5.4.4 Managed Vegetated Areas

URBAN FOREST, GRASSLANDS AND RIPARIAN BUFFERS

Variations: Prairie, no-mow lawn area, woodland, buffers

Figure 1: Managed vegetated area in native perennial grasses and shrubs in Athens, TN (Source: SMART Center).

Managed Vegetated Areas are those that sustain a determinant amount of vegetated cover such that it intercepts rainfall and covers the soil surface as well as has an established root matrix in the soil. Managed Vegetated Areas may be planted in native plants or non-native plants; however, there are many advantages to selecting and maintaining a native vegetation stand. Native plants are plants that evolved in place over geologic time and are distributed across the landscape largely in response to climatic episodes and adaptation to site conditions related to land formation. Natives are generally defined as plants that occurred in North America before European settlement. Native soil and vegetation retention is the single most effective strategy to reduce stormwater impacts on-site, and has the added benefit of enhancing baseflow in streams and recharge of aquifers [Lacey, 2010].

Key Design Criteria:

- Preserve open spaces and create healthy stands of vegetation
- Develop landscape plan using native materials when possible
- Protect areas during construction

Site Constraints:

- **Hotspots, Karst, or Run-on Volume:** Not suitable for hotspot area nor approved to accept run-on volume. Encouraged management around known karst (undisturbed).
- Water table to bedrock depth: N/A
- Soils: Vegetation should match soil types
- Slope: up to 1:1
- Max. drainage area: N/A

Limitations:

- Establishment period requires more intensive maintenance, such as weeding and watering

Advantages:

- **Facilitates evapotranspiration**
- **May reduce use of pesticides and fertilizers.** Native plants have adapted to local conditions, so they are more resistant to pest problems.
  - Saves time and money
  - Improves water quality
- **Improved air quality.**
- **Improved soil conditions** through organic material and macropore formation
- **Carbon sequestration**
- **Enhanced infiltration**
- **Settling and filtering of pollutants**
- **Groundwater recharge**

1. Design

The use of Managed Vegetated Areas (MVAs) is generally limited to two goals: 1) providing the desired use and aesthetic of a site, and 2) minimizing the amount of runoff generated. The design of MVAs relies solely on establishing a stand of vegetation, which can be characterized in terms of capacity to protect soil surface. The Soil Conservation Service (SCS) Curve Number method is the most widely accepted method for predicting runoff from surfaces with a consistent management (or cover). The effects of management are translated into the TNRRAT approach through adjusting the infiltration capacity of soils based on vegetative cover. To establish and maintain a stand of specific vegetated cover, see section 5.3 for Management Techniques that will assist in preparing a site for establishment. Also utilize local nursery and growers instructions for establishing and maintaining specific ornamental and nonnative vegetation stands. The remainder of this section will focus on establishing native vegetation as well as using managed vegetated areas to balance the stormwater runoff generated from impervious surfaces of a site.

1.1 Benefits of Selecting Native Vegetation

Using native plants to vegetate an area is an effective method of improving the quality and reducing the volume of site runoff. Native plants significantly change the soil medium by adding carbon, decreasing bulk density, and increasing infiltration rates by as much as a factor of 10 or more, even in clay soils (see Bharati, et.al, 2002 and Fuentes, et.al, 2004). Native species are generally described as those existing in a given geographic area prior to European settlement. Over time, native vegetation does not typically require significant chemical maintenance by fertilizers and pesticides. This results in additional water quality benefits. Native species are typically more tolerant and resistant to pest, drought, and other local conditions than non-native species. Landscape architects and ecologists specializing in native plant species are usually able to identify a wide variety of plants that meet these criteria anywhere in the state.

In addition to chemical applications, minimum maintenance also means minimal mowing and irrigation in established areas. Native grasses and other herbaceous materials that do not require mowing or intensive maintenance are preferred. Because selecting such materials begins at the concept design stage, this BMP can generally result in a site with reduced runoff volume and rate, as well as significant nonpoint source load reduction/prevention.

A complete elimination of traditional lawns as a site design element can be a difficult SMC to implement, given the extent to which the lawn as an essential landscape design feature is embedded in current national culture. Instead, the landscape design should strategically incorporate areas of native plantings – surrounding limited turf grass areas – to act as buffers that will capture and filter stormwater flowing off of turf grasses or pavements.

Native species have more extensive root systems (Figure 2). Dense root system increases ability to retain and store water which help reducing the amount of CO_2 in the atmosphere by taking in CO_2 and storing the carbon in the body of the plants, roots and soil.

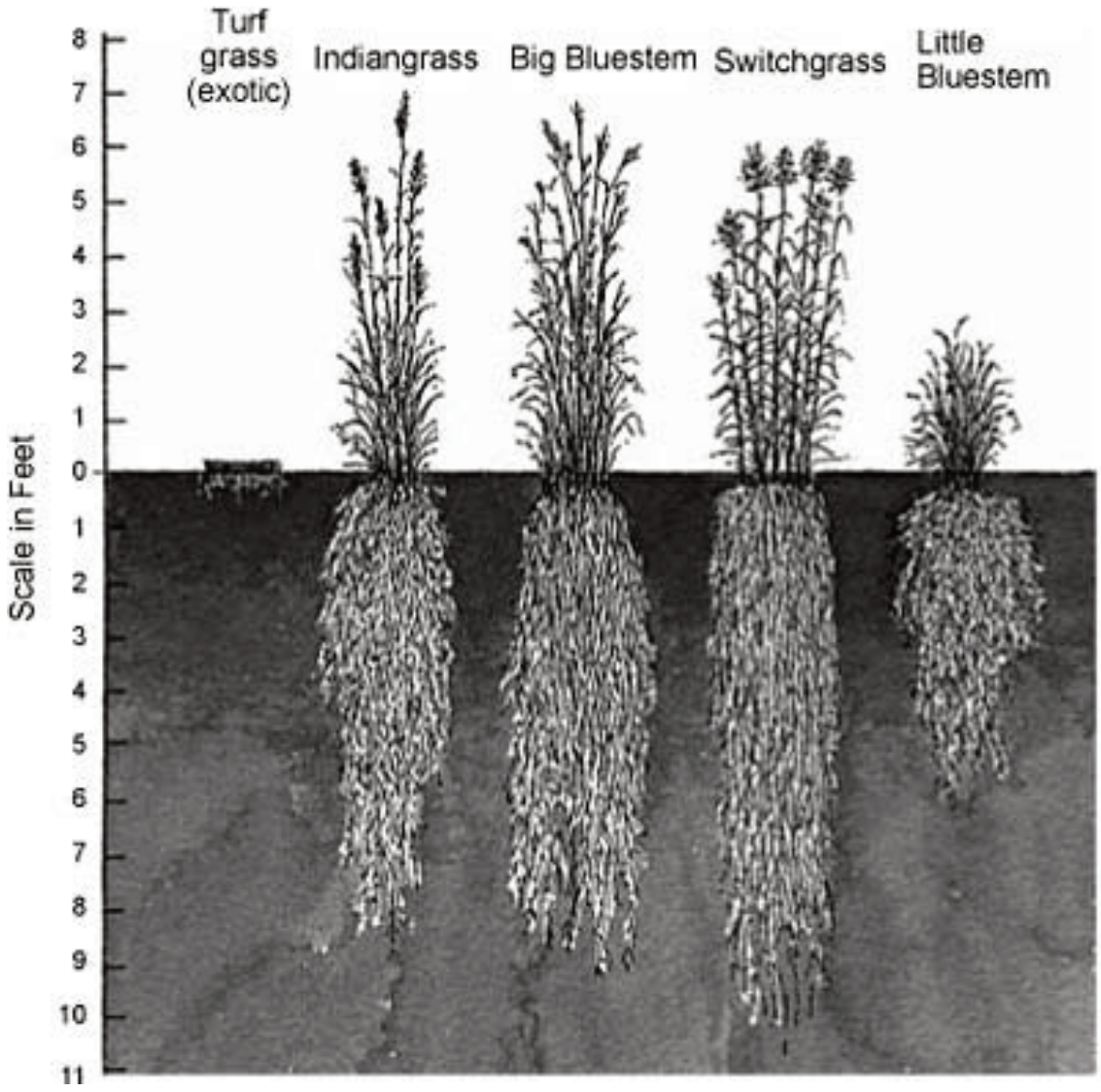

Figure 2: Native meadow species compared to turf grass (Source: TVA).

1.2 Variations

Species selection for any native landscape should be based on function, availability, and level of appropriateness for site conditions. Native species plantings can achieve variation in landscape across a variety of characteristics, such as texture, color, and habitat potential.

Properly selected mixes of flowering prairie species can provide seasonal color; native grasses offer seasonal variation in texture. Seed production is a food source for wildlife and reinforces habitat. In all cases, selection of native species should strive to achieve species variety and balance, avoiding creation of single-species or limited species "monocultures" which pose multiple problems. In sum, many different aspects of native species planting reinforce the value of native landscape restoration, typically increasing in their functional value as species grow and mature over time. Examples include:

- **Prairie** – Install Big Bluestem, Little Bluestem, Indian Grass, Switchgrass and others that resemble the Native Americans grassland. Prairies have a tendency to establish and regain function rather quickly (3-10 years), and can provide lower-growing vegetation with highly attractive native grasses and wildflowers.
- **No-mow lawn area** – Install low-growing native grasses that are used as a substitute for lawn or cool-season grass plantings.

- **Woodland** – Install a balance of native trees, shrubs, forbs, grasses, and sedges. Woodlands will provide shade, vertical structure, and a high level of rainfall interception in the long term. It typically requires a significant amount of time to mature.
- **Constructed wetlands** – Historic drained wetlands or existing artificial low areas may be planted with wetland species that will thrive in standing water or saturated conditions.
- **Buffer areas** – Bands of re-established native vegetation occurring between impermeable surfaces, lawns, or other non-native land uses and existing natural areas.
- **Replacement lawn areas** – Existing turf lawns may be converted to native prairies, wetlands, or woodlands to minimize maintenance while increasing stormwater benefits and wildlife habitat.

Figure 3: Tennessee native no-mow lawn and woodland (Source: S.R.).

Figure 4: Managed Vegetated Areas of fescue lawn and wet meadow adjacent to the parking area in this mixed-use/industrial zone in Asheville, NC.

1.3 Applications

1.3.1 New / Retrofit Development

- **Residential** – Native landscapes can be incorporated into common areas of residential developments. Additionally, individual homeowners may incorporate native landscapes into their own properties. Native revegetation should also be used to provide buffers around any existing natural areas that are undisturbed within the residential development.
- **Commercial** – Common areas and open spaces within commercial developments may be planted with native species, as well as any created detention/retention basins or artificial water ways. Native revegetation should also be used to provide buffers around any existing natural areas that are undisturbed within the commercial development.
- **Ultra Urban** – Use of native revegetation is limited in ultra-urban settings because of the lack of available green space. Wherever possible, however, native species should be incorporated.
- **Industrial** – Use of native revegetation in industrial settings is very similar to that in commercial settings.
- **Retrofit** – Established turf grass may be converted into prairie, woodland, or wetland.
- **Highway/Road** – Native plants may be established in rights-of-way to minimize long-term maintenance while establishing linear habitat corridors.

1.3.2 Preserving Native Vegetation

Preserving native vegetation should be the first priority wherever feasible. Native vegetation preservation and restoration areas should be incorporated to the maximum extent practical and where most effective (i.e., where there is intact native vegetation and soils and/or unconcentrated flows from developed areas). The goals for native vegetation preservation/retention are as follows:

- Large lot development: 65%
- Low density residential (0-4 dwelling units/acre): 50%
- Low-density residential (3-6 du/acre): 50%
- Medium density (6-12 du/acre): maximum practical extent
- High density (>6-20 du/acre): maximum practical extent. [Lacey, 2010].

1.3.3 Selecting Preservation Areas

Selection of areas for natural vegetation preservation should be made in consultation with a landscape architect. Native vegetation and soil protection areas should be prioritized by location and type as follows:

1. Large tracts of riparian areas, that connect, create or maintain contiguous protected riparian areas
2. Large tracts of critical and wildlife habitat area , that connect, create or maintain contiguous protected areas
3. Tracts that create common open space areas among or within developed sites
4. Protection areas on individual lots
5. Protection areas on individual lots that connect to protection areas on adjacent lots [Lacey, 2010].

1.4 Materials

Whenever practical, native species should be from the same ecoregion as the project area. When necessary, species may be used from adjacent ecoregions for aesthetic or practical purposes. Additional information relating to Tennessee native species and their use in landscaping is available from TVA and Southeast Exotic Pest Plant Council (TVA and SE-EPPC).

Developments should use native trees for replacement in areas separate from residential lots, or storm drainage areas adjacent to roadway or parking lots. Species selection should be based on the underlying soils and the historic, native indigenous plant community type for the site, if existing conditions can support the plant community.

Requirements for trees selected for replacement purposes are listed below:

- The trees must be free from injury, pests, diseases, and nutritional disorders.
- The trees must be fully branched and have a healthy root system
- Coniferous and broad leaf evergreen trees shall be no less than 3 feet in height at time of planting.
- Deciduous trees shall be a minimum of 5 feet in height or have a minimum caliper size of 1 inch at time of planting.
- Avoid the use of a single species of tree for replacement purposes. No individual species of replacement tree should exceed 50 percent of the total, and no individual species should be less than 10 percent of the total.

1.5 Calculation

Managed vegetation will lower runoff volume and peak rates by lowering the runoff coefficient (i.e., curve number). Runoff reduction requirements can be met through a site-wide mass balance of square feet of trees, shrubs, or grass and impervious surface. Proposed trees and shrubs to be planted under the requirements of these SCMs are assigned a curve number (CN) reflecting the condition of a stand, either in "good" condition, "fair" condition, or "poor" condition. These conditions are quantified based on plant cover density and described in detail below. The amount of rainfall attenuated is based on this curve number, which decreases in attenuation capacity in the preceding list. This is a function of vegetation characteristics that help retain rainfall, such as soil coverage with foliage canopy and root density. While this practice is not approved to accept run-on water volumes, implementing managed vegetated areas will minimize the overall site generation of runoff.

- Good condition
  - o ≤ 200 ft^2 / tree, or expected full canopy cover
  - o ≤ 25 ft^2 / shrub
  - o > 90% turf cover, with no continuous bare areas
  - o Trees or shrubs with lush undergrowth, with > 90% of surface under either canopy or ground cover
- Fair condition
  - o 200 - 350 ft^2 / tree, or expected canopy cover > 75%
  - o 25 - 40 ft^2 / shrub
  - o > 75% turf cover, with no contiguous bare area > 50 ft^2
  - o Trees or shrubs with fair undergrowth, with > 75% of surface under either canopy or ground cover
- Poor condition
  - o 350 - 500 ft^2 / tree, or expected canopy cover > 50%
  - o 40 - 60 ft^2 / shrub
  - o > 50% turf cover, with no contiguous bare area > 75 ft^2
  - o Trees or shrubs with some undergrowth, with > 50% of surface under either canopy or ground cover

- Below these recommended targets, it is not considered an adequate measure to claim credit, due to very limited infiltration capacity and potential to serve as a source of TSS.
- Minimum seeding/planting will receive "poor" credit, while optimize seeding/planting will receive "fair" credit. "Good" credit can only be achieved when optimized seeding/planting is followed by maintenance practice.

1.6. Design Process

Existing native vegetation is a good starting point for determining what can thrive on a given site. However, the designer should also consider and balance various factors in developing a successful plant list. The hydrologic patterns set the stage for where along the moisture continuum plants will be most successful (easily found in native plant resource guides).

The basis for native revegetation design scheme begins with assessing the site for:

- Existing native vegetation
- Soil texture and pH
- Hydrologic regimes
- Sun exposure
- Aesthetics

1. Analyze site's physical conditions

The most important physical conditions of the site are the topography, hydrology, and soil, each of which will guide protection activities and plant selection. Evaluate the soil using the USDA soil survey to determine important soil characteristics such as flooding potential, seasonal high water table, soil pH, soil moisture, and other characteristics. Evaluate the topography based on USGS maps or a topographical survey of the site.

2. Analyze site's vegetative features

Existing vegetation present at the site should be examined to determine the overall strategy for vegetation restoration and establishment. Strategies will differ whether pre-existing conditions are pasture, overgrown abandoned field, mid succession forest, or another type of setting. An effort to inventory existing vegetation for protection and to determine type of presettlement vegetation should be made to guide efforts.

a. **Identify desirable species:** Use native tree and shrub species that thrive in local habitats in Tennessee. These species should be identified in the restoration site and protected. Several native vines and shrubs can provide an effective ground cover during establishment of the area, though they should be controlled to prevent herbaceous competition.

b. **Identify undesirable species:** Control invasive plants prior to planting new vegetation.

c. **Identify sensitive species:** Because many areas are rich in wildlife habitat and could potentially harbor wetland plant species, be aware of any rare, threatened, or endangered plant or animal species. Take care to protect sensitive species during restoration activities.

3. Map the site

Prepare an existing conditions sketch of the site that denotes important features, including stream width, length, stream bank condition, adjacent land uses, stream activities, desired width of buffer, discharge pipes, obstructions, etc.

4. Create a design that meets multiple stakeholder objectives

a. Landowner objectives: Consider the current use of the existing vegetation, especially if the area will be protected by the landowner in perpetuity. Determine how the revegetated area will complement or conflict with existing and probable future uses of the property.

b. Community objectives: Consider linking the revegetated area to an existing or planned green infrastructure system, which may include trails, parks, preserves, and wildlife habitat corridors. Evaluate how the new vegetation could help achieve local recreation goals.

c. Watershed objectives: Examine the local watershed plan to identify goals related to establishing native plants. Have goals related to water quality been emphasized, or is wildlife habitat of primary concern? If no watershed plan has been prepared, examine other regional resource or recreation plans for reference to native plantings.

5. **Amend soil**

   In those sites where soils have been disturbed, restore compromised soils by subsoiling and/or adding a soil amendment, such as compost. This will help in reestablishing its long-term capacity for infiltration and pollution removal.

6. **Limit the development footprint** as much as possible, preserving natural site features, such as vegetation and topography. In contrast to turf, "natural forest soils with similar overall slopes can store up to 50 times more precipitation than neatly graded turf." (Arendt, Growing Greener, pg. 81) If lawns are desired in certain areas of a site, they should be confined to those areas with slopes less than six percent.

7. **Prairie restoration can reduce turf or create a buffer between turf and forest.** Meadow buffers along forests help reduce off-trail trampling and direct pedestrian traffic in order to avoid "desire-lines" which can further concentrate stormwater. Prepare the site for a prairie planting by weeding well before planting and during the first year. Perennial weeds may require year-long smothering, repeated sprayings with herbicides, or repeated tillage with equipment that can uproot and kill perennial weeds.

   The site should be sunny, open, and well-ventilated, as prairie plants require at least a half a day of full sun. Erosion prone sites should be planted with a nurse crop (such as annual rye or seed oats) for quick vegetation establishment to prevent seed and soil loss. Steep slopes (25 percent or steeper) and areas subject to water flow should be stabilized with erosion blankets, selected to mitigate expected runoff volumes and velocities. Hydro-seeding is generally not recommended for native species. There is tremendous variation among seed suppliers; choose seeds with a minimum percent of non-seed plant parts. Native seed should also be PLS (Pure Live Seed) tested by a third party to gauge seed viability.

8. Converting turf grass areas to prairie requires that all turf be killed or removed before planting, and care taken to control weeds prior to planting.

9. Forest restoration includes planting of tree species, 12-18 inches in height, and shrubs at 18-24 inches, with quick establishment of an appropriate ground cover to stabilize the soil and prevent colonization of invasive species. Trees and shrubs should be planted on eight-foot centers, with a total of approximately 430 trees per acre.

   Reforestation can be combined with other volume control SCMs such as retentive berming, vegetated filter strips and swales. Plant selection should mimic the surrounding native vegetation and expand on the native species already found on the site. A mixture of native trees and shrubs is recommended and should be planted once a ground cover is established.

10. Ensure adequate stabilization, since native grasses, meadow flowers, and woodlands establish more slowly than turf. Stabilization can be achieved for forest restoration by establishing a ground cover before planting of trees and shrubs. When creating meadows, it may be necessary to plant a fast growing nurse crop with meadow seeds for quick stabilization. Annual rye can be planted in the fall or spring with meadow seeds and will establish quickly and usually will not present a competitive problem. Erosion prone sites should be planted with a nurse crop and covered with weed-free straw mulch, while steep slopes and areas subject to runoff should be stabilized with erosion control blankets suitable for the expected volume and velocity of runoff.

11. Prepare a landscape maintenance plan that identifies weeding plans, mowing goals, irrigation needs, and trimming of herbaceous perennials or key tree specimens, as needed.

2. Construction

2.1 Conversion of Previously-Developed Surfaces to Native Vegetation

Conversion of a previously developed surface to native vegetated landscape or restoration of disturbed areas required to be native vegetation requires the removal of impervious surface and ornamental landscaping, de-compaction of soils, and the planting of native trees, shrubs, and ground cover in compost-amended soil according to all of the following specifications:

1. Existing impervious surface and any underlying base course (e.g., crushed rock, gravel, etc.) must be completely removed from the conversion area(s).
2. Underlying soils must be broken up to a depth of 18 inches. This can be accomplished by excavation or ripping with either a backhoe equipped with a bucket with teeth, or a ripper towed behind a tractor.
3. At least 4 inches of well-decomposed compost must be tilled into the broken up soil as deeply as possible. The finished surface should be gently undulating and must be only lightly compacted.
4. The area of native vegetated landscape must be planted with native species, trees, shrubs, and ground cover. Species should be selected as appropriate for the site shade and moisture conditions, and in accordance with the following requirements:
   a. Trees: a minimum of two species of trees should be planted, one of which is a conifer. Conifer and other tree species should cover the entire landscape area.
   b. Shrubs: a minimum of two species of shrubs shall be planted. Space plants to cover the entire landscape area, excluding points where trees are planted.
   c. Groundcover: a minimum of two species of ground cover should be planted. Space plants so as to cover the entire landscape area, excluding points where trees or shrubs are planted.

Note: For landscape areas larger than 10,000 square feet, planting a greater variety of species than the minimum suggested above is strongly encouraged. For example, an acre could easily accommodate three tree species, three species of shrubs, and two or three species of groundcover [Lacey, 2010].

3. Maintenance

3.1 Management Plan

Native vegetation and soil protection areas serve as stormwater control measures and should be managed as are other stormwater control measures. The Maintenance Plan for the SCM shall include a written vegetation management plan and protection mechanisms as necessary to maintain the benefit of these areas over time (Appendix F).

3.2. Monitoring the Survival Rate, Weed Control, and Soil Amendment.

Maintenance of native vegetation restoration areas should include monitoring the survival of planted species, weed control and soil amendment as necessary to ensure the establishment of the native vegetation. A minimum 80 percent survival of all planted vegetation at the end of two years should be required. Ongoing maintenance shall include weeding and watering for a minimum of three years from installation.

If during the 2-year period survival of planted vegetation falls below 80 percent, additional vegetation should be installed as necessary to achieve the required survival percentage. The likely cause of the high rate of plant mortality should also be determined and corrective actions taken to ensure plant survival. If it is determined that the original plant choices are not well suited to site conditions, these plants should be replaced with plant species that are better suited to the site. [Lacey, 2010]

3.3 Applying Carefully Selected Herbicides

Applying a carefully selected herbicide (Roundup or similar glyphosate herbicide) around the protective tree shelters/tubes may be necessary, reinforced by selective cutting/manual removal, if necessary. This initial maintenance routine is often necessary for the first two to three years of growth and may be needed for up to five years until tree growth and tree canopy form, naturally inhibiting weed growth (once shading is adequate, growth of invasive species and other weeds will be naturally prevented, and the woodland becomes self-maintaining). Survey the new woodland intermittently to determine if replacement trees should be provided (some modest rate of planting failure is usual).

3.4 Prairie Management

Prairie management is somewhat more straightforward. A seasonal mowing or burning may be required, although care must be taken to make sure that any management is coordinated with essential reseeding and other important aspects of meadow reestablishment. In addition, burning needs to be coordinated with the local fire marshal and follow local regulations. In the first year, weeds should be carefully controlled and consistently mowed back to four to six inches tall when they reach 12-18 inches in height. In the second year, continue to monitor and mow weeds and hand-treat perennial or rhizomatous weeds with herbicide. Weeds should not be sprayed with herbicide if the drift from the spray may kill large patches of desirable plants, allowing weeds to move in to these new open areas. If necessary, controlled spot herbicide applications may be used to treat invasive plants if the treatments can be completed without damage to off target vegetation.

3.5 Prescribed Burn

A prescribed burn should be conducted at the end of the second or beginning of the third growing season. If burning is not possible, the prairie should be mowed very closely to the ground instead. If possible or practical, the mowed material should be removed from the site to expose the soil to the sun. This helps encourage rapid soil warming which favors the establishment of “warm season” plants over “cool season” weeds. Long-term maintenance should incorporate burning or mowing on a two to five year cycle to minimize woody species growth while encouraging development of the native prairie species.

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