, white or pink, 5-petaled

Seed capsules egg-shaped, less than ¼" and blackish

Leaves opposite, lance-shaped, hairy, ¾ - 4" long

Roots up to 12' deep

Can disperse as a tumbleweed

Can cause allergic reactions including dermatitis, difficulty breathing, and sinus irritation

[illegible]

1 - 3' tall

Blooms June to October

Flowers white with four notched petals clustered at stem tips

Leaves oval- to lance-shaped, alternate; stem leaves attached and point upward

Leaves, stems, sepals, and seed pods have tiny star-shaped hairs

Reproduces only by seed

Seeds can remain dormant and viable for several years in persistent seed bank

Toxic to horses if forage is >30% contaminated

[illegible]

1 - 2' tall by 1 - 2' wide

Blooms June to October

Flowers ½" wide, bright blue to purple with white throats

Flower stems start out coiled, then straighten out as flower buds open

Fruit 4-chambered nutlet, 1 seed each

Stems fleshy, hairy, angular, multiple stems from single root crown

Leaves narrow, slightly pointed, alternate, get smaller up stem, fleshy and hairy

Roots historically used to make dyes

[illegible]

1 - 3' tall tufted clumps

Blooms July to August

Flowers ¾ - 1" wide

Flowering stems up to 20" tall, emerging from base, can be branching

Seeds triangular in cross-section with sharp edges

Leaves up to 18" long, three-sided and cylindrical, emerging from base

Does not smell like an onion

Roots fibrous, form dense mats, no bulb

[illegible]

1 - 3' tall and 3' wide

Blooms May to August

Flowers white, yellow or salmon color with 10 - 12 orange stamens

Fruit is a 4 - 5 celled capsule with 1 seed per cell

Leaves opposite and compound with 2 thick, fleshy leaflets

Stems succulent, multi-branched

Reproduces by seeds and root fragments

[illegible]

6 - 18" tall

Blooms May to August

Inflorescence is an open panicle, pyramidal in shape, 1 - 3" long, light yellow in color

Leaf color: bright green (early spring), nodes reddish- to purplish-black (late spring), silvery-green before senescence

Leaves mostly on the lower half of stem with open leaf sheaths and glabrous, membranous ligules

Seed is awnless, appears smooth, tiny hairs detectable when magnified

CLAY LOAM SOIL

Caucasian Bluestem

1 - 3' tall

Blooms June to July

Dense tufts of smooth blue-green leaf blades

Leaf blades up to 12" long and less than ½" wide with thickened mid-vein

Leaves have a strong turpentine smell when crushed

Leaves turn light yellow in fall

Nodes purple-tinged, smooth or with short hairs

Yellow Bluestem

1 - 3' tall

Larger than Caucasian bluestem

Blooms June to July

Leaf blades are basal, glabrous, flat, 1 - 10" long with scattered hairs

Stems slender, solid, green turning yellow when mature with brown to purple nodes

Inflorescence is silvery, reddish-purple with 2 - 18 racemes

Seeds are brown

Noxious Weed

WATCH LIST

Pocket Guide

COLORADO
Department of Agriculture
Conservation Services Division

2019

The CDA's Noxious Weed Program's "Watch List" consists of species that have been determined to pose a potential threat to the agricultural productivity and environmental values of the lands of Colorado. Many species included on this list are not yet known to occur in the state but have been recognized as noxious or problematic by another state or states in the region. More information is needed about the Watch List species regarding their distribution and impacts on agricultural and natural lands, before a determination of formal listing can be made. Management of Watch List species is not required by the Noxious Weed Act. Reports made through the EDDMapS West mapping system will help CDA determine if future Noxious Weed designation is warranted.

SHADY & MOIST

1 - 4' tall

1 - 3' tall

2 - 5' tall

WETLANDS

Common reed

Blooms July to October

Leaves 16 - 20" long and ½ - 2" wide

Yellow flag iris

Garden loosestrife

THE WATCH LIST PROCESS

Year 1: Become familiar with the species; look for and report infestations through EDDMapS.

Year 2: CDA will send out surveys to gather more information on certain Watch List species. All location data should be submitted at this time.

Year 3: CDA will determine if regulated listing is warranted.

REPORT SITINGS:
www.eddmaps.com

MORE INFO:
www.colorado.gov/ag/weeds

PHOTO CREDITS:
www.invasive.org

STATE OF COLORADO

Eschberger - DNR, Amy <amy.eschberger@state.co.us>

YRR M-2021-009 - Weed Management and Wildlife Plans

Katie Todt <katie@lewicki.biz> Thu, Feb 17, 2022 at 3:20 PM
To: "Eschberger - DNR, Amy" <amy.eschberger@state.co.us>
Cc: Robert Young <youngranchresource@gmail.com>

Email 2/2.

Cheers,

Katie Todt

Senior Consultant

Lewicki and Associates, PLLC

(314) 704-4505

Lewicki & Associates
ENGINEERING | GEOLOGY | ENVIRONMENTAL

[Quoted text hidden]

Young Ranch Wildlife Mitigation Plan 2-10-22.pdf
18671K

Ecological Resource Consultants, Inc.
2820 Wilderness Place, Suite A ~ Boulder, CO 80301 ~ (303) 679-4820

WILDLIFE MITIGATION PLAN

YOUNG RANCH RESOURCE

CLEAR CREEK AND GILPIN COUNTIES, COLORADO

February 10, 2022

Submitted to:
Bob Young
Young Ranch, LLC
ERC Project #1290-2001

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE AND NEED

Ecological Resource Consultants, Inc. (ERC) provides the following Wildlife Mitigation Plan (plan) for the proposed Young Ranch Resource (Project). The Project, which is slated to have an approximate 100-year lifespan, will be used to supply the Denver metro area and surrounding Colorado and regional markets with crushed stone and other aggregate products. With the current anticipated upward trend in economic activity and increasing population of Colorado, the Project will be a necessary resource to supply the region with a variety of aggregate products that are in high demand now and in the future.

The purpose of this plan is to identify potential wildlife impacts resulting from construction and operation of the Project and provide a proactive framework to avoid, minimize, and mitigate potential adverse impacts. Additionally, this plan provides an assessment of current conditions, including a description of vegetation communities and an evaluation of wildlife habitat and use within the footprint of the proposed Project. This evaluation is based on local knowledge of Young Ranch and associated landscapes, interviews with the ranch owner and Central City staff, as well as on-line information about existing vegetation communities, species activity mapping provided by Colorado Parks and Wildlife (CPW), and potential federal and state listed threatened or endangered species and/or habitat that could exist on or immediately surrounding the proposed Project. Additionally, this report contains an evaluation of potential impacts to wildlife along the Central City Parkway (CCP) corridor which is located immediately adjacent to the Project. This plan provides a variety of conceptual mitigation recommendations for preservation and enhancement of wildlife resource at the proposed Project.

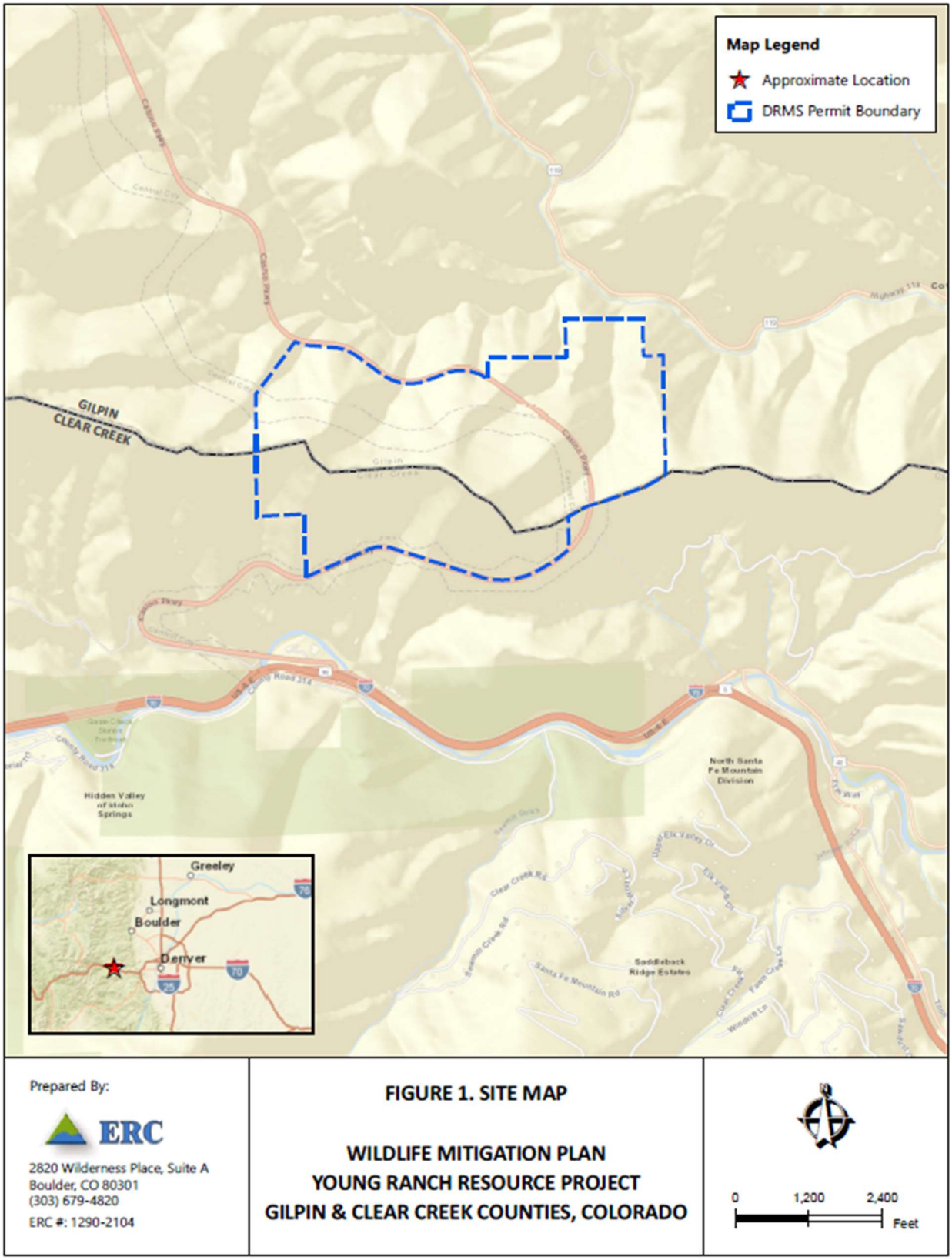
Requisite with this plan is the desire by the owners of Young Ranch to allow this Project and associated development phases to progress with minimal impact to wildlife and natural resources. Additionally, mitigation measures are proposed for areas north of the Project along the CCP. Currently, there are no wildlife mitigation measures in place along any portion of the CCP. As such, this plan has been written to help ensure that long-term Project operations progress in a manner that are ecologically responsible and consistent with the vision and stewardship goals that Young Ranch has emplaced upon future generations.

1.2 DESCRIPTION OF YOUNG RANCH PROPOSED MINING ACTIVITIES

The proposed aggregate mining operation is situated along the eastern boundary of the approximately 4,500-acre Young Ranch property. The proposed Project location and Colorado Division of Reclamation, Mining, and Safety (DRMS) permit boundary are shown on **Figure 1**. Additional information about the Project is provided in Section 2.0.

Mining operations will be conducted over five phases starting in approximately 2022 and lasting through approximately 2120, and as dictated by market conditions. Mining phases are shown on **Figure 2**. During the pre-mining phase (~1 yr), access roads will be constructed from the CCP for the processing area and waste rock landform areas. The drainage area to the east of the CCP will be partially filled in to create a staging area for crushing/screening, offices (portable trailer), and scales. Existing culverts will be enhanced to allow for stormwater to pass under the waste rock landform areas. Stormwater for the processing area

pad as well as Phase I mining stormwater will be collected, and suspended sediments will be allowed to settle prior to clean water entering the drainages to the east of the CCP.


Map Legend
Approximate Location
DRMS Permit Boundary
GILPIN
CLEAR CREEK
Greeley
Longmont
Boulder
Denver
Prepared By:
ERC
2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820
ERC #: 1290-2104
FIGURE 1. SITE MAP
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO
0
1,200
2,400
Feet

Phase 1 mining is expected to last 6 years (~2022-2028). An access road will be developed up to the top of Phase I. Mining will occur from the top of the Phase I area (~8,300 ft in elevation) down to the Project entrance (~8,050 ft). A road constructed to the top of the Phase 1 area will be completed along with entrance and exit ramps into the mine, and roads on the east side of CCP will be constructed that lead to the Westside Waste Rock Landform with a finished elevation of 7,880 ft. Drilling and blasting will occur with Phase 1, and coarse material will be stockpiled in the northern portion of the Phase 1 area. Up to two benches will be worked at any given time during Phase I using a 2:1 slope wall angle. The northern most slopes immediately adjacent to the CCP will remain undisturbed providing a buffer between the highway and the Project. **Figure 2** depicts the mining phase and affected areas.

Phase 2 mining is expected last 7 years up to approximately 2035 and will consist of permanent processing facilities installed into the Phase I area. Mining will occur from the top of Phase 2 (~8475 ft in elevation) down to a finished elevation of 8,275 feet. The east side of CCP will continue to be developed and the Eastside Waste Rock Landform will be complete to an elevation of 7,775 feet. **Figure 2** depicts the mining phase and affected areas.

Phase 3 mining will last approximately 30 years up to approximately 2065 and will consist of the continued mining and expansion of the Phase 2 footprint. All stormwater will be directed down drainages towards the northern extent of a central access gravel road into the Project Area as shown on **Figure 2**. This internal access gravel road will be available for use following the completion of Phase 3. The Eastside Waste Rock Landform will continue to expand with waste rock with a finished elevation of 7,880 feet. The majority of the southernmost face adjacent to the CCP will remain undisturbed to create a visual and sound buffer to Interstate 70 (I-70) and to maintain a deed restricted wildlife migration corridor along the south side of the Project. For all five phases, interim reclamation will occur following completion of each bench using 2:1 reclaimed slopes with a dry rangeland vegetation seed mix. **Figure 2** depicts the mining phase and affected area.

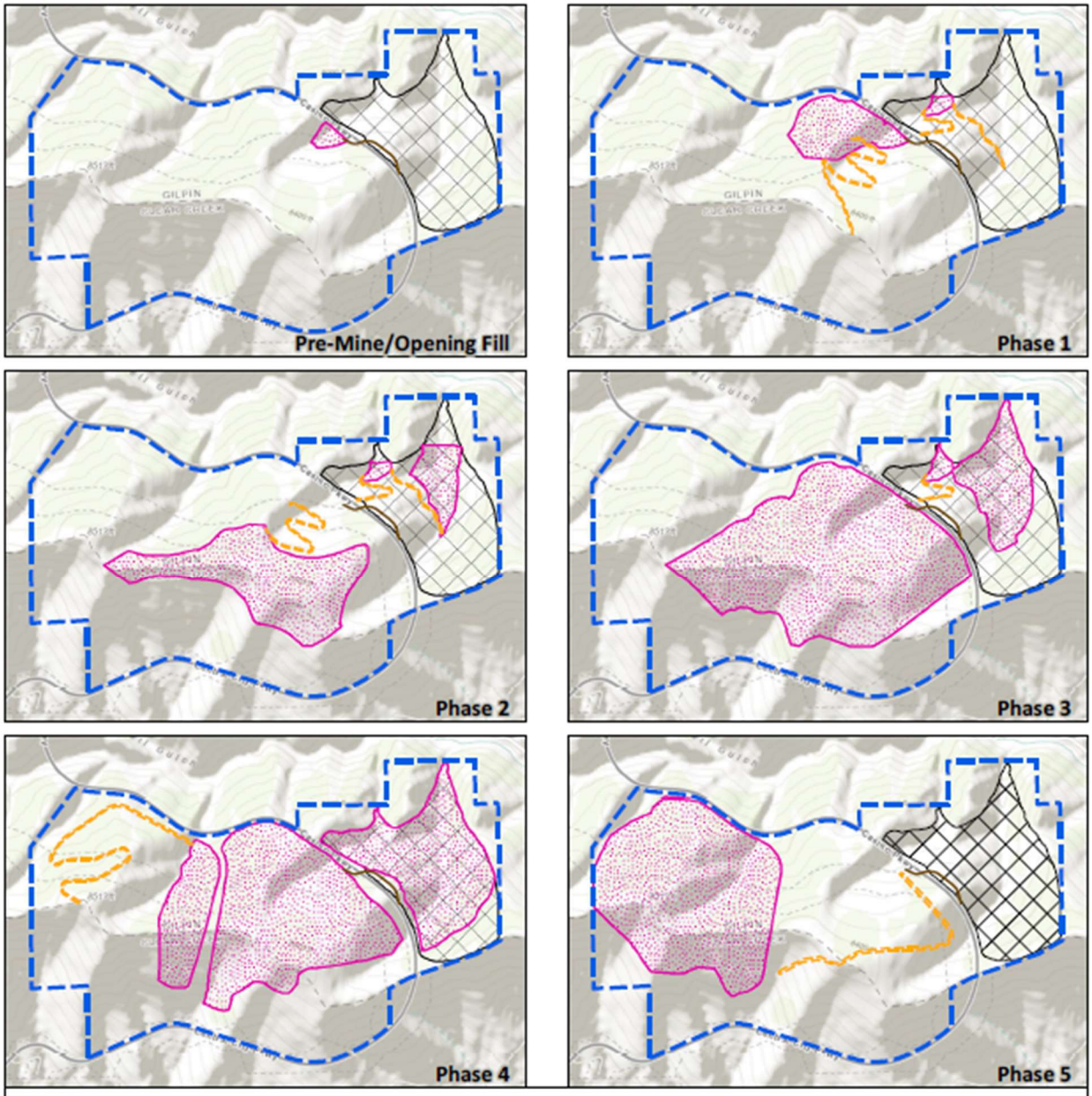
Phase 4 mining is expected last 9 years up to approximately 2074 and will consist of mining the area west of the internal gravel access road. A new access road will be constructed to the top of Phase 5. Mining will occur from the bottom of Phase 3 (8,050 ft in elevation) down to a finished elevation of 7,925 feet. The Eastside Waste Rock Landform will continue to expand further south to an elevation of 8,050 ft.

Phase 5 mining will last approximately 43 years up to approximately 2117 when the Project will be permanently closed. Phase 5 mining have a finished elevation of 7,850 feet with reclaimed slopes as forest areas using a 2:1 slope. The majority of the southernmost face adjacent to the CCP will maintain the deed restricted wildlife migration corridor along the south side of the Project. The Eastside Waste Rock Landform will be revegetated using a dry rangeland seed mix.

As shown on **Figure 2**, the two drainages to the east of the CCP will be used as waste rock landform areas for non-marketable material. Waste rock landform materials will be initially hauled from the processing area to the landform areas by truck. If feasible, an underpass or large box culvert will be installed for conveyor access to the waste rock landform areas. The western portion of the waste rock landforms (areas closest to the CCP) will be developed first and the eastern portion will be developed during Phases 2 and 3.

1.3 RECLAMATION

Reclamation will occur throughout all mining phases to ensure that vegetation within previously developed portions of the Project become re-established to provide forage for wildlife. Trees will be planted on the wetter north and east facing slopes and a dry rangeland seed mix will be used for the south and west facing slopes. Post-Project topography will include bedrock outcrops and sporadic cliff faces to mimic the natural landscape. Topsoil will be generated on-site using waste fines from mining and screened with imported topsoil, as needed, or amended with fertilizer. Hydroseeding will occur on each dump lift once the next dump lift is initiated as well as on steeper slopes where drill seeding is not feasible. Flat pads (i.e., processing area) will be revegetated using drill seeding methods during final site reclamation. Certified weed-free mulch/wood straw will be used to stabilize the soil surface and retain moisture during germination. Following all five mining phases, the following permanent features will remain: on-site access roads (per landowner request), and wildlife crossings.


Pre-Mine/Opening Fill
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5
Map Legend
DRMS Permit Boundary
On/Off Ramp
Mine Phase Boundary
Gravel Access Road
Waste Rock Landform
Prepared By:
ERC
2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820
ERC #: 1290-2104
FIGURE 2. MINING PHASES
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO
0
1,300
2,600
Feet

2.0 SITE INFORMATION

2.1 LOCAL VICINITY AND YOUNG RANCH

The proposed Project is located on the north side of I-70 and east of Idaho Springs in the counties of Clear Creek and Gilpin, Colorado. More specifically, the Project is located in **Section 27, 28, and 29, in Gilpin County, and Sections 32, 33 and 34 in Clear Creek County, Township 3 South, Range 72 West** (**latitude 39.75500° north, longitude 105.45222° west**). The Project is bordered to the west by undeveloped forest, CCP to the North, State Highway 119 and undeveloped forest to the east, and CCP to the South. From I-70, the Project can be accessed by heading west and taking Exit 243 to Hidden Valley, Central City for approximately 2.5 miles until reaching right-of-way pull out on the west side of Central City Parkway. The Project is best accessed by parking along the pullouts to the CCP and hiking into the Project. The Project is predominantly forestland with herbaceous understory. Refer to **Figure 1** for a location map of the Project.

The Project comprises approximately 469.7 acres and has an average elevation of 8,100 feet above mean sea level. Topography across the Project consists of steep, rocky slopes that slope downward toward the north/south. CCP borders the southern and northern edges of the Project and bisects the eastern portion of the Project. Two stormwater drainages exist on the northern and eastern portions of the Project (these will be the site of the waste rock landform areas, described in Section 1.2). Upper portions of these drainages have been historically disturbed due to the construction of the CCP and contain numerous quantities of riprap and fill material associated with the parkway. Existing culverts underneath the CCP will be widened during the pre-mining phase and Phase I. North Clear Creek is located east of the Project and flows from the north to the southeast. Numerous natural drainages exist within the Project with two stormwater drainages that divert precipitation and surface runoff from the CCP to offsite locations to the north, and to the drainages east of the CCP. All drainages located within the footprint of the proposed Project are intermittent/ephemeral and do not flow year-round. Fountain Gulch, a perennial stream, is located immediately to the north of the Project boundary and provides a year-round source of water for wildlife. Overall, the Project is confined and bound by heavily traveled roadways (CCP) and the vicinity of the Project is largely comprised of fragmented forestlands.

2.2 CENTRAL CITY PARKWAY CORRIDOR

Since opening in 2004, the CCP is a heavily used four-lane highway that provides vehicular access between Idaho Springs along I-70 and the historic mining town and gambling area of Central City. The highway is operated and maintained by Central City. The total length of the parkway is 8.4 miles. The CCP begins near the junction of U.S. Hwy 6 and U.S. Hwy 40 along I-70, and heads north through a series of steep U-shaped bends through and around the proposed Project. Most of the route is heavily forested; however, the CCP enters a small valley immediately before Mile Marker 5 where the topography opens and is less vegetated at that location north to Central City. Wildlife-vehicle collisions are more common in the vicinity of Mile Markers 1 and 2, as well as within the valley in the vicinity of Mile Markers 4 and 5. Barbed wire fences are located along the entire stretch of the CCP that traverses through the Project. Further to the north in the vicinity of Mile Marker 5, the barbed wire fence has been modified slightly to include a small diameter pipe (~4”) as a top rail, which helps to minimize wildlife entanglement.

2.3 VEGETATION

According to the United States Geological Survey (USGS) Gap Analysis Project (GAP) land cover data set, three primary vegetation communities exist within the Project that can be characterized as Southern Rocky Mountain Montane Shrubland, Western North American Temperate Cliff, Scree & Rock Vegetation, and Central Rocky Mountain Dry Lower Montane-Foothill (Faber-Langendoen et al. 2015). The vegetation communities are summarized in **Table 1** as follows:

Table 1. Vegetation Community Distribution Within the Project

Vegetation Community	Total (Acres)	Percentage
Central Rocky Mountain Dry Lower Montane-Foothill	270.1	57.4
Southern Rocky Mountain Montane Shrubland	154.6	33.0
Western North American Temperate Cliff, Scree & Rock Vegetation	45.0	9.6
Total	**469.7***	**100%**

*Total acreage of Project within DRMS permit boundary

Central Rocky Mountain Dry Lower Montane-Foothill Forest

This vegetation community generally includes conifer forests, woodlands found in the lower montane to foothill zones. It is generally dominated by ponderosa pine, Douglas fir (*Pseudotsuga menziesii*), and limber pine (*Pinus flexilis*). Shrub and herbaceous components are widely variable, ranging from taxa found in the Great Plains mixed grass region to those found across the Northern Rockies region into the eastern Cascades. Generally, these communities occur in lower montane to foothill settings, or on rock outcrops in the mixed grass region of the Great Plains. Occurrences are found on all slopes and aspects; however moderately steep to very steep slopes or ridgetops and plateaus are most common. Within the Project, lodgepole pine, gamble oak, alderleaf mountain mahogany, mountain parsley, western wallflower (*Erysimum capitatum*), and quaking aspen (*populus tremuloides*) are the common species within this plant community type.

Southern Rocky Mountain Montane Shrubland

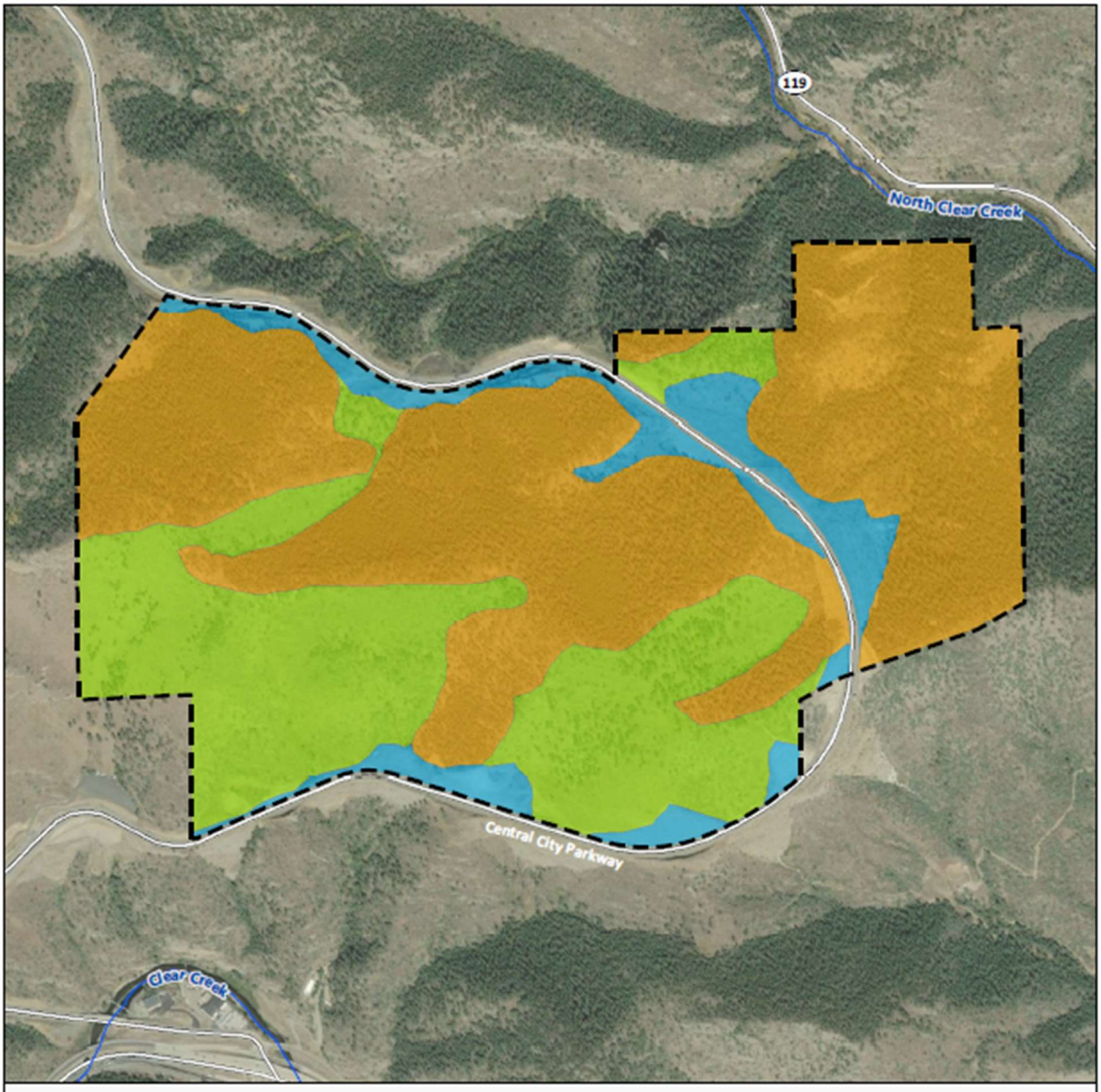
The Southern Rocky Mountain Montane Shrubland is characterized by an open-to-dense shrub layer typically dominated by Alderleaf mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), and/or gambel oak (*Quercus gambelii*) and several other characteristic shrubs. The Southern Rocky Mountain Montane Shrubland is dominant on the southern portion of the Project. The Southern Rocky Mountain Montane Shrubland is intermixed with wooly cinquefoil (*Potentilla hippiana*), cheatgrass (*Bromus tectorum*), mountain parsley (*Cymopterus lemmonii*), Indian paintbrush (*Castilleja coccinea*), and yucca (*Yucca glauca*). Tree species within this community include pinion pine (*Pinus edulis*)

and ponderosa pine (*Pinus ponderosa*). This vegetative community is found on the lower slope positions in montane zones ranging from 4,900 feet to 10,000 feet in elevation. The herbaceous layer is sparse to moderately dense and dominated by perennial graminoids. Stands may occur on level to steep slopes, cliffs, escarpments, rimrock slopes, rocky outcrops, and scree slopes. Within the Project, this community generally includes the southern slopes in the southern portion. This community also encompasses a small parcel within the Project to the north and northeastern portions.

Western North American Temperate Cliff, Scree & Rock Vegetation

The Western North American Temperate Cliff, Scree, & Rock vegetation community occurs typically within the right-of-way of the CCP and the unnamed drainages associated with the Parkway. These communities were likely formed with the construction of the parkway and are characterized by bedrock outcrops, including cliffs, talus, or scree. The vegetation is highly variable within this plant community type and consists of a sparse cover of vascular/herbaceous species with a limited cover of lichens, mosses, ferns or fern allies. Characteristic nonvascular species include lichens of the genera rock tripe (*Umbilicaria esculenta*), map lichens (*Rhizocarpon ramond*), snow lichen (*Stereocaulon hoffm*), cup lichen (*Cladonia P. Browne*), tortula moss (*Tortula Hedw.*), and racomitrium moss (*Racomitrium canescens*). Generally, these areas within the Project are bare of any woody plants, but some shrubs and trees were present and consisted of lodgepole pine (*Pinus contorta*), ponderosa pine, and pinion pine.

A map showing vegetation within the Project is provided as **Figure 3**. **Appendix A** to this report provides representative photographs of the vegetation communities and associated habitats within the Project.



Map Legend

- DRMS Permit Boundary
- Central Rocky Mountain Dry Lower Montane-Foothill Forest
- Southern Rocky Mountain Montane Shrubland
- Western North American Temperate Cliff, Scree and Rock Vegetation

Prepared By:

ERC

2820 Wilderness Place, Suite A
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ERC #: 1290-2104

FIGURE 3. VEGETATION MAP

WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO

0 600 1,200
Feet

2.4 WILDIFE

Wildlife utilize the general landscape of the Project in a multitude of ways and occupy habitats within the Project as areas of permanent inhabitance, seasonal inhabitance, breeding grounds, migratory routes, foraging, and temporary shelter. Potential wildlife habitat includes the entire Project and adjacent undeveloped areas.

Historic and current land use associated with the CCP have fragmented the north, east, and south portions of the Project. However, the west portion is undeveloped and is part of Young Ranch. As discussed in Section 2.3, three habitat types were observed within the Project and include: Central Rocky Mountain Dry Lower Montane-Foothill Forest, Southern Rocky Mountain Montane Shrubland, and Western North American Temperate Cliff, Scree and Rock vegetation communities. The Central Rocky Mountain Dry Lower Montane-Foothill Forest (57.4%), Southern Rocky Mountain Montane Shrubland (33%), and Western North American Temperate Cliff, Scree and Rock (9.6%) vegetation types are dominated by native species. Such lands are altered due to fire regime, fragmentation from roads, development near urban areas, mining, invasive species, livestock grazing, and other human disturbances (CNHP 2010). Montane foothill and shrubland can also support large mammals including deer, elk, and black bear. The components of these vegetation communities provide unique, high quality nesting, foraging, and hunting habitat in the Project. The Western North American Temperate Cliff, Scree and Rock vegetation land, which is present across the northern portion of the Project has replaced the native montane shrubland habitat which would have been historically present in this region. This vegetation community has altered the structure, function, community composition, and habitat value of land within a minor portion of the Project. Within the Project, limitations for wildlife use exist due to land use activities such as habitat fragmentation from fences, and noise disturbances from the CCP.

Local wildlife species that may use this habitat within the Project include moose (*Alces alces*), hawks (*Buteo sp*.), elk (*Cervus canadensis*), turkey (*Meleagris gallopavo*), meadow vole (*Microtus pennsylvanicus*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), bighorn sheep (*Ovis canadensis*), deer mouse (*Peromyscus maniculatus*), mountain lion (*Puma concolor*), western meadowlark (*Sturnella neglecta*), garter snake (*Thamnophis sp.*), barn owl (*Tyto alba*), and black bear (*Ursus americanus*).

2.4.1 FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

The purpose of this section is to evaluate potential impacts to federally listed Threatened and Endangered (T&E) as a result of proposed activities associated with the Project. The Endangered Species (ESA) of 1973 was enacted by the United States to conserve T&E species and the ecosystems that they depend on. Under the ESA, species may be listed as either “endangered” or “threatened”; both designations are protected by law. The ESA is administered by the U.S. Fish and Wildlife Service (USFWS). The USFWS has developed Project-specific species lists, available online by request, identifying threatened, endangered, and proposed species, designated critical habitat, and candidate species protected under the ESA that may occur within the boundary of a proposed Project and/or may be affected by a proposed Project (USFWS 2022). The species list for the Clear Creek and Gilpin Counties, Colorado has identified the potential for eight T&E species to be located within the Project.

Species Not Present

Table 2 below lists federal T&E species that are identified to occur within Clear Creek and Gilpin Counties. However, these species are not known to exist within or in the vicinity of the Project and/or have specific habitat requirements (i.e., elevation range, vegetation communities) that are not common in the vicinity of the Project.

Table 2. Federally Listed Threatened and Endangered Species

Clear Creek and Gilpin County			
Common Name	**Scientific Name**	**Status***	**Determination**
Preble's Meadow Jumping Mouse	*Zapus hudsonius preblei*	FT	NOT LIKELY TO ADVERSELY AFFECT
Least Tern**	*Sterna antillarum*	FE	NOT LIKELY TO ADVERSELY AFFECT
Piping Plover**	*Charadrius melodus*	FT	NOT LIKELY TO ADVERSELY AFFECT
Whooping Crane**	*Grus americana*	FE	NOT LIKELY TO ADVERSELY AFFECT
Colorado Pikeminnow**	*Ptychocheilus lucius*	FE	NOT LIKELY TO ADVERSELY AFFECT
Greenback Cutthroat Trout**	*Oncorhynchus clarkia stomias*	FT	NOT LIKELY TO ADVERSELY AFFECT
Pallid Sturgeon**	*Scaphirhynchus albus*	FE	NOT LIKELY TO ADVERSELY AFFECT
Razorback Sucker**	*Zyrauchen texanus*	FE	NOT LIKELY TO ADVERSELY AFFECT

*Status key:
FE – Federally listed as endangered
FT – Federally listed as threatened
**Represents water depletion species. Project is assumed to not constitute a water depletion.

The Project does not contain the specific habitat characteristics necessary to support the species listed above; therefore, these species and/or critical habitat are not present within the Project. As such, the

proposed Project should not adversely affect the species, their habitats, or proposed or designated critical habitats.

The Project is located within the potential known range for the following (**Table 3**) federally listed T&E species: Canada lynx, Mexican spotted owl, and the western prairie fringed orchid. Further analysis was conducted to determine if the species or habitat has the potential to exist within the Project considering site-specific conditions and characteristics. A brief explanation is provided as to the species life cycle, habitat requirements and potential occurrence within the Project. The Project is not within designated critical habitat of any federally listed species.

Table 3. Federally Listed Species Potentially Occurring Within the Project

Common Name	Scientific Name	Status*	Determination
Canada Lynx	*Lynx canadensis*	FT	NOT LIKELY TO ADVERSELY AFFECT
Mexican Spotted Owl	*Strix occidentalis lucida*	FT	NOT LIKELY TO ADVERSELY AFFECT
Western Prairie Fringed Orchid	*Platanthera praeclara*	FT	NOT LIKELY TO ADVERSELY AFFECT

*Status key:
FE – Federally listed as endangered
FT – Federally listed as threatened

Canada Lynx (*Lynx canadensis*)

On March 24, 2000 the USFWS issued a final rule to list the Canada lynx as a federally threatened species under the ESA. The Canada lynx range extends from most of Canada and Alaska, which combined, encompass about 98% of the species breeding range. The contiguous U.S. distinct population segment (DPS) accounts for the other 2% and includes resident breeding populations in Northern Main, northeastern Minnesota, northwestern Montana, northern Idaho, and north-central Washington. An introduced population also occurs in western Colorado, and several other areas may have historically supported small resident populations (e.g. northern New Hampshire, Isle Royale, Michigan, northeastern Washington, and the Greater Yellowstone area of southwestern Montana and northwestern Wyoming) (USFWS 2020). In Colorado, a resident Canada lynx has been introduced in the Southern Rocky Mountains in areas within subalpine and upper montane forest zones, generally above 9,500 feet in elevation (Shenk 2009). In the upper elevations of the subalpine zone, forests are typically dominated by subalpine fir and Engelmann spruce. Canada lynx bears one litter per year, between one and four lynx kittens are born in each litter in May or June. Habitat for the Canada lynx is generally considered to be at higher elevations

than the Project; and not commonly found utilizing the lower, more open, montane forests and shrublands within the Project Area. Therefore, activities within the Project are not likely to adversely affect this species.

Mexican Spotted Owl (*Strix occidentalis lucida*)

On March 16, 1993 the U.S. Fish and Wildlife Service issued a final rule to list the Mexican spotted owl as a federally threatened species under the ESA. The Mexican spotted owl range extends from Utah, Colorado, Arizona, New Mexico, and the wester portions of Texas south into several States of Mexico. However, within this range, the Mexican spotted owl occurs in local areas that contain isolated forested mountain systems, forested canyons, and steep, rocky canyon lands (USFWS 2013). These areas typically included parallel-walled canyons up to 1.2 miles in width and include side canyons. An owl site is used by a pair of adults and used for nesting, roosting, and foraging. Habitat for this species is not present within the footprint of the proposed Project; therefore, activities within the Project are not likely to adversely affect this species.

Western Prairie Fringed Orchid (*Platantherea praeclara*)

On September 28, 1989 the U.S. Fish and Wildlife Service issued a final rule to list the western prairie fringed orchid as a federally threatened species under the ESA. The western prairie fringed orchid historic range extends throughout the tallgrass regions of North America. This includes the Dakotas, Nebraska, Kansas, Oklahoma, Missouri, Iowa, Minnesota, and Manitoba. The Mississippi River is the eastern limit of its range. The western prairie fringed orchid occurs in moist, tallgrass prairies and sedge meadows. In Colorado, the species relies heavily on the Platte River system. Western prairie fringed orchids begin to emerge in late May. Plants flower from mid-June in the southern portion of their range to late-July in the more northerly portions. Plants will display flowers for three weeks with individual flowers lasting for approximately 10 days. Recruitment is accomplished primarily through sexual reproduction. Plants require nocturnal fertilization provided by a specific group of moths adapted to harvesting nectar from the long spur of the orchid (USFWS 1996). Habitat for this species is not present within the footprint of the proposed Project; therefore, activities within the Project are not likely to adversely affect this species.

2.4.2 COLORADO STATE-LISTED SPECIES

The purpose of this section is to evaluate potential impacts to state-listed species as a result of proposed activities at the Project. Species identified as state threatened or endangered are protected by the CPW under Colorado Statute Title 33. State regulations prohibit "*any person to take, possess, transport, export, process, sell or offer for sale, or ship and for any common or contract carrier to knowingly transport or receive for shipment*" any species or subspecies listed as state endangered or threatened. The CPW also has identified State Species of Special Concern, which are species or subspecies of native wildlife that are currently vulnerable in their Colorado range and have the potential to become threatened or endangered. Species of Special Concern are not protected under State regulations but the 'take' of individuals and disturbance of their habitat is strongly discouraged.

All state listed species were screened as potential inhabitants of the Project based on general habitat requirements and CPW Species Profiles (CPW 2022). ERC evaluated the species listed by CPW as threatened or endangered that could potentially exist within the Project. All animal species listed above

as threatened or endangered by the USFWS are also listed by the CPW as threatened or endangered, respectively, therefore were not duplicated below.

Species Potentially within Range

The following State listed threatened and endangered species are identified to occur within the State (CPW 2022) and may be present within Clear Creek and Gilpin Counties. However, of the state-listed species below in **Table 4**, none are listed as either State Endangered or State Threatened and are not statutorily protected.

Table 4. State-Listed Species Potentially Occurring on the Project

	Scientific Name	Common Name	Status*	Determination
Birds	*Falco peregrinus anatum*	American Peregrine Falcon	SC	NOT LIKELY TO ADVERSELY AFFECT
	Haliaeetus leucocephalus	Bald Eagle	SC	NOT LIKELY TO ADVERSELY AFFECT
	Tympanuchus phasianellus columbianus	Columbian Sharp-tailed Grouse	SC	NOT LIKELY TO ADVERSELY AFFECT
	Buteo regalis	Ferruginous Hawk	SC	NOT LIKELY TO ADVERSELY AFFECT
Mammals	*Thomomys talpoides macrotis*	Northern Pocket Gopher	SC	NOT LIKELY TO ADVERSELY AFFECT
	Vulpes velox	Swift Fox	SC	NOT LIKELY TO ADVERSELY AFFECT
	Corynorhinus townsendii	Townsend's Big-Eared Bat	SC	NOT LIKELY TO ADVERSELY AFFECT
Reptiles	*Cnemidophorus neotesselatus*	Triploid Checkered Whiptail	SC	NOT LIKELY TO ADVERSELY AFFECT
	Fambelia wislizenii	Longnose Leopard Lizard	SC	NOT LIKELY TO ADVERSELY AFFECT

	Scientific Name	Common Name	Status*	Determination
	Lampropeltis getula	Common King Snake	SC	NOT LIKELY TO ADVERSELY AFFECT
	Leptoyphlops dulcis	Texas Blind Snake	SC	NOT LIKELY TO ADVERSELY AFFECT
	Phrynosoma modestum	Texas Horned Lizard	SC	NOT LIKELY TO ADVERSELY AFFECT

*Status Key
SE = State Endangered
ST = State Threatened
SC = State Special Concern (not a statutory category)

2.4.3 COLORADO PARKS AND WILDLIFE SPECIES ACTIVITY MAPPING

The CPW has developed Species Activity Mapping (SAM) which identifies buffer zones and other distribution data for general wildlife species which is available in Geographic Information Source (GIS) format (CPW 2022). This mapping provides information on wildlife distributions to public and private agencies and individuals, for environmental assessment, land management resource planning, and general scientific research. This mapping provides a broad overview of CPW wildlife species and habitats within Clear Creek and Gilpin Counties, Colorado. This data was used to broadly identify wildlife species, movement patterns and habitat use within the generally vicinity of the Site. Some wildlife use areas which are part of the SAM program do fall within the Site.

Literature review and publicly available SAM data from CPW depict overall range for a variety of species. These include bighorn sheep, black bear, elk, Canada lynx, moose, mountain lion, mule deer, plains gartersnake, prairie lizard, plateau fence lizard, prairie rattlesnake, western rattlesnake, smooth greensnake, terrestrial gartersnake, and wild turkey.

Habitat does exist for larger big game species. Signs of elk, bighorn sheep, mule deer, coyote are present throughout the Project. Migratory birds such as a golden eagle (*Aquila chrysaetos*), black-capped chickadees (*Poecile atricapillus*), and hairy woodpecker (*Dryobates villosus*) were directly observed within the Project, though no nests were observed.

The specific CPW-mapped wildlife use areas or ranges for these species within and around the Project are summarized as follows in **Table 5**. Refer to **Appendix B** for the CPW maps within the vicinity of the Project.

Table 5. CPW SAM Mapping Summary (see Appendix B for maps)

CPW SAM Layer[1]	Definition[1]	Distribution On/Near Project
BIGHORN SHEEP		
OVERALL RANGE	The area which encompasses all known seasonal activity areas within the observed range of a population of bighorn sheep.	• Overall range mapped across large portions of Clear Creek and Gilpin Counties, north of I-70
SUMMER RANGE:	That part of the range of a species where 90% of the individuals are located between spring green-up and the first heavy snowfall, or during a site-specific period of summer as defined for each Data Analysis Unit. Summer range is not necessarily exclusive of winter range; in some areas winter range and summer range may overlap.	• Summer range mapped as being the same as overall range within the vicinity of the Project. Migration corridors generally follow an east/west or west/east direction.
WINTER RANGE:	That part of the winter range of a species where densities are at least 200% greater than the surrounding winter range density during the same period used to define winter range in the average five winters out of ten.	• Slightly smaller areas than overall/summer range, and generally restricted to south-facing slopes during winter.
BLACK BEAR		
OVERALL RANGE:	The area which encompasses all known seasonal activity areas within the observed range of a population of black bear.	• Overall range mapped across majority of the Colorado front range • Black bear may use portions of the Project area and general surrounding area.
ELK		
OVERALL RANGE:	The area which encompasses all known seasonal activity areas within the observed range of an elk population.	• Overall and summer range mapped across majority of the Project area.
SUMMER RANGE:	That part of the range of a species where 90% of the individuals are located between spring green-up and the first heavy snowfall, or during a site-specific period of summer as defined for each Data Analysis	

CPW SAM Layer[1]	Definition[1]	Distribution On/Near Project
	Unit. Summer range is not necessarily exclusive of winter range; in some areas winter range and summer range may overlap.	
LYNX		
POTENTIAL HABITAT[2]:	Areas having the highest potential of lynx occurrences in the state. These areas usually contain positive, probable, or possible reports. This information was derived from modeling potential lynx habitat (*see footnote for additional information*).	• Mapped along the higher elevation hillslopes to the north and south of the Project area. • Portion of the Project area along north-facing slopes are mapped as having potential lynx habitat.
MOOSE		
OVERALL RANGE:	The area which encompasses all known seasonal activity areas within the observed range of a population of moose.	• Overall range mapped along the central mountains of Colorado including the entire Project area.
SUMMER RANGE:	That part of the overall range where 90% of the individuals are located during the summer months. This summer timeframe will be delineated with specific start/end dates for each moose population within the state (ex: May 1 to Sept 15). Summer range is not necessarily exclusive of winter range.	• Summer range mapped along the central mountains of Colorado including the entire Project area.
MOUNTAIN LION		
OVERALL RANGE	The area which encompasses all known seasonal activity areas within the observed range of a population.	• Overall range mapped along the central mountains of Colorado including the entire Project area.
MULE DEER		
OVERALL RANGE:	Area which encompasses all known seasonal activity areas within the observed range of a mule deer population.	• Overall range mapped throughout the entire state of Colorado including the entire Project area.
SUMMER RANGE:	Part of the Overall Range where 90% of the individuals are located between spring green-up and the first heavy snowfall. Summer Range is not	• Summer range mapped along the central mountains of Colorado including the entire Project area.

CPW SAM Layer[1]	Definition[1]	Distribution On/Near Project
	necessarily exclusive of Winter Range; in some areas Winter Range and Summer Range may overlap.	
WINTER RANGE	Part of the Overall Range where 90% of the individuals are located during the average five winters out of ten from the first heavy snowfall to spring green-up, or during site-specific period of winter as defined for each Data Analysis Unit. Winter Range is only delineated for migratory populations.	• Winter range mapped across the entire Project area.
WINTER CONCENTRATION AREA	Part of the Overall Range where higher quality habitat supports significantly higher densities than surrounding areas. These areas are typically occupied year-round and are not necessarily associated with a specific season. Includes rough break country, riparian areas, small drainages, and large areas of irrigated cropland.	• Concentration area is mapped across the central portion of the Project area.
PLAINS GARTERSNAKE		
OVERALL RANGE	The area which encompasses all known seasonal activity areas within the observed range of a population.	• Overall range mapped along the central mountains of Colorado including the entire Project area.
PRAIRIE LIZARD AND PLATEAU FENCE LIZARD		
OVERALL RANGE	The area which encompasses all known seasonal activity areas within the observed range of a population.	• Overall range mapped along the central mountains of Colorado including the entire Project area.
PRAIRIE RATTLESNAKE AND WESTERN RATTLESNAKE		
OVERALL RANGE	The area which encompasses all known seasonal activity areas within the observed range of a population.	• Overall range mapped along the central mountains of Colorado including the entire Project area.

CPW SAM Layer[1]	Definition[1]	Distribution On/Near Project
SMOOTH GREENSNAKE		
OVERALL RANGE	The area which encompasses all known seasonal activity areas within the observed range of a population.	• Overall range mapped along the central mountains of Colorado including the entire Project area.
TERRESTRIAL GARTERSNAKE		
OVERALL RANGE	The area which encompasses all known seasonal activity areas within the observed range of a population.	• Overall range mapped along the central mountains of Colorado including the entire Project area.
WILD TURKEY		
OVERALL RANGE	The area which encompasses all known seasonal activity areas within the observed range of a population.	• Overall range mapped along the central mountains of Colorado including the entire Project area.

[1] Colorado Parks and Wildlife (CPW) Species Activity Mapping (SAM) Layers and Definitions taken from: https://cpw.state.co.us/learn/Maps/CPW-Public-GIS-Species-Activities-Definitions.pdf.

[2] *Potential habitat* refers to areas that have been identified by CPW using modeling of possible habitat attributes using vegetation cover type, elevation, climate, and other site characteristics. *Potential habitat* does not indicate that species are necessarily present. Lynx, which are listed as having *potential habitat* within the Project area, are generally found in moist, subalpine coniferous forests. These forest types are not present in the Project area.

For the big game species that are likely to migrate through the Project, the Project is not mapped within the following CPW activity use areas:

BIGHORN SHEEP	Highway Crossing Production Area Limited Use Area Resident Population Migration Corridors Summer Concentration Severe Winter Winter Concentration
BLACK BEAR	Fall Concentration Human Conflict Area Summer Concentration
ELK	Highway Crossing

	Production Area Limited Use Area Resident Population Migration Corridors Summer Concentration Severe Winter Winter Range
MOOSE	Priority Habitat Concentration Area Winter Range
MULE DEER	Highway Crossing Resident Population Severe Winter Range

2.4.4 SITE-SPECIFIC WILDLIFE USE OF THE PROPOSED PROJECT

Wildlife can utilize the landscape in a multitude of ways. Wildlife can use specific habitats as areas of permanent inhabitance, seasonal inhabitance, breeding grounds, migratory routes, for foraging purposes, as a temporary shelter and as general "open space." General wildlife habitat within the Project consists primarily of dense forest, rocky shrublands, grass and shrub covered south facing slopes, open meadows, and intermittent/ephemeral drainages.

Generally, the Project provides adequate year-round habitat for the big game species listed in Section 2.4.3. The vegetation communities of the Project can provide a variety of wildlife habitat values such as general foraging areas, refuge, nesting, or movement corridors for a variety of species. The overall quality of the existing habitat within the Project is good, given the relatively undisturbed nature of the area.

Bighorn sheep are common in the area and most often can be found along the south-facing slopes adjacent to the CCP and within the Project during the spring and fall (Butler 2020). During the summer, bighorn sheep are less common and are more likely to be found at higher elevations further away from the Project. Black bear and mountain lion are common through all areas of the Project; however, CPW SAM data indicate that the Project is not the location of black bear fall/summer concentration areas and human conflict areas. According to Butler (2020), most mountain lion and bear are observed along the CCP north of the Project in the vicinity of mile marker 3 and 4. Elk are ubiquitous throughout, and may use the Project as general habitat, forage, and cover. No elk migration routes are mapped by CPW SAM for the Project. According to Butler (2020), most elk are observed north of the Project between CCP mile markers 5 and 6.5. However, elk, bighorn sheep, and mule deer may occasionally cross the Project to access water sources to the north (e.g., Fountain Gulch) and to the east (e.g., spring in unnamed drainage). Mule deer are commonly observed between CCP Mile Markers .5 and 2 to the south of the Project, and bighorn sheep are common between CCP mile markers 1.5 and 2 (Butler 2020) within and adjacent to the Project's south-facing slopes.

Wetland and riparian areas can provide a variety of wildlife habitat features such as cover, forage, nesting habitat and can act as a movement corridor for various small mammals, amphibians, birds and reptiles. The predominant wetland/riparian habitat types within or adjacent to the Site include Fountain Gulch to

the north, Clear Creek to the east and south, and the unnamed drainage to the east. Wildlife values associated with these habitats are generally considered higher due to vegetation diversity, cover, refuge, and a seasonal water source for wildlife. The deep drainages along Fountain Gulch and Clear Creek also provide a valuable wildlife movement corridor adjacent to the Project due to the structural complexity including overstory canopy trees, mid-story shrubs, dense herbaceous vegetation, and variable topography that provides significant cover in an otherwise open and agricultural landscape.

3.0 IMPACT ASSESSMENT

3.1 IMPACTS ON VEGETATION

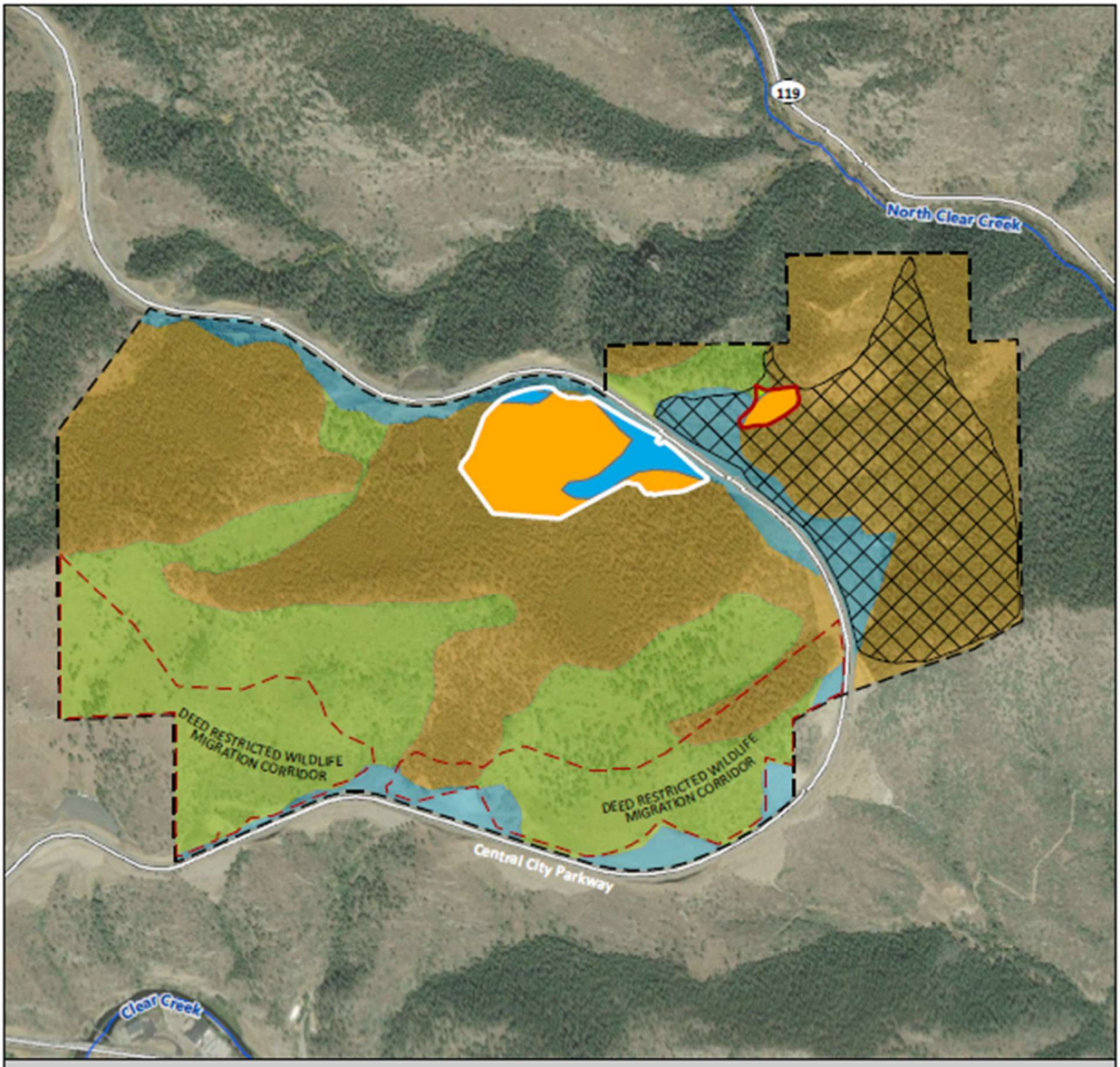
The Project was evaluated for potential impacts to vegetation communities. **Table 6** presents the impacts from each mining phase on the vegetation communities present within the DRMS permit boundary. **Figures 4, 5, 6, 7 and 8** identify the impacts for each phase, land use class, and vegetation cover type.

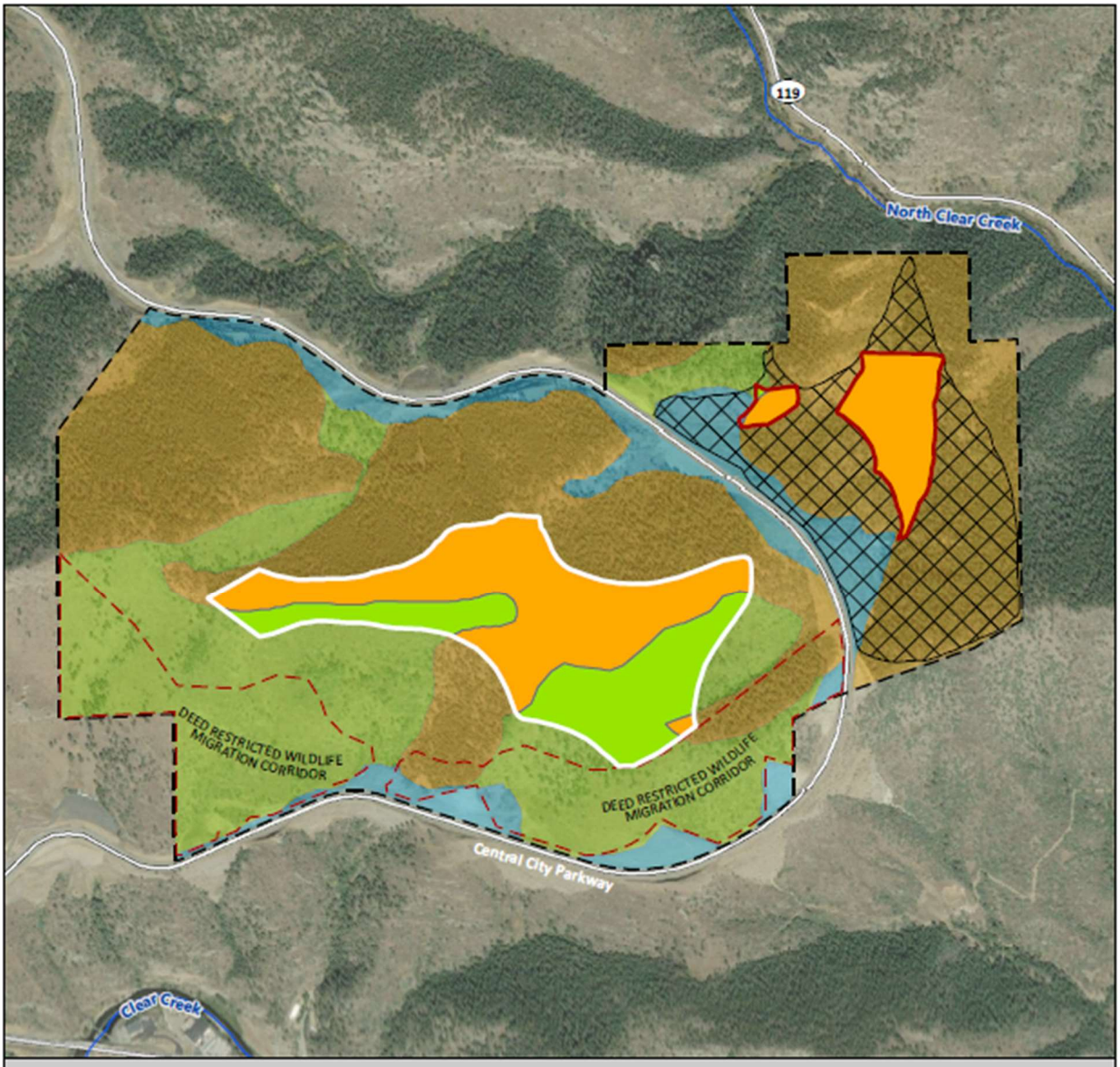
Table 6. Impacts to Land Use Class and Vegetation Cover Type within the Project.[1]

Phase 1				
Vegetation Community	**Final Mined Surface* (acres)**	**Reclaimed Slope^ (acres)**	**Waste Rock Landform Surface* (acres)**	**Waste Rock Landform Reclaimed Slope^ (acres)**
Central Rocky Mountain Dry Lower Montane-Foothill Forest	11.7	5.7	1.5	0.6
Southern Rocky Mountain Montane Shrubland	0	0	0.1	0.3
Western North American Temperate Cliff, Scree and Rock Vegetation	3.7	1.0	0.1	0
Total	**15.4**	**6.7**	**1.7**	**0.8**
Phase 2				
Vegetation Community	**Final Mined Surface* (acres)**	**Reclaimed Slope^ (acres)**	**Waste Rock Landform Surface* (acres)**	**Waste Rock Landform Reclaimed Slope^ (acres)**
Central Rocky Mountain Dry Lower Montane-Foothill Forest	37.3	1.4	13.4	4.6
Southern Rocky Mountain Montane Shrubland	24.0	1.3	0.1	0.3
Western North American Temperate Cliff, Scree and Rock Vegetation	0	0	0.1	0

[1] ^ Reclaimed slope only
* Flat surface only

Total	**61.3**	**2.7**	**13.6**	**4.9**
Phase 3				
Vegetation Community	**Final Mined Surface* (acres)**	**Reclaimed Slope^ (acres)**	**Waste Rock Landform Surface* (acres)**	**Waste Rock Landform Reclaimed Slope^ (acres)**
Central Rocky Mountain Dry Lower Montane-Foothill Forest	90.5	10.1	21.6	8.7
Southern Rocky Mountain Montane Shrubland	27.5	19.4	0.1	0.2
Western North American Temperate Cliff, Scree and Rock Vegetation	4.6	2.0	0.6	0
Total	**122.6**	**31.5**	**22.4**	**8.9**
Phase 4				
Vegetation Community	**Final Mined Surface* (acres)**	**Reclaimed Slope^ (acres)**	**Waste Rock Landform Surface* (acres)**	**Waste Rock Landform Reclaimed Slope^ (acres)**
Central Rocky Mountain Dry Lower Montane-Foothill Forest	53.3	41.7	29.1	22.0
Southern Rocky Mountain Montane Shrubland	8.9	17.4	0.0	0.5
Western North American Temperate Cliff, Scree and Rock Vegetation	0.8	5.5	7.8	1.6
Total	**63.0**	**64.7**	**36.9**	**24.1**
Phase 5				
Vegetation Community	**Final Mined Surface* (acres)**	**Reclaimed Slope^ (acres)**	**Waste Rock Landform Surface* (acres)**	**Waste Rock Landform Reclaimed Slope^ (acres)**
Central Rocky Mountain Dry Lower Montane-Foothill Forest	28.9	45.3	0	0
Southern Rocky Mountain Montane Shrubland	26.8	15.9	0	0
Western North American Temperate Cliff, Scree and Rock Vegetation	3.2	0	0	0
Total	**58.9**	**61.2**	**0.0**	**0.0**


119
North Clear Creek
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
Central City Parkway
Clear Creek
Map Legend
DRMS Permit Boundary
Waste Rock Landform
Final Mined Surface - Phase 1
Waste Rock Landform Top of Pad - Phase 1
Deed Restricted Wildlife Mitigation Corridor
Not Impacted
Impacted
Central Rocky Mountain Dry Lower Montane-Foothill Forest
Southern Rocky Mountain Montane Shrubland
Western North American Temperate Cliff, Scree & Rock Vegetation
Prepared By:
ERC
2820 Wilderness Place, Suite A
Boulder, CO 80301
(303) 679-4820
ERC #: 1290-2104
FIGURE 4. PHASE 1 VEGETATION COVER IMPACTS
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO
0
600
1,200
Feet


119
North Clear Creek
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
Central City Parkway
Clear Creek
Map Legend
DRMS Permit Boundary
Waste Rock Landform
Final Mined Surface - Phase 2
Waste Rock Landform Top of Pad - Phase 2
Deed Restricted Wildlife Mitigation Corridor
Not Impacted
Impacted
Central Rocky Mountain Dry Lower Montane-Foothill Forest
Southern Rocky Mountain Montane Shrubland
Western North American Temperate Cliff, Scree & Rock Vegetation
Prepared By:
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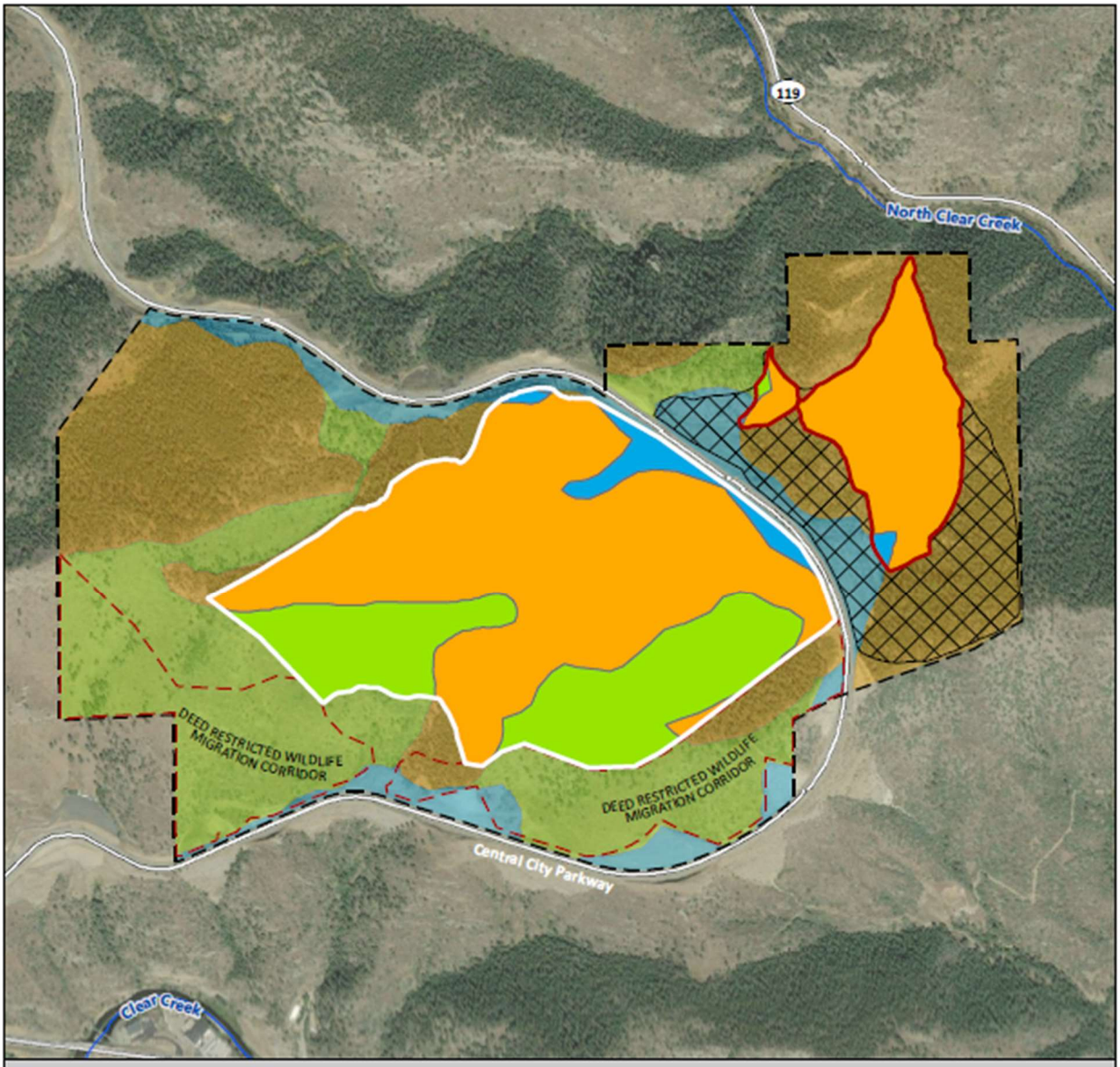
(303) 679-4820
ERC #: 1290-2104
FIGURE 5. PHASE 2 VEGETATION COVER IMPACTS
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO
0
600
1,200
Feet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North Clear Creek
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
Central City Parkway
Clear Creek
Map Legend
DRMS Permit Boundary
Waste Rock Landform
Final Mined Surface - Phase 3
Waste Rock Landform Top of Pad - Phase 3
Deed Restricted Wildlife Mitigation Corridor
Impacted
Not Impacted
Central Rocky Mountain Dry Lower Montane-Foothill Forest
Southern Rocky Mountain Montane Shrubland
Western North American Temperate Cliff, Scree & Rock Vegetation
Prepared By:
ERC
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ERC #: 1290-2104
FIGURE 6. PHASE 3 VEGETATION COVER IMPACTS
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO
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1,200
Feet

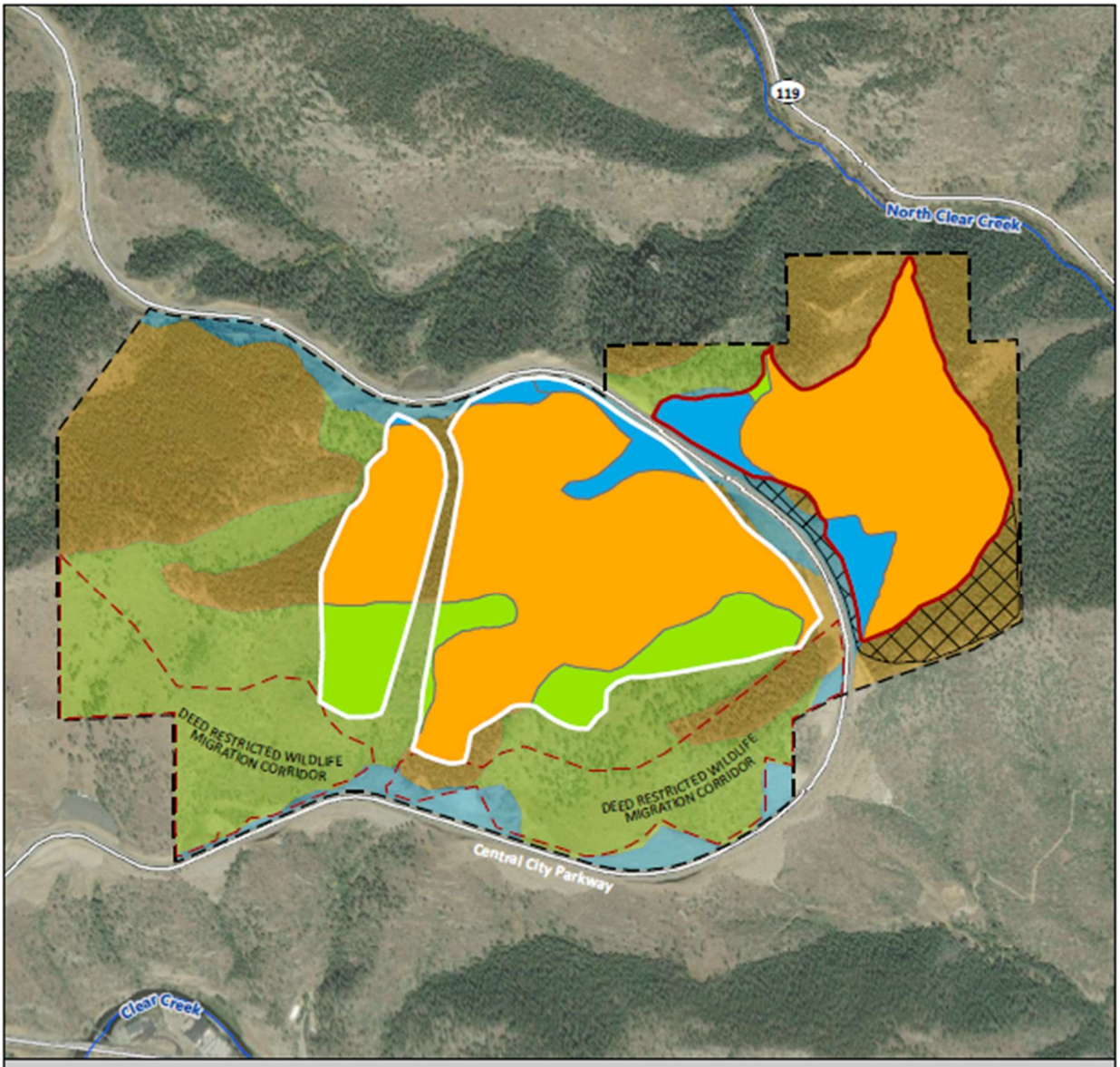
119
North Clear Creek
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
Central City Parkway
Clear Creek
Map Legend
DRMS Permit Boundary
Waste Rock Landform
Final Mined Surface - Phase 4
Waste Rock Landform Top of Pad - Phase 4
Deed Restricted Wildlife Mitigation Corridor
Not Impacted
Impacted
Central Rocky Mountain Dry Lower Montane-Foothill Forest
Southern Rocky Mountain Montane Shrubland
Western North American Temperate Cliff, Scree & Rock Vegetation
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FIGURE 7. PHASE 4 VEGETATION COVER IMPACTS
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO
0
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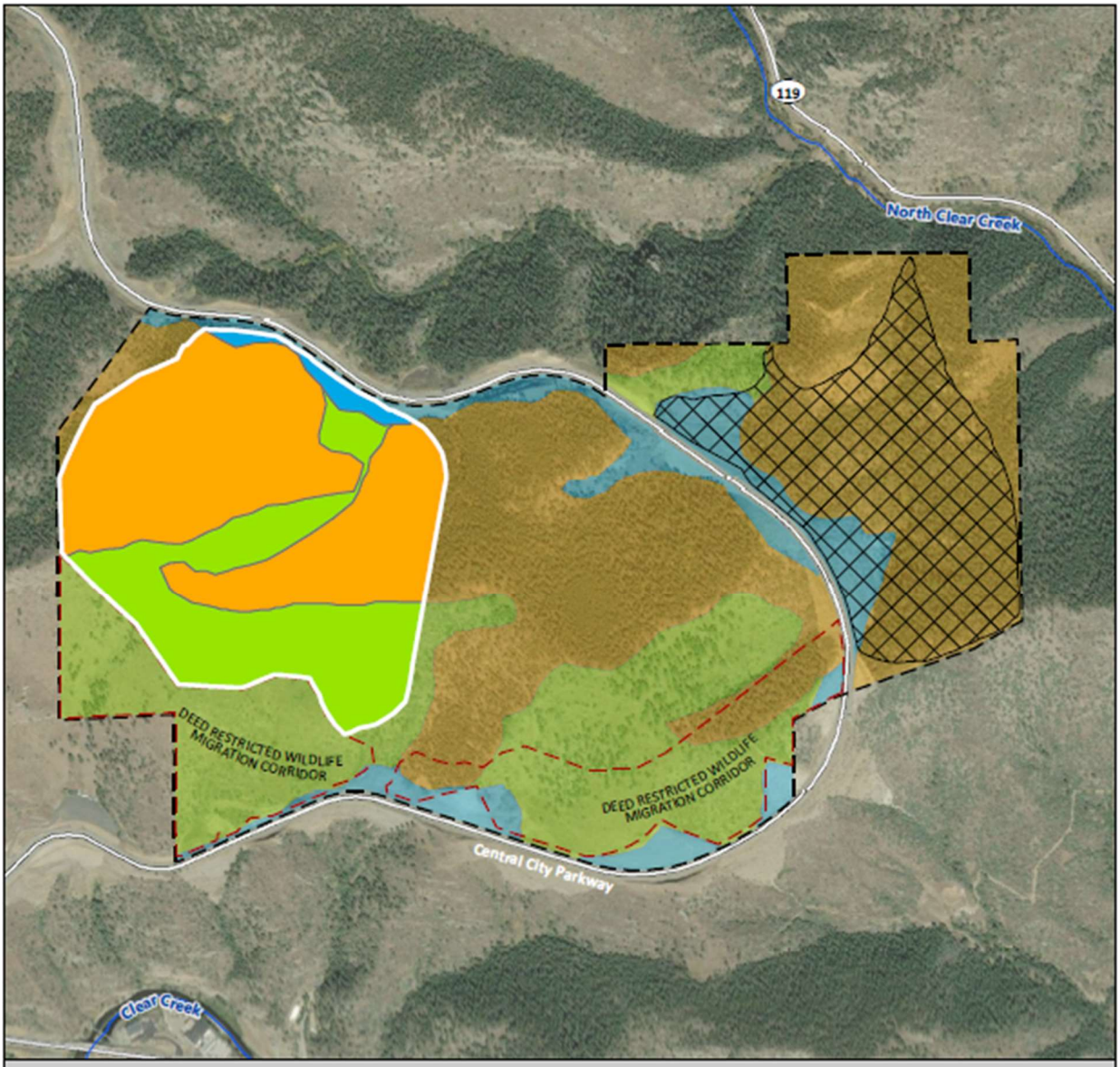
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North Clear Creek
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
DEED RESTRICTED WILDLIFE MIGRATION CORRIDOR
Central City Parkway
Clear Creek
Map Legend
DRMS Permit Boundary
Waste Rock Landform
Final Mined Surface - Phase 5
Deed Restricted Wildlife Mitigation Corridor
Not Impacted
Impacted
Central Rocky Mountain Dry Lower Montane-Foothill Forest
Southern Rocky Mountain Montane Shrubland
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FIGURE 8. PHASE 5 VEGETATION COVER IMPACTS
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO
0
600
1,200
Feet

3.2 IMPACTS ON COLORADO PARKS AND WILDLIFE (CPW) SPECIES ACTIVITY MAPPING (SAM)

The Project is located within the CPW mapped seasonal range for mule deer, elk, moose, black bear, and bighorn sheep (**Attachment B** maps). The specific CPW-mapped wildlife use areas or ranges for these species comprise overall/summer/winter range. No CPW-mapped critical winter range, winter concentration areas, or migration corridors are mapped within the Project. The Project is not identified within any production areas, severe winter range or priority habitat based on available CPW mapping (CPW 2020) which are typically considered the highest priority ranges by the CPW.

The identified habitat ranges for mule deer, elk, moose, black bear and bighorn sheep designate very large regional territories utilized by the identified species. The Site represents only a *de minimis* portion of some of these species' regional habitat ranges. Therefore, mining activities are not expected to negatively impact individuals or populations of wildlife.

- **CPW mapped species, including regional populations of mule deer, elk, moose, black bear, and bighorn sheep will not likely be impacted as a result of the Project.**
- **As shown on Figures 5, 6, and 7, the footprint of the Project is intentionally designed to minimize the impact to south-facing slopes within Clear Creek County. Two "Deed Restricted Wildlife Migration Corridors" will be established to allow for populations of big game species to access the Clear Creek corridor to the south of the Project area. These areas will be permanently set aside and will remain undeveloped through the life of the Project.**

3.3 MIGRATORY BIRD TREATY ACT

Based upon literature review and an onsite assessment, ERC has determined that some migratory birds may utilize the Project area, however, are not anticipated to be impacted. Migratory birds are protected under the MBTA and killing or possession of these birds is prohibited. Proposed activities which will remove native vegetation, in particular large overstory trees should first ensure that active nests are not disturbed. Generally, the active nesting season for most migratory birds in this region of Colorado occurs between April 1 and August 31.

- **Migratory birds will not likely be impacted as a result of the Project.**

3.4 FEDERAL AND STATE THREATENED AND ENDANGERED SPECIES

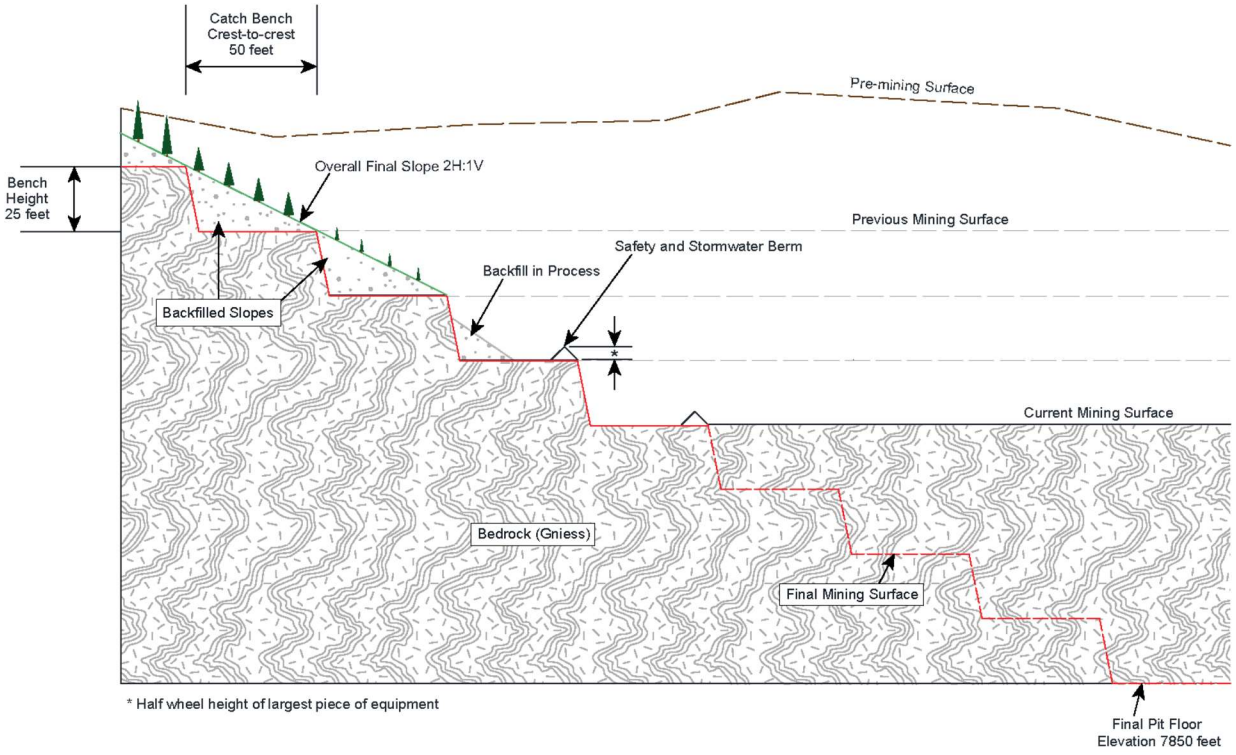
No federally listed threatened and endangered species and/or habitat protected under the ESA were identified within Project. The vegetation communities within the Project were investigated as potential habitat for federally listed species. Potential federal listed threatened and endangered species habitat was found to lack one or more habitat components critical for the federally listed species likely to occur in the area.

- **Federal and/or State threatened and endangered species will not likely be impacted as a result of the Project.**

3.5 IMPACTS ON GENERAL WILDLIFE USE AT THE PROPOSED YOUNG RANCH RESOURCE

As with any Project, potential disturbances from construction, natural habitat loss and increased human activity can result in increased human-wildlife conflicts, increased mortality, habitat fragmentation, dispersion of wildlife populations and adjustments in wildlife use patterns. The direct loss of habitat (vegetation removal) through the conversion of land from forest/shrubland to an aggregate extraction operation represents the greatest impact of the proposed Project. The proposed Project affects potential wildlife use within the proposed disturbance areas (e.g. mining phases) for a finite time period. This will represent a temporary loss of habitat. However, as discussed in Section 1.2 and Section 1.3, mining will occur in five phases, with reclamation/reseeding occurring between each phase. As shown on **Table 6** and **Figures 4 through 8**, only a portion of each mining phase will be disturbed. Reclamation and mining will occur on a bench basis and will be much smaller than the total area of each phase. Thus, it is expected that wildlife may use portions of the Project that have been reclaimed before the overall operation is complete. A schematic showing reclamation of the mining benches is shown on **Figure 7** below.

Figure 7. Schematic Showing Mining Slope and Reclamation Plan (Source: Greg Lewicki Associates, PLLC).



The proposed Project may have indirect impacts to wildlife use. Increased noise, lighting, human activity and general heavy construction operations will result in localized dispersion and avoidance of use in the immediate vicinity of the Project. Subsequently, wildlife movement through the Project to adjacent areas may be affected by the proposed activity.

- **Disturbance to wildlife is inevitable with any proposed activity, especially in the mountainous areas of Colorado and Clear Creek/Gilpin Counties. Impacts on wildlife use from the proposed Project would include direct temporary elimination of potential habitat within the Project area, and temporary localized displacement associated with additional noise and lighting from the proposed Project. This localized loss of habitat would not disrupt regional migration or significant movement patterns and would not threaten the overall health and viability of a species. Nearby lands that adjoin the Project area are largely undeveloped therefore it is anticipated that local wildlife (specifically elk, mule deer, and bighorn sheep) would easily adapt to disturbances and find sufficient habitat to sustain locally displaced species. In the long-term, the proposed Project will be fully reclaimed at the conclusion of mining which will restore some degree of wildlife habitat over time, unlike residential/commercial developments which may persist permanently. As stated in Section 1.3 and discussed above, interim reclamation will be used throughout all mining phases to ensure that vegetation within previously developed portions of the Project become re-established to provide forage for wildlife.**

4.0 ACTIONS TO AVOID, MINIMIZE, AND MITIGATE WILDLIFE IMPACTS

The following section provides information regarding potential wildlife mitigation options that are available for the Project. Smart technology (described in Section 4.1), wildlife underpasses, fencing, and exit ramps are the preferred choice for this Project based on knowledge of known wildlife migration corridors as well as topographic constraints. It is important to note that at the time of installation and prior to each mining phase, the best technology will be evaluated (i.e., smart technology vs. underpass). As described in Section 2 to this report, a variety of wildlife species may occupy the Project, including small game, big game, and avian species. Generally, the mitigation options provided herein are geared toward helping to reduce the chance of wildlife-vehicle collisions and enhance the effectiveness of wildlife movement areas within or adjacent to the Project. As discussed in Section 2.4.4, wildlife movement areas include seasonal migration paths, winter range, within home range movements, and dispersal movements between populations. **Figures 9 through 13** to this report provides suggestions for the placement of site-specific mitigation features, including smart technology, wildlife underpasses, wildlife fencing, and exit ramps. The purpose of these mitigation features is to allow for continued wildlife use of the area during the life of the Project, while implementing protective measures to help avoid human-wildlife interactions. Mitigation options shown on **Figures 9 through 13** are placed in prioritization areas that are most likely to see wildlife-vehicle collisions and wildlife movement, as described in Section 2.4.4.

- **The goal of the mitigation options shown on Figures 9 through 13 is to disperse big game species away from the Project by installing smart technology and/or underpasses, wildlife fencing, and exit ramps at strategic locations where wildlife movements are known to occur.**

4.1 DESCRIPTION OF POTENTIAL MITIGATION OPTIONS

Wildlife Overpasses

Wildlife overpasses are a habitat conservation practice where structures are designed to allow for safe passage of terrestrial species over the top of human-made barriers. Of the types of human-made barriers that penetrate and divide wildlife habitat, roads have been the most widespread and have had the most

detrimental effects (Spellerberg 1998). Road fragmentation affects wildlife populations by decreasing the habitat quality and amount, increasing mortality due to wildlife-vehicle collisions, preventing access to foraging and other resources, and subdividing wildlife into smaller, more vulnerable populations. Generally, the advantage to using a wildlife bridge would be the potential to place soil and seed native vegetation along the top, creating a "green bridge" and increasing native plant habitat. Wildlife overpasses and underpasses should complement one another in that each are utilized to a greater extent by different species. As examples, mule deer and elk tend to prefer wildlife overpasses, while black bear and mountain lion generally prefer wildlife underpasses (Huijser 2008). The approach of the grades perpendicular to the road can be a determining factor in the feasibility of using a wildlife bridge versus a wildlife culvert. Wildlife bridges are typically less economical to construct than wildlife culverts.

Wildlife Culverts/Underpasses

Wildlife culverts/underpasses (preferred choice for this Project) are a habitat conservation practices where structures are designed to allow for safe passage of flightless, terrestrial species under human-made barriers. As with wildlife bridges, wildlife culverts/underpasses should be designed in coordination with CPW to determine optimal placement along the barrier. Studies have shown that underpasses can effectively be used underneath a two-lane highway (Western EcoSystems 2011, Capson 2014). Wildlife underpasses are most effective in conjunction with continuous fencing and berms to funnel wildlife movement into the underpasses. One advantage to using a wildlife culvert versus a wildlife bridge would be the opportunity to tie wetland and water drainage Projects into wildlife culvert Projects. Another advantage would be that wildlife culverts are more economical of the two. A disadvantage to using wildlife culverts is the possibility of snow and ice buildup, which can reduce the effectiveness of the underpasses. Wildlife culverts should be constructed in a manner where wildlife does not feel confined during use (Western EcoSystems 2011, Capson 2014).

Game Cameras

Game cameras should be installed at each wildlife culvert and bridge to determine the effectiveness of those mitigation measures and determine the needs around scheduled maintenance, sediment and/or snow and ice removal. Monitoring is a valuable tool to evaluate the use of underpasses and overpasses (Western EcoSystems 2011). Game cameras are a minimally disruptive means of observing wildlife and functional capacity of wildlife mitigation measures. Game cameras also provide a less invasive method of observing sensitive and protected species in the area than human observation. Cameras as a detection method allows for the possibility to alert wildlife managers of potential conflicts when they arise.

Wildlife Guards

Wildlife guards are metal grids placed on the ground (usually over ditches) with openings designed small enough to allow vehicles and pedestrians to pass over, and large enough that wildlife is unable to. Wildlife guards are similar to cattle guards, although they are generally at least twice the width of a standard cattle guard in order to accommodate for certain deer and pronghorn species' ability to jump over greater distances (Reed et al. 1974). Wildlife guards should be placed at all access roads onto the highway corridor to reduce wildlife accessibility. A disadvantage to the installation of wildlife guards is that they may be a potential hazard to cyclists and pedestrians (Peterson et al. 2003).

Wildlife Escape/Exit Ramps/Slope Jumps

Wildlife escape ramps are one-way passages designed to move wildlife out of areas that are detrimental to wildlife and human use, such as a roadway. Wildlife ramps can be designed in a variety of sizes and constructed with a variety of materials. Large ramps are considered the most effective but also the most expensive measure to escape from highway corridors (Dodd et al. 2007, Gagnon et al. 2009). These ramps are generally constructed with raised retaining walls of either pressure treated planks or concrete walls on footers. Ramps are typically built on relatively level terrain with a wall erected up to 6 feet, behind which, fill is used to create a sloping ramp on the fenced corridor side of the fence. An opening in the fence allows animals to jump out and down off the ramp yet prevents them from jumping up and breeching the corridor. Perpendicular wing fences help facilitate animals slowing down and seeing the opening in the fence through which they can escape the fenced corridor (AZDOT 2019). The smaller, scaled-down ramps are both functionally and cost effective, and thus increase their application under limited budgets. An escape ramp design constructed from anchored gabion baskets have also been used in the western U.S. (Bristow and Crabb 2008). This escape ramp design provides yet another cost-effective alternative to expensive full-sized ramp designs. Due to their lower cost and increased potential for application, along with their demonstrated effectiveness elsewhere (Hammer 2001), these small escape ramp designs provide a viable and preferred option to larger, more costly ramp designs. Slope jumps are an inexpensive measure for wildlife escape within a fenced/bermed corridor. Along the fencing an eight to twelve-foot section of the fence is lowered approximately to 4-5 feet above the ground with the down slope away from the highway. The shorter section of fencings creates an opening wildlife can identify and jump through onto the downslope. The gradient of the slope needs to be so that entry into the corridor from the downslope is not possible. Existing and future bridge abutments create a natural drop when complemented with wildlife fencing.

Wildlife One-Way Gates

The earliest reported application of escape measures were one-way gates with spring loaded metal tines (Reed et al. 1974). These one-way gates have been widely applied in the western U.S. and Canada, including along State Route 260. Gates are typically installed in the fence at fence offsets so that animals that travel along the fence encounter and thus pass through them, exiting the corridor. However, it has been reported that mule deer in Utah used earthen escape jumps 8 to 11 times more frequently than one-way gates (Hammer 2001, Bissonette and Hammer 2000). Although earthen jumps are considerably more expensive than one-way gates, it has been found that they were considerably more cost effective than one-way gates, when considering reduced incidence of wildlife-vehicle collisions associated with fenced corridors with ramps. Given the comparative reduced efficacy, one-way gates should be considered as a lower priority option for a wildlife escape measure from fenced corridors even with their relatively low cost and ease of installation.

Right-of-Way Vegetation Management

Increasing and enhancing lines of sight between motorists and wildlife would reduce incidents of wildlife-vehicle collisions. Improved visibility can be facilitated by removal of vegetation and maintenance of grass and herbaceous plants. Grasses and herbaceous vegetation are a food source for ungulates in a forested

environment and may be an attractant (Rea et al. 2003). The creation of open habitat could reasonably be a deterrent to smaller animals such as birds and butterflies, increasing the barrier effect of roads. A roadside vegetation management plan should be designed with small animal habitat, visibility, and reduction of wildlife-vehicle collisions in mind.

Wildlife Safe Fencing

Wildlife safe fencing is an important component in mitigation design for highway corridors and mining activities. All fencing that are problematic for wildlife including loose wires, barbed wires, wires spaced too closely together, and fencing that lacks the appropriate number of breaks, crossings, and wildlife escape ramps in the instance of road corridors. Mitigating wildlife-vehicle collisions at the ends of wildlife fencing is an important component to reducing conflicts along gaps in corridor barriers. Wildlife warning signs, ending the fence near the road, boulder fields between the fence and road, wildlife guards across the road, electric mats embedded in the road surface, and strategies that allow for better driver visibility such as ending fences on straight highway sections or with increased lighting are all effective mitigation strategies for reducing collisions (Huijser et al. 2008).

Earthen Berms

Earthen berms should be placed strategically to complement wildlife safe fencing that would help to funnel wildlife to the designated road crossings (overpasses and underpasses). Berms should also be used alongside wildlife safe fencing to encompass the entire mining operation minimize conflict between wildlife and human operations. Earthen berms can be installed or retrofitted along wildlife underpasses with ledges to encourage tunneling by mid-size mammals and amphibians of varying sizes (Veenbaas et al. 1999). Additional benefits to installing berms parallel with road corridors is the reduction of traffic disturbance and noise to the surrounding habitat, while also enhancing roadside snow drift controls.

Avoid Impacts to Riparian and Other Important Wildlife Corridors

Riparian and other important corridors should be preserved and protected to the greatest extent practicable. Riparian corridors are unique habitats that provide critical habitat and migration pathways for a variety animal species. Other important wildlife corridors may be considered in the placement of wildlife crossings and reducing impacts. For example, Canada lynx (*Lynx canadensis*), an endangered species, prefers to travel along ridges and saddles within tree cover through the mountains (Koehler 1990). A minimum of a 50 buffer, extending from the riparian corridor edge (not just the wetland buffer) should be established and maintained. Preserving movement along these corridors would be essential for optimizing wildlife crossing effectiveness.

Problem Species Management

Right-of-way corridors and lands in and around mining activities should be routinely maintained to prevent the establishment and spread of noxious weeds. Disturbed lands should be temporarily or permanently reclaimed with appropriate native species to provide competition for invasive plant species. Impacts from problematic animal species should be considered during construction and maintenance efforts. For example, the mountain pine beetle (*Dendroctonus ponderosae)* is a native Colorado bark beetle that predominately infest ponderosa pine (*Pinus ponderosa*), lodgepole pine (*P. contorta*), and limber pine (*P.*

flexilis). Eventually infestation can lead to the death of the host tree and become a hazard to the roadway, mining operation, or other mitigation structures. Management may include removal of infested trees, using trap trees, solar treatments, pesticides, or pheromone packets (Leatherman et al. 2011).

Avoid Construction Operation during Nesting Season

Locally, mining operations may cause severe displacement of terrestrial species causing stress to be placed on adjacent lands. Mining operations being performed outside of the nesting season for a bird species may mitigate disruptions and reduce overall displacement. No new mining areas should be opened during the active nesting season. Rearing young requires intense energy expenditure for the parents and is a highly vulnerable time for offspring bound to the nest. Implementing CPW buffer recommendations during construction and maintenance may help to eliminate destruction of or disturbance to active nests (CPW 2020).

Minimize Artificial Light Use at Night

Artificial lighting at nighttime in and around mining operations and roadways has a detrimental effect on wildlife and should be minimized to the greatest extent practicable while maintain safe operations. Artificial light disturbs sleep cycles (Raap et al. 2015), interrupts predation activities (Rich et al. 2006), and influences plant-animal interactions (Bennie et. al 2015). Non-essential nighttime lights should be turned off during non-operating hours and lighting should not spill off site to avoid unnecessary nighttime wildlife disturbance. Lighting should not extend into riparian or other important wildlife corridors.

Increasing Wildlife Signage, Controlling Traffic Volume, and Speed

Strategically placed wildlife warning signs have shown to increase motorist's alertness while driving through highway corridors. Flashers should be installed to wildlife signage and triggered at dawn, dusk, or throughout the night depending on the site-specific placement. Automatic speed cameras are an effective tool in speed reduction and vehicle collision reduction (Decina et al. 2007). A systematic review of the effectiveness of speed cameras showed a reduction in vehicle speed by an average of between 1-15%, a reduction in the proportion of vehicles violating the speed limit by 14-65%, a reduced total of crashes by 8-49%, and reduced fatal and serious-injury crashes 11-44% (Wilson et al. 2010). Traffic volume and speed are contributing factors to wildlife road mortality. This relationship is not necessarily linear and can vary by species (Charry et al. 2009). If it is known when traffic and wildlife will interact over a specific period, temporary mitigation measures that reduce traffic or slow vehicle speeds may be useful. Traffic calming measures may also include increased human enforcement in speed reduction zones, use of speed bumps, and road design measures. Speed limit reduction could be implemented during night-time or seasonally for migration events. Digital signage with variable speed limit controls would allow for ease in implementation.

Smart Technology

Smart technology is being considered at several locations for the Project. At the time of installation and prior to each mining phase, the best technology will be evaluated (i.e., smart technology vs. underpass or combination). Smart technology may include a variety of options discussed above or a combination of mitigation options that best suit the type of species where mitigation is warranted. For example, fencing

in combination with crossing structures (underpass, exit ramp, etc.) may be the most effective system for terrestrial wildlife. It may also be determined that at-grade wildlife crossings provide more benefit versus grade-separated wildlife crossings (i.e., underpass/overpass), especially in areas where topography may constrain the placement of underpasses. Due to topographic constraints or other factors, underpasses may not be the best choice for wildlife. Smart technology may also include future technology yet to be designed (i.e. remote sensing, wildlife detection systems, etc.).

4.2 MITIGATION ACTION SUMMARY TABLE

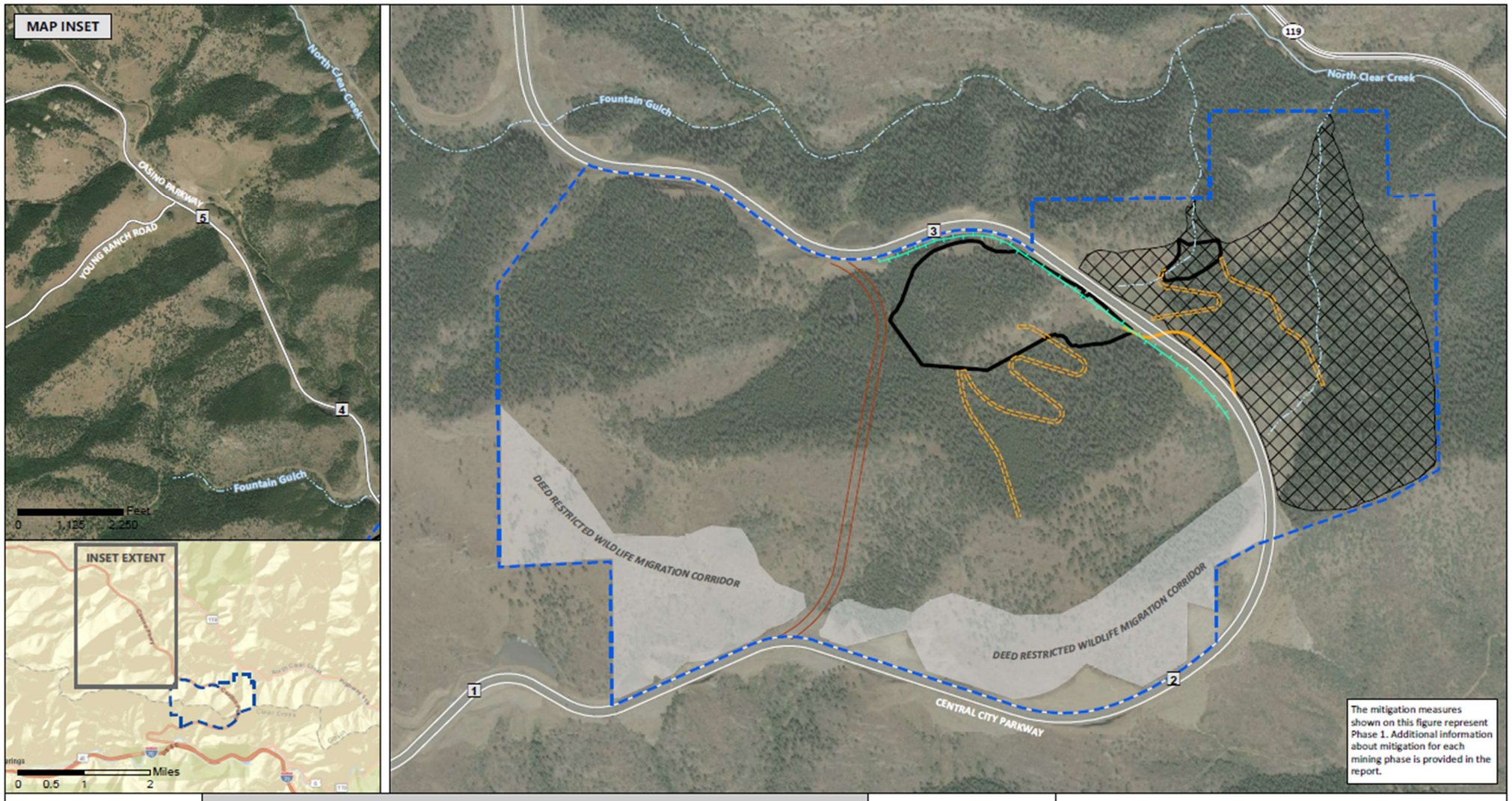
Table 7 below provides a summary of potential mitigation options for the Project. Additionally, **Figures 9 through 13** provides priority areas within and adjacent to the Project where certain mitigation options are recommended. The mitigation areas shown on **Figures 9 through 13** are the locations most likely to have either wildlife-vehicle conflict and/or wildlife movement.

Table 7. Mitigation Action Summary Table

Mitigation Action Summary Table		
Action	Intended Effect	Potential Concerns
Wildlife Overpasses	Create safe passage for wildlife species across human made barriers. Allow for additional native plant habitat creation.	May aid in the spread of invasive species, fire, parasites, and pathogens. Cost can be prohibitive.
Wildlife Culverts/Underpasses (preferred choice)	Create safe passage for wildlife species across human made barriers. Could be in conjunction with wetland and stream preservation Projects.	May aid in the spread of invasive species, parasites, and pathogens. Maintenance may be required to remove ice and snow build up.
Game Cameras	Document effectiveness and utilization of mitigations measures/maintenance needs.	Observation is limited to mid-size to larger animals and by camera angles
Wildlife Guards	Prevention of wildlife from entering on access roadways into fenced highway corridors and mining operations.	Hazardous to cyclist and pedestrian.
Wildlife Escape Ramps/Slope Jumps	Allow for wildlife that have entered onto fenced highway corridors to exit.	Relative cost to one-way gates. Slope jumps require specific topography to be effective.

Wildlife One-way Gates	Allow for wildlife that have entered onto fenced highway corridors to exit.	Limited relative efficacy to escape ramps.
Vegetation Management in the Right-of-Way	Increase visibility along roadways to allow for wildlife and motorist early detection of one another. Reduce spread of invasive plant species.	Sustained seasonal maintenance.
Wildlife Safe Fencing	Funneling wildlife towards crossings and preventing wildlife from entering highway corridors and mining operations. Preventing human-wildlife conflicts.	Some maintenance required to prevent loose wiring and contiguous effectiveness.
Earthen Berms	Funneling wildlife towards crossings and preventing wildlife from entering highway corridors and mining operations. Preventing human-wildlife conflicts. Increasing snow drift barrier protection and low-cost noise reduction	Could create a visual barrier for motorists when wildlife is behind the berm within the highway corridor.
Avoid Impacts to Riparian and Other Important Wildlife Corridors	Protects critically important, wetlands, streams, corridor habitats, and riparian and other site-specific dependent species.	Initial construction costs may be increased.
Problem Species Management	Enhance native habitat disturbed by highway corridors and mining operations, reduce tree fall danger, mitigate fire danger potential, and reduce mitigation measure damage costs.	Sustainable seasonal maintenance.
Avoid Construction Operation during Nesting Season	Reduce impacts during energy intense rearing process to birds	Limited season without potential for snow and ice during construction.
Minimize Artificial Light Use at Night	Reduce detrimental effects of artificial lighting on wildlife and plant-wildlife cycles.	Reduce visibility dependent safety measures.

Increasing Wildlife Signage, Controlling Traffic Volume, and Speed	Increase motorist alertness, reduce vehicle speeds, and increase available reaction times for motorists.	Flasher and lighting around signs may increase light pollution along roadways.
Smart Technology	Create safe passage for wildlife species across human made barriers. Incorporates a variety of mitigation options that best suit the Project. Allows for the use of future technologies (i.e., remote sensing, wildlife detection systems, etc.)	No Concerns



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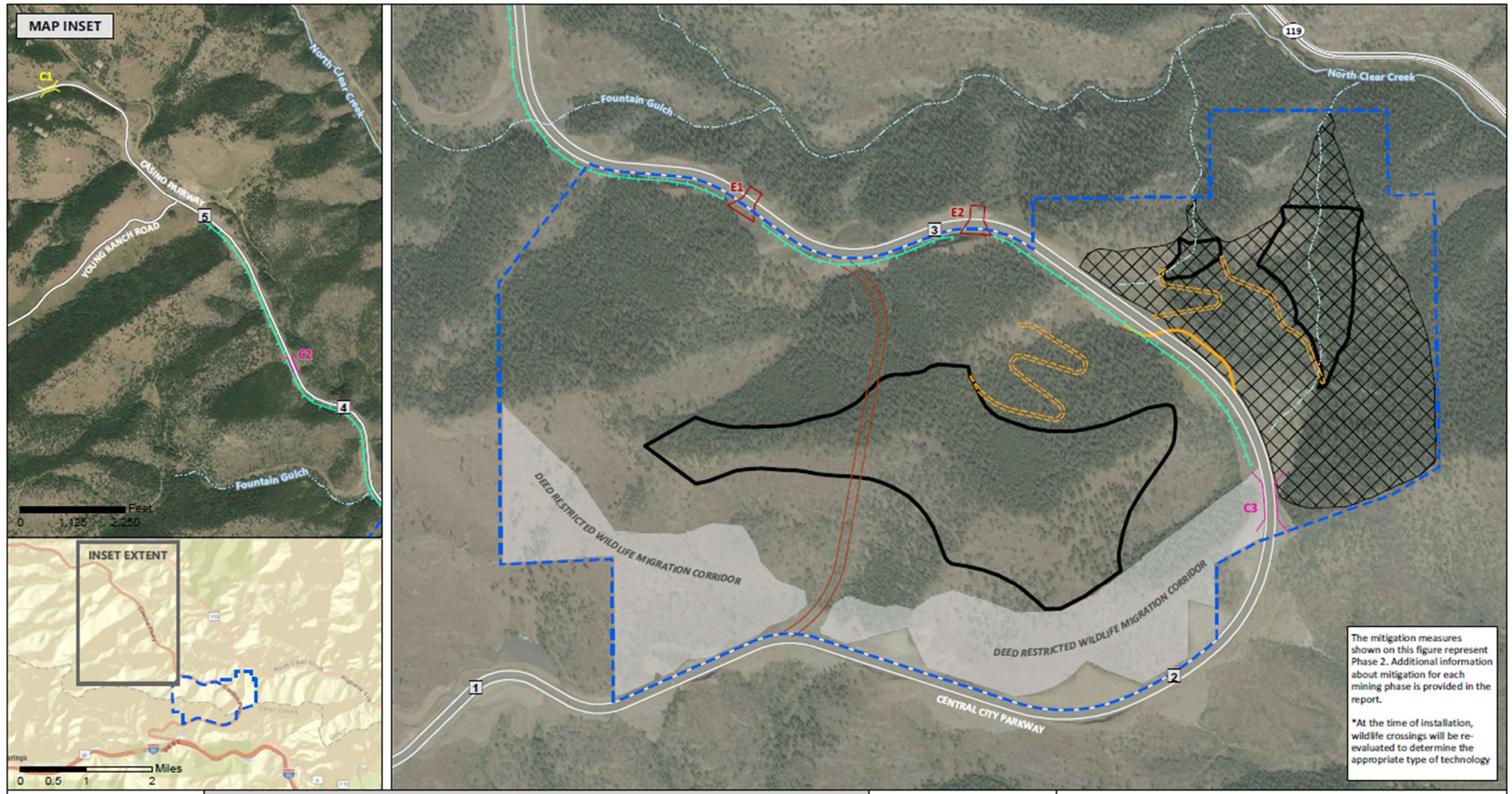
MAP LEGEND

- DRMS Permit Boundary Phase
- Boundary
- Waste Rock Landfill
- New Internal Gravel Access Road
- Gravel Access Road - Phase 1
- On/Off Ramp
- Proposed Wildlife Fencing
- Highway/Main Road
- Mile Marker
- Perennial Stream
- Intermittent/Ephemeral Drainage

0 250 500 1,000 Feet

FIGURE 9. PROPOSED MITIGATION OPTIONS PHASE 1

WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO



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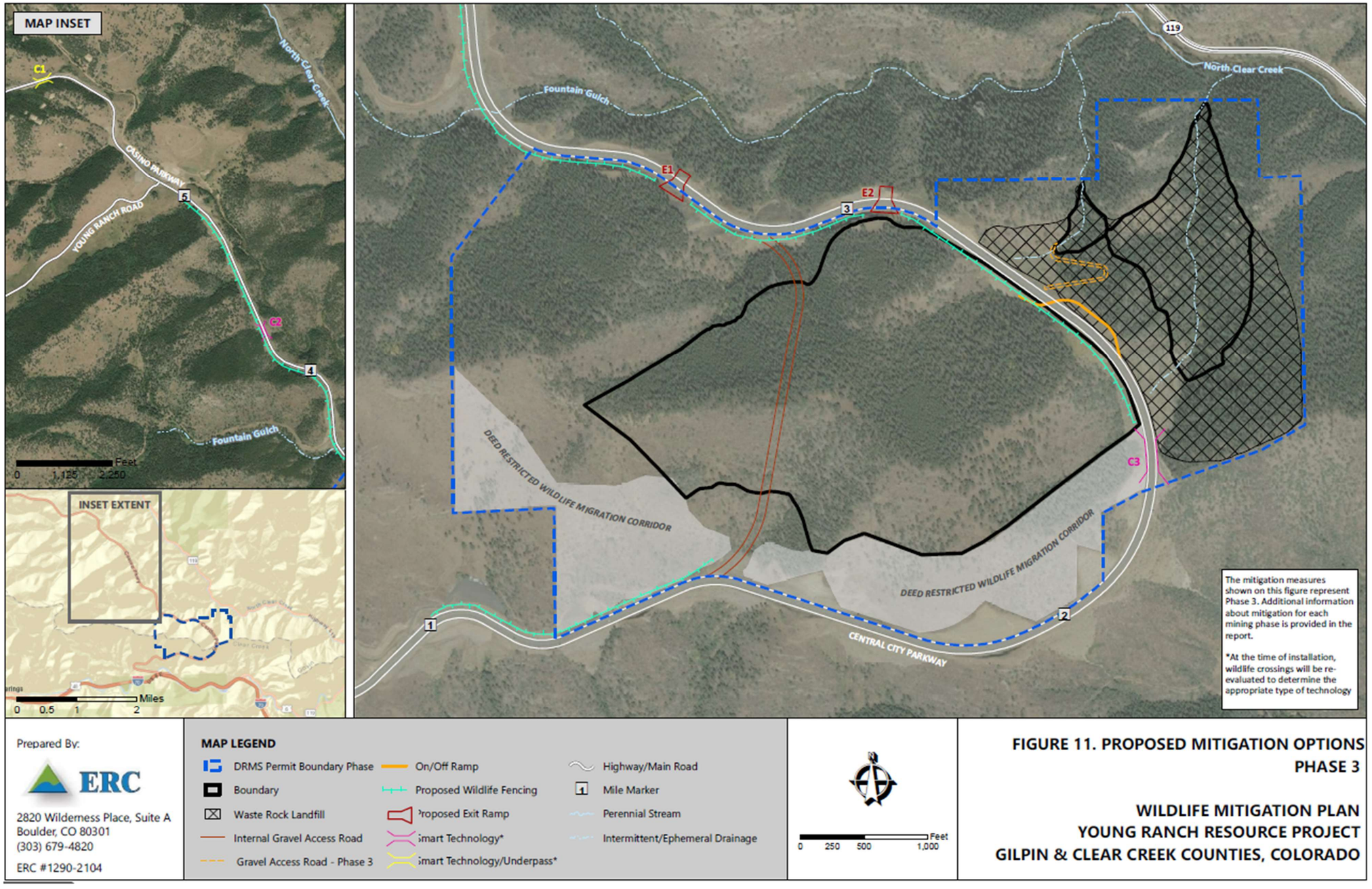
MAP LEGEND

- DRMS Permit Boundary Phase
- Boundary
- Waste Rock Landfill
- Internal Gravel Access Road
- Gravel Access Road - Phase 2
- On/Off Ramp
- Proposed Wildlife Fencing
- Proposed Exit Ramp
- Smart Technology*
- Smart Technology/Underpass*
- Highway/Main Road
- 1 Mile Marker
- Perennial Stream
- Intermittent/Ephemeral Drainage

Feet
0 250 500 1,000

FIGURE 10. PROPOSED MITIGATION OPTIONS PHASE 2

WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO



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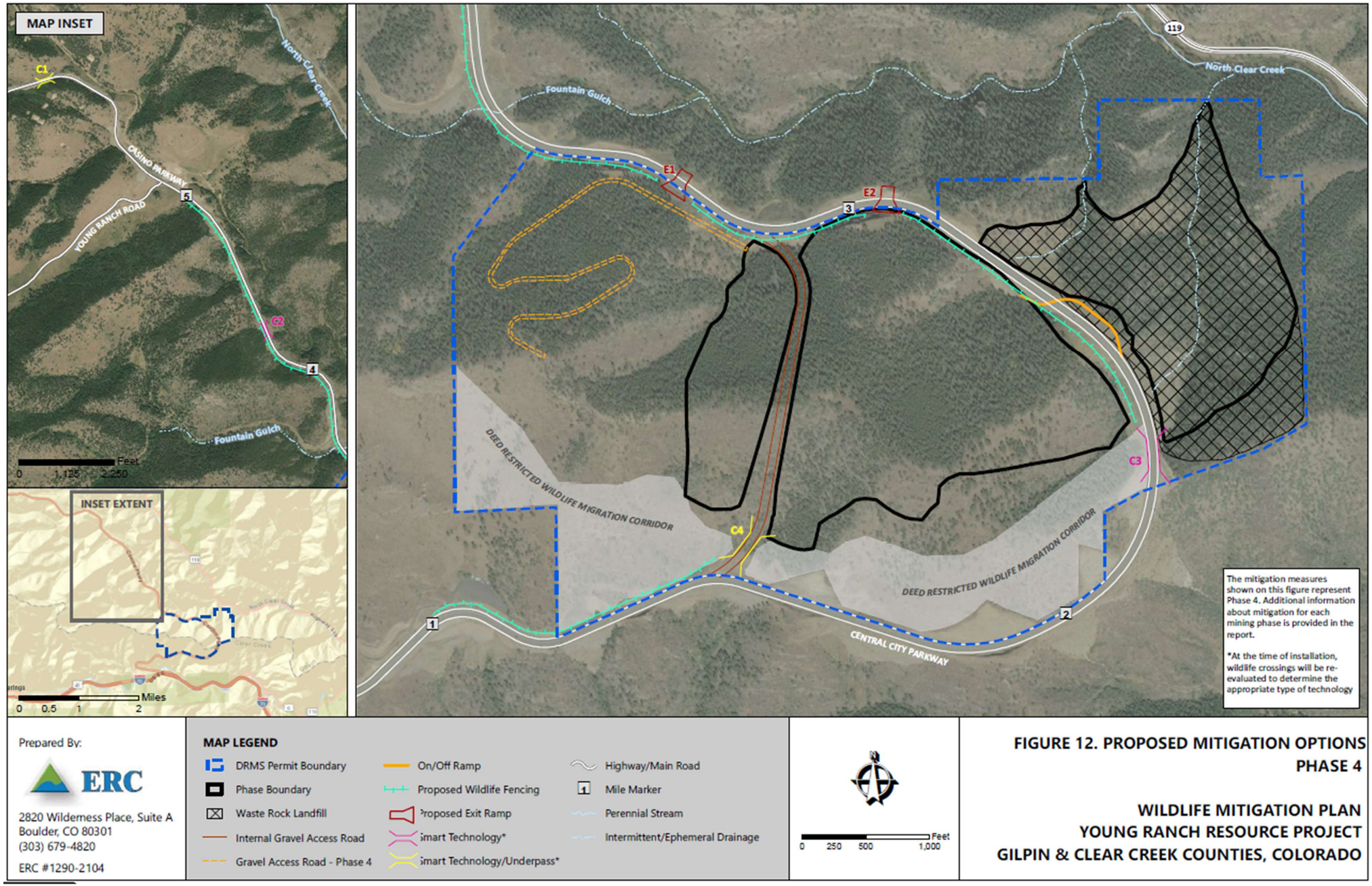
MAP LEGEND

- DRMS Permit Boundary Phase
- Boundary
- Waste Rock Landfill
- Internal Gravel Access Road
- Gravel Access Road - Phase 3
- On/Off Ramp
- Proposed Wildlife Fencing
- Proposed Exit Ramp
- Smart Technology*
- Smart Technology/Underpass*
- Highway/Main Road
- Mile Marker
- Perennial Stream
- Intermittent/Ephemeral Drainage

Feet
0 250 500 1,000

FIGURE 11. PROPOSED MITIGATION OPTIONS PHASE 3

WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO



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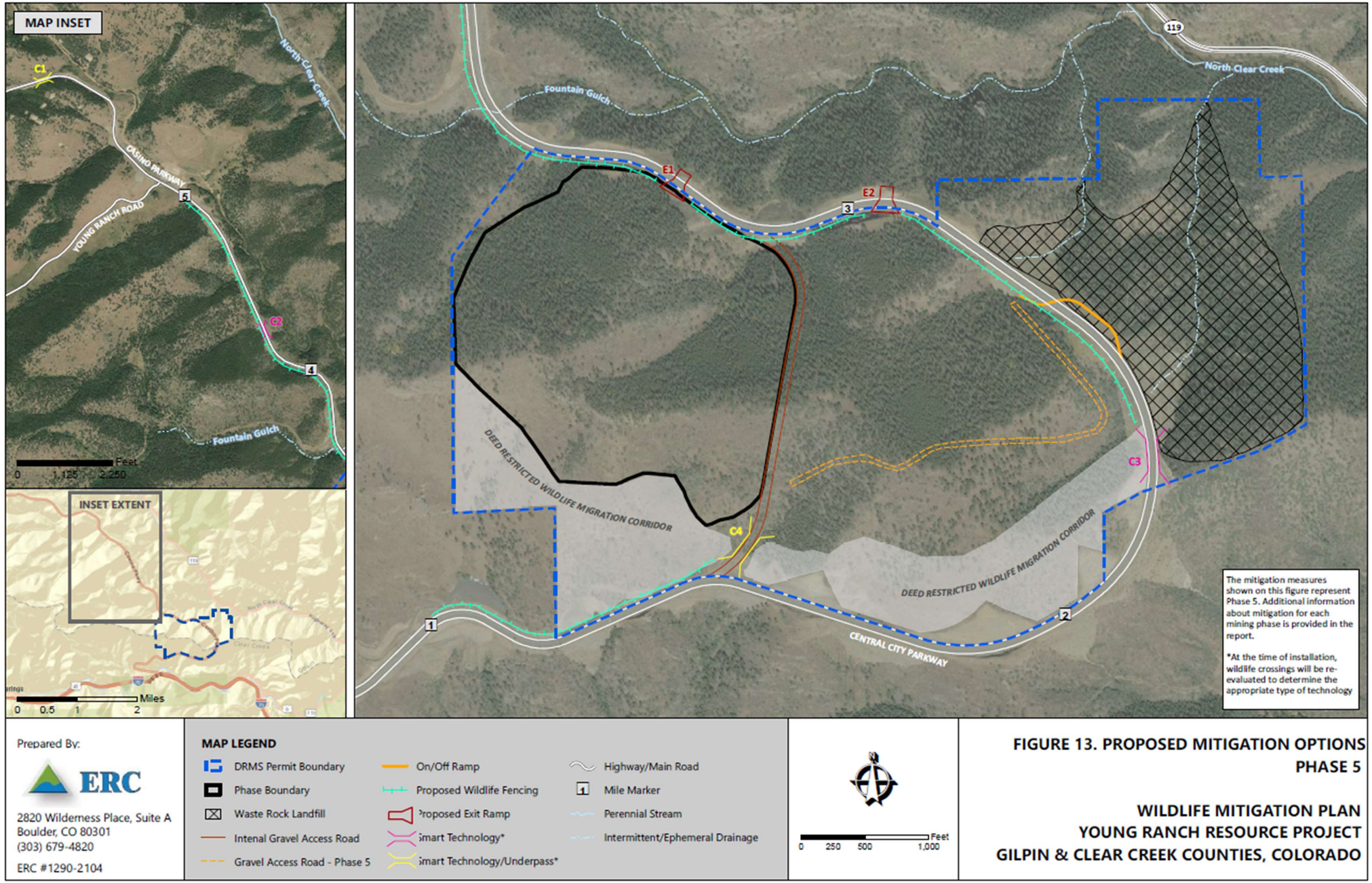
MAP LEGEND

- DRMS Permit Boundary
- Phase Boundary
- Waste Rock Landfill
- Internal Gravel Access Road
- Gravel Access Road - Phase 4
- On/Off Ramp
- Proposed Wildlife Fencing
- Proposed Exit Ramp
- Smart Technology*
- Smart Technology/Underpass*
- Highway/Main Road
- Mile Marker
- Perennial Stream
- Intermittent/Ephemeral Drainage

Feet
0 250 500 1,000

FIGURE 12. PROPOSED MITIGATION OPTIONS PHASE 4

WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO



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MAP LEGEND

- DRMS Permit Boundary
- Phase Boundary
- Waste Rock Landfill
- Intenal Gravel Access Road
- Gravel Access Road - Phase 5
- On/Off Ramp
- Proposed Wildlife Fencing
- Proposed Exit Ramp
- Smart Technology*
- Smart Technology/Underpass*
- Highway/Main Road
- Mile Marker
- Perennial Stream
- Intermittent/Ephemeral Drainage

Feet
0 250 500 1,000

FIGURE 13. PROPOSED MITIGATION OPTIONS PHASE 5

WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE PROJECT
GILPIN & CLEAR CREEK COUNTIES, COLORADO

5.0 SUMMARY AND PROJECT SCHEDULE

Providing big game animals with safe opportunities to cross roadways and disturbed areas can greatly reduce potential impacts of roadways, open pits, processing areas, and disposal areas associated with the Project. To ensure effectiveness, mitigation measures should be placed in locations where animals naturally approach and cross certain areas. Design-based mitigation should consist of minimizing barriers to lessen the impact of at-grade crossings or providing structures for above- or below-grade crossings while using barriers to reduce at-grade crossings. Additionally, habitat management (i.e., revegetation) near suspected migration routes or seasonal ranges within the Project (i.e., south facing slopes for bighorn sheep) may help reduce crossing rates in high disturbance areas. The following provides a generalized list for consideration.

1. **Berms and fencing.** Tall earthen berms with native vegetation should be placed strategically around Project area in effort to reduce visual disturbance and noise. Wildlife-safe exclusion fencing should also be considered to surround the active work zones to discourage wildlife access thereby minimizing human-wildlife conflict with operations. Fencing should be eliminated in non-active work zones to promote wildlife use.
2. **Mitigation Project Locations.** As shown on **Figures 9 through 13**, there are numerous locations within the Project where underpasses, exit ramps, or other structures may be placed to promote wildlife movement through the Project. To identify the location of these features, habitat suitability or areas where animals are likely to concentrate should be the primary indicator of crossing activity. Consider how landscape structure (i.e., steep slopes, natural barriers, etc.) interact with habitat suitability to increase the level of use an area receives wildlife. Additionally, the type of mitigation being installed will be re-evaluated during each phase.
3. **Phased mining approach.** As discussed in Section 1.2 and Section 3.5, mining will occur in five phases. Interim reclamation will occur between phases, allowing potential wildlife habitat to become re-established prior to the completion of overall mining activities. Reclamation should be completed as soon as possible with each phase. This will allow potential wildlife use on portions of the Project during the operating period.
4. **Weed Control.** All disturbed and non-disturbed lands should be routinely maintained to prevent the establishment and spread of noxious weeds. Any non-active disturbed lands should be temporarily or permanently reclaimed with appropriate native species.
5. **CCP Wildlife Signage**. Upon further discussion and approval from Central City Parkway management, additional wildlife caution signs may be appropriate in the vicinity of the Project along the CCP to warn motorized vehicles and minimize wildlife collisions.
6. **Employee Education**. Project employees should be educated on the sensitivity of wildlife harassment in the area.
7. **Secure Dumpsters and Debris.** All dumpsters and debris should be contained in wildlife safe containers from not only bears but also birds and small mammals.
8. **Final Reclamation.** The final reclamation plan is essential to ensure only temporary disturbances occur. The reclamation plan should consider reestablishment of appropriate native species and local habitat communities. Upon reclamation the area should be reopened for wildlife use and general open space to minimize long-term regional impacts to wildlife. The seed mix chosen for revegetation of the Project should be selected to establish a diverse, effective, and long-lasting vegetative cover that is

capable of self-regeneration without continued dependence on irrigation, soil amendments or fertilizer, and provides equal or better coverage than the existing vegetation of the surrounding area. Plantings should be limited to grasses, forbs, and trees that are well-suited to the Project considering the soils and climate. The overall goal (and it is anticipated) that revegetation of the Project will provide better forage/habitat for wildlife versus existing conditions, which are degraded and overgrazed (i.e., poor quality habitat).

9. **Traffic Control**. Posted speed limits should be observed and slow down lanes will be installed at the Project entrance (CCP on/off ramp) to enhance safety. During mining operations, truck operators should be advised of potential wildlife hazards. Additional wildlife signage will be placed along the CCP.

As shown on **Figures 9 through 13**, proposed mitigation options will be installed that are unique and tailored to each mining phase. Additionally, mitigation options will be installed on portions of the CCP north of the Project (between mile markers 4 through 6). No wildlife mitigation is currently present along the CCP. The locations of these mitigation options have been selected at each location based on local site knowledge, topographical constraints, knowledge of wildlife movement/migration routes, as well as overall habitat considerations. Additionally, the Deed Restricted Wildlife Migration Corridor has been set aside along the southern Project boundary. This migration corridor will provide a permanent migration corridor for bighorn sheep (and other wildlife) during the life of the Project.

Table 8 below provides a summary of the mitigation options that will be installed during each phase of the Project. It is important to note that at the time of installation, wildlife crossings will be re-evaluated to determine the appropriate type of technology (i.e., Smart Technology).

Table 8. Mitigation Installation Schedule

Project Phase	Mitigation Options
Pre-Mine/Opening: 1 year	• Install wildlife crossing signs along CCP, install wildlife monitoring cameras at selected locations (locations TBD)
Phase 1 (**Figure 9**): 6 years	• Install wildlife fencing along Phase 1 portion of the CCP immediately north and south of the on/off ramp to the mine entrance
Phase 2 (**Figure 10**): 7 years	• Install smart technology/underpass[1] wildlife crossing C1 • Install smart technology wildlife crossing C1, C2 and C3 • Install wildlife exit ramps E1 and E2 • Install wildlife fencing along CCP from Phase 1 area past Phase 2 to CCP mile marker 5.
Phase 3 (**Figure 11**): 30 years	• Install wildlife fencing from CCP MM 1 to the central access gravel road.
Phase 4 (**Figure 12**): 9 years	• Install smart technology wildlife crossing C4 along internal gravel access road.
Phase 5 (**Figure 13**): 43 years	• Continue wildlife monitoring at appropriate crossings.

[1]Crossings where both smart technology and/or an underpass is proposed will be re-evaluated prior to each mining phase to determine which technology will be used.

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APPENDIX A

Site Photographs

Appendix A. Photographs showing characteristics of habitat identified within the Project Area.

Photo 1. Overview of upland vegetation near the central portion of the Project Area, west of Central City Parkway.

Photo 2. Overview of upland vegetation and topography of the central portion of the Project Area, west of Central City Parkway.

Photo 3. Typical understory throughout the Project Area.

Photo 4. View east of the Southern Rocky Mountain Montane Shrubland vegetation community within the southern portion of the Project Area.

Photo 5. Overview of northern drainage in the north-central portion of the Project Area.

Photo 6. Overview of north central portion of Project Area, south of Central City Parkway. Central Rocky Mountain Dry Lower Montane-Foothill Forest vegetation community.

Photo 7. View east of eastern portion of the Project Area. East of Central City Parkway

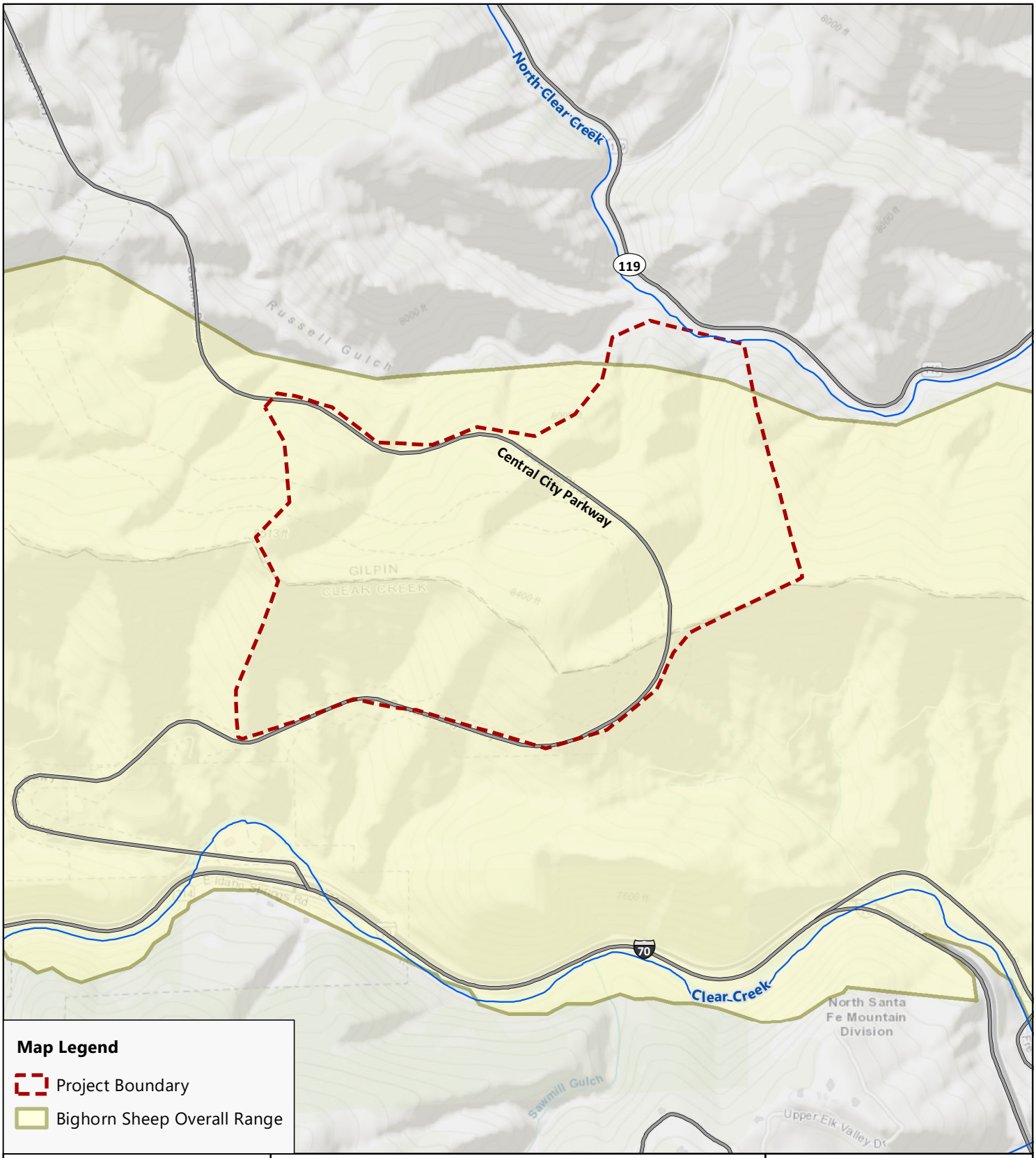
Photo 8. View west of the Southern Rocky Mountain Montane Shrubland vegetation community within the western portion of the Project Area.

Photo 9. Overview of the Western North American Temperate Cliff, Scree, and Rock Vegetation community.

Photo 10. Overview of the Western North American Temperate Cliff, Scree, and Rock Vegetation community.

APPENDIX B

Colorado Parks and Wildlife (CPW) Species Activity Mapping (SAM) Maps by Species



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BIG HORN SHEEP - OVERALL RANGE
CPW SPECIES MAP
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE MINE
GILPIN & CLEAR CREEK COUNTIES, COLORADO

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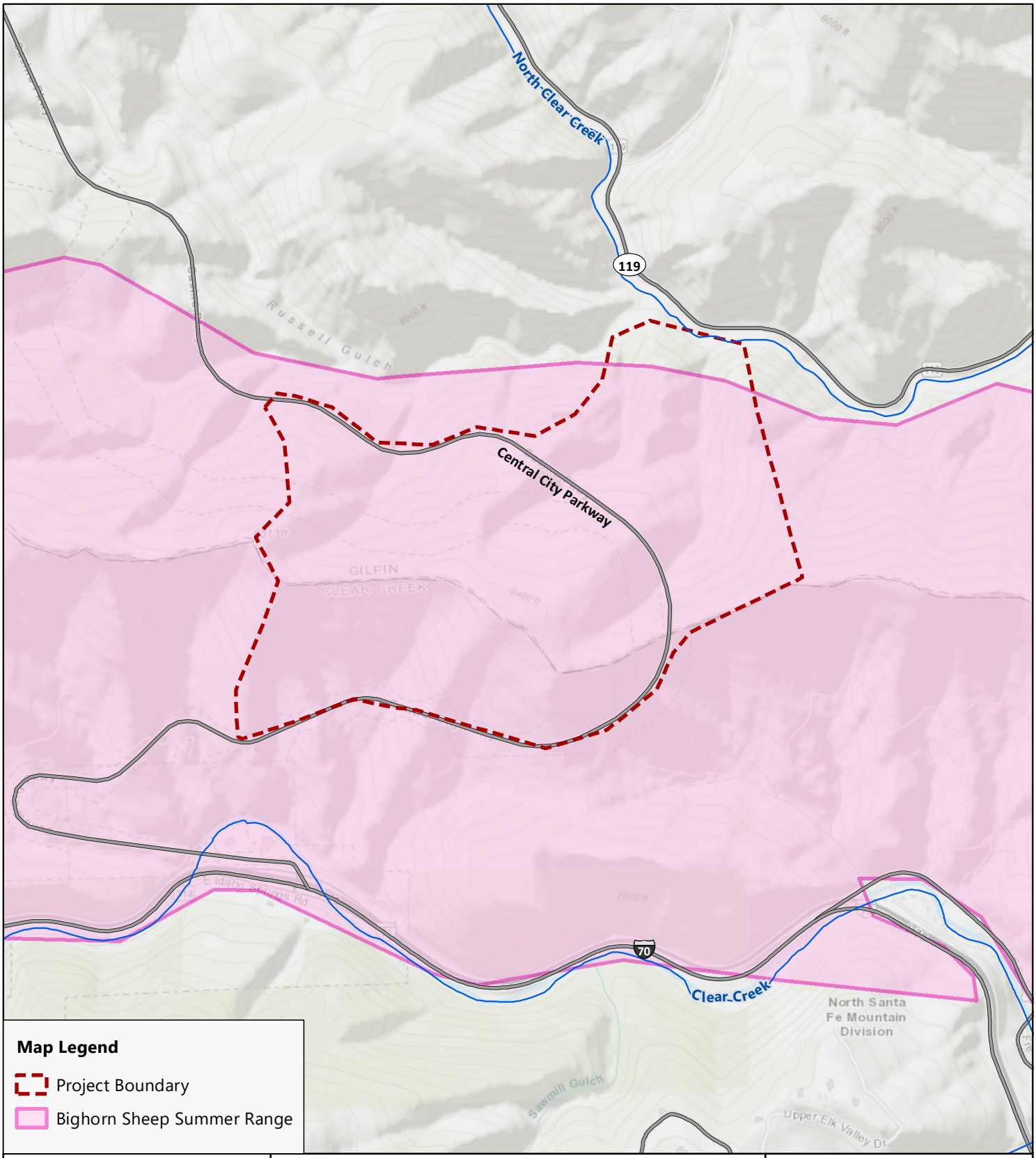

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BIG HORN SHEEP - SUMMER RANGE
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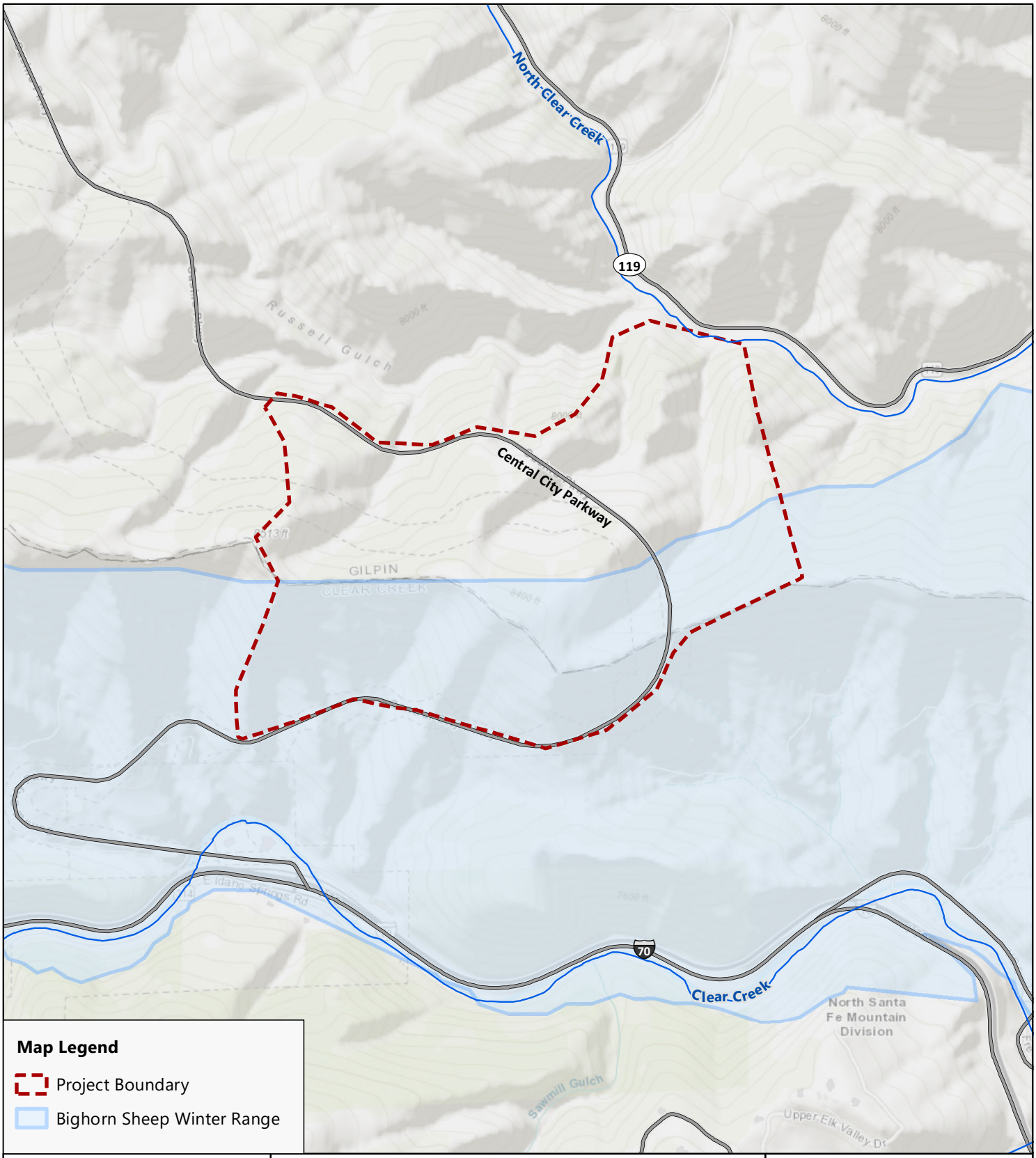

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BIG HORN SHEEP - WINTER RANGE
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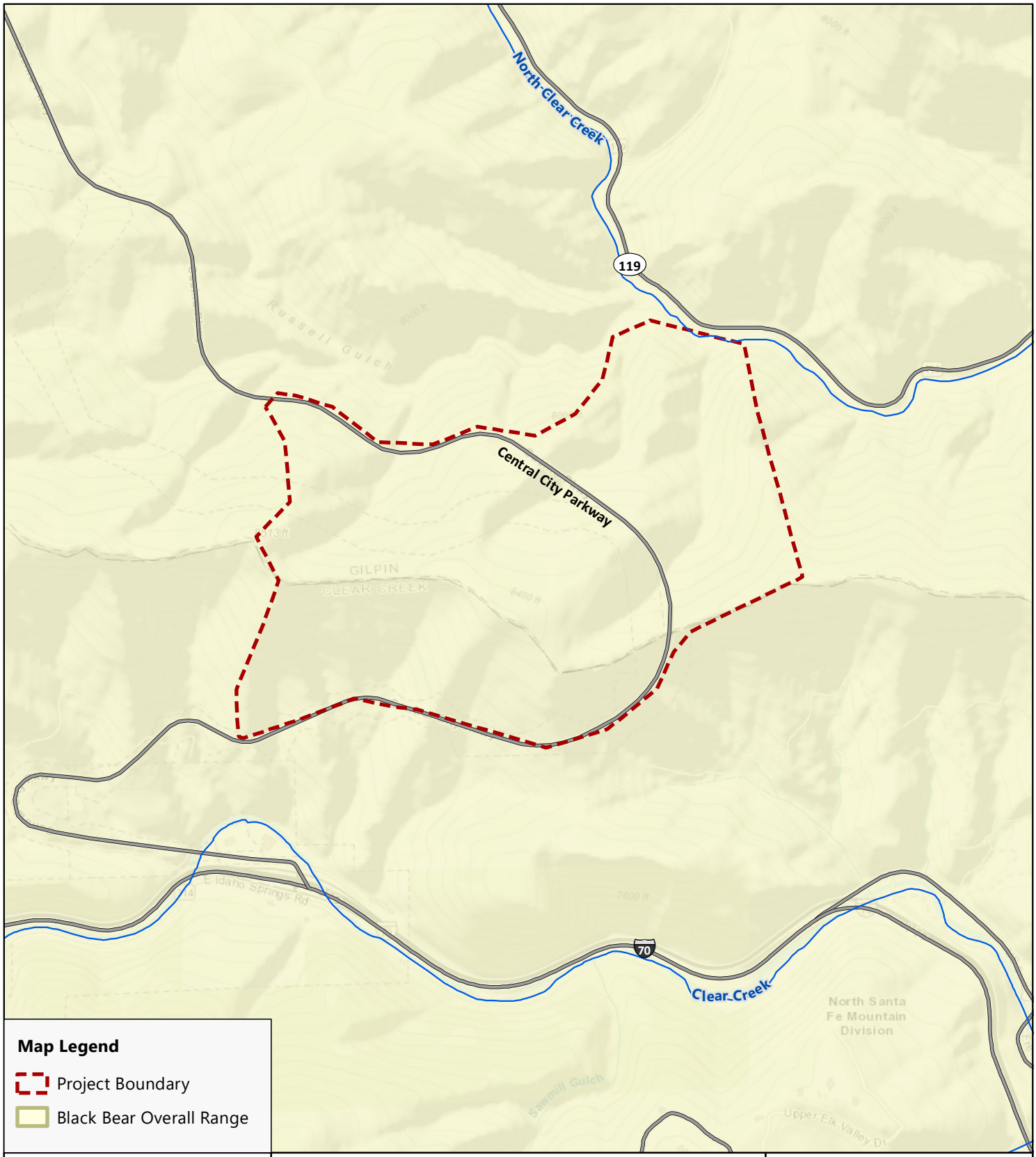

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BLACK BEAR - OVERALL RANGE
CPW SPECIES MAP
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GILPIN & CLEAR CREEK COUNTIES, COLORADO

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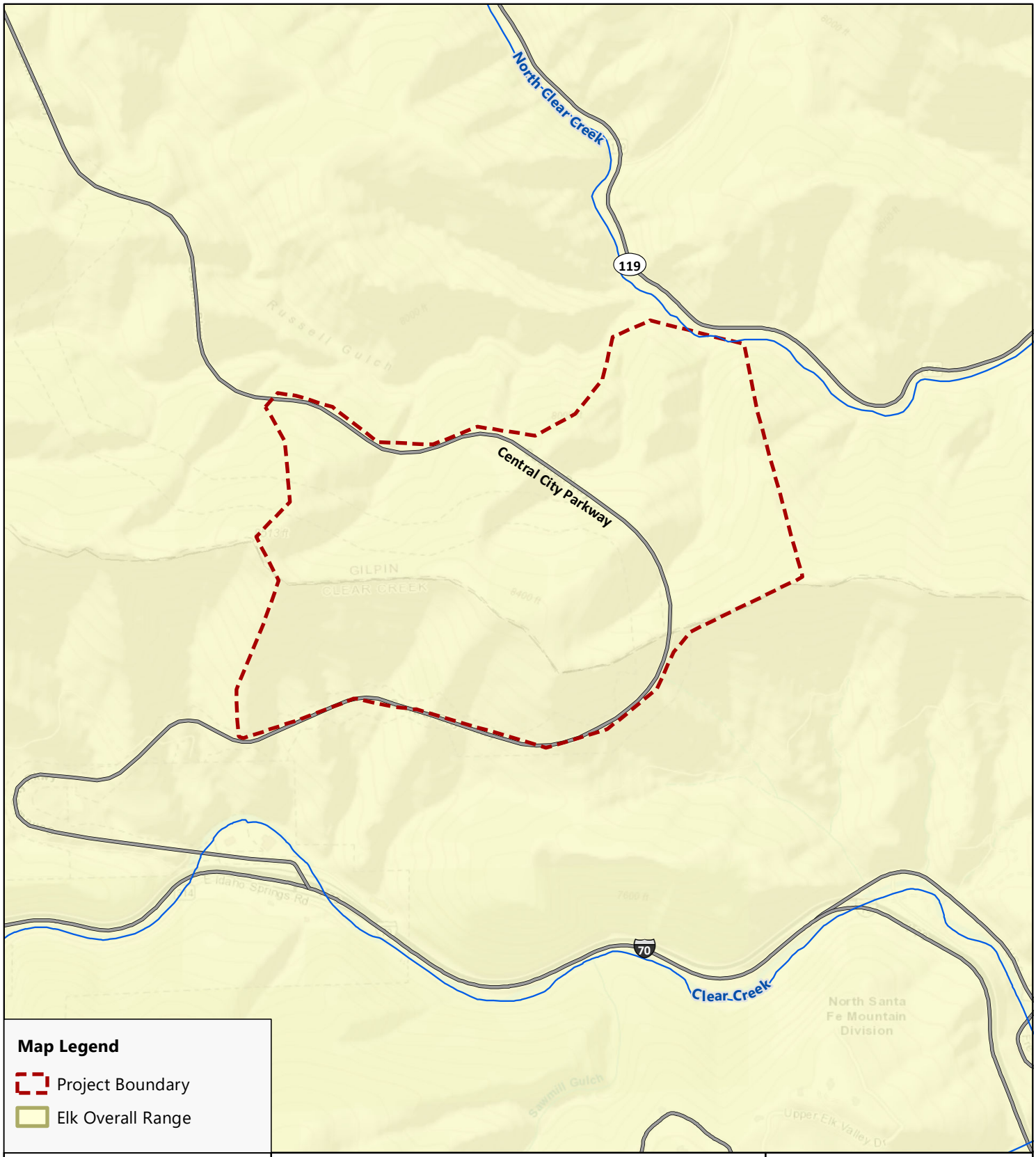

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ELK - OVERALL RANGE
CPW SPECIES MAP
WILDLIFE MITIGATION PLAN
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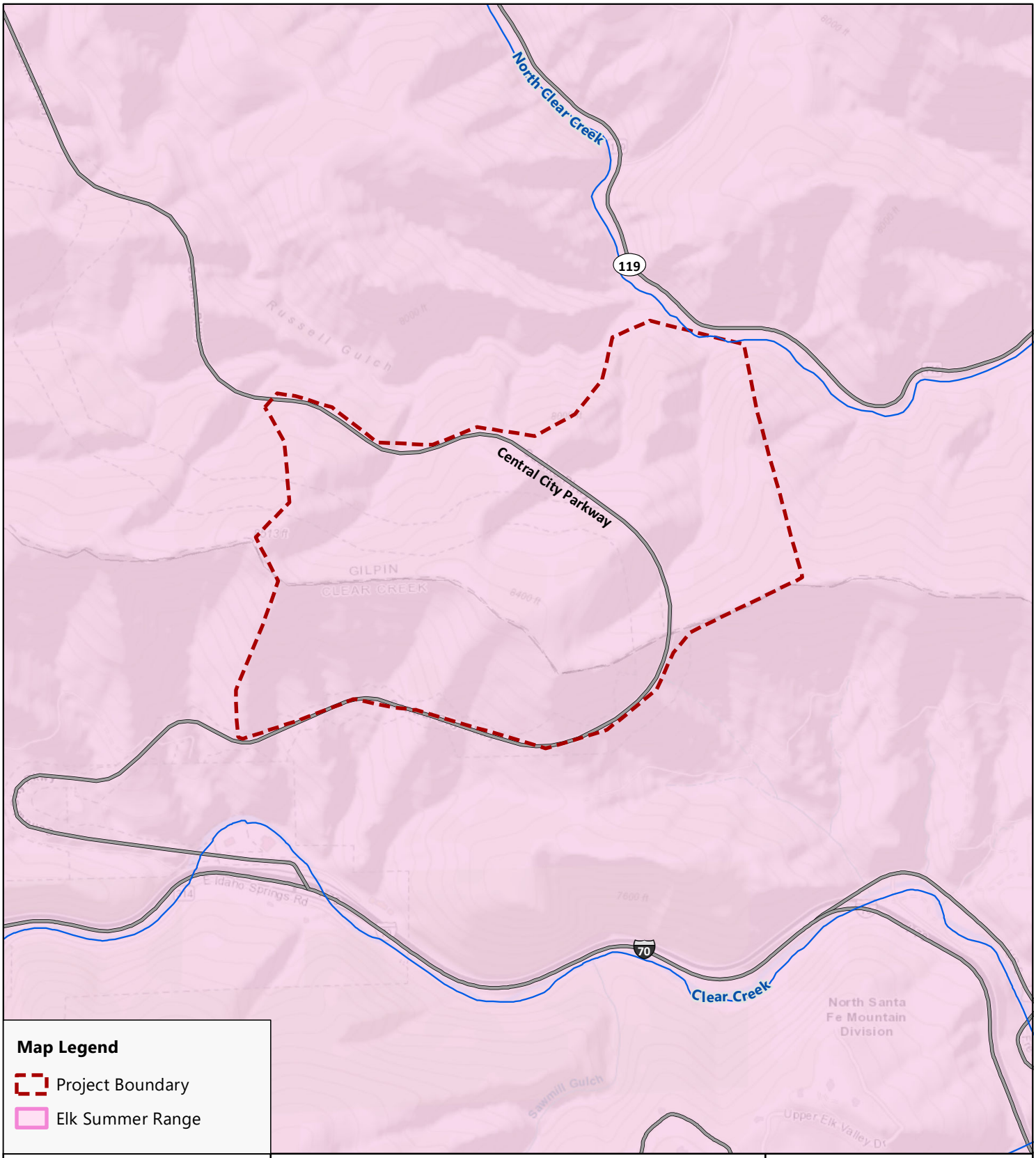

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ELK - SUMMER RANGE
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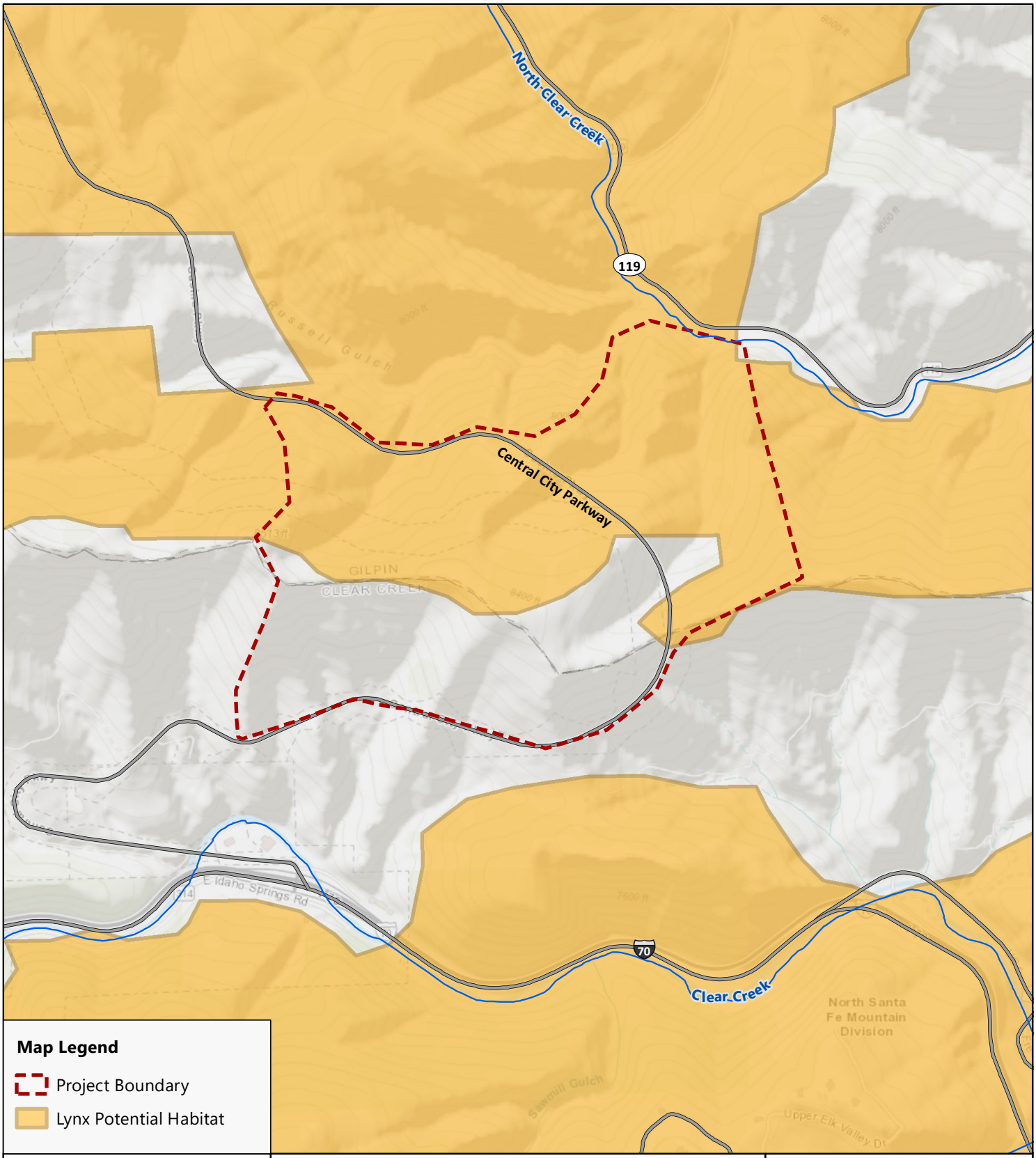

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LYNX - POTENTIAL HABITAT
CPW SPECIES MAP
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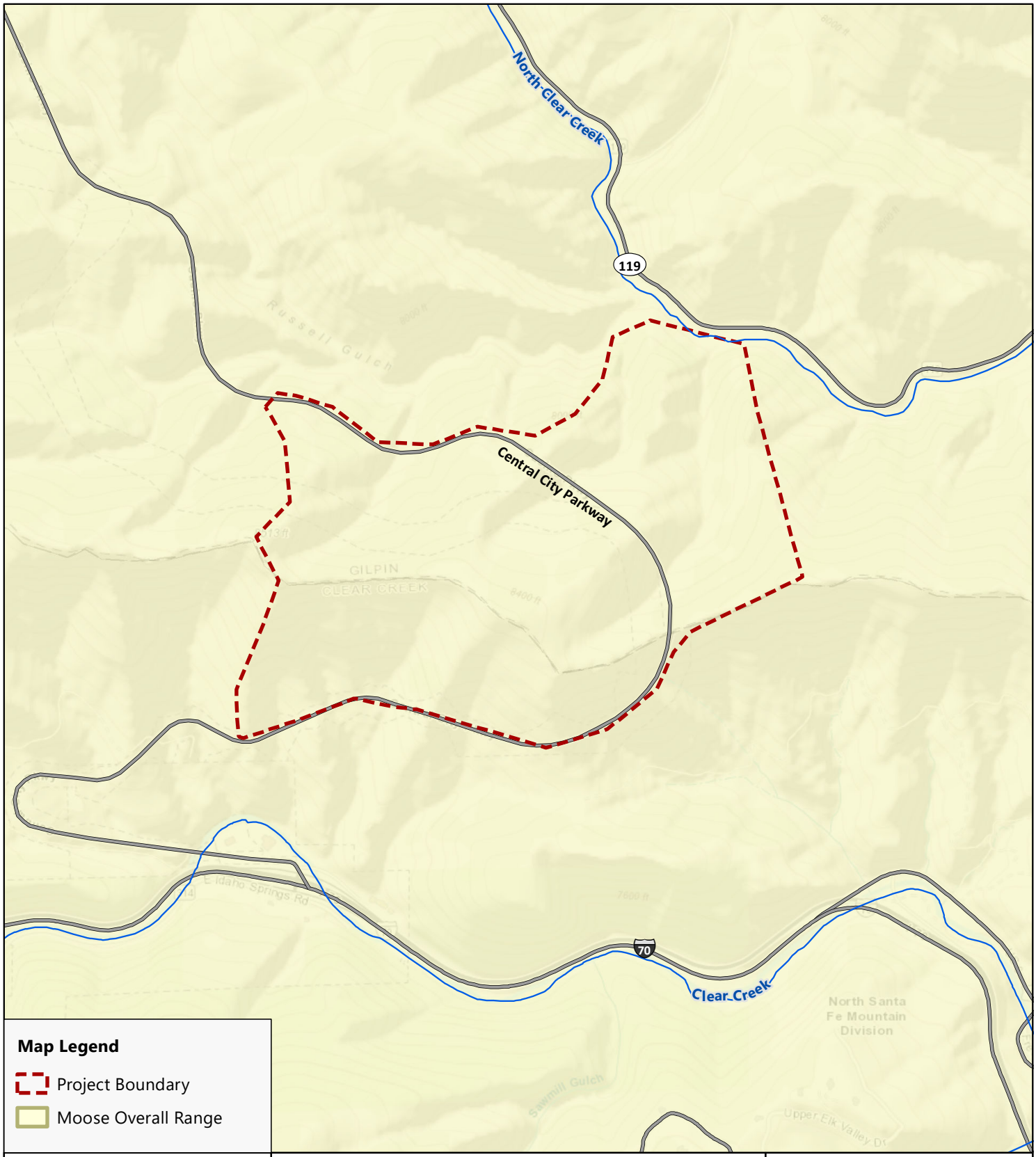

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MOOSE - OVERALL RANGE
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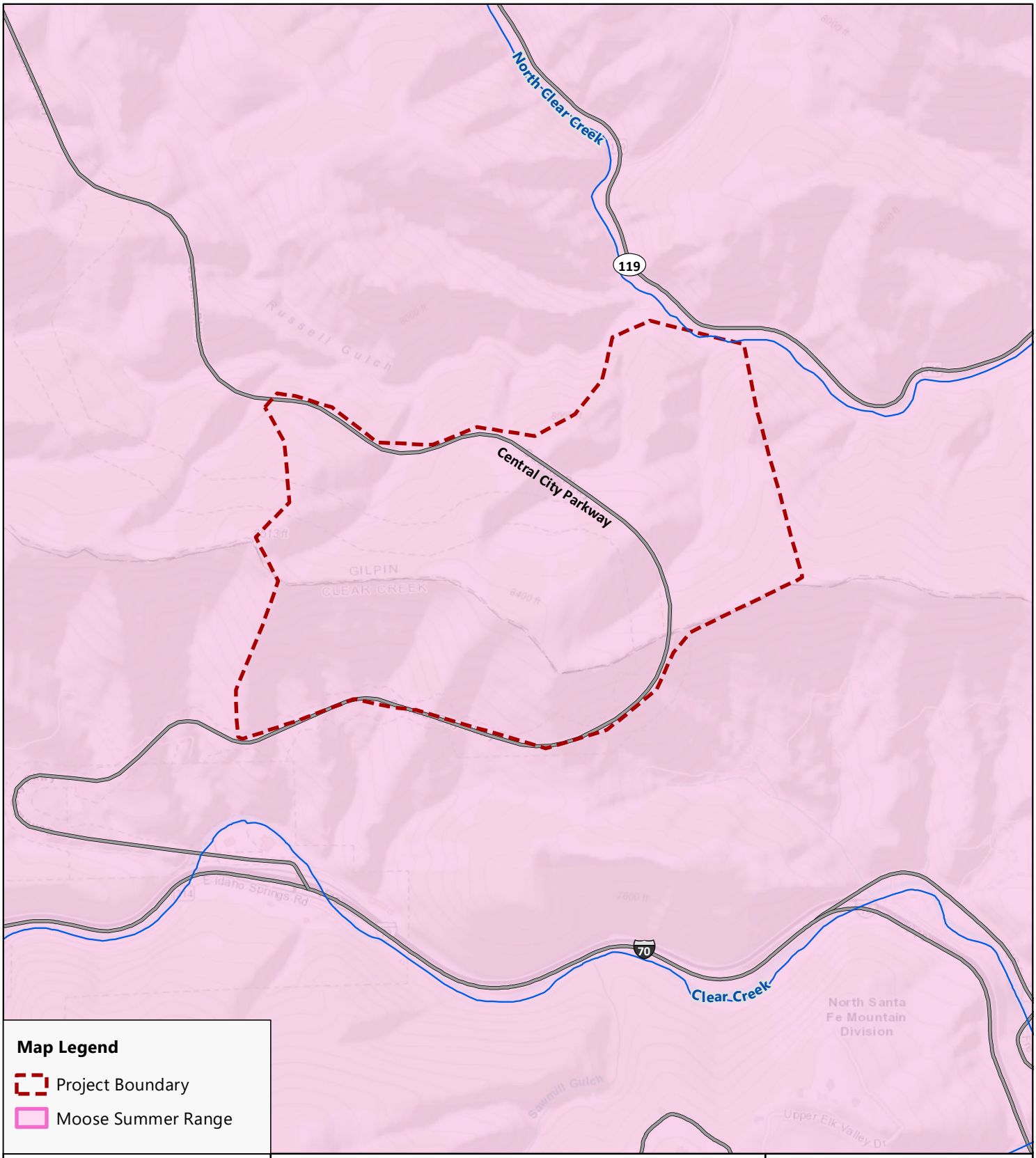

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MOOSE - SUMMER RANGE
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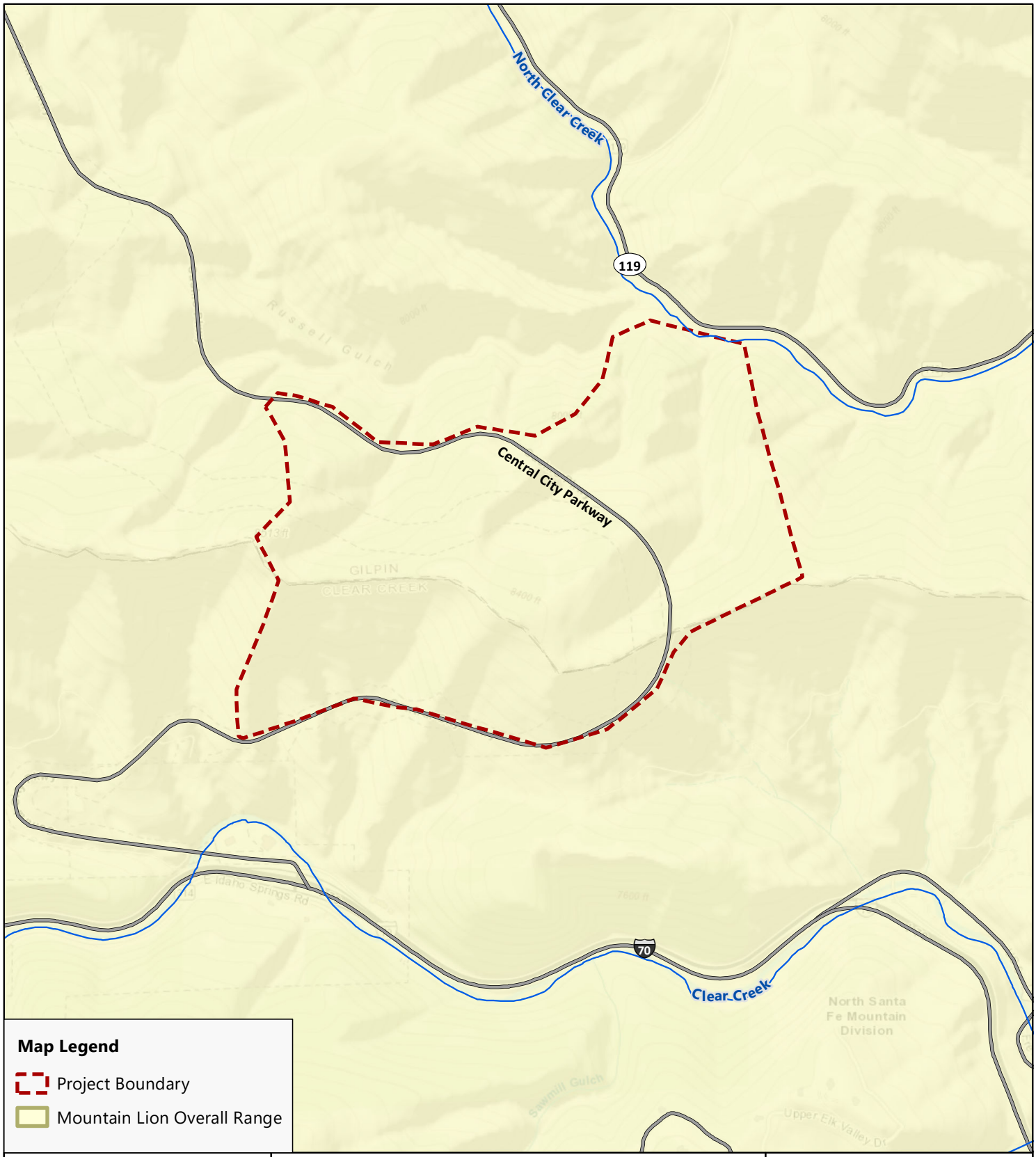

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MOUNTAIN LION - OVERALL RANGE
CPW SPECIES MAP
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GILPIN & CLEAR CREEK COUNTIES, COLORADO

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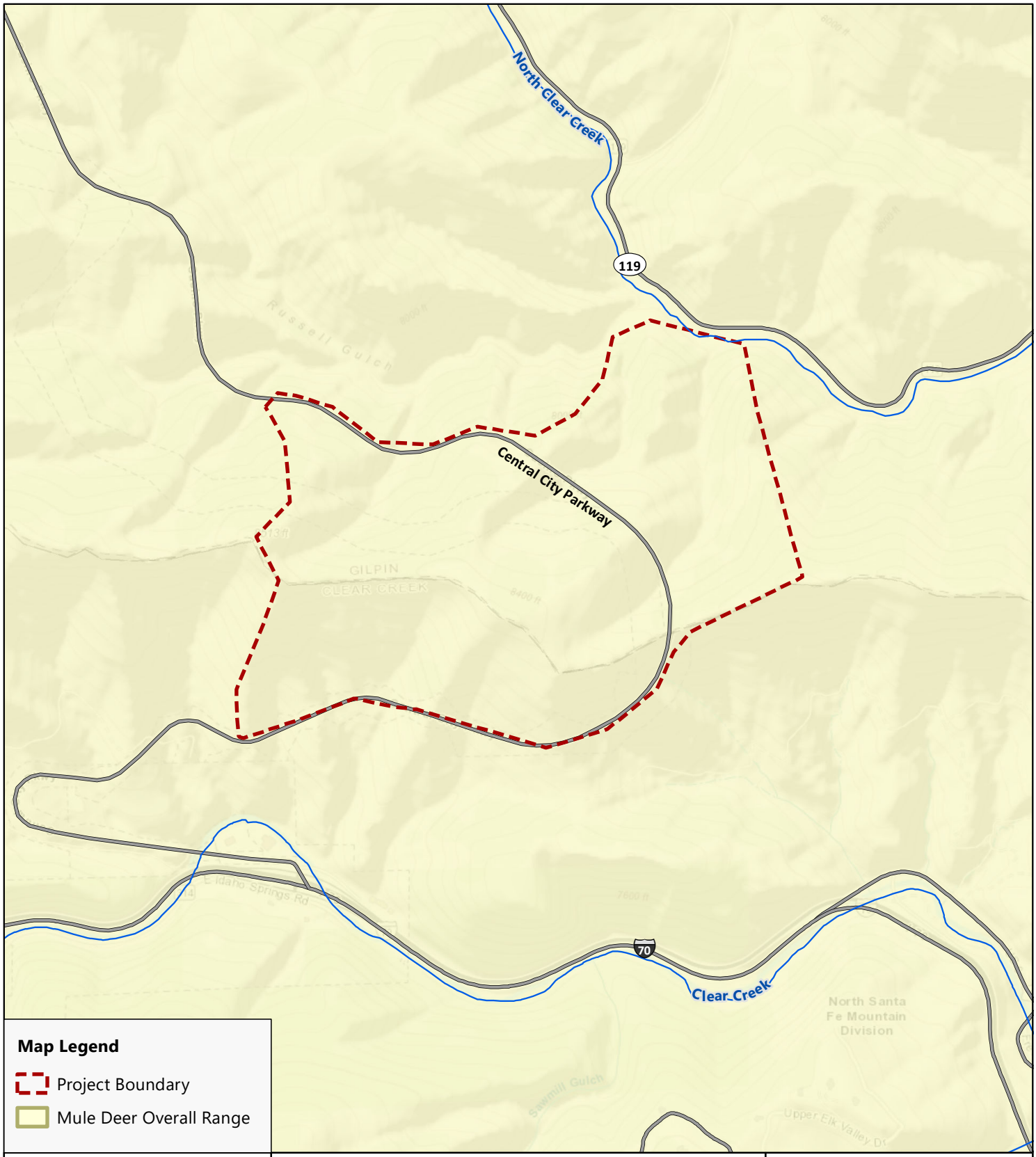

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MULE DEER - OVERALL RANGE
CPW SPECIES MAP
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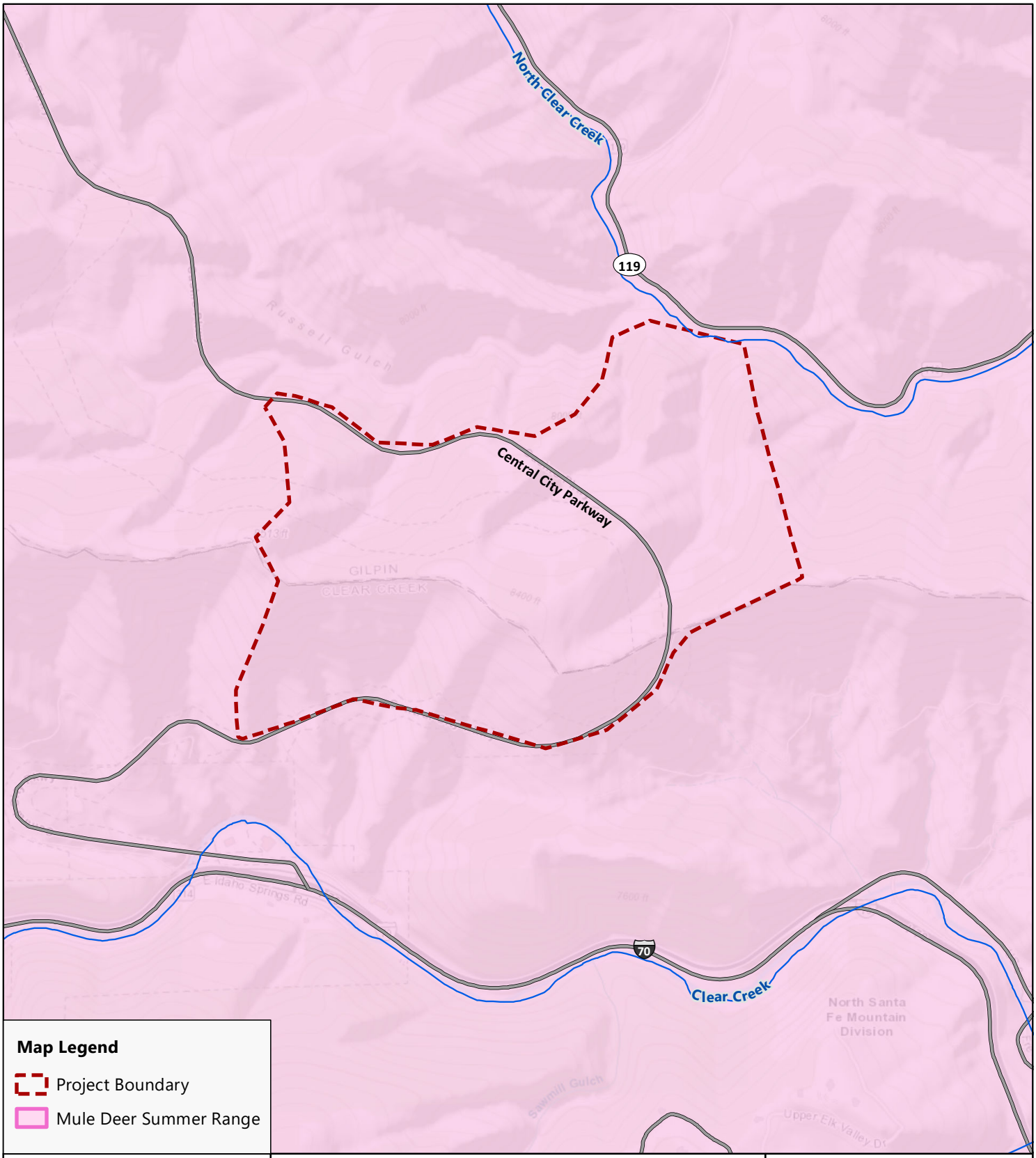

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MULE DEER - SUMMER RANGE
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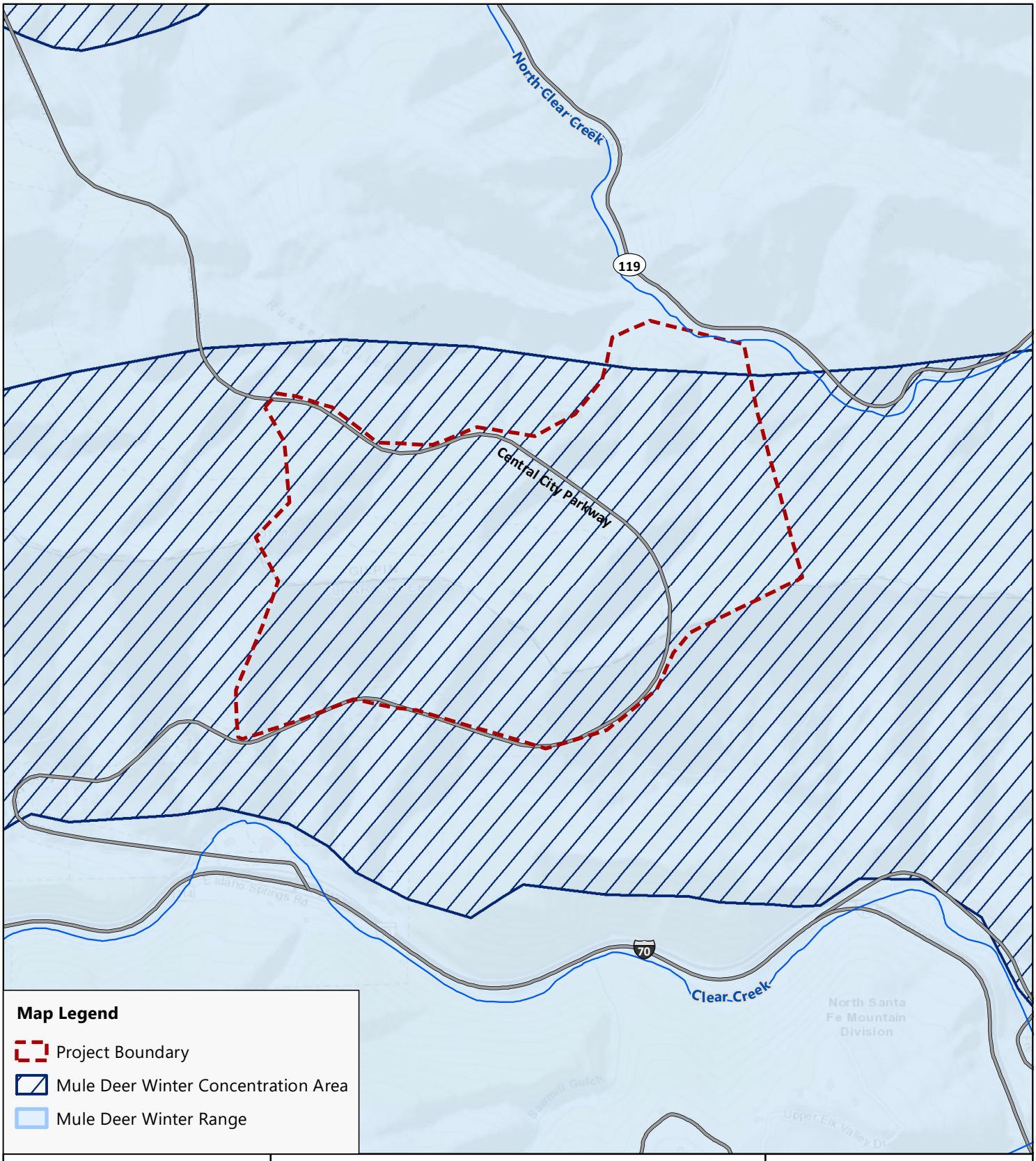

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MULE DEER - WINTER RANGE
CPW SPECIES MAP
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE MINE
GILPIN & CLEAR CREEK COUNTIES, COLORADO

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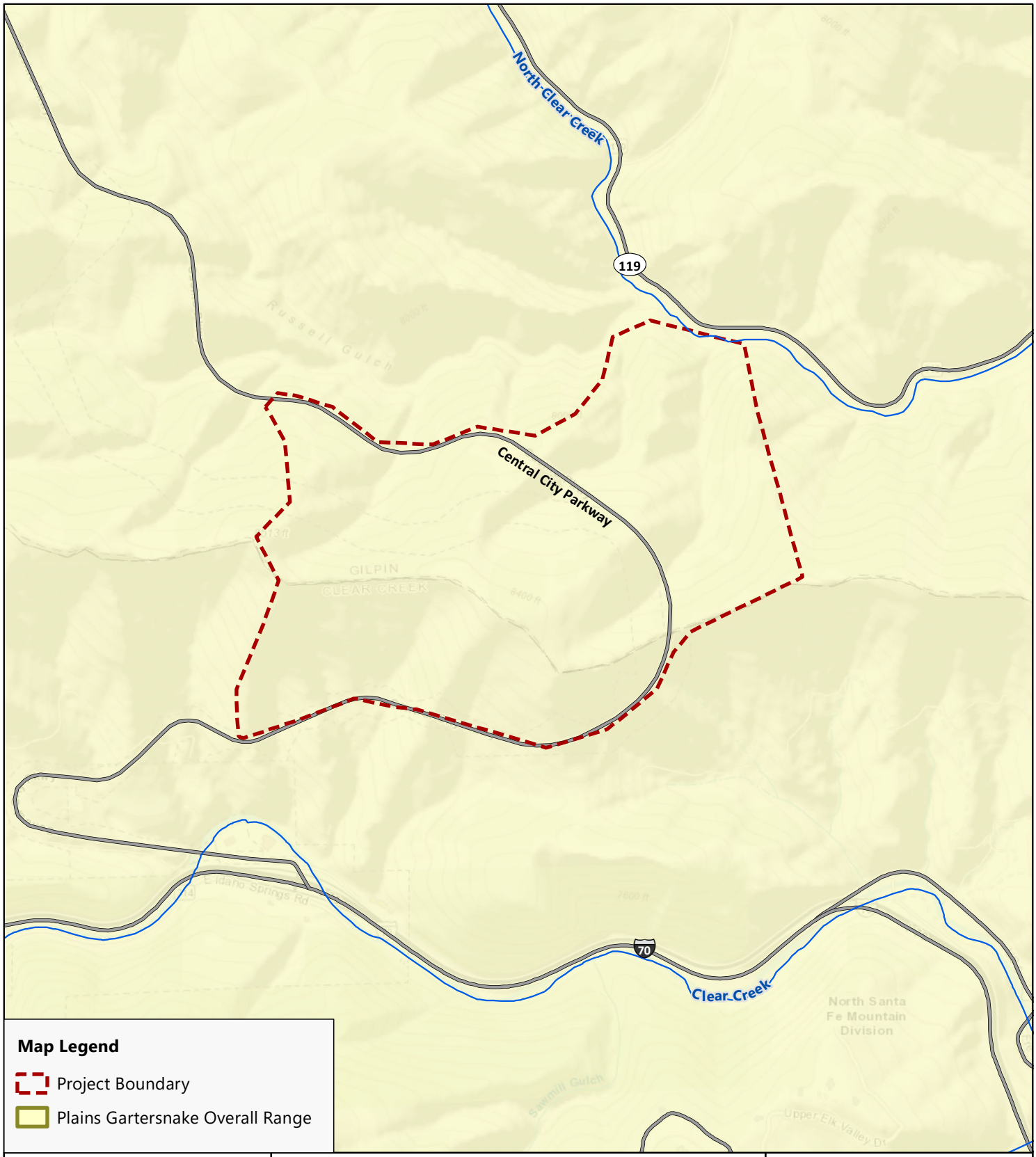

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PLAINS GARTERSNAKE - OVERALL RANGE
CPW SPECIES MAP
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE MINE
GILPIN & CLEAR CREEK COUNTIES, COLORADO

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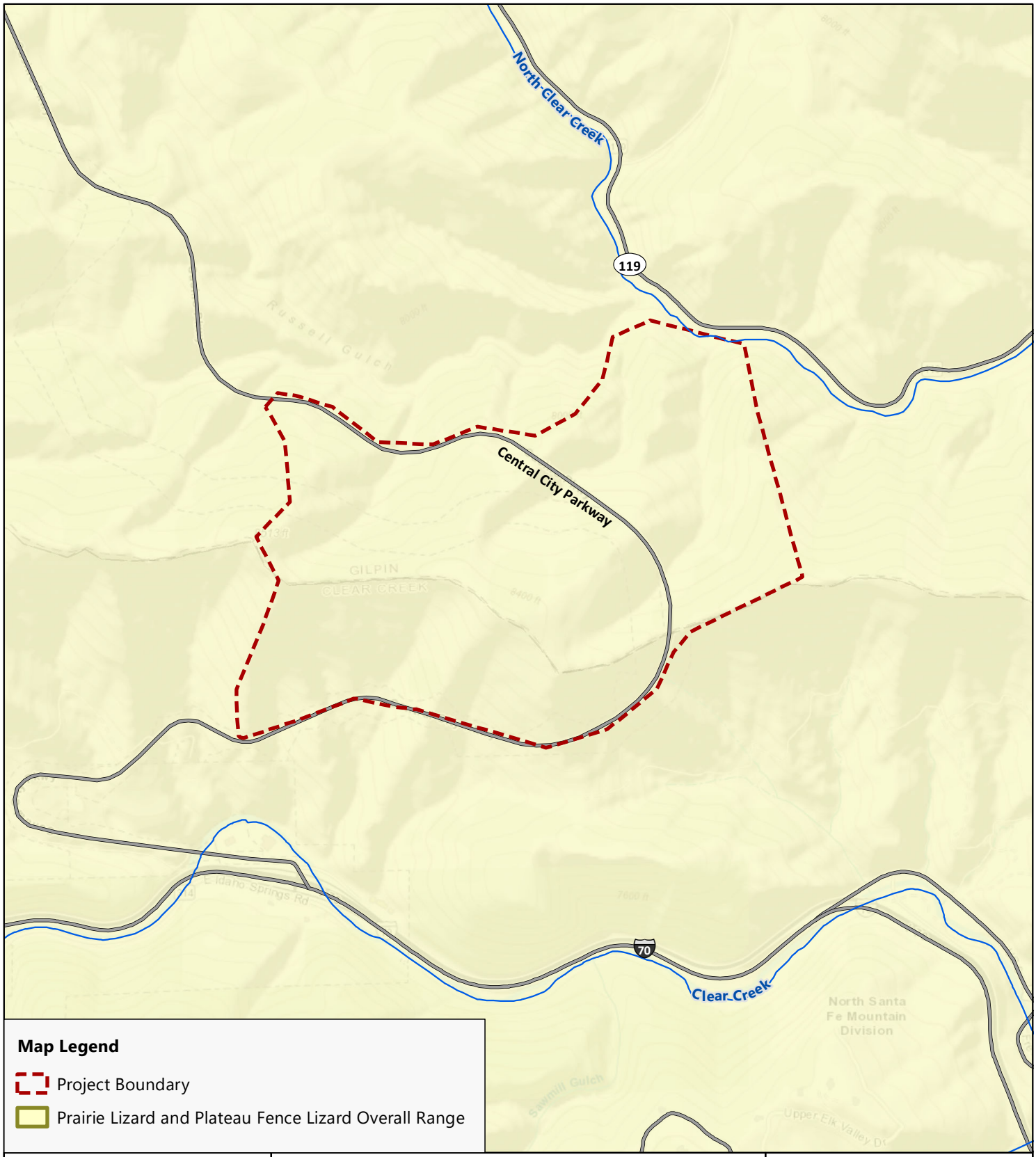

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PRAIRIE LIZARD & PLATEAU FENCE LIZARD - OVERALL RANGE CPW SPECIES MAP

WILDLIFE MITIGATION PLAN YOUNG RANCH RESOURCE MINE GILPIN & CLEAR CREEK COUNTIES, COLORADO

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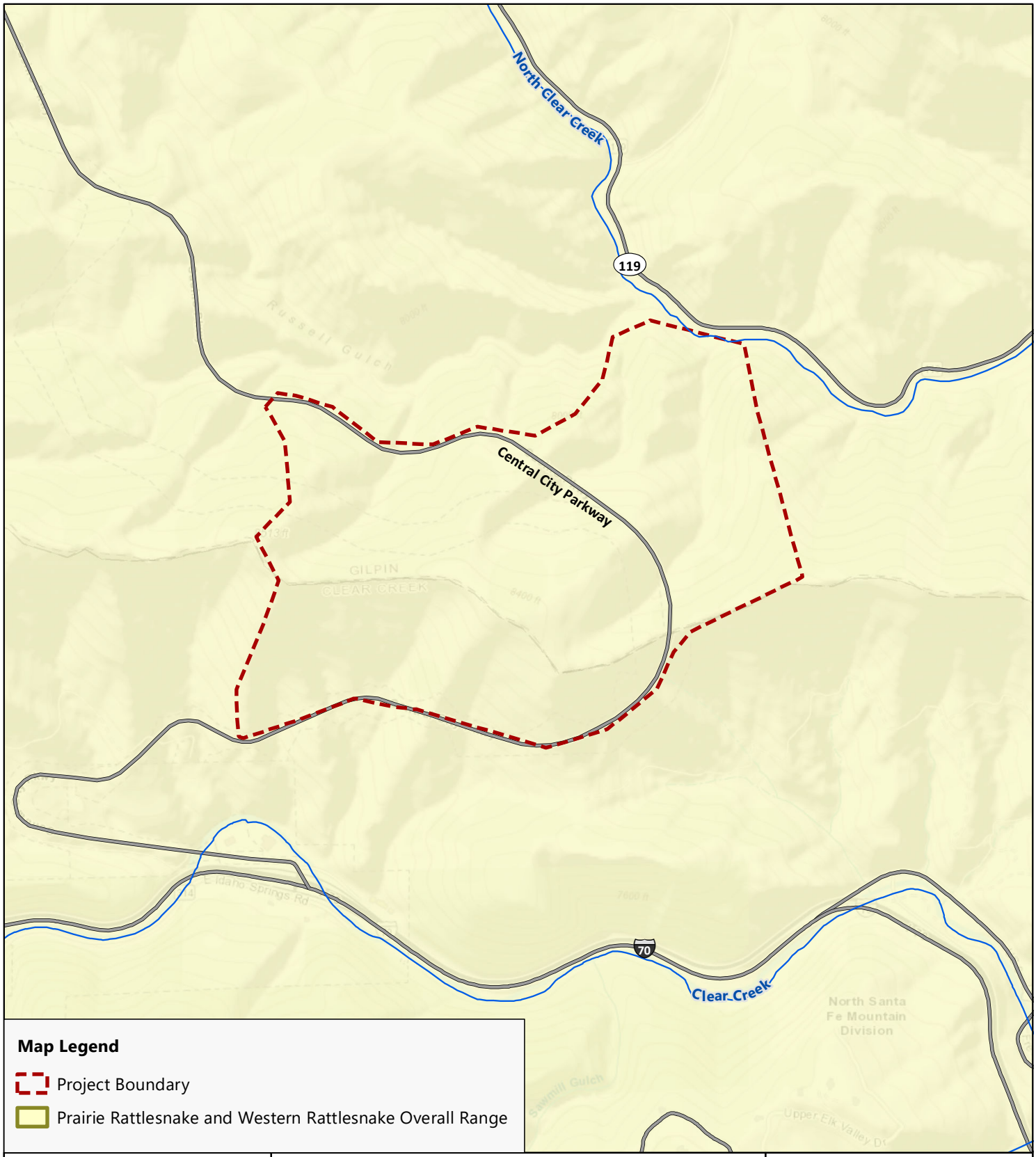

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PRAIRIE RATTLESNAKE & WESTERN RATTLESNAKE - OVERALL RANGE CPW SPECIES MAP

WILDLIFE MITIGATION PLAN YOUNG RANCH RESOURCE MINE GILPIN & CLEAR CREEK COUNTIES, COLORADO

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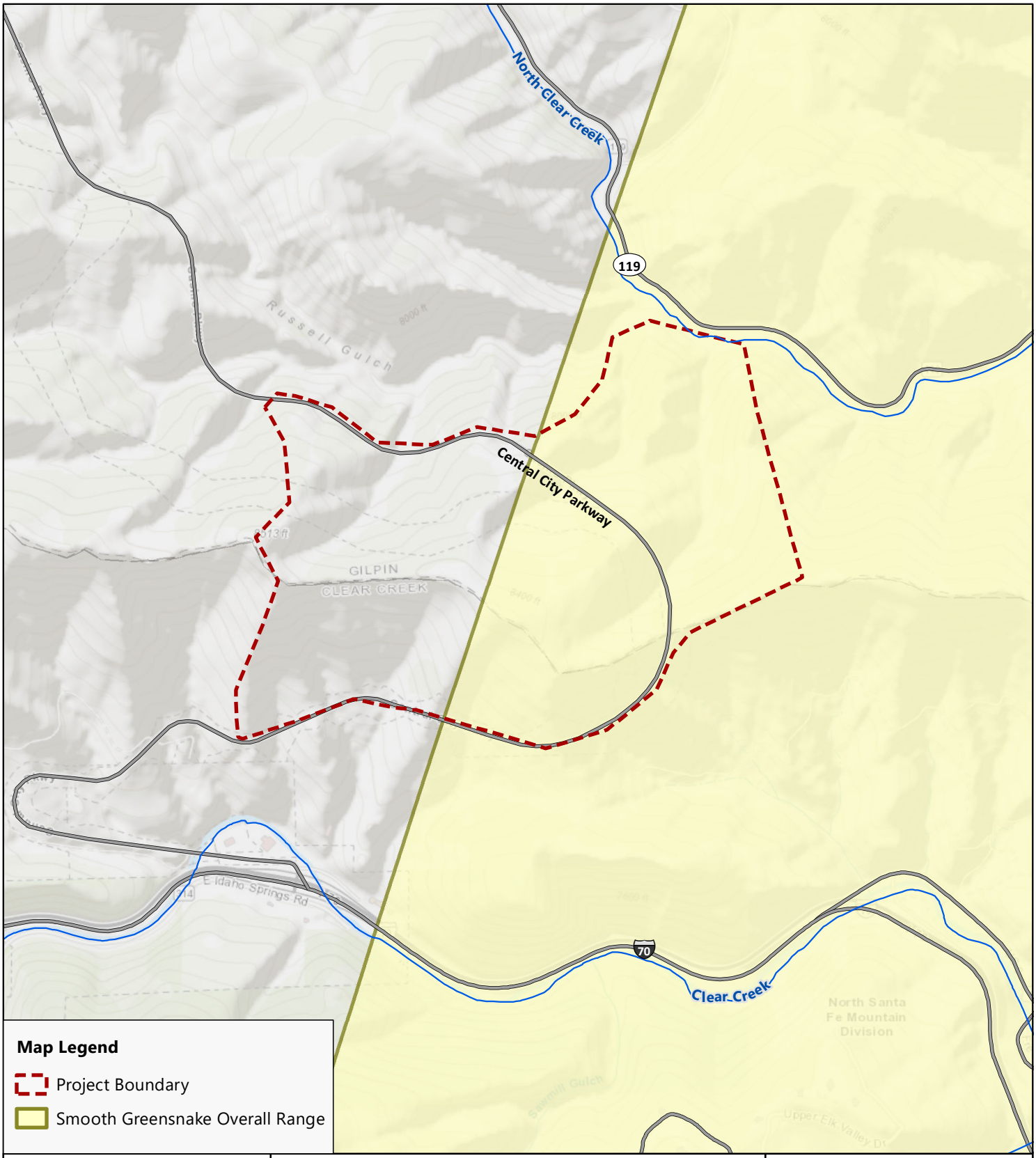

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SMOOTH GREENSNAKE - OVERALL RANGE
CPW SPECIES MAP
WILDLIFE MITIGATION PLAN
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GILPIN & CLEAR CREEK COUNTIES, COLORADO

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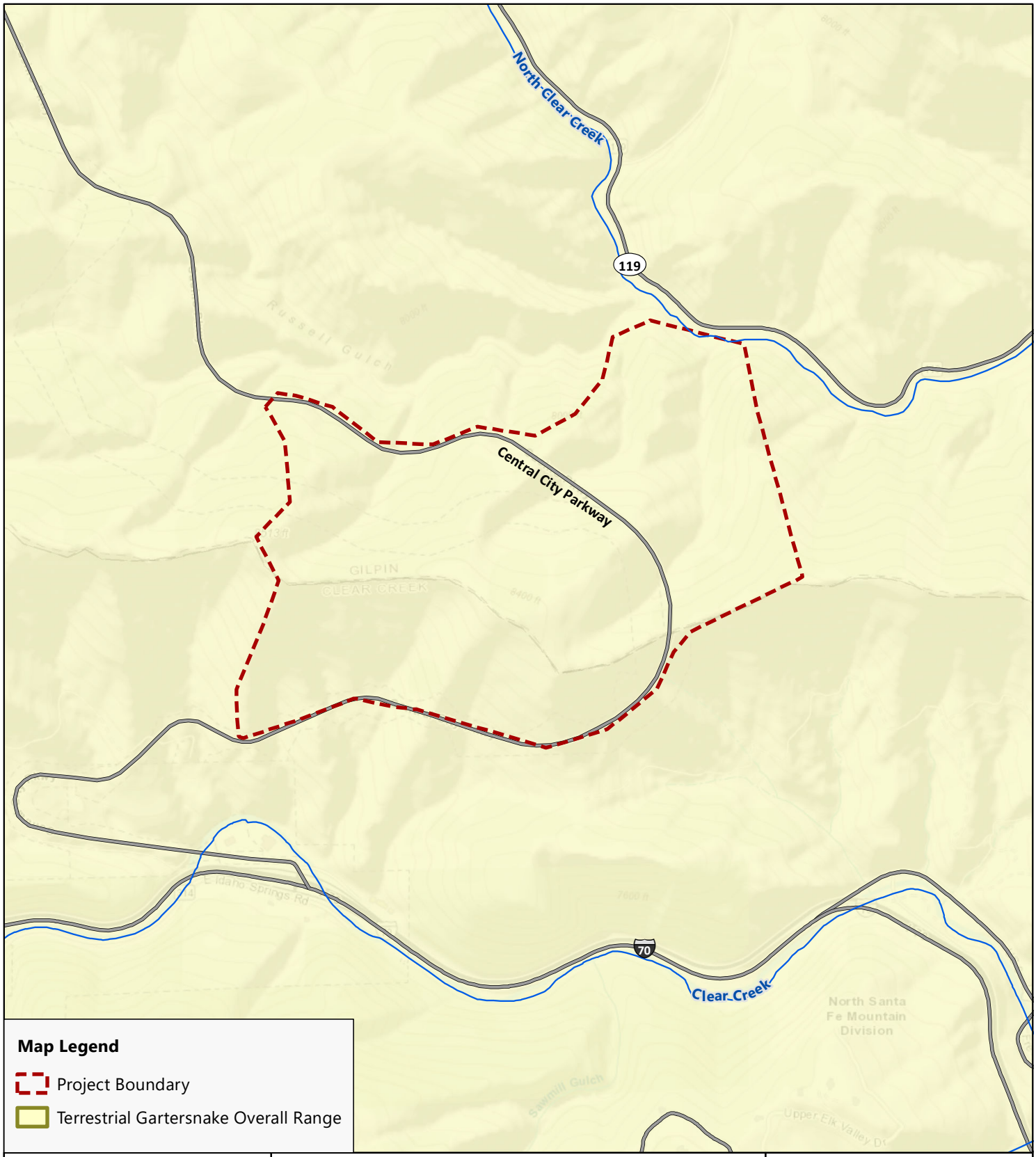

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ERC #: 1290-2001

TERRESTRIAL GARTERSNAKE - OVERALL RANGE
CPW SPECIES MAP
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE MINE
GILPIN & CLEAR CREEK COUNTIES, COLORADO

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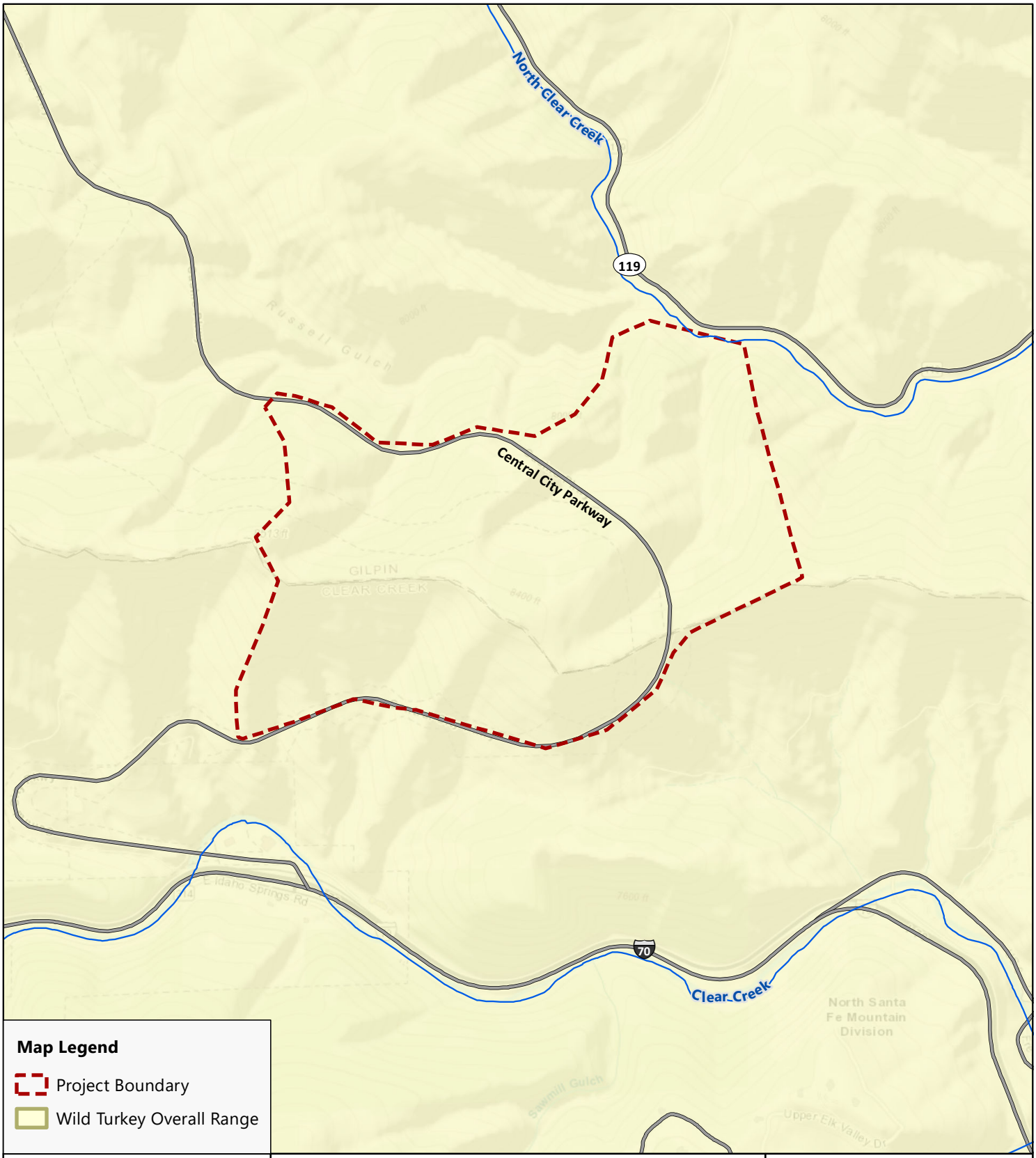
Feet



Prepared By:

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ERC #: 1290-2001

WILD TURKEY - OVERALL RANGE
CPW SPECIES MAP
WILDLIFE MITIGATION PLAN
YOUNG RANCH RESOURCE MINE
GILPIN & CLEAR CREEK COUNTIES, COLORADO

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