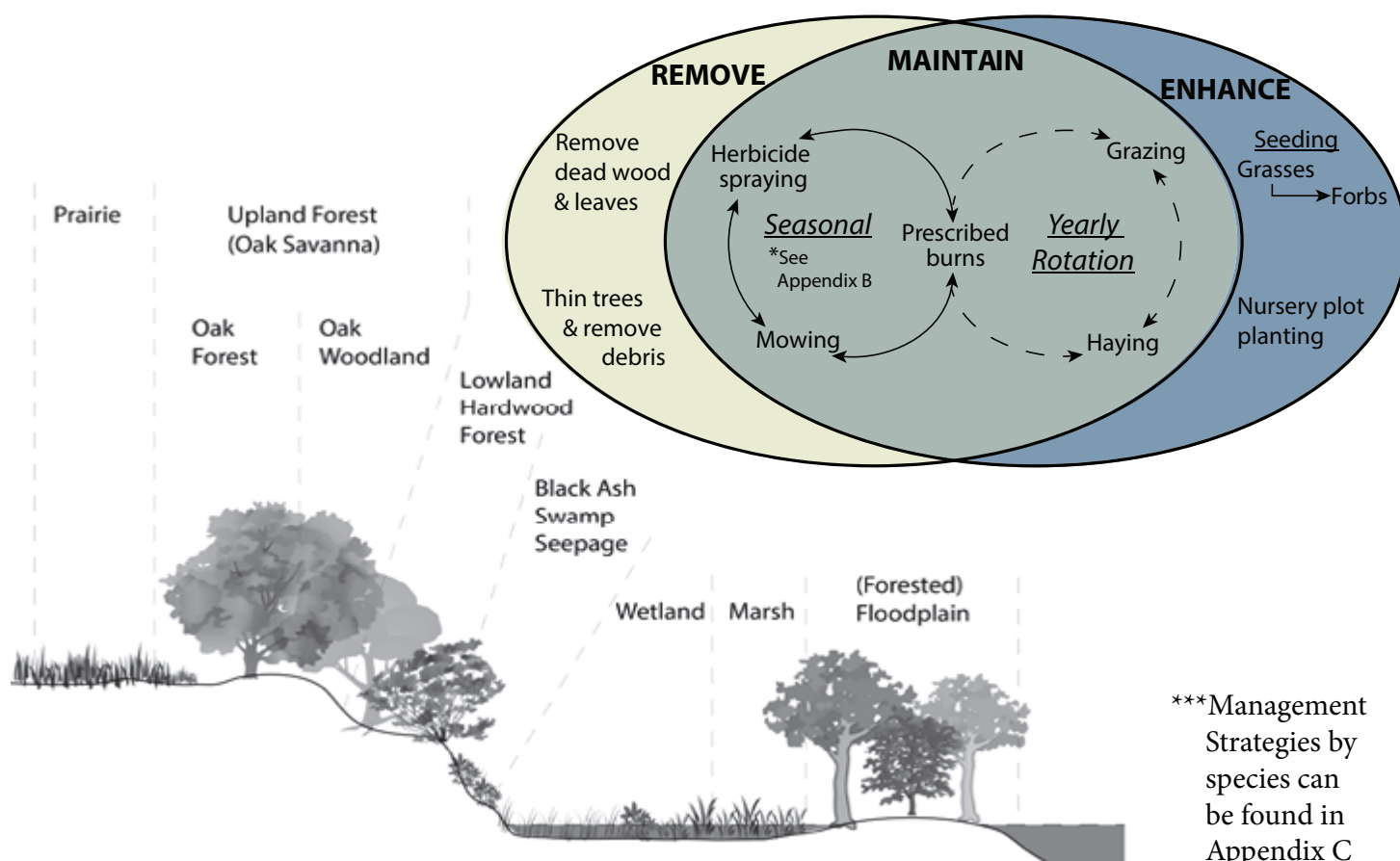




# APPENDIX B: MANAGEMENT STRATEGIES

# A General Framework



## Typical Management Sequences by Habitat

### Savanna, Forested Floodplain

1. Pre-treatment survey, establish photo points
2. Remove excess dead, fallen wood
3. Thin trees
4. Remove undesirable shrubs by cutting and treating stumps
5. Seed native grasses and forbs
6. Mow site continuously, especially during the first 2 years of site enhancement
7. Establish desirable species by reducing excessive nutrients and not allowing undesirable vegetation to shade out desirable vegetation
8. Utilize a combination of haying, grazing, and prescribed burning

### Wetland, Marsh

1. Pre-treatment survey, establish photo points
2. Forestry mow and perform prescribed burns to manage woody encroachment
3. Hay bale and prescribed burn to reduce nutrient undesirable inputs

### Prairie

1. Perform strategies similar to Savanna, Floodplain Forest habitat
2. Focus on cutting and removing woody species along the edges to protect existing prairies with smaller, remnant plant communities

### Black Ash Swamp Seepage and Lowland Hardwood Forest

1. Pre-treatment survey, establish photo points
2. Thin trees
3. Seed bare soils on steep slopes and along stream banks where possible
4. Establish desirable species by reducing excessive nutrients and not allowing undesirable vegetation to shade out desirable vegetation
5. Cut and remove woody species along the edges



# Haying

**Cost: \$400-800/ acre**

Haying is very effective at facilitating diverse native plant communities because it prevents afforestation and restricts nitrogen inputs. The lower nitrogen levels in soils allow greater potential for plant biodiversity. Compared to prescribed burning and grazing, haying provides the most effective means to remove undesired nutrients. Haying is often more technically feasible than grazing since no fencing and water requirements are needed.

The benefits of haying include:

- Reduces the amount of undesirable nutrients, specifically nitrogen, that leach into soils
- Prevents the overgrowth of woody species
- Reduces competition for sunlight for desirable species
- Facilitates structural heterogeneity of vegetation
- Increases long-term carbon storage in soils
- Provides forage that may be marketable or used elsewhere

## Equipment



Mini hay baler  
(source: Earth Tools, Inc)

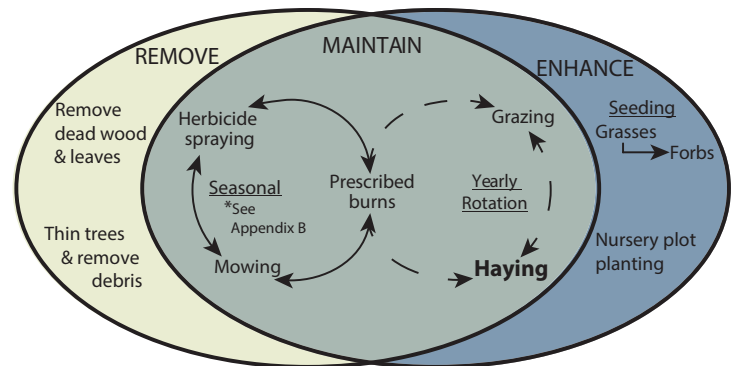


Round bale  
(source: Earth Tools, Inc)

## When

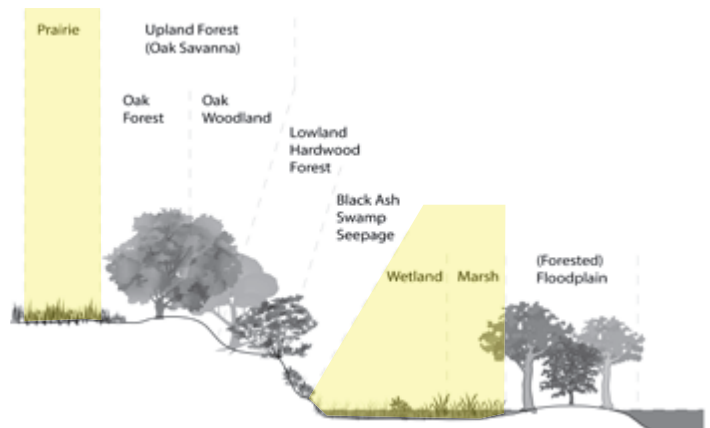
Typically, haying follows mowing. Haying is often a viable option when prescribed burning is not feasible.

Biomass harvest, such as haying, should occur in the summer months when spring wildflowers are dormant.



## Where

Haying wetlands for marsh hay was once common, and is known to reinforce high biodiversity of both plants and animals. Additionally, native marsh hay is highly nutritious and can be highly marketable as forage. Even lower quality hay from species such as nettles, ragweed, and cattail can be used for biomass fuels.



## Grazing

**Cost: \$1,200-1,800 / acre**

Grazing provides a viable method to achieve and maintain high quality grasslands and savannas, and is especially useful in areas with steep slopes. Grazing by goats, sheep, or other wildlife can serve a variety of purposes for land management:

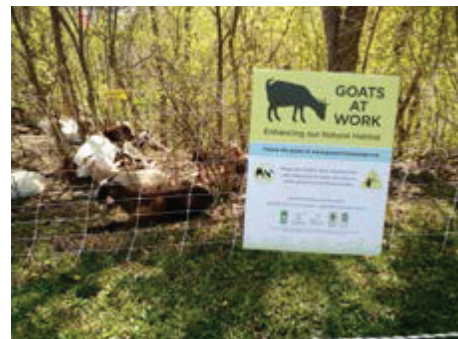
- Controls weed growth and afforestation,
- Reduces undesired nutrients, such as nitrogen, from leaching into soils,
- Creates heterogeneous vegetation patterns,
- Improves wildlife habitat, and
- Provides food and fiber for humans.

Oftentimes, grazing offers a practical opportunity when other management options are unsuitable due to inaccessibility or other reasons.

## Equipment



Several companies throughout the state offer goat grazing rental services



Goats grazing along the Mississippi River bluffs in 2017.

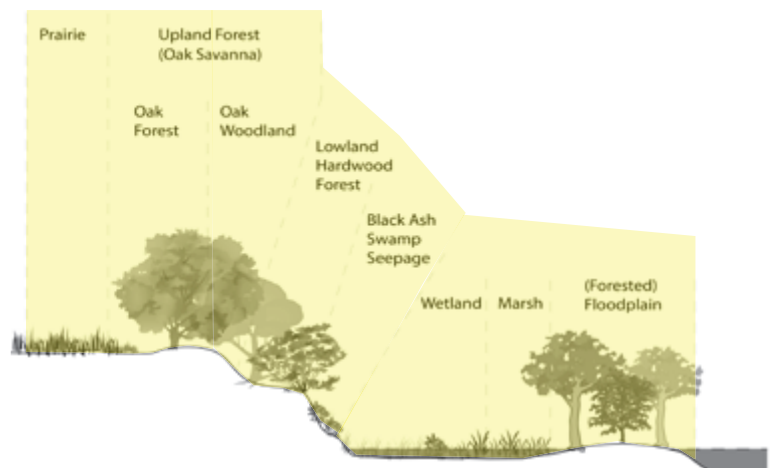
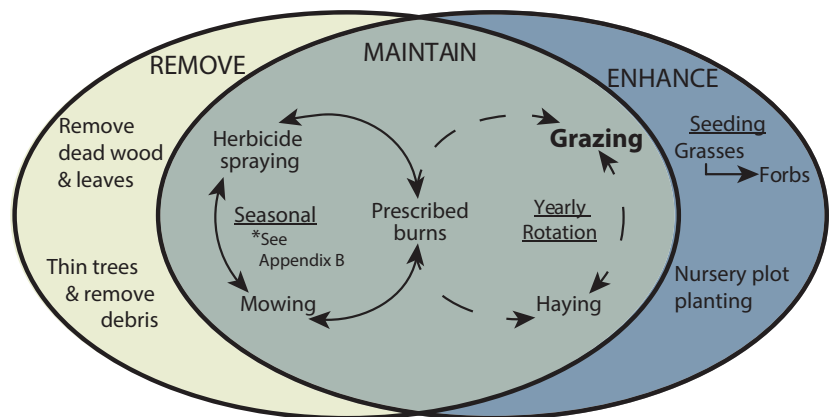
## When

Grazing provides an alternative to mowing and spraying. The ideal timing based on targeted species can be referenced in the management protocols in Appendix D.

In some areas, special care should be taken when spring wildflowers associated with the “grazing lawn” plant community are present. In this situation, grazing should occur in the summer months after the flowers become dormant.

## Where

Grazing can be performed anywhere in the River Valley. However, the steep slopes along the bluffs, the wetlands, and the marshlands in the River Valley are especially favorable for grazing.



# Herbicide Spraying

There are two general types of herbicide application techniques. Broadcast spraying entails blanket-spraying everything within reach, whereas spot spray treatments are more selective. The type treatment that should be applied depends on the targeted species and site conditions.

While broadcast spraying is mostly foliar, there are different types of spot spraying:

- **Foliar** targets the leaves of undesirable species. This is the most common approach due to its ease of application and effectiveness for most species.
- **Basal bark** targets the bark at the base of trees, and the herbicide is mixed with oil instead of water.
- **Cut stem & treat**

This approach is most commonly used for removing buckthorn species. It entails cutting woody vegetation at ground-level, then spraying around the outside of the exposed trunks/stems.

## Cost:

**Spot spray: \$1,000-2,500 / acre**

**Broadcast spray: \$250-750/acre**

## Equipment



Foliar spray  
(source: <http://www.eattheweeds.com>)



Basal bark spray  
(source: *The Maple News*)



Cut stump treatment



Broadcast spray  
(source: U.S. Fish and Wildlife Service/ Public domain)

## When

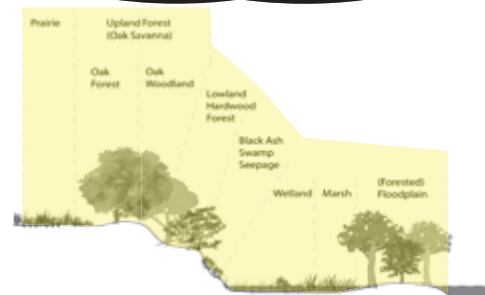
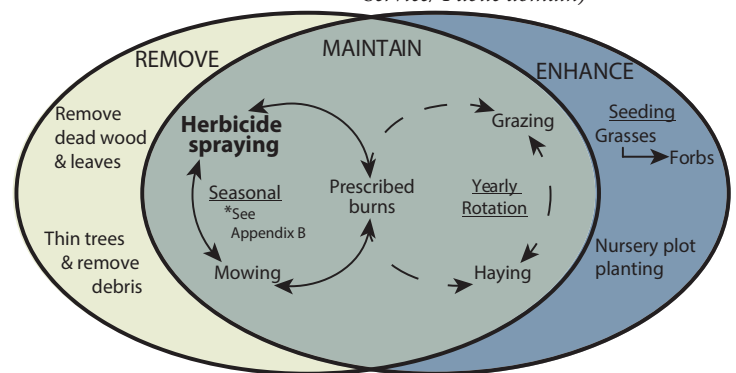
Spraying is effective after mowing when vegetation is disturbed and more susceptible the effects of to herbicides. Spraying is also worthwhile before prescribed burns because it creates a thatch that burns readily. In general, spraying should target undesirable plants before seeds are formed. Appropriate timing of herbicide treatment by species is found in Appendix D.

## Where

Spot spray treatments are best for small areas with pockets of desirable species in which herbicide contamination needs to be avoided. Broadcast spraying is best for large areas with few desirable species. Additionally, areas that are difficult to access, have steep slopes, or contain water-logged soils may be better for spot spraying.

## Notes:

While herbicide removes undesirable species, it also negatively impacts surrounding plants, wildlife, and water quality. Therefore, its use should be limited to the extent possible and it should be applied judiciously. Typically, spot treatment is preferred to broadcast treatment in terms of ecosystem health and fostering the growth of desirable species. However, spot treatment is much more time intensive. A weighing of costs and benefits, size of the targeted area, and existing vegetation needs to be conducted in order to determine if spot spray or broadcast treatments are best suited for a site.





# Tree Thinning

**Cost: \$4,500+ / acre (roughly)**

Tree thinning is a management strategy aimed at achieving the appropriate number of trees and density of tree canopy that will allow enough sunlight to reach and sustain desirable ground layer of vegetation. Typically, the desired outcome is to achieve 80-100% ground cover by desirable species. Tree thinning entails removing trees by either cutting or girdling, and removing the woody debris. Thinning can be highly effective, but is also one of the more costly management strategies. Cost can vary significantly depending on steepness of terrain, access to a site, and method of woody debris removal (burning, or hauling off-site, or stacking in piles on-site).

## Equipment



Chainsaw



Feller-buncher

(source: John Deere)



Wood Chipper

(source: J.P. Carlton/Stumpcutters)

## When

Tree thinning is typically the first step to restoring a site. It can be conducted in any season, but most often occurs in the winter. Thinning should occur over a several year period.

## Where

In the River Valley, tree thinning is needed almost everywhere. However, it can be most effective in areas where desirable oaks and other species are overgrown by weedy trees. Thinning should occur in patches around the desirable species.

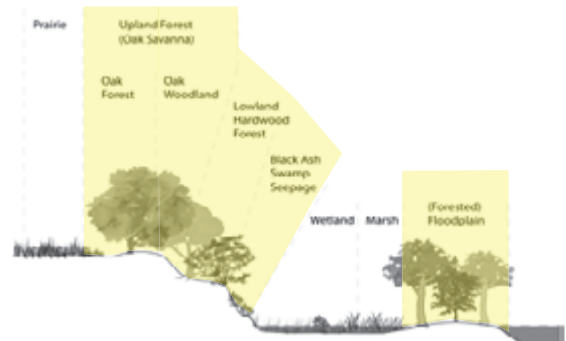
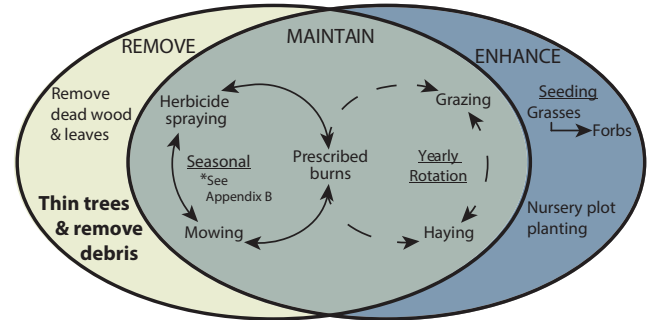
Tree removal may also be desirable to enhance visitor experience and open scenic views of the valley. Selective thinning can strategically open up patches of sunlight to encourage ground layer vegetation, while maintaining enough shade to keep trail users cool.

## Notes:

The land type, restoration objectives, and tree quality should be considered when determining the appropriate number, density, and type of trees desired. One tool for determining tree quality is the Species Quality Index (SQI) provided in Appendix C.

All cut wood should be removed, stacked, or burned on site. Burning the cut woody vegetation will help reduce nitrogen build up in the soil. Removal is significantly more resource intensive, requiring trucks and potentially multiple trips to haul the woody material off-site. However, removing cut material is most effective at reducing undesirable nutrients on site.

Tree thinning should occur strategically to facilitate short and long-term management. Thinning can create corridors for machinery to carry out tasks such as mowing, removing dead, fallen wood, and selective cutting. Terrain aspect also needs to be considered when selectively cutting trees to allow sunlight to reach the ground.



## Nursery Plot Planting

Nursery plots can be established for species that were once common, but are now rare. Species such as anemones are expensive, hard to find, and difficult to grow by seed. Stable populations of native wildflowers can serve as transplants for plug planting in other areas of the valley. Native Americans likely practiced this strategy by spreading the rootstock of unique forest wildflowers, which increased their resilience as a viable population in some of the river valley areas today. With appropriate care and management, this practice can be continued.

### Cost: Varies

Dependent on volunteer time or staff management

## Equipment



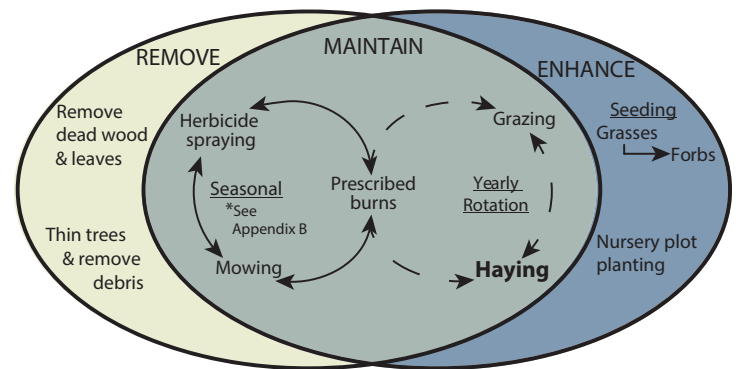
Signage at the National Wildlife Refuge protects vegetation by informing visitors not to harvest plants on site.



Fencing provides specific area designations for nursery plots.

## When

Plants are best transplanted when they are thriving and are under the least amount of stress. In general, early morning hours or late afternoon hours are suitable due to limited stress from sun and heat.



## Where

Before this strategy is applied, suitable transplant sites should be identified. The most effective strategy might entail transplanting to areas immediately adjacent to existing native wildflowers, thereby expanding outward the current populations.





## Mowing

When properly timed, mowing can be very efficient and effective at reducing the dominance of undesirable vegetation and fostering the growth of desirable vegetation. It is often a favorable strategy due to its general ease and feasibility. Additionally, mowing can typically be performed in lieu of other management practices, such as prescribed burns, that might not be feasible. The mowing techniques – flail, forestry, and spot mowing – differ in that spot mowing can be more selective, whereas flail and forestry mowing are efficient at cutting large patches of mostly undesirable vegetation.

### Cost:

**Flail Mowing \$125-200 / acre**

**Forestry Mowing \$650-850 / acre**

**Spot Mowing \$125-200 / hour**

## Equipment



String trimmer / Brush saw  
Spot mowing



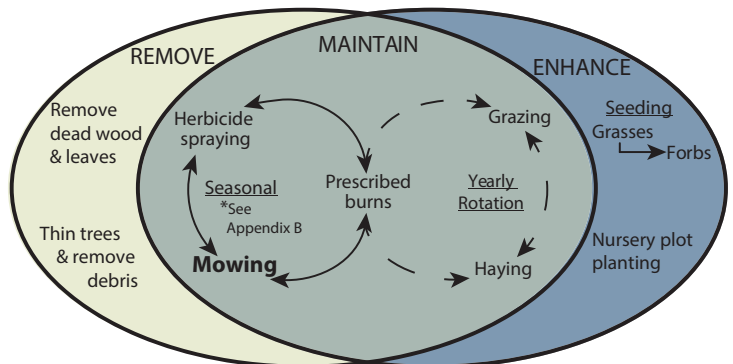
Forestry mower



Flail mower

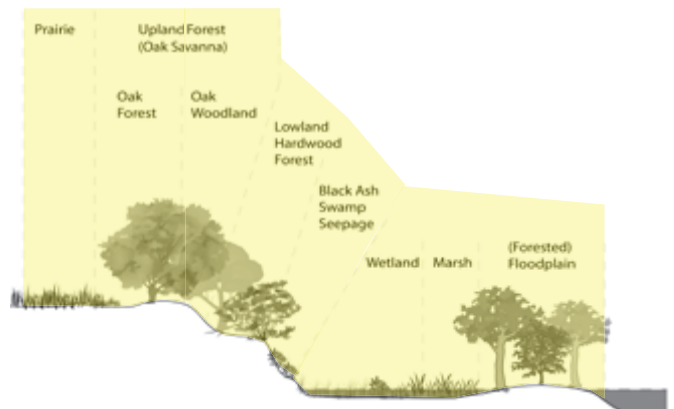
## When

Mowing should occur before any vegetation exceeds 6-12 inches in height. Seeds can be prevented from forming on some invasive species when mowed in the appropriate months (Appendix B). Forestry mowing in the winter can potentially shatter the base of woody stems and prevent invasive trees from resprouting.



## Where

Areas that are difficult to access or have unique, desirable species can be spot mowed by hand with a brush saw, string trimmer, or scythe. At sites that don't contain sensitive, desirable species and need mowing throughout the whole area, forestry or flail mowing is most efficient.



## Notes:

Continuous mowing is especially needed during the first 2 years of site enhancement, and should be routinely performed thereafter for site maintenance. While mowing can be time intensive initially, it is one of the most effective management strategies and there is less of a time demand in the long-term. The addition of herbicide broad-leaf treatment in conjunction with mowing can be a very efficient practice.



## Prescribed burn

**Cost: \$3,000-9,000 / occurrence**

Fire plays an integral role in the maintenance and management of native ecosystems, such as grasslands and woodlands. Periodic fires help to remove thatch and leaf litter, return nutrients to the soil, and control invasive species. Prescribed burning is an effective management tool to control invasive species that did not evolve in a fire dependent system.

### Equipment



Drip torch



The mowed firebreak should be monitored with extra water

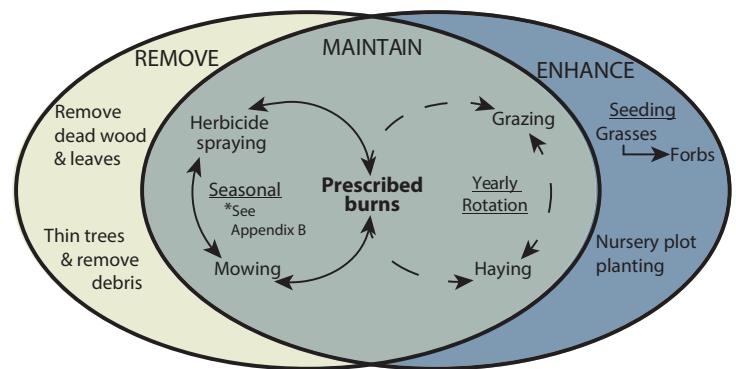


Fire lines

### When

Prescribed burns generally occur in the spring and fall, and can be timed to specifically impact either woody or herbaceous invasive species that are in a life stage that is especially susceptible to fire.

Some habitat types, such as prairies, may require more frequent prescribed burns.



### Where

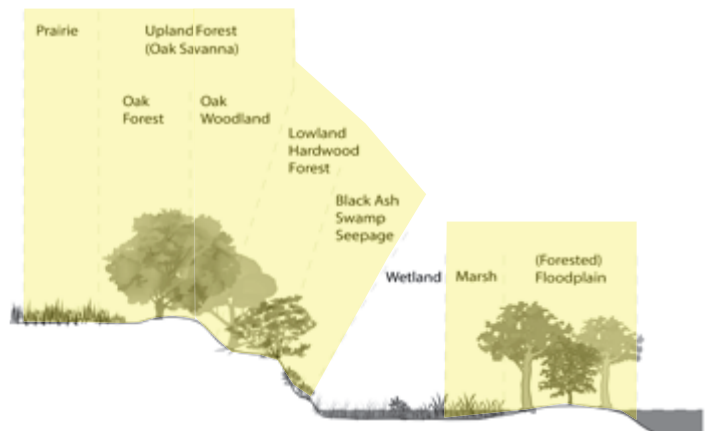
Prescribed fire is an important tool in restoring and maintaining fire dependent ecosystems such as Oak Woodlands, Oak Savannas, and Prairies.

### Management Considerations

1. A burn permit needs to be obtained
2. A 10-15 ft wide firebreak should be mowed, and all accumulated materials must be raked off of the firebreak.
3. For burns on steep terrain, the burn should be initiated at the top of a hill.

#### Prescribed burns are only conducted when:

- Fuel in the burn area is dry.
- Wind velocities are moderate, 5 - 15 MPH, in a direction that results in the least amount of smoke impact on a residential area.
- Humidity is 35% - 80%.
- Air temperature is 32° - 65° F.



### Notes:

Burns can also be used to facilitate herbicide treatments by removing thatch in preparation for herbicide treatment, or as a follow-up to herbicide treatment. The removal of thatch or leaf litter is also beneficial for follow-up seeding.

## Seeding

Seeding is a common strategy to revegetate bare soils. Bare soils will require at least two seed mixes and additional enhancement seedings as necessary.

### Cost:

**Grass seeding: \$600-1,000 / acre**

**Forb seeding: \$1,000-3,000 / acre**

## Equipment



**The first seed mix** of native graminoids should include:

- Cool, mid, and warm season species,
- Sun and shade tolerant species,
- A variety of species that provide function and cover from spring through fall

Graminoids are especially beneficial in the first seeding because they provide fast establishment, competition to noxious seedlings, tolerance of selective herbicides, fuel for prescribed burns, tolerance to mowing, and forage for hay and grazing.

Forb species can be included in the initial mix, but should be limited to less expensive, bi-annual, and disturbance tolerant plants.

## When

Seeding is an effective follow-up strategy after thinning and mowing have occurred. Reseed areas with poor germination 30 days after the first seeding.

The second seed mix should be sown only when the site displays a stable grassland state in response to management, such as mowing.

## Where

Seeding can be performed almost anywhere in the River Valley to create a more desirable plant configuration. Areas with bare soils, steep slopes, and stream banks are especially in need of seeding or revegetation.

## Notes:

Mowing should take place three to four times during seeding to prevent vegetation from getting higher than 6-12 inches. The reduction in sunlight competition will facilitate robust forb populations, stimulate graminoids, and provide competition to germinating weedy species.

**The second seed mix** should be composed of a diverse forb mixture of:

- Cool, mid, and warm season species
- Sun and shade preferential species
- Several local genotypes of the same species to ensure long-term genetic diversity and resilience

If propagation rates are low, additional enhancement seedings might be needed.

