



REVEGETATION PLAN FOR DISTURBED SITES

Subdivision/Project Name:

Location/Legal Description:

Number of Acres, Lots or Lineal Feet of Disturbance:

Type(s) of Disturbance (Road Construction, Sewer Installation, Approach Construction, etc.):

A. Disturbed Area Revegetation Plan:

1. Site Preparation (topsoil management and seed bed preparation):

2. Seed Species and Seeding Rates (lb/PLS/acre):

3. Seeding Method (drill, hydroseed, broadcast, other):

4. Time of Seeding:

5. Fertilization (lb/acre):

6. Weed Control Method(s) and Timing:

B. Landowner or Responsible Party:

Name

Address

City	State	Zip	Phone Number
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Signature of Landowner/Responsible Party Date
This signed plan constitutes a binding agreement between Missoula County and the responsible person or agency.

Comments and approval or disapproval from the Missoula County Weed Control Board:

Approved: _____ Date: _____
For Missoula County Weed Board

MAIL THIS FORM TO:

WEED PREVENTION COORDINATOR
MISSOULA COUNTY WEED DISTRICT
2825 Santa Fe Court
Missoula, MT 59808
Phone: 406-258-4218 Fax 406-258-3916

This form can be filled out digitally or printed off at:

<http://www.missoulaeduplace.org/images/weeds/plansandpermits/reveg.for.disturbed.sites.fillable.pdf>

Revegetation Area



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1. A Source Guide - Revegetation Basics

(Adapted from *Revegetation Guidelines for Western Montana: Considering Invasive Weeds, 2006*)

The quick and successful establishment of healthy, use/type appropriate vegetation is the ultimate goal for any revegetation project. It is the most effective way to minimize weed invasion and establishment on your site in the long term. Depending on the severity of the current noxious weed infestation, actual revegetation may or may not be required. Typically, revegetation is recommended if the cover by desirable species is less than 30% at the time weed control actions are undertaken. Conditions such as soil type, annual precipitation, slope, aspect, intended use, wildlife and more can all affect the success of a revegetation effort, and have to be taken into consideration when choosing the appropriate species for a revegetation project. The following is a basic introduction to 1) assessing the need for revegetation, 2) determining the site characteristics that will affect your revegetation project, 3) site preparation and 4) a guide to the "workhorse" species and seeding recommendations for common land types and uses. It is always recommended that you contact the Missoula County Weed District or other local experts for more in depth revegetation methods for your project.

1.1 Assessing the need for revegetation at your site

Revegetation of your site may or may not be needed depending on the current condition of your site and on the uses or actions that you plan for it. The following is a simple method that you can use to determine the percent cover of desirable species on your site, which will allow you to decide if you should revegetate following your weed control action or any other action that may be detrimental to the plant community on your site.

Determining percent cover of desirable species:

Step 1. Purchase a hula hoop. Kid's sized hula hoops typically have a diameter of roughly 28-30", which are the perfect size to be used as a simple plot frame when conducting your percent cover survey.

Step 2. Toss the hula hoop out randomly on your site so that it is lying flat on the ground.

Step 3. Stand over the hula hoop and estimate the percentage of the area that is covered with desirable vegetation (good grasses and forbs), undesirable vegetation (weeds) and bare ground. Do not worry about counting individual plants or distinguishing between species of grasses, forbs or weeds, you simply want to know how much of the area is covered with good vs. bad plants.

Step 4. Repeat this process at least 9 more times in the area where you are working.

Step 5. Add up all the percentages of desirable vegetation and divide by 10 (or by the number of times that you tossed out your hula hoop. This will give you the average desirable vegetation cover for your area.

Be sure to repeat this process for all of your different community types (woodland, riparian, grassland, wetland, etc.) as well as all of the different use types (park land,

pond, natural area *etc.*) that you have within your project area, as different plant communities and use areas will have different conditions. If your average desirable vegetation cover is less than 30%, then you will need to revegetate the area. **Note:** Disturbances that create bare ground (such as new roads) and that are susceptible to erosion should always be revegetated.

1.2 Determining the site characteristics that will affect your reeve project

It is important to remember that soil, moisture, aspect, slope and other characteristics will play a large part in the success or failure of your revegetation project. For the highest likelihood of success, you must match the appropriate vegetation (and use) to the characteristics of your site. All projects and sites will be different. If you are planning a large project, you should consider contacting local experts on soils and revegetation for your area. Contact the Missoula County Weed District for assistance in this matter. Here we will cover basic soil assessment, as well as other simple measures that can help increase your chances of a successful revegetation project. The NRCS Web Soil Survey (websoilsurvey.nrcs.usda.gov/app/) is an excellent resource for determining a wide variety of pertinent soil, moisture, and temperature information for your site. Simply go to the website above and follow the directions for the program to get site specific information.

Soil. For larger projects, tests should be run on pH, Electrical conductivity (or salinity of the soil) and the organic matter of the soil, all of which can affect the type and ability of plants to grow on your site. For smaller sites, a simple test called "manual texturing" can be done to give you an idea of soil type and texture, which will give you a good idea of what plants will grow well on your site. To perform the test, take a cup of soil from your site and add a little water to it. Next rub the soil in your hands. If it feels gritty and will not ball up, then you have a sandy soil type. If it feels similar to talcum powder and forms a loose ball in your hand, then you have a silty soil type. If it is sticky and forms a tight ball, then you have a clay heavy soil. Sandy soils will drain well and require a drought-tolerant plant mix. Heavy clay soils will retain a lot of moisture and require plants that can handle excess moisture and the soil compaction that can often occur in construction areas. Ideally, you want a soil type that is in between all three soil types, with about equal amounts of silt and sand and a little less clay.

Annual Precipitation. Annual precipitation will play a large role in the success of your planting. Planting moisture-loving plants in a dry area with low annual precipitation will doom your project from the beginning. The NRCS Web Soil Survey mentioned above will give you this information.

Temperature (USDA Plant Hardiness Zone). You should consult an USDA Plant Hardiness Zone Map to more easily choose the plant species (especially shrubs and trees) that will survive your sites average minimal winter temperatures. For a Montana specific hardiness zone map, go to:

<http://www.plantmaps.com/interactive-montana-usda-plant-zone-hardiness-map.php>.

1.3 Site preparation

Preparing your site for the type of revegetation that you are doing will increase your chances for a successful project. The two most common preps that must be undertaken for a project are 1) dealing with compacted soil and 2) preparing the seed bed to increase establishment and survival.

Compacted Soils. Sites that have seen a lot of traffic and use (such as construction sites), especially if they have clay dominant soils, will suffer from soil compaction. All sites that suffer from soil compaction should be tilled or plowed in order to improve the soil structure in a way that will allow seeds to germinate easier and moisture to percolate through rather than run-off. Any site where the topsoil has been removed should be plowed or ripped to a depth of 6-12" before adding topsoil to the site.

Topsoil should be spread at a depth of 4-6" if possible. After plowing, the site should be firmed but not compacted. Depending on the soils, this can be accomplished through irrigation of the site, which will aid in the settling of the soil on your site. If the site is prone to run-off and erosion, it will be best to mechanically firm the soil of the site before irrigation is applied. If contouring of the site is needed, then wait until your site has dried.

Seedbed Preparation. Seedbed prep is only necessary when you will be broadcast seeding your site, and will provide for a multitude of small niches for your seeds to germinate and establish. The two most important things to manage for when preparing your seedbeds are 1) good seed-to-soil contact and 2) protection from wind and water erosion. Depending on the size of your site, seedbed prep can be accomplished using a simple garden rake to harrows pulled behind an ATV or tractor. Even when seeding into an area that already has desired vegetation, harrows can provide your site with the seed niches you require without damaging the existing vegetation.

1.4 Species and seeding recommendations for common land types and uses

The following is a list of commonly used and available plant species that can be used according to type/use of your site. You should always consult with the Missoula County Weed District or other local experts before moving forward with a seeding/planting mix.

Native Plant Recommendations by Type for Western Montana			
Name	Soil Type	Minimum Precipitation	Notes
Dry, Warm Site: Typically open grassland at low elevations and on south- and west-facing slopes at higher elevations			
Grasses			
Slender wheatgrass	Sandy to Clayey	16"	Has moderate drought tolerance. Rapid establishment in a wide range of sites, including site with high salinity. Short-lived species.
Thickspike wheatgrass	Sandy to Clayey	8"	Drought-tolerant and fairly easy to establish. Long-lived.
Bluebunch wheatgrass	Silty-loamy to loamy to	10"	Drought-tolerant and moderately easy to establish. Adapted to most sites, including nutrient poor soils.
Beardless wheatgrass	Silty-loamy	13-15"	Fair establishment and intolerant of poor drainage, high water tables and spring flooding.
Big bluegrass	Silty-loamy to	8"	Easy to establish, but intolerant of poor drainage or high water tables. Can take mildly saline soils.
Canada wildrye	Sandy	12"	Quick establishment and short-lived. Prefers moist but well-drained sites
Prairie junegrass	Sandy	12"	Drought-tolerant with moderate establishment.
Sandberg bluegrass	Sandy to Clayey	8"	Drought-tolerant and does well on nutrient poor soils.
Needle and thread	Sandy to silty-	10"	Drought-tolerant and long-lived. Does well on disturbed sites.
Idaho fescue	Silty-loamy to	10"	Moderately drought-tolerant with slow establishment.
Forbs			
Common yarrow	Sandy to loamy	10"	Drought-tolerant and aggressive. Good for erosion prevention.
Blanketflower	Sandy to silty-	10"	Fairly drought-tolerant and good for erosion prevention mixes.
Rocky Mountain beeplant	Silty-loamy to	16"	Annual good for short-term establishment.
Hairy evening primrose	Sandy	12"	Does well in disturbed areas.
Prairie flax	Sandy to silty-	10"	Drought-tolerant and easy to establish. Does very well in well-drained sites.
Sulfur flower	Sandy to silty-	10"	Requires well-drained sites.
Prairie coneflower	All-types	16"	Drought-tolerant and does well on well drained sites.
Arrowleaf balsamroot	Silty-loamy	12"	Drought-tolerant, but slow to establish
Lupine spp.	Silty-loamy to	12-16"	Found in a wide variety of sites and conditions
Penstemon spp.	Sandy to silty-	10-14"	Widely adaptable and drought-tolerant
Fringed sage	Silty-loamy	6"	Does well on nutrient poor, dry soils
Trees and Shrubs			
Trees: Ponderosa pine, Douglas fir Shrubs: snowberry, woods rose, bitterbrush, sumac, mountain mahogany, mockorange, chokecherry			

Native Plant Recommendations by Type for Western Montana			
Name	Soil Type	Minimum Precipitation	Notes
Moist, Warm Site: Typically found on north- and east-facing slopes at low elevations and on south- and west-facing slopes at high elevations.			
Grasses			
Slender wheatgrass	Sandy to Clayey	16"	Has moderate drought tolerance. Rapid establishment in a wide range of sites, including site with high salinity. Short-lived species.
Thickspike wheatgrass	Sandy to Clayey	8"	Drought-tolerant and fairly easy to establish. Long-lived.
Beardless wheatgrass	Silty-loamy	13-15"	Fair establishment and intolerant of poor drainage, high water tables and spring flooding.
Big bluegrass	Silty-loamy to clayey	8"	Easy to establish, but intolerant of poor drainage or high water tables. Can take mildly saline soils.
Canada wildrye	Sandy	12"	Quick establishment and short-lived. Prefers moist but well-drained sites
Mountain brome	Silty-loamy to clayey	16"	Useful for disturbed sites and drought-tolerant.
Forbs			
Common yarrow	Sandy to loamy	10"	Drought-tolerant and aggressive. Good for erosion prevention.
Blanketflower	Sandy to silty-loamy	10"	Fairly drought-tolerant and good for erosion prevention mixes.
Rocky Mountain beeplant	Silty-loamy to clayey	16"	Annual good for short-term establishment.
Hairy evening primrose	Sandy	12"	Does well in disturbed areas.
Prairie coneflower	All-types	16"	Drought-tolerant and does well on well drained sites.
Arrowleaf balsamroot	Silty-loamy	12"	Drought-tolerant, but slow to establish
Lupine spp.	Silty-loamy to clayey	12-16"	Found in a wide variety of sites and conditions
Penstemon spp.	Sandy to silty-loamy	10-14"	Widely adaptable and drought-tolerant
Trees and Shrubs			
Trees: Ponderosa pine, Douglas fir, western larch Shrubs: snowberry, woods rose, currant, serviceberry, Rocky Mountain maple			

Native Plant Recommendations by Type for Western Montana			
Name	Soil Type	Minimum Precipitation	Notes
Riparian Areas: Stream bottoms, wet meadows: sites which are subirrigated for at least a portion of each growing season.			
Grasses			
Slender wheatgrass	Sandy to Clayey	16"	Has moderate drought tolerance. Rapid establishment in a wide range of sites, including site with high salinity. Short-lived species.
Western wheatgrass	Silty-loamy to clayey	10"	Drought-tolerant and fairly easy to establish. Good for saline and poorly drained soils.
Tufted hairgrass	Silty-loamy to clayey	20"	Most common in moist sites.
Native sedges and rushes are also recommended for riparian areas as plugs; planted at a rate of 11,000/acre.			
Forbs			
Common yarrow	Sandy to loamy	10"	Drought-tolerant and aggressive. Good for erosion prevention.
Lupine spp.	Silty-loamy to clayey	12-16"	Found in a wide variety of sites and conditions
Penstemon spp.	Sandy to silty-loamy	10-14"	Widely adaptable and drought-tolerant
Trees and Shrubs			
Trees: black cottonwood, quaking aspen, Englemann spruce Shrubs: snowberry, woods rose, native willows, red osier dogwood, chokecherry, mockorange, Rocky Mountain maple, water birch, alder, serviceberry			

Native Plant Recommendations by Type for Western Montana			
Name	Soil Type	Minimum Precipitation	Notes
Moist, Warm Site: Found predominantly on north- and east-facing slopes at mid elevations and on all aspects of high elevations.			
Grasses			
Slender wheatgrass	Sandy to Clayey	16"	Has moderate drought tolerance. Rapid establishment in a wide range of sites, including site with high salinity. Short-lived species.
Beardless wheatgrass	Silty-loamy	13-15"	Fair establishment and intolerant of poor drainage, high water tables and spring flooding.
Big bluegrass	Silty-loamy to clayey	8"	Easy to establish, but intolerant of poor drainage or high water tables. Can take mildly saline soils.
Tufted hairgrass	Silty-loamy to clayey	20"	Most common in moist sites.
Mountain brome	Silty-loamy to clayey	16"	Useful for disturbed sites and drought-tolerant.
Forbs			
Common yarrow	Sandy to loamy	10"	Drought-tolerant and aggressive. Good for erosion prevention.
Lupine spp.	Silty-loamy to clayey	12-16"	Found in a wide variety of sites and conditions
Penstemon spp.	Sandy to silty-loamy	10-14"	Widely adaptable and drought-tolerant
Trees and Shrubs			
Trees: Douglas fir, western larch, Engelmann spruce Shrubs: snowberry, woods rose, Scouler's willow, red osier dogwood, alder, Rocky Mountain maple			

Agricultural Grass Recommendations by Type for Western Montana			
Name	Soil Type	Minimum Precipitation	Notes
Dryland Pasture			
Grasses			
Italian ryegrass	Silty-loamy	10"	Quick and easy to establish. Highly palatable.
Hard fescue	Sandy to Clayey	16"	Moderately drought-tolerant. Does well on hilly, upland sites with low fertility.
Tall wheatgrass	Silty-loamy to clayey	12"	Drought-tolerant and easy to establish.
Sheep fescue	Sandy to Clayey	10"	Drought-tolerant but slow to establish. Poor palatability but good erosion control.
Perennial ryegrass	Silty-loamy to clayey	12"	Rapid establishment but short-lived. Excellent palatability
Russian wildrye	Silty-loamy to clayey	12"	Drought-tolerant but difficult to establish. Good palatability year-round.
Intermediate wheatgrass	Silty-loamy to clayey	14"	Moderately drought-tolerant with easy establishment.
Pubescent wheatgrass	Sandy to Clayey	12"	Easy to establish and long-lived. Not very winter hardy so use in less harsh sites.
Irrigated Pasture			
Meadow fescue	Sandy to Clayey	18"	Slow establishment but suited to cool, moist sites. Very palatable.
Tall fescue	All soils but sandy	18"	Tolerates wet, poorly-drained sites and tolerant to relatively heavy grazing.
Meadow brome	Silty-loamy to clayey	16"	Good drought tolerance and easy establishment. Very productive, and winter hardy.
Orchardgrass	Silty-loamy to clayey	16"	Easily established and good palatability.
Intermediate wheatgrass	Silty-loamy to clayey	14"	Moderately drought-tolerant with easy establishment.

2. A Source Guide - Weed Control Guide

The following guide has been adapted from various weed control guides and publications. For more information regarding any of the species mentioned below, please contact the Missoula County Weed District or visit the following sites:

NRCS Technical Notes: <http://www.mt.nrcs.usda.gov/technical/ecs/invasive/technotes/>
MSU Extension: <http://www.msuetr.org/store/Departments/Agriculture-Topic-Categories/Weeds.aspx?sortorder=1&page=1>

Any mention of products in this guide does not constitute a recommendation by the Missoula County Weed District. It is a violation of Federal law to use herbicides in a manner that is inconsistent with their labeling.

Blueweed, *Echium vulgare*

Hand pulling: Pulling blueweed is effective for smaller infestations, especially if the soil is moist. Be sure to remove the entire taproot otherwise the plant will regenerate from the leftover rootstock. If plants have already begun to flower they should be burned or bagged for disposal to prevent seed production. Stiff hairs on the stem and leaves can cause skin irritation, so gloves and long sleeves are recommended.

Mowing: Mowing blueweed will provide you with short term prevention of seed production, but re-sprouting and flowering will occur below the level of the blades after continued mowing. This method alone is not recommended for long term management of this species.

Biological control: N/A

Grazing: Blueweed has been shown to contain pyrrolizidine alkaloids, which are toxic to horses and cattle if ingested. While sheep and goats have shown resistance to these alkaloids, grazing is *not* a recommended control action for this species.

Herbicide: Some herbicides have resulted in almost 100 percent control of blueweed one year after treatment. The following herbicides are recommended for control of blueweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for blueweed, *Echium vulgare*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Escort	metsulfuron	1 oz. per acre	most effective if applied on rosettes in spring or fall	Cannot be used near wells, surface water, or shallow ground water
Telar	chlorsulfuron	1 oz. per acre	most effective if applied on rosettes in spring or fall	
Escort + Telar	metsulfuron + chlorsulfuron	.5 oz. per acre each	most effective if applied on rosettes in spring or fall	See above comments

Canada thistle, *Cirsium arvense*

Hand pulling: Hand pulling is only effective on small infestations if done consistently and persistently throughout the growing season and for multiple years. Be sure to wear gloves.

Mowing: Mowing is an inconsistent method of control for Canada thistle, depending on the conditions present at the site. In some instances mowing two to three times annually for a period of three or more years can eliminate an infestation of Canada thistle, in other situations the same regime will only accomplish a reduced seed crop.

Biological control: N/A

Grazing: Grazing is not a recommended method of control because livestock tend to avoid it because of its spiny stems and leaves.

Herbicide: The following herbicides are recommended for control of Canada thistle. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Canada thistle, *Cirsium arvense*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Tordon 22k	picloram	1 quart per acre	Most effective in actively growing plants, spring or fall.	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Milestone	Aminopyralid	5-7 oz. per acre	Most effective in actively growing plants, spring or fall.	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
ForeFront	Aminopyralid + 2,4-D	2-2.5 pints per acre	Most effective in actively growing plants, spring or fall.	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
Curtail	Clopyralid + 2,4-D	2-4 quarts per acre	Most effective in rosette to bud stages	Do not apply to shallow groundwater areas
Transline	Clopyralid	1-1.3 pints per acre	Least effective herbicide listed	Do not apply to shallow groundwater areas

Cheatgrass, *Bromus tectorum*

Hand pulling: Hand pulling can be very effective on small scale infestations if the plants are removed and burned before seed set. Cheatgrass is an annual species that relies on its seed for dispersal. Its seeds do not persist for very long in the soil, so preventing plants from going to seed will allow you to deplete the seed bank. Continued hand pulling is needed for multiple years in order to deplete the seed bank and eliminate small patches.

Mowing: Similar to hand pulling, mowing at the appropriate time will help prevent plants from producing seed and will allow you to deplete the seed bank. Mowing will allow you to control seed production over a larger area, but will need to be carried out multiple times in the late spring/early summer depending on rainfall. Mowing when cheatgrass has begun to turn purple will not prevent seed production.

Biological control: N/A

Grazing: Grazing is an effective method of preventing seed production in cheatgrass, and should be carried out when it is tall enough to be accessible to livestock but before turning

purple. Two rounds of grazing are typically necessary for seed prevention, and is required for at least two consecutive years for good control

Herbicide: There are a number of herbicides that have worked well for cheatgrass, but also cause damage to desirable species. Care should be taken to prevent damage to desirable species by applying herbicide when they are dormant in the early spring or late summer/early fall. The following herbicides are recommended for control of cheatgrass. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Cheatgrass, *Bromus spp.*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Roundup	Glyphosate	6-12 oz per acre	Most effective if applied in early spring prior to seed production	Non-selective and must be applied very carefully if you are to prevent damage to non-target species
Journey	Imazapic + Glyphosate	16-32 oz per acre	effective if applied late summer/early fall before cheatgrass emergence	
Plateau	Imazapic	2-12 oz per acre	effective if applied late summer/early fall before cheatgrass emergence	

Common tansy, *Tanacetum vulgare*

Hand pulling: Hand pulling is only effective on small infestations if it successfully removes the rhizomes. Multiple treatments will be necessary in order to deplete the seed bank and eradicate the infestation.

Mowing: Mowing should be done prior to flower in order to reduce seed production. If mowing is utilized, blades should be set at a height of greater than 4 inches in order to minimize the damage to competitive desirable species.

Biological control: N/A

Grazing: Sheep have been used in Montana to graze common tansy, and they are an effective method of removing above ground plant materials, thus reducing seed production. Other forage species should be available and sheep should be taken completely off of common tansy infestations at least four weeks prior to birthing, as common tansy does contain toxins that have been shown to cause abortions in livestock.

Herbicide: The following herbicides are recommended for control of common tansy. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for common tansy, *Tanacetum vulgare*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Escort	metsulfuron	.5-1 oz. per acre	Effective if applied during bolt or bud stages	Cannot be used near wells, surface water, or shallow ground water
Telar	chlorsulfuron	.5-1 oz. per acre	Effective if applied during bolt or bud stages	

Dalmatian toadflax, *Linaria dalmatica*

Hand pulling: Hand pulling may only be effective on extremely small infestations that have not yet established an extensive root system. For all other infestations, hand pulling is not an effective method of control.

Mowing: Due to the extensive root system, mowing is not a recommended method of control, though it will reduce seed production if repeated often enough to prevent flowering.

Biological control: There have been six biocontrol agents released in the U.S. for the control of Dalmatian toadflax. Of those, only one is readily available and known to be well established in Montana. *Mecinus janthinus* is a stem-boring weevil that feeds on the leaves as an adult and lays eggs in the stem, where the larvae develop and feed. Contact the Missoula County Weed District for assistance with monitoring and/or additional releases

Grazing: Sheep and goats can be trained to feed on Dalmatian toadflax and have been shown to consume nearly 90% of the vegetative matter, drastically reducing seed production but increasing overall toadflax density in the infestation from re-sprouting. The seeds of Dalmatian toadflax will pass through the systems of grazers unharmed, so be sure to contain animals for at least five days and feed them weed-seed free forage before moving them to a weed-free site.

Herbicide: Herbicide treatments for Dalmatian toadflax are highly variable due to a thick, waxy covering on the leaves, creeping rhizomes and long-lived seeds. Timing of herbicide application may also play a large part in successful herbicide control. The following herbicides are recommended for control of Dalmatian toadflax. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Dalmatian toadflax, *Linaria dalmatica*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Plateau	Imazapic	12 oz. per acre	Most effective if applied in late fall.	
Escort	Metsulfuron	1.5 oz. per acre	Will control toadflax for up to 3 years applied in fall or spring	Cannot be used near wells, surface water, or shallow ground water
Tordon	Picloram	1-2 quarts per acre	Best applied in spring up to early bloom.	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.

Diffuse knapweed, *Centaurea diffusa*

Hand pulling: Hand pulling is an extremely effective method on small scale infestations of diffuse knapweed. Pulling is easiest when soil is moist; allowing you to remove most of the taproot and kill the plant. Any stage from flowering on should be bagged and removed from the site in order to minimize seeds at the site.

Mowing: Mowing will help reduce seed production of diffuse knapweed; however, repeated mowing will result in knapweed plants flowering and setting seed below the blades of the mower. Mowing should occur during the bud stage but before flower to prevent cut plants from producing viable seed.

Biological control: There are thirteen biological control agents that have been released in Montana to control spotted and diffuse knapweed. Of those species, eight have been shown to affect knapweed populations. The majority of these species are wide spread in Western

Montana. Contact the Missoula County Weed District for assistance with monitoring and additional releases.

Grazing: Repeated grazing by cattle, sheep and goats can be effective at reducing levels of diffuse knapweed if managed to reduce damage to desirable species such as native forbs and grasses. Grazing should occur when native species are dormant (either in the spring before native species begin growing or in the fall after they have dropped their seed). Managers should also be careful not to graze so much as to produce excessive bare ground, which can result in increased weed invasions.

Herbicide: There are a number of herbicides that provide effective control of diffuse knapweed. The following herbicides are recommended for control of diffuse knapweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Diffuse knapweed, *Centaurea diffusa*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Tordon 22k	picloram	1 pint per acre	Most effective in actively growing plants, spring or fall.	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Milestone	Aminopyralid	4-7 oz. per acre	Most effective in actively growing plants, spring or fall.	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
ForeFront	Aminopyralid +2,4-D	2 pints per acre	Most effective in actively growing plants, spring or fall.	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
Curtail	Clopyralid + 2,4-D	2 quarts per acre	Most effective in rosette to bud stages	
2,4-D amine	2,4-D	2 quarts per acre	Least effective herbicide listed	

Dyer's woad, *Isatis tinctoria*

Hand pulling: Repeated hand pulling treatments have been very effective in managing infestations of dyer's woad in Montana. First treatment should occur when infestation is close to full bloom, with a second treatment occurring three to four weeks later to catch any individuals that were missed the first time or re-sprouted. The root crown and most of the taproot must be removed in order for hand pulling to be effective. All flowering plants must be placed in plastic bags and removed from the site. Pulling is most successful when soil is moist.

Mowing: Mowing has the potential to be an effective method of control if done when plants have begun to form seed pods, but prior to the plant forming more than 75 % of its seed pods.

Biological control: N/A

Grazing: Grazing is not an effective method of control for dyer's woad because the intensity of grazing required tends to do more damage to competitive desirable plant species than to the dyer's woad infestation.

Herbicide: There are a number of effective herbicides for dyer's woad. Herbicide treatments should occur in rosette to bolt stage, although plants that have begun to flower can be cut and the basal leaves sprayed. The following herbicides are recommended for control of dyer's woad. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Dyer's woad, *Isatis tinctoria*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Escort	Metsulfuron	1 oz per acre	Most effective if used when plant is in rosette to bud stages with a non-ionic surfactant	Cannot be used near wells, surface water, or shallow ground water
Telar	Chlorsulfuron	1 oz per acre	Most effective if used when plant is in rosette to bud stages with a non-ionic surfactant	

Field bindweed, *Convolvulus arvensis*

Hand pulling: Hand pulling is not an effective method of control for field bindweed because of its extensive, rhizomatous root system.

Mowing: Mowing may reduce the amount of seeds produced by the infestation, but usually grows below the level of most mower blades. Mowing is not an effective method of control for field bindweed.

Biological control: There have been two biocontrol agents released in the U.S. for the control of field bindweed, but they have limited availability in Western Montana. Biocontrol is not a recommended method of control for field bindweed in Missoula County.

Grazing: Most livestock will forage on the leaves and stems of field bindweed, but it will not decrease the size and density of an infestation of field bindweed.

Herbicide: The following herbicides are recommended for control of field bindweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for field bindweed, *Convolvulus arvensis*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Tordon 22k	Picloram	1 quart	Most effective if used after there is 12" of growth present	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Tordon 22k + 2,4-D	Picloram + 2,4-D	1 quart of picloram + 1 quart 2,4-D	Most effective if used after there is 12" of growth present	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.

Hoary allysum, *Berteroia incana*

Hand pulling: Hand pulling is an effective method of control when used on small infestations and scattered individuals just establishing or missed by herbicide treatments. Effective hand pulling requires the removal of the tap root, which is most easily accomplished when soil is moist. Repeated treatments are required to deplete the seed bank, and all plants that are past bud stage should be removed in plastic bags and burned to prevent seed spread.

Mowing: Mowing alone is not a recommended method of control for hoary allysum due to the damage to competitive desirable forage.

Biological control: N/A

Grazing: To date grazing has not been used as a method to control hoary allysum and is not recommended.

Herbicide: Due to hoary allysum's tendency to germinate throughout the growing season, repeated treatments are needed to deplete the seed bank in established infestations of hoary allysum. The following herbicides are recommended for control of hoary allysum. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Hoary allysum, *Berteroia incana*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Escort	Metsulfuron	1 oz per acre	Most effective if used when plant is in rosette to bud stages with a non-ionic surfactant	Cannot be used near wells, surface water, or shallow ground water
Telar	Chlorsulfuron	1 oz per acre	Most effective if used when plant is in rosette to bud stages with a non-ionic surfactant	
Chaparral	Metsulfuron + Aminopyralid	2-2.5 oz per acre	Most effective in spring or fall when applied to seedlings and rosettes	

Houndstongue, *Cynoglossum officinale*

Hand pulling: Hand pulling, especially with the aid of a shovel, can be a very effective method of control on patches of both rosettes and flowering houndstongue plants at any time during the growing season. Pulled plants that are in or past the flowering stage should be placed in plastic bags and removed from the site to prevent seed dispersal.

Mowing: Mowing can be an effective method of control for bolting individuals if done before flower, but will not effect rosettes of houndstongue.

Biological control: N/A

Grazing: Grazing is not a recommended method of control for houndstongue due to it containing high levels of pyrrolizidine alkaloids that are poisonous to livestock. Grazing will only increase pressure on competitive desirable species.

Herbicide: The use of herbicides on houndstongue should focus on individuals that are in the rosette or bolting stages, as flowering individuals will already die at the end of the season (houndstongue is a biennial). The following herbicides are recommended for control of houndstongue. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for houndstongue, *Cynoglossum officinale*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Escort	metsulfuron	.5-1 oz per acre	Most effective if applied at rosette to late bud stages	Cannot be used near wells, surface water, or shallow ground water
Telar	chlorsulfuron	.5-1 oz per acre	Most effective if applied at rosette to late bud stages	
2,4-D	2,4-D	2 quarts per acre	Most effective if applied at rosette stage	

Japanese knotweed complex, *Polygonum* spp.

Hand pulling: Hand pulling is only effective on small infestations if done at least twice a month or as new shoots emerge. Since knotweed can re-establish from root or stem fragments, all parts of the plant that are removed should be placed on a tarp and allowed to completely dry out before being burned.

Mowing: Mowing has the potential to be effective at reducing the size of infestations if done consistently and persistently over many years. Mowing or cutting should occur at least three times a year with the last mowing occurring before plants start to lose their leaves prior to winter. Care should be taken to ensure all stem fragments are removed from the site and from the mower and treated like those removed by hand pulling.

Biological control: N/A

Grazing: Knotweed is palatable for almost all forms of livestock, but grazing will not kill the plants. Grazing could potentially reduce the size and vigor of knotweed infestations if it is heavy and consistent.

Herbicide: There are a number of herbicides that have proven effective in controlling knotweeds in Western Montana. Care should be taken when knotweed infestations occur in wetland or riparian areas to use appropriately labeled herbicides. Cutting an infestation and waiting for fresh re-growth prior to herbicide treatment may also increase effectiveness. The following herbicides are recommended for control of Japanese knotweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Japanese knotweed, *Polygonum* spp.

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Habitat	Imazapyr	2 quarts per acre	Most effective if plants are cut and 12" of re-growth allowed before treatment	Can cause injury to desirable trees and shrubs if root systems extend into treatment area
Rodeo	Glyphosate	2.5-8% solution	Most effective if plants are cut and 12" of re-growth allowed before treatment	Non-selective and must be applied very carefully if you are to prevent damage to non-target species

Leafy spurge, *Euphorbia esula*

Hand pulling: Hand pulling is not an effective method of control for leafy spurge because of its extensive root system. Even seedlings that are a few weeks old have vegetative buds capable of producing new shoots when disturbed by pulling.

Mowing: Mowing is not an effective method of control for leafy spurge.

Biological control: Twelve insects have been released as biocontrols for leafy spurge in the U.S. Of those insects, *Aphthona* flea beetles have had the most success in establishing and suppressing leafy spurge. The different species do better or worse depending on site conditions of the infestation (e.g. sun, soil type and moisture), so care should be taken to choose the appropriate species for your site. Contact the Missoula County Weed District for additional information and for assistance with monitoring or additional releases.

Grazing: Grazing with sheep or goats that have been trained to eat leafy spurge can be an effective method of control. Persistent grazing over the long term can reduce stand density, reduce seed production and weaken the infestation making herbicide and biocontrol more effective. Grazing can be utilized at any time during the growing season as long as plants are green.

Herbicide: There are a number of herbicides that are effective on newly established or small infestations of leafy spurge. Due to the extensive root system and the need for repeated treatments over a period of many years, management of large infestations of leafy spurge through the use of herbicides alone may be uneconomical and have an overall negative effect on your site. The following herbicides are recommended for control of leafy spurge. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Leafy spurge, *Euphorbia esula*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Tordon 22k	Picloram	1-2 quarts per acre	Most effective at full flower or fall	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Tordon 22k + 2,4-D	Picloram + 2,4-D	1-2 pints of picloram + 1 quart 2,4-D	Most effective at full flower or fall, repeat annually for 3 years	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
Plateau	Imazapic	8-10 oz per acre	most effective if used in fall prior to first frost	

Meadow hawkweed complex, *Hieracium spp.*

Hand pulling: Hand pulling will only be effective on small infestations when rosettes and the majority of the stolons are removed repeatedly and consistently throughout the growing season.

Mowing: Mowing is not an effective method of control for hawkweed because it grows below the level of most mower blades. Mowing flower heads only may reduce seed production but also stimulates vegetative spread.

Biological control: N/A

Grazing: Grazing hawkweed has a similar effect as mowing. While flowers may be grazed the majority of the plant grows too low to the ground to be utilized as forage, therefore stimulating vegetative spread. Grazing may also have a negative effect on desirable species, which will also increase the competitiveness of hawkweed.

Herbicide: There are a number of herbicides that are effective in suppressing hawkweed growth. The following herbicides are recommended for control of meadow hawkweed complex. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Orange and meadow Hawkweed Complex, *Hieracium* spp.

Trade Name	Active Ingredient	Rate	Efficacy	Comments
ForeFront R&P	Aminopyralid +2,4-D	2-2.5 pints per acre	most effective if used from bolting stage to bud stage	Can be applied to water's edge, do not get in water
Milestone	Aminopyralid	4-6 oz per acre	most effective if used from bolting stage to bud stage	Can be applied to water's edge, do not get in water
Transline	Clopyralid	1.5 pints per acre	most effective if used from rosette stage to bud stage	Do not apply to shallow groundwater areas

Orange hawkweed, *Hieracium auranticum*

Hand pulling: Hand pulling will only be effective on small infestations when rosettes and the majority of the stolons are removed repeatedly and consistently throughout the growing season.

Mowing: Mowing is not an effective method of control for hawkweed because it grows below the level of most mower blades. Mowing flower heads only may reduce seed production but also stimulates vegetative spread.

Biological control: N/A

Grazing: Grazing hawkweed has a similar effect as mowing. While flowers may be grazed the majority of the plant grows too low to the ground to be utilized as forage, therefore stimulating vegetative spread. Grazing may also have a negative effect on desirable species, which will also increase the competitiveness of hawkweed.

Herbicide: There are a number of herbicides that are effective in suppressing hawkweed growth. The following herbicides are recommended for control of orange hawkweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Orange and meadow Hawkweed Complex, *Hieracium* spp.

Trade Name	Active Ingredient	Rate	Efficacy	Comments
ForeFront R&P	Aminopyralid +2,4-D	2-2.5 pints per acre	most effective if used from bolting stage to bud stage	Can be applied to water's edge, do not get in water
Milestone	Aminopyralid	4-6 oz per acre	most effective if used from bolting stage to bud stage	Can be applied to water's edge, do not get in water
Transline	Clopyralid	1.5 pints per acre	most effective if used from rosette stage to bud stage	Do not apply to shallow groundwater areas

Oxeye daisy, *Leucanthemum vulgare*

Hand pulling: Hand pulling can be an effective method of control, especially on small infestations, if carried out persistently over the course of several years. Care should be taken to remove as much of the plants root system as possible in order to minimize re-growth from missed root fragments.

Mowing: Mowing is not an effective method of controlling oxeye daisy, but can be utilized to reduce seed production. mowing should be done just as infestations begin to flower and should be repeated if the growing season is long enough to permit a second or third flowering.

Biological control: N/A

Grazing: Under normal grazing conditions, oxeye daisy infestations will increase in density and size. Heavy, intense grazing will force livestock to feed on oxeye daisy and reduce seed production, but may also damage competitive desirable species as well.

Herbicide: There are a number of herbicides that can be used to effectively control oxeye daisy. The following herbicides are recommended for control of oxeye daisy. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Oxeye daisy, *Chrysanthemum leucanthemum*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
ForeFront R&P	Aminopyralid +2,4-D	2-2.5 pints per acre	Most effective if used on rosette to early flower stages	Can be applied to water's edge, do not get in water
Milestone	Aminopyralid	4-6 oz per acre	Most effective if used pre-bud	Can be applied to water's edge, do not get in water
Escort	Metsulfuron	.5 oz per acre	Most effective if used on rosette to early flower stages	Cannot be used near wells, surface water, or shallow ground water

Perennial pepperweed, *Lepidium latifolium*

Hand pulling: Hand pulling can be an effective method of control for small infestations if large portions of the root system are removed with the stems. Roots should be bagged and removed from the site to be dried and burned.

Mowing: Mowing should be carried out at the first sign of flowering at a height of approximately 4 inches. Herbicide treatments may be necessary for re-sprouting plants. Care should be taken to only mow in areas where desirable plants can withstand repeated mowing.

Biological control: N/A

Grazing: Grazing is only recommended for infestations that have not yet established thick monocultures and have other forage plants growing with the perennial pepperweed. Seeds remain viable after passing through the systems of livestock animals, so care should be taken when moving animals to non-infested sites. They should be contained for five days and fed weed-seed free forage before moving them to non-infested sites.

Herbicide: There are a number of herbicides that can be used to control infestations of perennial pepperweed on a yearly basis, though repeated applications will be needed to decrease the size of infestations and/or eradicate perennial pepperweed. The following herbicides are recommended for control of perennial pepperweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Perennial pepperweed, *Lepidium latifolium*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Escort	Metsulfuron	.75-1 oz per acre	Most effective if used when plant is in rosette to bud stages with a non-ionic surfactant	Cannot be used near wells, surface water, or shallow ground water
Telar	Chlorsulfuron	1 oz per acre	Most effective if used when plant is in rosette to bud stages with a non-ionic surfactant	
Plateau	Imazapic	10 oz per acre	most effective if used at flower stage with a methylated seed oil surfactant	

Purple loosestrife, *Lythrum spp.*

Hand pulling: New infestations of purple loosestrife typically consist of a few scattered plants that can be effectively controlled by hand pulling if the root crown is fully removed. Established infestations will have too large of roots to effectively pull. Be sure to remove all parts of the plant from the site because fragments of the plant can re-sprout if left on site.

Mowing: Purple loosestrife often occurs in sites that are too wet for mowing, but cutting plants as low to the ground as possible can reduce seed production. Best time for cutting is after flower but before full seed development.

Biological control: There are currently 5 species of insects that have been released as biocontrols for purple loosestrife in the US; however, infestations in Montana are not large enough to warrant the use of biocontrols as a method of control. Biocontrol is not a recommended method of control for purple loosestrife in Missoula County.

Grazing: Grazing is not a recommended method of control for purple loosestrife because of its habitat.

Herbicide: Since purple loosestrife infestations occur in wetland and riparian habitats, herbicides must have an aquatic label in order to be used to treat them. Please contact the Missoula County Weed District prior to any herbicide treatments for purple loosestrife. The following herbicides are recommended for control of purple loosestrife. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Purple loosestrife, *Lythrum salicaria*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Garlon 3A	Triclopyr	1.5 % solution	Most effective if applied July through August	Can be used in aquatic sites
Rodeo	Glyphosate	2 quarts per acre	Effective if used while plant is actively growing, clip flowers prior to treatment to prevent seed production	Be sure to use aquatic labeled glyphosate
Habitat	Imazapic	1 pint per acre	Effective if used while plant is actively growing.	Can be used in aquatic sites

Rush skeletonweed, *Chondrilla juncea*

Hand pulling: Persistent hand pulling of rush skeletonweed throughout the year and for a period of six to ten years can be an effective way to eradicate small infestations. Hand pulling is most effective when soil is moist, and plants should be completely removed from the site in plastic bags to be burned at a high enough temperature to kill both root stocks and seeds.

Mowing: Mowing is not considered to be an effective method of control for rush skeletonweed and because of the large root system will only limit seed production on very dry years.

Biological control: Three biocontrol agents have been released in North America to control rush skeletonweed: a rust, a mite and a midge. Since Missoula County has no known infestations of rush skeletonweed, these biocontrol agents are not recommended for its control at this time, as focus should be placed on eradication.

Grazing: Grazing is an effective method of reducing seed and rosette production of rush skeletonweed if it is continuous and moderate. Heavy grazing will also reduce seed and rosette production, but will also damage competitive desirable species. Since Missoula County has no known infestations of rush skeletonweed, grazing is not a recommended method of control at this time.

Herbicide: Rush skeletonweed is difficult to control using herbicides due to its deep taproots that can re-sprout from a depth of up to 4 feet. Soil and moisture conditions at the infestation can also make effectiveness of herbicide applications variable. Repeated, annual applications are often needed to get acceptable control of a site. The following herbicides are recommended for control of rush skeletonweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Rush skeletonweed, *Chondrilla juncea*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Milestone	Aminopyralid	5-7 oz per acre	Most effective if applied in rosette to early bud stage	can be applied to water's edge, do not get in water
Tordon 22k	Picloram	1 quart per acre	Most effective if applied in rosette to early bud stage or fall	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Transline	Clopyralid	1 pint per acre	Most effective if applied in rosette to early bud stage or fall	Safe to use in conifer trees

Russian knapweed, *Centuarea repens*

Hand pulling: Handpulling is not an effective tool for the management to Russian knapweed as it will rapidly re-sprout from rhizomes.

Mowing: While Russian knapweed does spread by seed, it mostly spreads by rhizomes through the soil. Mowing will reduce biomass, but it is not an effective method of control for this species.

Biological control: N/A

Grazing: Grazing is not an effective tool for the management of Russian knapweed due to its deep, rhizomatous root system and can actually cause a neurological disorder called “chewing disease” in horses.

Herbicide: There are a number of herbicides that provide effective control of Russian knapweed. The following herbicides are recommended for control of Russian knapweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Russian knapweed, *Centaurea repens*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Tordon 22k	picloram	1 quart per acre	Effective if used at bud, flower or in the fall	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Milestone	Aminopyralid	4-6 oz. per acre	Effective if used from bolt to bud or in the fall	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
ForeFront	Aminopyralid +2,4-D	2-2.5 pints per acre	Effective if used from bolt to bud or in the fall	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.

Salt cedar, *Tamarix spp.*

Hand pulling: Hand pulling is not an effective method of removing salt cedar.

Mowing: Mowing is not an effective method of removing salt cedar, but it may be necessary and/or beneficial in increasing the efficacy of an herbicide application or a root ripping treatment.

Root plowing: Root plowing at a depth of 12 to 18 inches has proven to be an effective method of controlling infestations of salt cedar. In order to prevent re-sprouting, all above ground vegetation and worked up plant material should be piled and burned.

Biological control: While there have been a number of insects that have been proven as effective biocontrol agents for salt cedar, there are currently none available in Montana at this time.

Grazing: Salt cedar is only palatable as new sprouts and seedlings. Grazing is not a practical or effective method of control for salt cedar in Western Montana.

Herbicide: There are a few herbicides that have been somewhat effective in managing salt cedar; some with a foliar application and some as cut-stump treatments. The following herbicides are recommended for control of salt cedar. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Salt cedar, *Tamarix spp.*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Arsenal	Imazapyr	4-6 pints per acre	effective foliar application	Can cause injury to to desirable trees and shrubs if root systems extend into treatment area
Garlon 3A	Triclopyr	50% solution	Effective as a cut stump treatment; applied directly to the stump immediately after cutting	Can be used in sites near water
Redeem	Triclopyr	20-30% solution	Effective as a cut stump treatment; applied directly to the stump immediately after cutting	Cannot be used near water as it is highly toxic to fish, aquatic plants and aquatic invertebrates.

Spotted knapweed, *Centaurea stoebe*

Hand pulling: Hand pulling is an extremely effective method on small scale infestations of spotted knapweed. Pulling is easiest when soil is moist; allowing you to remove most of the taproot and kill the plant. Any stage from flowering on should be bagged and removed from the site in order to minimize seeds at the site.

Mowing: Mowing will help reduce seed production of spotted knapweed; however, repeated mowing will result in knapweed plants flowering and setting seed below the blades of the

mower. Mowing should occur during the bud stage but before flower to prevent cut plants from producing viable seed.

Biological control: There are thirteen biological control agents that have been released in Montana to control spotted and diffuse knapweed. Of those species, eight have been shown to affect knapweed populations. The majority of these species are wide spread in Western Montana. Contact the Missoula County Weed District for assistance with monitoring and additional releases.

Grazing: Repeated grazing by cattle, sheep and goats can be effective at reducing levels of spotted knapweed if managed to reduce damage to desirable species such as native forbs and grasses. Grazing should occur when native species are dormant (either in the spring before native species begin growing or in the fall after they have dropped their seed). Managers should also be careful not to graze so much as to produce excessive bare ground, which can result in increased weed invasions.

Herbicide: There are a number of herbicides that provide effective control of spotted knapweed. The following herbicides are recommended for control of spotted knapweed. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Spotted knapweed, *Centaurea stoebe*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Tordon 22k	picloram	1 pint per acre	Most effective in actively growing plants, spring or fall.	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Milestone	Aminopyralid	4-7 oz. per acre	Most effective in actively growing plants, spring or fall.	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
ForeFront	Aminopyralid +2,4-D	2 pints per acre	Most effective in actively growing plants, spring or fall.	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
Curtail	Clopyralid + 2,4-D	2 quarts per acre	Most effective in rosette to bud stages	
2,4-D amine	2,4-D	2 quarts per acre	Least effective herbicide listed	

St. johnswort, *Hypericum perforatum*

Hand pulling: Hand pulling can be effective on small infestations if done consistently and persistently over the course of several years. Depletion of the seed bank is necessary for the complete eradication of the infestation.

Mowing: Mowing is not an effective method of control for St. Johnswort, though if done prior to flower it will reduce the amount of seeds produced that season.

Biological control: There have been five insects released as biocontrols for St. Johnswort in the U.S., and they have been very effective at reducing large infestations. Most of the insects prefer open, sunny, warm areas. Contact the Missoula County Weed District for assistance with choosing the appropriate species, monitoring and/or additional releases.

Grazing: Grazing is not a recommended method of control for St. Johnswort due to the potential for livestock poisoning.

Herbicide: There are a number of herbicides that can be used to control infestations of St. Johnswort. The following herbicides are recommended for control of St. Johnswort. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for St. Johnswort, *Hypericum perforatum*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Tordon 22K	picloram	1-1.5 pint/acre	Most effective if applied pre-flower stage	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Milestone	aminopyralid	5-7 oz. per acre	Most effective if applied pre-flower stage	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.

Sulfur cinquefoil, *Potentilla recta*

Hand pulling: Hand pulling is not an effective method of control for sulfur cinquefoil as above ground stems tend to break, leaving the root system intact and able to re-grow.

Mowing: Mowing is not an effective method of control for sulfur cinquefoil as the massive root system acts as a food reserve system allowing the plants to re-grow immediately after mowing.

Biological control: N/A

Grazing: Grazing is not a recommended control option for this species. Sulfur cinquefoil is not a preferred forage plant for goats or sheep, resulting in selective pressures on other forage that allow sulfur cinquefoil an ever increasing window to out compete the desired plant community.

Herbicide: Sulfur cinquefoil can be controlled with a number of different chemicals at 2 to 4 year intervals. Seed that persists in the soil retains a high viability for well over 5 years, allowing sulfur cinquefoil to re-establish on sites that are not managed beyond an initial treatment. The following herbicides are recommended for control of sulfur cinquefoil. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for sulfur cinquefoil, *Potentilla recta*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Tordon 22K	picloram	1 pint/acre	Most effective in actively growing plants, spring or fall.	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.
Milestone	aminopyralid	4-7 oz. per acre	Most effective in actively growing plants, spring or fall.	Can be applied to waters edge; cannot be used in landscaped areas and current or future vegetable gardens.
Banvel + 2,4-D	dicamba, 2,4-D	.5 lbs ai/acre dicamba + 1 lb ai/acre 2,4-D amine	Most effective when applied to early growth stages	Either product used alone does not provide adequate control of sulfur cinquefoil.

Tall buttercup, *Ranunculus acris*

Hand pulling: Hand pulling can be an effective method of control for small infestations of tall buttercup. Care must be taken to remove all the rootstock as plants can re-sprout from root fragments left on site. Pulled plants should be removed from the site in plastic bags and burned in order to prevent seed production on site.

Mowing: Mowing should only be used in instances where it will increase the vigor and competitiveness of desirable species that are present on the site.

Biological control: N/A

Grazing: Grazing has been shown to increase the density of tall buttercup infestations and is not a recommended method of control.

Herbicide: There are many herbicides that have been used successfully on tall buttercup in Western Montana. The following herbicides are recommended for control of tall buttercup. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Tall buttercup, *Ranunculus acris*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
ForeFront R&P	Aminopyralid +2,4-D	2 pints per acre	Most effective if used on seedling to early flower stages	Can be applied to water's edge, do not get in water
Milestone	Aminopyralid	4-6 oz per acre	Most effective if used on seedling to early flower stages	Can be applied to water's edge, do not get in water
MCPA	2,4-D	2 quarts per acre	Most effective if used on seedling to early flower stages and treated for 2 consecutive years	

Tansy ragwort, *Senecio jacobaea*

Hand pulling: Hand pulling can be an effective method of control for small patches of tansy ragwort. Hand pulling must be done throughout the growing season to ensure that plants do not flower and produce seed. Be sure to remove all flowering or seed producing plants from the site in plastic bags to be burned. It is recommended that the site then be treated with herbicide.

Mowing: Mowing tansy ragwort is only recommended if herbicide treatment is going to occur soon after. While repeated mowing may reduce the number of seeds produced in the short-term, it also stimulates the plants to grow side shoots that often flower on shorter stems below the blades of a mower.

Biological control: Three biocontrols have been released for tansy ragwort, the cinnabar moth, the ragwort seed fly and the tansy ragwort flea beetle. While all are considered established in areas that have an established tansy ragwort infestation, there are currently no known infestations of tansy ragwort in Missoula County. Biocontrols are not a recommended method of control for tansy ragwort in Missoula County.

Grazing: Grazing tansy ragwort can often increase the density of infestations if done improperly (similar to mowing). Sheep have been used, however, to prevent seed production in pastures prior to bolt. Grazing is not a recommended method of control for tansy ragwort infestations if they are found in Missoula County.

Herbicide: Tansy ragwort infestations can be effectively controlled with a number of herbicides, though multiple treatments over a series of years are needed to effectively eradicate it. Tansy ragwort also dies very slowly from herbicide, so allow plenty of time for the plants to decay, especially if you are planning on grazing the area (4 to 6 weeks). The following herbicides are recommended for control of tansy ragwort. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Tansy ragwort, *Senecio jacobaea*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Milestone	Aminopyralid	4-6 oz per acre	Effective if used from seedling stage to pre-bud	Can be applied to water's edge, but do not get it in the water, will damage conifer trees
Tranline	Clopyralid	1 pint per acre	Effective if used while plant is actively growing, clip flowers prior to treatment to prevent seed production	Safe to use in conifer trees
2,4-D	2,4-D	2 quarts per acre	Effective in suppressing growth only if used prior to flower	

Whitetop, *Cardaria draba*

Hand pulling: The tremendously deep and rhizomatous root system of whitetop makes hand pulling an ineffective management tool in all situations except infestations that are very small and new.

Mowing: While mowing may reduce seed production and biomass, it is not considered a viable management tool for whitetop.

Biological control: N/A

Grazing: Cattle, sheep and goats will all utilize whitetop; however, this species contains toxic levels of glucosinolates which cause anti-thyroid symptoms in livestock. Recommended time for grazing is from the rosette to bloom stage when levels of glucosinolates are lowest. As with mowing, grazing will reduce biomass and seed production, but will not effectively manage whitetop infestations.

Herbicide: Whitetop can be controlled with a number of herbicides, but it is difficult and usually requires a number of reapplications. The following herbicides are recommended for control of whitetop. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for whitetop, *Cardaria draba*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Escort	metsulfuron	1 oz. per acre	can suppress whitetop regrowth for 1-2 years	Cannot be used near wells, surface water, or shallow ground water
Telar	chlorsulfuron	1 oz. per acre	can suppress whitetop regrowth for 1-2 years	
2,4-D	2,4-D	2 quarts per acre	will not kill root crowns resulting in resprouting	
Roundup	glyphosate	per label instructions	will not kill root crowns resulting in resprouting	Non-selective and must be applied very carefully if you are to prevent damage to non-target species

Yellowflag iris, *Iris pseudacorus*

Hand pulling: Hand pulling or digging and removing the rhizomes of yellowflag iris can be effective if you can remove all of the rhizomes from the site. Rhizomes should be bagged and removed from wet sites and allowed to dry before burning.

Mowing: Yellowflag iris is a semi-aquatic species that tends to grow in areas where mowing is not practical or effective. Mowing or cutting is not a recommended method of control.

Biological control: N/A

Grazing: Yellowflag iris is avoided by livestock.

Herbicide: Herbicide treatment is limited to aquatic labeled glyphosate. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Yellowflag iris, *Iris pseudacorus*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Rodeo	Glyphosate	8% solution	Effective if used prior to full bloom with an aquatic approved surfactant	Be sure to use aquatic labeled glyphosate

Yellow Toadflax, *Linaria vulgaris*

Hand pulling: Hand pulling is not an effective method of control for yellow toadflax.

Mowing: Mowing is not an effective method of control for yellow toadflax, though it can be used to limit seed production if done just before flowering.

Biological control: There have been six biocontrol agents released in the U.S. for the control of yellow and Dalmatian toadflax. While none have them have proven to be the best fit for yellow toadflax (they tend to be more effective on Dalmatian toadflax), they do affect the overall fitness of a yellow toadflax infestation if present. They should definitely be considered as part of an integrated approach to the management of yellow toadflax.

Grazing: Grazing is not recommended as a method of control for yellow toadflax as livestock generally tend to avoid it as a type of forage.

Herbicide: There are a number of herbicides that have been used to control yellow toadflax if reapplied annually for up to three years. Yellow toadflax recovers very well from single treatments, so expect a long term management regime for effective control. The following herbicides are recommended for control of yellow toadflax. Always consult product labels and read them carefully to ensure correct species/land management usage and chemical application.

Herbicides for Yellow toadflax, *Linaria vulgaris*

Trade Name	Active Ingredient	Rate	Efficacy	Comments
Plateau	Imazapic	12 oz. per acre	Most effective if applied in late fall.	Results may be inconsistent, be sure to use a methylated seed oil surfactant
Escort	Metsulfuron	1.5 oz. per acre	Will control toadflax for up to 3 years applied in fall or spring	Cannot be used near wells, surface water, or shallow ground water
Tordon	Picloram	1-2 quarts per acre	Best applied in spring up to early bloom.	Cannot use near surface water, shallow ground water, landscaped areas and current or future vegetable gardens.