IOWA STORMWATER MANAGEMENT MANUAL

11 NATIVE LANDSCAPING

IOWA DEPARTMENT OF NATURAL RESOURCES

TABLE OF CONTENTS

CONTENTS

Refer to the glossary for words in **bold black text.**
Some items of emphasis are in **bold blue text.**

11-1 DESIGN

A. SUMMARY

For the purpose of this manual, native landscaping is the use of plant species that would have been present in Iowa before European settlement, and therefore are adapted to this environment. The tallgrass prairie ecosystem, which dominated most of the state, developed over 10,000 years ago. It was an extremely diverse habitat that consisted of a rich assemblage of grasses, forbs, insects, and many other animals. A variety of wetlands (including prairie potholes, marshes, and lowland forests) occupied lower, wet areas in the landscape. Some uplands consisted of savannas, with scattered trees and groupings of shrubs. These native plant communities adapted to survive conditions that ranged from hot and dry to cool and wet in any given year; in addition to severe winters, frequent high winds, grazing by bison, and routine fire. Many of Iowa's native prairie species evolved to have deep root systems to survive these ever-changing environmental conditions. These root systems led to the development of Iowa's carbon-rich, fertile soils that can still contribute significantly to soil quality enhancement. The primary focus of this section is how selectively chosen **native plants** (sometimes in conjunction with other species) can be used effectively in a wide variety of stormwater best management practices (BMPs) to provide benefits beyond conventional landscaping.

DESIGN PROCESS OVERVIEW

1. Complete Site Evaluation and Planning
2. Develop Site Layout
3. Consider Special Case Adaptations
4. Develop Establish and Maintenance Plan
5. Integrate into Stormwater Plan

MAINTENANCE REQUIREMENTS

1. Designate Responsible Parties for Maintenance
2. Complete Construction Sequencing
3. Ensure Proper Topsoil Respread / Surface Preparation
4. Implement Short-term Maintenance (Establishment) Plan
5. Implement Long-term (Perpetual) Maintenance Plan

Native landscaping.

NOTE

See Section 11-4 for more detail on establishment maintenance requirements

B. APPLICATIONS

Landscaping with native plants provides multiple benefits through mimicking the native ecosystems of the tallgrass prairie, oak savannas, woodlands, and wetlands. Native species can be lower maintenance once established because they are adapted to Iowa temperatures, wind, and rainfall patterns. Properly designed native landscaping can improve the value of the site, improve aesthetics, support wildlife, increase soil and water quality, sequestering carbon and absorb noise.

Plants can uptake nutrients and pollutants from soil and water, and they also remove water through evapotranspiration. Pathways for rainfall infiltration are created through root development, which also contributes to a healthy soil structure. Each year, a part of the deep root mass of native plants dies off and decomposes. Over time, organic matter builds up in the soil, sequestering organic carbon, which in turn helps the soil absorb more water. Soil microbes help bind together particles of sand, silt, and clay, along with organic matter, creating a more granular soil structure, which increases porosity and water holding capacity. An added benefit of the deep root system is seen when native plants also resist local pests and disease. Properly sited native plants experience less stress than most non-native species during droughts or other severe environmental conditions common in Iowa. **Therefore, these native landscapes typically eliminate the need for irrigation, fertilizer, and pesticide inputs required by lawns and most traditional landscaping.** However, just like conventional landscapes, native plant communities need to be managed so that **invasive species** are kept under control, native species thrive, and project goals are achieved.

Most of Iowa's beneficial birds, butterflies, insects, and other native wildlife have evolved to co-exist and even depend on the state's native plant species. These plants provide full life-cycle support for many of these animals – from food to nesting to overwintering habitat. A variety of naturalized stormwater BMPs rely on vegetation, and as described above, these projects can have multiple additional benefits when they employ native plant species. Brief descriptions of several types of naturalized stormwater management BMPs are provided below.

Illustration showing root depth.

INFILTRATION-BASED PRACTICES

Bioretention cells, tree trenches and other infiltration-based BMPs typically feature native plant materials, whose deep root systems help keep soil structures loose and support (or improve) the ability to infiltrate and percolate water through soil layers. Evapotranspiration is also increased where moisture is used by plants and returned to the atmosphere. This frees up available pore space for the next rainfall event, reducing runoff volumes.




Infiltration-based practices

SWALES AND DRAINAGEWAYS

Native plant materials are often easier to maintain along swales and drainageways used for stormwater conveyance. Many native species are adapted to wetter soils, and the deeper root systems are more resistant to surface erosion than the shallow root structure of turf grasses. Given the fact that swales and drainageways convey surface water flow, consideration needs to be given to how wet these areas are, how water levels vary, how they should be appropriately seeded or planted, and how they are stabilized to prevent erosion.

Photograph of drainageway

DRY DETENTION BASINS

Even in dry detention basins, parts of the bottom of the basin may remain wet between storm events. Properly selected native vegetation can often thrive in these areas, compared to attempting to mow and maintain turf grass. Native plants can also improve pollutant removal and reduce runoff volume.

Dry detention basin.

WET DETENTION PONDS

Native vegetation is particularly useful along the shoreline edges and shallow areas of wet detention ponds and those areas that may be frequently flooded, such as those areas inundated by the Channel Protection event (1-year storm high water elevation). Above that elevation, native vegetation better suited for drier soil conditions can be used. The presence of taller vegetation can be used to deter large populations of geese, as they fear predators which could be obscured by the taller plants.

Wet detention pond.

CONSTRUCTED STORMWATER WETLANDS

Different native species are typically used in constructed wetlands to establish vegetation in areas with shallower water ponding and the adjacent areas that are frequently flooded. As with wet ponds and dry detention ponds, natives that are suited for drier conditions can also be used in areas that are more elevated above the normal water surface elevation.

Constructed stormwater wetlands.

PRAIRIE AND SAVANNA

Prairie landscapes are characterized by a diverse assemblage of native grasses and forbs, and savannas have similar vegetation in the ground layer as well as well-spaced trees (often oaks) and groupings of shrubs (e.g., wild plum, downy hawthorn). These prairie and savanna native plant communities once dominated Iowa, but now are relatively small and/or uncommon in the landscape.

Prairie savanna area.

PRAIRIE OUTLOTS

Native vegetation has been established within public or private open spaces in some residential and commercial developments. These spaces provide greater biological diversity and require fewer inputs to maintain than comparable areas of turf grass. Passive or active trails can be created to provide for public access through these areas.

Converting turf grass to prairie (e.g., where lawn is not needed) is an effective strategy to reduce maintenance while simultaneously improving "**ecosystem services**" (the many benefits that healthy natural systems provide, including aesthetics, pollinator habitat, etc.). While there are many variables to consider, installation and management of prairie can cost more up front, but due to the native landscapes' reduced maintenance needs, cost savings can be realized within 3 to 5 years – and after that, the cost savings accrue over time.

Prairie outlot in a residential neighborhood.

CONSERVATION BUFFERS

Native plants are well suited to be established in spaces along streams, wetlands, ponds and other resources of value. These buffers can help separate development from more natural areas while they also resist surface erosion, reduce runoff volumes and rates, decrease water temperatures, intercept pollutants, and provide important habitat and corridors for native plants and wildlife.

A conservation buffer in a residential area.

LANDSCAPING WITH NATIVES

There are very few areas where native plants can't be used for creating beautiful and low-maintenance landscapes. They can be incorporated into various urban land uses and development projects to provide aesthetic landscapes and habitat for birds and pollinators. In these settings, stormwater management may not be the stated goal, but they may still offer many benefits. Strategic placement of prairie strips can be used to reduce the runoff generated on urban landscapes.

Wetland seed mixes are adapted in areas with saturated soils or where groundwater or subdrain flows keep soils wet compared fix. These types of species may be preferable to turf grasses which may be difficult to mow and maintain in these areas with wet soils.

Utilizing native landscaping in an urban area.

C. SITE EVALUATION AND PLANNING

SITE LOCATION

Soil properties

Native landscaping is generally suitable for almost all soil types that have sufficient topsoil and organic matter and limited compaction to enable seed or plant materials to establish. Deeper topsoil layers or increased organic matter will often allow establishment to be more rapid. Deeper layers of topsoil may be needed to sustain native trees or shrubs.

If the project utilizes existing soils on site, consider utilizing topsoil testing on a scale appropriate for your site to understand the soil characteristics, chemistry, and nutrient availability. While soil surveys are helpful, disturbed sites are usually mixes of different soils. Soil quality restoration (SQR) can be completed on disturbed areas to improve soil health before seeding is performed. **For native landscapes, use of compost in SQR operations is discouraged, as that may increase the presence of weed or invasive plant seeds and other things.**

Slopes

There are no slope limitations for native plant materials. However, on steeper slopes temporary seeding, mulch or other erosion and sediment control measures may be needed to keep soil and seed materials in place until the slower growing **native plants** can establish with enough density to hold the soil in place on their own.

Amount of Sun or Shade

The amount of sun or shade directly affects plant material selection; however, there are native plants appropriate for a variety of sun/shade scenarios. Often a site will be divided into different zones where different seed mixes and live plant palettes will be used, in part due to the amount of sun or shade.

Aspect

The direction of surface slopes (north-facing, south-facing, etc.) often influences the amount of direct sunlight a certain area will receive, which should be considered when selecting native seed mixes and live plant species.

WATER INFLUENCES

Water levels or soil moisture

Soil moisture is one of the most significant drivers of what plant species will persist in a location because different species are adapted to drier (**xeric**) or wetter (**mesic**) conditions. Soil moisture can be influenced by inundation, topography, shallow groundwater, soil texture, aspect, and many other factors. As described above under Amount of Sun or Shade, often a site will be divided into different zones where different seed mixes and live plant palettes will be used, in part due to the amount of soil moisture or inundation.

NOTE

See ISWMM Section 7.03 (currently Chapter 5, Section 6) for more information.

NOTE

County soil maps can be accessed using the NRCS Web Soil Survey online tool at:

https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Hydric soil ratings can be found under the "Systainability and Limitations for Use Tab", under "Land Classifications".

The search function can also be used to find the keyword "Hydric".

NOTE

Minnesota's online Stormwater Manual contains links to the four sections of Plants for Stormwater Design book (see first four links under: https://stormwater.pca.state.mn.us/index.php?title=Minnesota_plant_lists

Flood frequency, depth and duration

Related with soil moisture, areas subject to occasional flooding (often along streams, near natural water bodies, or adjacent to inundated stormwater management BMPs) should be designed and planted with species adapted to the anticipated frequency, depth, and duration of flooding. Along smaller streams, urban tributaries, and many stormwater BMPs, the length of inundation after a flood event may be only a matter of hours, which may not affect most plants adapted for wetter soil conditions. However, along some larger rivers and water bodies, flood events can last days, weeks or even months in extreme circumstances. In these locations, particular care may be needed to select from a narrower band of plant species that can survive more frequent, deeper, and longer periods of inundation. (1)

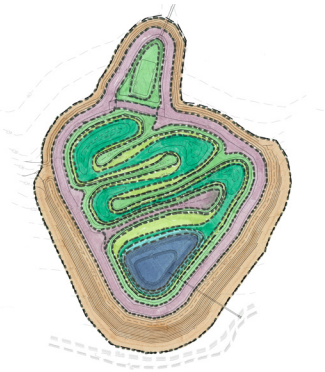


Illustration for example of landscape zones in wetland.

NOTE

See Section 11-1.D and 11-8 for more information on how these factors are related to seed or plant mix selection.

Low water levels

During drought conditions, low water levels may stress plants which typically prefer wetter conditions. Many plant species can withstand short periods of drought. However, there are locations where low water levels may be more common. For example, infiltration-based stormwater BMPs (including rain gardens) are typically designed to draw down within 12 to 24 hours. Periods of no precipitation can create very dry conditions in these BMPs for an extended length of time, necessitating the planting design to consider species that can not only tolerate temporary flooding but also drought conditions.

Sediment loads

Many stormwater management BMPs can receive runoff with elevated sediment loads. Fine sediments are a major concern in infiltration-based stormwater BMPs – especially during construction. Bare soils, common in construction sites, are prone to erosion, and if fine materials enter infiltration areas, they can clog soil pores, significantly reducing infiltration rates and making the BMP less effective. Sediment loads can reduce root density and decrease the diversity of species that can establish (Shaw and Schmidt, 2003, page 16).

Effective pretreatment upstream of BMPs can reduce, but not eliminate, the amount of sediment input. Pretreatment areas (e.g., filter strips, vegetated swales, sediment forebays) can be designed to filter runoff, dissipate concentrated flows, and reduce velocity, encouraging deposition and the reduction of sediment reaching infiltration BMPs further downslope.

Areas subjected to intermittent flooding (e.g., floodplains) may also experience sediment deposits, which can smother and impede the growth of **native plants** and encourage the establishment of invasive vegetation, such as reed canary grass. Care should be taken to consider site-specific environmental conditions when selecting the most appropriate native plant species and installation approach. Seeding or small live plants may not be appropriate in these locations, due to potentially variable water levels and sedimentation. More rigid, robust plants (e.g., river bulrush, dogwood, willows, buttonbush, prairie cordgrass) may be more appropriate in such locations. In some settings, it may not be cost-effective or feasible to establish and maintain diverse native vegetation due to these stressors of flooding and sedimentation.

Sources:
(1) Shaw and Schmidt, 2003.

EROSIVE FORCES

Many deep-rooted native plants are very resistant to soil erosion once they are well established. However, **it can take a few years for some species to fully establish themselves, which may leave some areas less protected from surface erosion.** Some key areas of concern are inflow / outflow points from stormwater BMPs and areas with steeper slopes (those generally greater than 10% in grade), Note that lesser slopes can also have issues, especially with natives along concentrated flow paths, along stream banks and adjacent flood plain areas. Effective erosion controls such as mulch, rolled erosion control products (RECPs), turf reinforcement mats (TRMs), temporary seeding, and nurse crops are critical in areas with higher potential for surface erosion. Sediment controls such as wattles or soil logs may be needed to break up the length of longer, steep slopes.

Seeding over RECPs and TRMs may reduce the ability to get good contact between seed and soil. In most cases, it is best to apply permanent seeding before RECPs and TRMs are installed, even if that means seeding outside of typical seeding windows.

Along eroded streambanks or incised channels, even established deep-rooted vegetation can be undermined and displaced. In some areas, bank instability or channel erosion will need to be corrected by more significant means (e.g., re-grading to more stable slopes, armoring with riprap, installing bioengineering techniques) before trying to establish desired vegetation.

Example of a turf reinforcement mat.

CLIMATE CHANGE INFLUENCES

Plant species are often selected based on their historic presence in a region. However, climate data has shown an upward trend in average annual temperature and rainfall across the state. However, these trends are not well understood, and there could be more variability in rainfall patterns, resulting in more severe flooding as well as more severe periods of drought. The changing climate will influence which plant species are best adapted for a certain location. Species that were historically adapted for southerly locations may find northern locations more suitable in the future; therefore, native landscaping designs should consider using species adapted to slightly warmer conditions as well as species that may be more flood and drought tolerant. Given the uncertainties in Iowa's future climate, using a diversity of native plant species will help build resilience into native landscape designs and related stormwater BMPs.

While lawns with low to moderate management can act as a carbon sink, turfgrass lawns typically utilize fertilization. Excess nitrate available in soils after fertilization can be consumed by microbes to release N_2O, a greenhouse gas that is 298 times more powerful than CO_2. Moderate lawn management can contribute 0.049 kg CO_2 equivalent per m2 a year. (2)

While the carbon sequestration rate of prairie changes over its lifetime, a conservative average sequestration rate is around 0.04 kg CO_2 a year. Conversion of an acre of lawn to prairie can sequester 162 kg CO_2 a year once established, while preventing 198.3 kg CO_2 from the maintenance and soil interaction, a difference of 360.3 kg CO_2 equivalent a year. (3)

POLLUTANTS

Nutrients

Excessive levels of nutrients such as nitrogen and phosphorus are a common water quality concern in Iowa. Some **invasive species**, such as reed canary grass and invasive cattails, thrive in nutrient-rich conditions and can displace desirable native species that are adapted to sites with lower nutrient availability. However, when established, diverse native vegetation can improve the water quality performance of stormwater BMPs. (4)

Salts and road treatments

Salts and other chemicals are used to melt snow and ice from parking lots, sidewalks and roadway surfaces. Concentrations of these chemicals may be highest close to paved surfaces, but then decline rapidly as runoff passes through vegetation. Warm-season grasses may be more tolerant to stress from these chemicals compared to cool-season grasses. Cattails are one species that are able to grow aggressively in ponds and wetlands with higher salt inputs. Shorelines should be monitored for cattail growth and removals performed as needed to keep them under control. (5)

NOTE

See page 18 of this section for more information on salt tolerant plant species.

Sources:
(2) Carbon Positive Design, 2020; (3) Yang, Tilman, Furey & Lehman, 2019;
(4) Shaw and Schmidt, 2003, page 19;
(5) Schaw and Schmidt, 2003, page 20.

ADJACENT AND NEARBY PLANT COMMUNITIES

Attention should be paid to the species of vegetation adjacent to, nearby, and upstream of sites, as these can influence native landscapes and maintenance needs. Particular attention should be given to aggressive or invasive plant species. Wind-blown seed, such as that produced by invasive cattails and the noxious weed Canada thistle, can blow far distances before germinating. Some invasive woody species (e.g., non-native honeysuckles, common buckthorn) are spread by birds that eat their berries, spreading these species across the landscape. Invasive reed canary grass seed can float downstream, wash into floodplains, and germinate, presenting intermittent invasion pressure to flood-prone areas. Even native species such as cottonwood can invade prairie restorations, warranting control during initial establishment. **The presence of such invasive or aggressive species may influence site design and the frequency or type of pre-construction preparation and post-installation maintenance needed.**

Example of native landscaping with maintained edge.

RESOURCE PRESERVATION

Proposed native landscapes should work with or enhance existing natural areas, and stormwater BMPs should limit disturbance to established native plant communities whenever possible.

High quality woodlands

Existing high quality forests and woodlands should be protected when constructing stormwater BMPs or installing native landscaping. Many communities have their own ordinances or polices about tree removals or preservations of open spaces which should be consulted when planning proposed developments or native planting areas. However, many of Iowa's woodlands are highly degraded due to past land uses, invasive species, and other ecological stressors. Many of these degraded woodlands can be enhanced by removal of invasive/aggressive understory trees, shrubs, and other weedy species. When this is completed, there may be enough sunlight reaching the ground surface to stimulate growth of native plants that have been shade-suppressed for years. If natural regeneration of desirable native species does not occur, native seeding and/or live planting can be done to create the desired plant community. Well planned prescribed burns can be used effectively to control understory growth and less desirable tree species.

High quality woodland.

NOTE

See Section 11-1.D and 11-8 for more information on how these factors are related to seed or plant mix selection.

Wetlands

Naturally occurring wetlands provide a variety of important functions in the landscape, including groundwater recharge, improved downstream water quality, and habitat for a diversity of wildlife. The U.S. Fish and Wildlife Service supports an online map tool that shows the location of previously identified wetlands and other potential wetland areas. Since this mapping is based only upon aerial imagery, a delineation by a trained professional is required to confirm the presence of wetlands on a site and ensure compliance with permitting requirements and legal protections. Wetland delineations consider the vegetation, soils, and hydrology of a site, and these studies can be performed only during certain times of the year (generally during the growing season).

The delineation expert determines whether wetlands are present on site or not. If they are, the delineation report is sent to the U.S. Army Corps of Engineers (USACE) to determine if the wetland is jurisdictional or not. If the wetland is jurisdictional, that means it is protected by federal law. Projects that could impact wetlands are required to go through a "sequencing" process which entails: 1) first try to avoid impacts to wetlands, 2) if impacts can't be avoided, they should be minimized, and 3) impacts determined to be unavoidable must be mitigated (typically construction of new wetland areas or the purchase of credits from wetland banks). Wetland permits must be secured through both the Iowa Department of Natural Resources (IDNR) and USACE. While it may be allowable to disturb non-jurisdictional wetlands, these ecosystems still provide important benefits, so any wetland impacts should be avoided to the greatest extent possible.

Many wetlands have been degraded due to past land uses, invasive species, and hydrologic alterations (e.g., draining or flooding). There are often opportunities to restore, expand, and/or enhance these wetlands through restoring the historical hydrologic regime, treating urban and agricultural runoff before it enters the wetland, and removing and controlling invasive species. These actions can provide "ecological lift", improving wetland functions, plant diversity and habitat value. However, even such improvements to jurisdictional wetlands must be reviewed and approved by IDNR and USACE, and in some settings, it may not be cost-effective or feasible to control invasive plant communities and establish and maintain diverse native vegetation.

Wetlands are not always obvious to the untrained eye. There are a few signs that wetlands that might lead you to seek a delineation study:

- The area shows up on the NWI Online Map Tool
- The area is inundated with water in historical or recent photos
- The soil appears darker than surrounding soils in aerial imagery (suggesting wetness)
- The site is a chronically poorly drained low lying area
- The site is in a floodplain (wetlands and floodplains go hand in hand)
- County Soil Maps indicate that local soils have a high hydric soil rating value

The above is not an exhaustive list. If there is any question, the best policy is to employ qualified experts to perform a delineation study

Natural wetlands.

Prairie Remnants

Prairie remnants are small areas of the historic tallgrass prairie that have their native plant communities still intact. Usually, these areas have never been plowed or altered by human activities. These are not reconstructed or planted prairies. Prairie remnants are exceedingly rare in Iowa, as over 99% of the original prairie landscape in Iowa has been lost or degraded.

The quality of remnants can be evaluated by a variety of metrics, including native species diversity, the presence of "conservative" species (i.e., plant species that have a strong affinity for only certain environmental conditions), site history (including past disturbance of the soil profile) and the presence of invasive, exotic or woody species. (6)

Prairie remnant.

Impacts to prairie remnants should be avoided, and adjacent or nearby native landscaping projects or stormwater BMPs should consider how they can be designed to protect and ideally enhance these important and rare remnant native plant communities. Projects occurring near remnants should be particularly sensitive to not contaminating the genetics of remnant plant species. This can be accomplished by using seed and plants with **genetic origins** very close (e.g., within 25 miles) of the nearby remnant. Some remnants are large enough and healthy enough whereby seed collecting could be conducted in the remnant and sown in nearby restoration areas, ensuring very local genetics are used.

HERBIVORES

Geese are known for feasting on young herbaceous plant material, and aquatic plants can be consumed and/or uprooted by invasive carp. Deer, beaver, rabbits, muskrats and rodents may be attracted to (and often damage) native tree and shrub plantings. Protection measures may need to be taken at some locations, especially to protect young plant materials.

NOTE

Refer to Part 11-1.E for more information on Browse and Herbivore Protection.

Sources:
(6) Houseal, Greg. 2015.

D. LAYOUT AND APPEARANCE

PROJECT SCALE

Project Scale

Native landscapes can be installed at a variety of scales. They can be as small as planted areas of a few square feet in a parking lot or residential home site. They can be as large as open fields spanning many acres. The scale of the project will often dictate the type of plant material that will be selected and how it will be installed and maintained.

PLANT MATERIALS

Seed

Seed is generally the cheapest option to establish native grasses and forbs, especially over larger areas. Native restoration and landscaping projects should strive to ensure that the provenance (genetic origin) of each species is from within a 200-mile radius of the project site and native to Iowa. This helps ensure the species being seeded are adapted to the local climate and will reduce the potential for altering the genetics of native plants already out in the landscape. See the Construction and Installation section for further details about seeding.

Live Plant Plugs

Plugs are young versions of native grasses and forbs that have been grown to a certain size at a nursery for planting. They can come in assorted sizes. As they are more expensive, their use is usually limited to smaller areas (e.g., in select locations of a site or up to a few acres in size). In some cases, they are installed in native seeding areas to provide faster establishment. Live plant plugs (or rhizomes, tubers, or other root stocks) are often used to establish native vegetation in the shallow water edges of ponds and wetlands where seeding is often ineffective.

Potted plants

Potted plant materials are basically plug materials allowed to grow to a larger size. They have more developed root structures and have already grown to a level of maturity. These are more expensive than plugs, so their use is often limited to small areas where it is desired to have more mature plants established immediately. Additionally, some native plants have a reduced establishment success rate when planted at a larger size

Potted plants being installed in an urban landscape.

NOTE

Refer to Part 11-3 and 4 for more details on installation, establishment and maintenance.

Trees and Shrubs

When selecting trees and shrubs for landscaping plans, it is recommended to use species that are native to Iowa. These woody plants come in a variety of sizes and types, including from ball & burlap, container, and bare-root stock. Due to the cost and availability of native trees and shrubs, thought should be given to how project goals can be met within a project's schedule and budget. Utilize smaller plant size when able, as this reduces the duration of transplant shock. Utilizing plants grown in air-prune containers provide for faster establishment of root structure, allowing the canopy to develop faster

LOCAL REQUIREMENTS

Some jurisdictions have preferred and/or prohibited plant lists or may have plant height or vision triangle setback requirements that need to be considered when developing a site design. Each city or county may also have other requirements, such as a preferred width for mowed edges around the perimeter of the native landscaped area.

EDGES AND BOUNDARIES

The way native landscapes are presented along their edges can have a significant impact on how they are accepted by the general public. A border of short vegetation is recommended along sidewalks, shared use paths, streets, parking lots and right-of-ways. This edge treatment may consist of low-grow turf (although trials in the state have generally proven unsuccessful), mowed conventional turf (for a more formal appearance, but one that requires more maintenance), or mowed prairie. If maintaining a mowed prairie edge, mow twice per year to a 6-8" height, typically conducted in June and August or early July and early September (depending on plant species present, growth rate, and seasonal weather). The mowing regime should be executed in a manner that prevents weeds from setting seed, allows for natives to self-seed (if possible), prevents plants from growing too tall and lodging (i.e., falling over), and avoids generating long, unsightly clippings (removal of clippings may be warranted if mowing occurs after substantial growth).

The width of the mowed border may depend on the type of mowing equipment the landowner or maintenance contractor plans to use, but when mowing trail or sidewalk edges, the mower can overlap the walking surface to allow for mowed widths narrower than the equipment might suggest. Use of shorter vegetation (e.g., the "short" seed mixes provided in this chapter's appendix) can also help edge aesthetics and limit lodging of vegetation. Some designers may choose to use only a few, short-growing species in edge areas, but this may lead to a greater chance of failure (due to a lack of diversity) and the edge may be more susceptible to invasive species and weeds. In more formal sites such as a bioretention cell or planting bed within a parking lot, the maintained edge might consist of mulch materials. All of these edge treatments help make stormwater BMPs and restoration plantings more aesthetically acceptable and convey to the public that the area is being maintained. **Edge plantings can also be designed as fire breaks to facilitate prescribed burns – see See Prescribed Burning section for more information.**

PATHS

Paths for public access or maintenance should be considered when designing the native landscape area. This could be for maintenance of the landscape itself, access to key infrastructure (such as a pond outlet or shoreline edge) or to allow for public movement from one location to another. These access paths can be paved paths, gravel trails or even simple mowed paths. If a prairie, savanna, or even wetland landscape will be maintained using prescribed fire (often the most cost-effective method), paths can serve as burn breaks. See Prescribed Burning section for more information.

The designer should consider if they want a different mix of plant species to be used along paths. A mix with lower height may be easier to maintain, but it may still need to be mowed occasionally. Over time, species from adjacent zones may creep into the access path, which may necessitate more frequent mowing to keep the path open.

Photograph of an access path with maintained edge.

Mowed prairie edge.

NOTE

For smaller sites or areas where shorter vegetation is desired, see Seed Mix #15 in the Appendix.

PLANTING ZONES

The proposed native landscape should be divided into different zones where different seed mixes or plant distributions will be used. These will be informed by many of the factors discussed above under Site Evaluation and Planning, (e.g., soil properties, slopes, amount of sun or shade, aspect, soil moisture, water influences), considering what the site's existing conditions are and what they are proposed to be.

Desired Plant Height

In addition to the environmental factors that influence planting zones, aesthetics are also an important consideration. In smaller sites, areas with more public access, or where clear sightlines are important, shorter plant materials may be preferred. In larger, more open sites, medium to tall plant species may be more acceptable. Because Iowa used to be dominated by tallgrass prairie, using seed mixes and plant palettes not restricted to only short species will enable a more diverse, resilient, and historically-appropriate plant community.

Taller mixes are often easier to establish and have a more diverse palate of species. **Seed mixes that include taller species should be considered as the default option, with mixes tailored toward shorter species used in specific settings as noted above.**

NOTE

See Section 11-8 for information on how different seed mixes may apply to planting zones shown for each stormwater BMP.

STORMWATER MANAGEMENT PRACTICES

Each type of BMP listed in this chapter has individual recommendations for seeding and planting. It is advisable to refer to the section of ISWMM related to the appropriate stormwater BMP for more information.

AESTHETIC AND MANAGEMENT DETAILS

The designer should make sure the owner understands the expected timeline for establishing native plants and the long-term (perpetual) management needs to maintain the desired vegetation. The owner's ability to identify weeds and invasive species and provide the necessary ongoing management may influence the complexity of design and species selection. While a less diverse planting may be desired for an aesthetic or ease of identification purpose, they typically create additional management to maintain.

E. SPECIAL CASE ADAPTATIONS

POLLINATOR HABITAT ADAPTATIONS

Pollinators (including birds, bats, and many insect groups) have received much attention over the past decade due to peoples' recognition of the important role they play in our food system and the population declines of many species. Many pollinators rely on native plants for completing their life cycles, so providing diverse native plantings as part of naturalized stormwater BMPs and other native landscaping will help support pollinators.

An effective pollinator habitat planting consists of a diversity of native shrubs, grasses, and/or wildflowers that provide cover, nectar and pollen for native pollinators – ideally fulfilling the needs of multiple pollinator species over the course of their life cycles. Wildflowers should be selected to provide not only a large diversity of species, but also to provide a diversity of flower color and structure, and to ensure flowering throughout the growing season. Additional guidance for pollinator habitat design and management can be found at:

- Iowa DNR: https://www.iowadnr.gov/Conservation/Iowas-Wildlife/Pollinators
- Iowa State University: https://www.extension.iastate.edu/smallfarms/helping-monarchs-and-pollinators-through-usda-assistance-programs
- USDA/NRCS & Xerces Society: https://www.xerces.org/publications/habitat-installation-guides/michigan-crp-safe-cp-38e-pollinator-habitat-planting
- Keystone Plants Native to Iowa, Northern Missouri and Western Illinois (for supporting moths, butterflies, and other insects): https://www.fairfield.lib.ia.us/application/files/4316/7450/0542/SE_Iowa_Keystone_trees2.pdf
- National Wildlife Federation Keystone Native Plants: https://www.nwf.org/-/media/Documents/PDFs/Garden-for-Wildlife/Keystone-Plants/NWF-GFW-keystone-plant-list-ecoregion-9-great-plains.ashx?la=en&hash=D93EC537B17AF4BEA41B4CC0149413C15A46CC29

While some of these references are Iowa-specific, some are more regional in their application. Always confirm that species selected are appropriate for your particular project area.

A pollinator habitat in an urban setting.

WILDLIFE HABITAT

All animals require habitat – the environment that provides the food, water, and shelter they need to survive. In addition to pollinators (discussed above), native plant communities provide critical habitat needs for a broad array of native mammals, birds, reptiles, amphibians, countless insects, and other animal groups.

To ensure the greatest variety of wildlife species, provide the largest variety of food, shelter and cover by providing different types of plants, feeders and shelter. Some species need more specialized cover than others, and full life-cycle needs of species should be considered so they can overwinter and persist over the long term. Natural sources of food can be things such as nectar-bearing flowers, seeds, fruits, berries and insects. Planting a wide variety of herbaceous plants, shrubs and trees provides a variety of species and a variety of structure. Plant trees and bushes for nesting birds and add coniferious trees for protection against winter storms and winds (it should be noted that there are a limited number of coniferous trees that are native to Iowa). Standing dead and down logs are important for over 50 species of Iowa wildlife. If they are not available on your property, you can provide constructed housing for many species. A source of water is essential for birds year-round (7).

FLOODPLAINS

In locations along larger rivers and water bodies where flood events have been known to last for extended periods, species selection may need to focus on a narrower band of plant species that can survive longer periods of inundation and associated sedimentation. Some floodplain areas may not be appropriate for stormwater BMPs due to these intermittent disturbances. See "Sediment loads" section above under 11-1.C for additional discussion.

TOLERANCE FOR SALTS AND ICE MELT SOLUTIONS

Some plant types are more tolerant to salts and other ice melt solutions applied to paved areas which may be washed into adjacent landscapes or stormwater management practices. The seeding list at the end of this section (Appendix, Section 11-8) offers recommendations for plant selection in areas where salt inputs are supposed to be elevated.

Many naturalized stormwater BMPs, and in some settings other native landscaping areas, will be exposed to elevated levels of salts (NaCl, MgCl, etc.) due to deicing practices common throughout Iowa. Salt can stress or kill vegetation, but some native plant species (including many used in the example seed mixes) exhibit tolerance to elevated salt levels. While far from an exhaustive list, some commonly used salt-tolerant native plant species include the following:

- big bluestem *(Andropogon gerardii)*
- some milkweeds *(Ascelpias spp)*
- some beggar ticks *(Bidens spp)*
- some grama grasses *(Bouteloua spp)*
- some sedges *(Carex spp)*
- some prairie clovers *(Dalea spp)*
- some spikerushes *(Eleocharis spp)*
- Canada wild rye *(Elymus canadensis)*
- rattlesnake master *(Eryngium yuccifolium)*
- blue flag *(Iris shrevei)*
- some rushes *(Juncus spp)*
- junegrass *(Koeleria macrantha)*
- great lobelia *(Lobelia siphilitica)*
- wild bergamot *(Monarda fistulosa)*
- stiff goldenrod *(Oligoneuron rigidum)*
- switchgrass *(Panicum virgatum)*
- common mountain mint *(Pycnanthemum virginianum)*
- gray-headed coneflower *(Ratibida pinnata)*
- black-eyed Susan *(Rudbeckia hirta)*
- little bluestem *(Schizachyrium scoparium)*
- bulrushes *(Scirpus spp)*
- prairie cordgrass *(Spartina pectinata)*
- some dropseed grasses *(Sporobolus spp)*
- some asters *(Symphyotrichum spp)*
- blue vervain *(Verbena hastata)*
- golden Alexanders *(Zizia aurea)*

BROWSE AND HERBIVORY PROTECTION

At some locations, geese controls including deterrents, fencing and decoys can be used to deter the presence of large populations of geese. The presence of dogs and swans may also reduce resident geese populations. **If large populations of geese are expected, it may be wise to defer installation of plugs until temporary or permanent seeding is better established.** This does reduce the benefit of the plugs (more quickly establishing some plant species) but may make them more difficult for geese to find and consume (compared to a bare earth or mulched landscape).

Deer, beaver, rabbits, and rodents may be attracted to native tree and shrub plantings. Emergent and submergent wetland plantings may be susceptible to consumption and/or uprooting by invasive carp. Therefore, in some cases, native plantings may need to be protected by cages or fencing.

SEPTIC FIELDS

When selecting plant materials over septic fields, select from those suited for dry prairie locations. Native plant roots can improve removal of nutrients, reducing the amount that can be readily passed into groundwater. Native plant species that prefer dry soil conditions are less likely to have root growth into the saturated zones around septic system pipes. For this reason, these species are less likely to grow into and clog the septic system pipes. **Dry prairie vegetation is preferable to turf lawn over septic systems,** as turf lawns require more watering and mowing equipment over the septic field. When installing plants over an existing septic field, avoid placing additional soil or heavy tilling operations over the septic field. Trees, shrubs or other woody perennials should not be planted in the area over or immediately surrounding the septic field. (8 and 9)

DENSE SHADE AND ALTERED SOILS

While mature forests with dense tree canopies can have healthy and abundant ground layer vegetation, many native grasses and forbs do not thrive in dense shade. Many areas of dense shade are the result of invasive or aggressive tree and shrub species, and soils have often been modified (through past land uses and/or chemicals secreted by existing vegetation) to the point that native vegetation struggles to grow. Therefore, during project planning and design, it is important to consider sunlight conditions (existing and proposed) and soil conditions in addition to other environmental variables (e.g., moisture).

CONIFEROUS TREES

The needles dropped by many coniferous trees lower soil pH and their dense canopy limits sunlight. The ability to establish native seed mixes or plants immediately under these trees is limited. The Eastern Red Cedar (*J. virginiana*), a native coniferous tree of Iowa, will invade native prairie plantings if burning or maintenance mowing does not occur. This means the native prairie may convert to a cedar glade over time, losing diversity and functions of a healthy native prairie. Coniferous trees (being fire intolerant) should not be planted into or retained in prairies and other native landscapes where prescribed fire will be used as a management tool.

Sources:
(7) Iowa State University Extension and Outreach. (8) Clawson, Beth. 2018; (9) Long, Rebecca. 2022.

11-2 CALCULATIONS

A. UNIFIED SIZING CRITERIA

Native landscapes are typically integrated within other stormwater BMPs, such as soil quality restoration, bioretention cells, bioswales and vegetated buffers. Each practice has specific design and installation requirements that need to be satisfied in order to meet various aspects of the Unified Sizing Criteria (USC). Refer to the relevant section of ISWMM for the Unified Sizing Criteria for each type of practice is addressed.

GRASS SWALES

Concentrated flow paths through native landscaped areas can be evaluated as grass swales. Refer to ISWMM Section 5.02.

VEGETATIVE FILTER STRIP

When runoff enters a native planting area spread evenly across the strip length (sheet flow) it can be considered a filter strip. Refer to ISWMM Section 5.03.

GREEN ROOFS

Native plantings on rooftops should be evaluated based on methods listed in ISWMM Section 6.02.

SOIL QUALITY MANAGEMENT AND RESTORATION

Native plantings can be integrated into Soil Quality Management and Restoration areas. Similar to vegetative filter strips, to count toward stormwater management goals, the runoff to be treated needs to be spread evenly over the area being counted as a water quality practice. Refer to ISWMM Section 7.03.

TREE FILTER SYSTEMS AND STORMWATER PLANTERS

Native plantings are frequently used in planter boxes on sites and within street right-of-way. Refer to ISWMM Section 7.04.

BIORETENTION CELLS AND BIOSWALES

Native plantings are most commonly used as permanent vegetation for bioretention cells and bioswales. Refer to ISWMM Sections 7.07 and 7.08 (currently titled Chapter 5, Section 4 and Section 5).

Seed mixes may be appropriate in some settings (e.g., bioretention elements in less developed areas or within larger native landscapes), but often live native plants are installed in bioretention cells and bioswales due to more rapid establishment and greater resilience to water level fluctuations compared with germinating seed.

RAINGARDENS

Raingardens are similar to bioretention cells, but typically they are smaller in scale and rely more on infiltration into site subsoils than bioretention cells. Raingardens are usually installed for private homeowners and landowners and typically do not require design by an engineer. The ISWMM does not include a design section on this topic. For native plant selection in raingardens, refer to the Iowa Rain Garden Design & Installation Guide.

NOTE

See Section 3.01 for more information on ISWMM's Unified Sizing Criteria.

NOTE

The Iowa Raingarden Manual is also a reference that can be used to select plant materials in raingardens and bioretention cells.

INFILTRATION BASINS

Native plantings may be used as permanent vegetation for infiltration basins. Refer to ISWMM Section 7.08 (currently titled Chapter 5, Section 3).

STORMWATER WETLANDS

Native plantings are typically planted in the shallow water and sideslope areas within constructed stormwater wetlands. Refer to ISWMM Section 9.08.

DRY DETENTION BASINS

Native plantings require less mowing operations within dry detention basins, which may be easier to maintain when soils are frequently wet. Refer to ISWMM Section 9.09 for Traditional Dry Detention Basins and 9.10 for Extended Dry Detention Basins 9.08.

WET POND DETENTION BASINS

Native plantings are used in the shallow water depth areas around the pond shoreline and often used on the sideslope areas that are frequently flooded. Natives may also be used on the adjacent drier landscapes. Refer to ISWMM Section 9.11.

STORMWATER MODELING

For stormwater modeling purposes, native landscapes are generally assigned Curve Numbers (CNs) consistent with meadow in good condition, based on the Hydrologic Soil Group (HSG) category of the soils at the site location. Meadow has one of the lowest CNs registered in the NRCS TR-55 (and TR-20) methodology, which is used by many computational systems and software packages to calculate runoff rates and volumes. Therefore, these areas are expected to generate less runoff volume and have lower peak rates of flow than almost all other land uses. For this reason, applying native landscapes can reduce the required sizes of downstream storm sewer pipes and stormwater management detention practices.

Table 11-2-1 Curve Numbers for Native Prairie and Prairie Savanna Landscapes

Hydrologic Soil Group (HSG)	A	B	C	D
Curve Number	30	58	71	78

Table 11-2-2 Comparison of runoff rates and volumes for native and turf landscapes on HSG B soils

	1-YEAR STORM EVENT		10-YEAR STORM EVENT		100-YEAR STORM EVENT	
	Peak Rate (cfs)	Volume (CF)	Peak Rate (cfs)	Volume (CF)	Peak Rate (cfs)	Volume (CF)
Native	0.5	6,400	5.5	32,000	19	91,000
Turf Lawn (good)	1.0	9,000	7.5	38,000	23	100,000
Turf Lawn (poor)	10	35,000	26	86,000	52	170,000

Example: Central Iowa (Region 5) rainfall data, 10-acre site, Tc computed from NRCS Lag equation with 850 foot flow length, 2% average watershed slope.

Table 11-2-3 Comparison of runoff rates and volumes for native and turf landscapes on HSG C soils

	1-YEAR STORM EVENT		10-YEAR STORM EVENT		100-YEAR STORM EVENT	
	Peak Rate (cfs)	Volume (CF)	Peak Rate (cfs)	Volume (CF)	Peak Rate (cfs)	Volume (CF)
Native	4.7	21,000	16	63,000	38	140,000
Turf Lawn (good)	6.7	25,000	20	70,000	44	150,000
Turf Lawn (poor)	18	51,000	38	109,000	68	200,000

Example: Central Iowa (Region 5) rainfall data, 10-acre site, Tc computed from NRCS Lag equation with 850 foot flow length, 2% average watershed slope.

11-3 CONSTRUCTION AND INSTALLATION

A. CONTRACTOR QUALIFICATIONS

Native landscaping and **ecological restoration** is not as simple as conventional landscaping using native plant materials. Preparing sites for native vegetation, establishing that vegetation (with seed and living plant material), and ensuring its establishment and persistence requires specialized training, experience, equipment, and knowledge. Therefore, **it is in a project's best interest to ensure that qualified contractors are hired to implement and maintain native landscapes.** Sample language that can be used in bid documents follows.

Projects bid by government agencies may not be allowed to directly require contractor qualifications under state law (see Iowa Code 26.16). Creating separate contracts for plant material installation, establishment and maintenance can avoid this work being delegated to subcontractors. Making this work the focus of a separate contractor will typically solicit more qualified contractors that are ready to manage and complete this type of work.

> **Qualified Contractor:** The Contractor should have references and work examples to the Owner documenting that the Contractor has completed a minimum of five (5) native landscaping//ecological restoration projects in the past five (5) years of similar scale and entailing all site preparation, installation, and maintenance tasks described in this bid package. In addition, the Contractor should provide documentation that the project's dedicated on-site Field Supervisor(s) overseeing project implementation have a minimum of five (5) years' experience conducting ecological restoration and vegetation management in Iowa as described in this specification package.

Contractor qualifications may limit the number of bidders and/or increase the cost of bids, but they can also reduce the need for construction oversight, reduce maintenance costs, and result in better project outcomes overall.

Native vegetation establishment requires proper installation and proper management, and is best assessed over several years; this is why it is advantageous to retain the same contractor for at least a three year installation and short-term (establishment) management period. This avoids the issue of a landscape management contractor blaming an installation contractor for bad performance or vice versa.

Due to the nature of many stormwater projects, it is often advantageous to have two separate bids and contracts: one for earthwork and infrastructure (which is typically completed in less than one year), and the other for vegetation installation and short-term (establishment) management (lasting at least three years). This bid/contract structure can attract more qualified bidders, as well as it allows earthwork and infrastructure contractors to wrap up their work and close out their contract in a timely manner (rather than requiring them to keep their contract open for several years while their landscaping subcontractor continues to conduct establishment management).

NOTE

See Part 11-4.A of this section for more details about Establishment and Maintenance contract work.

NOTE

Information included in Part 11-4.B and C of this section can be adapted by designers into construction notes and project specifications to guide construction.

B. POLLUTION PREVENTION

If the native landscaping area is part of a project whose total disturbed area exceeds one acre (including all parts of a common plan of development) a stormwater pollution prevention plan (SWPPP) is required by state and federal law to be prepared.

Prior to construction, coverage under the State of Iowa's NPDES General Permit No. 2 shall be obtained (or, if required, coverage through an individual permit).

The SWPPP document will meet state and local regulatory requirements and will detail the structural and non-structural pollution prevention best management practices (BMPs) that are to be employed at the site.

EXTERIOR PROTECTION

All perimeter and site exit controls should be installed prior to any land-disturbing activities. Such controls may include (but are not limited to) stabilized site construction exits, perimeter sediment controls, construction limit fencing, waste collection, sanitary facilities and concrete washout containment systems.

INTERIOR PROTECTION

As construction activities begin, internal controls will be added to prevent erosion and sediment loss from the site area.

Erosion controls (mulches, rolled erosion control products, turf reinforcement mats, etc.) prevent detachment of soil particles from the surface. Sediment controls (wattles, filter socks, silt fences, sediment basins, etc.) capture sediments after they have become suspended in runoff. Installation of controls may need to be staged to be implemented immediately after construction operations have ceased or are paused in a certain area.

Project phasing can also be used as a form of protection. This is done by staging construction operations to limit the amount of surface area that is disturbed or left unprotected by erosion controls at any given time.

If the native landscaping is included within a stormwater management practice, refer to the relevant section of ISWMM for pollution prevention information.

C. CONSTRUCTION SEQUENCING

PRIOR TO SEEDBED PREPARATION

This construction sequencing process assumes that any site demolition, clearing, topsoil stripping or stockpiling, grading and other site construction has been completed. If the project includes stormwater BMPs, refer to the relevant section of ISWMM for more details on construction sequencing for those activities. Remove debris, gravel, concrete from subgrade surface prior to placing topsoil. Topsoil should be placed to the depth specified on plans across all open space areas. The Iowa Statewide Urban Design Standards and Specifications (SUDAS) Section 2010, Part 3.02 can be referenced in project specifications for topsoil placement. Make sure that topsoil is not excavated, moved or placed while wet. Make sure the surface area is within tolerance of proposed grades and any rills, uneven areas or low spots have been repaired. The surface should be free of any clods, lumps, roots, litter, other debris or stones larger than 1 inch in size.

SEEDBED PREPARATION

Seedbed preparation refers to the steps necessary to prepare site soils for temporary or permanent seeding. If the native planting area is on a landscape disturbed by recent grading, make sure that seedbed preparation is completed prior to permanent seeding or planting operations. In some cases, seedbed preparation will need to be completed prior to installation of even temporary seeding, so that the soils and cover crop don't need to be disturbed prior to permanent seeding or planting operations. The Iowa Statewide Urban Design Standards and Specifications (SUDAS) Section 9010, Part 3.04.C can be referenced in project specifications.

The screwdriver method can be used to evaluate soil compaction prior to seeding. If a flathead screwdriver can't be pushed more than 2 inches into the soil by hand into at least half of multiple spots tested, the soil is too compacted. (Note that drought conditions may also make it difficult to penetrate surface soils with this test.) If this is the case, the upper 4 inches of the soil should be rototilled prior to seeding. Some site that are severely compacted may require deep tine aeration or soil ripping prior to tilling. To reduce large clods after tilling, drag a harrow across the rototilled area. (10)

A prepared seedbed.

Sources:
(10) Williams, Dave. 2018.

REMOVE WEEDS AND INVASIVE PLANTS

If the native plantings are being installed in an area that has not been disturbed by recent construction, weeds and **invasive species** should be removed by use of physical, biological, and/or chemical treatments prior to seeding operations. Whenever feasible, non-chemical removal and control methods should be considered. Feasibility is influenced by factors such as the target species present, environmental conditions, project schedules and goals, and available budget. The effectiveness of different removal methods should be considered, since many techniques will not completely eradicate the target weedy and invasive species. **Integrated pest management** (IPM) is the practice of using a variety of methods with the intent of achieving the best ecological results with the least environmental risk or harm.

Physical Removal Methods

Sod cutting/removal may be feasible for smaller sites, but the process removes the upper topsoil, so consideration should be given to the soil conditions that will remain. It may also be feasible with smaller sites to cover existing turf or other unwanted vegetation with cardboard to smother and kill these plants; however, cardboard must be left in place for several months to ensure effective kill, and the seedbank will often germinate after the cardboard is removed. Tillage (sometimes used for seedbed preparation) can help remove existing unwanted vegetation, but it also destabilizes soils (increasing the potential for erosion) and can bring weed seeds to the surface, encouraging their growth. Other physical removal techniques include conventional mowing, string trimmers, brushing saws, and forestry mowing. Prescribed fire can also be an effective tool in preparing a site for seeding/planting. See Prescribed Burning section for more information.

Biological Removal Methods

Biocontrol agents (e.g., beetles that consume invasive plants) are available for some target plant species; however, this technique is often not effective during site preparation. Controlled browsing or grazing (e.g., goats or sheep) can be used to remove unwanted vegetation with less reliance on herbicides, but these require special planning, fencing, and monitoring to ensure project goals are met.

Chemical Removal Methods

Prior to seeding in many native landscape and ecological restoration projects, chemicals can be very cost-effective at removing weedy and invasive vegetation prior to installation of native seed and live plants, Care should always be taken to use herbicides with the least impact to the environment and following the manufacturer's application restrictions. Use of state-licensed pesticide applicators will help ensure proper use of herbicides. **The Tallgrass Prairie Center has developed a guide for Site Preparation that includes a list of persistent perennial plants and the herbicide that can be used to control them.** In some cases, multiple applications of herbicide may be needed over different growing seasons prior to seeding or planting. (11)

Sources:
(11) Williams, Dave. 2018. *Site Preparation.*

SEEDING OPERATIONS

SUDAS Section 9010, Part 3.04.E.1 can be used as a reference for seed preparation.

Seeding operations.

TEMPORARY SEEDING

At times when native seed cannot be installed into freshly graded soils (e.g., native seeding is usually avoided during the hotter and drier timeframe of July through October), temporary seeding is recommended to prevent erosion of surface soils. SUDAS Section 9010 provides recommendations regarding temporary erosion control seed mixtures, including recommended species, rates, and methods. **SUDAS temporary seeding recommendations include non-native rye grasses (e.g., *Lolium spp* and *Secale cereale*), which may inhibit establishment of native seedings if those are installed immediately following temporary seeding.** If temporary seeding will immediately be followed by native seeding, it is recommended to limit temporary seeding to approximately 100+ lbs per acre of oats (*Avena sativa*) if temporary seeding occurs in the spring through August 14, or approximately 100 lbs per acre of winter wheat (*Triticum aestivum*) if temporary seed is installed after August 14. Note that soils, slopes, and other factors should inform the most appropriate rate of temporary seeding for a particular site. In addition, fertilizer (recommended in SUDAS 9010) should be avoided to prevent its runoff and subsequent eutrophication of downstream water resources.. Slopes and areas that may experience concentrated flows may warrant additional soil stabilization techniques, such as rolled erosion control products (RECPs).

Nurse crops (also called cover crops) are installed simultaneously with native seed; nurse crops are addressed below under Permanent Seeding.

NOTE

See Section 11-8 for temporary seed mix information.

NOTE

Frost Dates in Iowa Reference:

https://yardandgarden.extension.iastate.edu/frost-dates-iowa

Permanent Seeding

Permanent seeding of natives should be completed in the early spring (typically by June 30) or dormant period (typically late November or later, but before significant snowfall (≥2 inches). Early spring planting can be utilized but expect a reduction in spring and fall forb establishment (12). SUDAS Section 9010, Part 3.04.E.2 and 4a can be used a reference for permanent seeding operations. A nurse crop (or cover crop) is often installed simultaneously with native seed. Nurse crops germinate quickly, stabilizing the soil and reducing weed pressure as the slower-growing **native plants** become established. Typically, oats (*Avena sativa*) are used as a nurse crop with spring seedings, and winter wheat (*Triticum aestivum*) is used with fall dormant seedings. **Non-native rye species are discouraged, as they can impede the growth of some native species.** Nurse crop is often installed at a rate of approximately 20 lbs per acre, but soils, slopes, and other factors should inform the most appropriate rate for a particular site.

Seed is preferentially installed using a seed drill when feasible, but a mechanical broadcast seeder or even hand-broadcasting can be effective. Seed should be spread relatively evenly, ensuring good seed-to-soil contact, and installation should be to a very shallow depth in the soil (typically 1/4"). Hydraulic seeding is not recommended for native seed; however, applying a thin coating of hydromulch over properly-seeded native species can be effective. More common erosion control for seeded areas includes crimping 1 to 1.5 tons per acre of weed-free straw or hay into seeded soils or installation of rolled erosion control products (RECPs, discussed below).

INSTALLING LIVE PLANT MATERIAL

Follow SUDAS 9030 for installation of woody plant materials. When installing herbaceous plant plugs, consider marking plug groupings with flags or other markers for easier evaluation of establishment. Designers and installers should consult with local growers to verify expected production and shipping schedules for the expected plant species to be used, which would impact the expected planting schedules. Species that don't enter a dormant state until summer or fall would be better planted when they are dormant and not actively growing.

PLANTING PHASE EROSION AND SEDIMENT CONTROL

Turf Reinforcement Mats (TRMs) or Rolled Erosion Control Products (RECPs)

TRMs or RECPs may be needed to reduce erosion potential on steep slope areas or where concentrated water flow may be expected. Material choice should consider sources of erosion, slope and flow energies, the duration that soil stabilization may be required, the specified plant materials, and how the area is to be maintained post-construction.

All-natural fiber RECPs are recommended wherever permanent protection is not required. These natural-fiber products are more environmentally friendly since they are not manufactured with petrochemicals and they pose much lower risk to wildlife that can be entangled and perish in them. RECP or TRM materials made from polymers are also susceptible to damage from fire.

Coir fabric, open weave blankets often provide adequate surface protection while allowing room for forb seedlings to grow through the fabric season after season. Coir fabrics should be considered temporary RECPs, as they biodegrade over time and may be damaged or destroyed by fire or mowing activities. **Mat materials with rigid grids or dense infills may be less suitable for use as they may restrict vegetation growth (especially forbs) and limit sunlight to the ground surface.** An exception might be denser TRMs that can be topdressed with soil and seeded, allowing root growth down through the mat and into the underlying soil. This installation technique can also protect synthetic mats from fire damage.

If long-term permanent TRM protection is needed (for auxiliary spillway areas with frequent overflow for example), open cell articulated concrete block structures or mats may be appropriate. These structures or mats have open spaces within or between blocks that can be filled with topsoil and planted or seeded.

TRMs and RECPs should be installed after permanent seeding operations. Otherwise, these products may limit seed contact with the soil if installed prior to seeding. Care needs to be taken to not excessively disturb seeded areas when installing mats or blankets. If these features must be installed prior to seeding, seeding rates may need to be increased over mats or blankets to increase the chance that adequate amounts of seed will be in contact with the soil surface and germinate.

Sources:
(12) *Tallgrass Prairie Center.* 2021.

TRMs and RECPs should be inspected during the initial growth period to make sure plant growth isn't causing tenting or otherwise displacing the mats where they would no longer have good contract with the ground surface. If blankets and mats lose contact with the ground surface, they are far less effective at preventing surface erosion.

Sediment Controls

Silt fences, filter socks, wattles and some other sediment controls may limit sunlight to the surface or allow seeded areas to be covered in deposited sediment. **Once the sediment and controls are removed, the area surrounding the controls may need to be reseeded to infill any dead or bare spots.** Silt fences may be less desirable for use, since they need to be removed after plantings have been establishment. Soil materials can be disturbed as they are removed. There have been many cases where silt fences have been left in place for years after installation. They can be difficult to see when plant growth is tall, leading to potential hazards from falling over or on the fence fabric and posts. If used, the contractor should remove all fences and posts prior to completion of their contract work.

Rolled erosion control product used near a stream edge.

Mulch

Weed-free straw or hay mulch is often applied with temporary or permanent seeding operations. Use 1 to 1.5 tons per acre of mulch, considering site conditions. After permanent seeding, hydraulic mulch over native seed may be added for erosion control and to hold moisture for the seed, but application rates may need to be reduced to avoid covering seed. SUDAS Section 9010, Part 3.04.F can be used as a reference for mulch operations.

D. CONSTRUCTION OBSERVATION

SUBMITTALS

For all seed and plant materials, SUDAS Section 9010 Part 1.03 and 9030 Part 1.03 can be used a reference for submittal. This should include both nurse / cover crop and permanent seed materials. Products should be labeled for inspection by Owner's Representative. SUDAS Section 9010.2.01 can be used as a reference for product quality and container labels.

In addition to SUDAS standard submittals, the following submittals should be considered for projects entailing native seed:

Native Seed:

A. ICIA Yellow Tag Certified Seed – Native species should have their origin documented by the Iowa Crop Improvement Association (ICIA). The level of certification is at the "Yellow Tag" level according to the ICIA Quality Control Program. If certain species may not be available as certified, those species may be supplied by an ICIA Certified Approved Collector/Producer along with documentation demonstrating the origin of those materials.

B. Submit detailed seed order to Owner's Representative well in advance of scheduled seeding date for approval. Seed orders should document the genetic origin (i.e., not the nursery location) of all native from within a 200-mile radius of the project site and native to Iowa. Species should be true to their scientific name as specified.

The following submittals should be required for projects entailing live native herbaceous plants:

Live Native Herbaceous Plants:

A. Submit detailed live native herbaceous plant order to Owner's Representative well in advance of scheduled planting date for approval. Plant orders should document the genetic origin (i.e., not the nursery location) of all live native herbaceous plants from within a 200-mile radius of the project site and native to Iowa. Species should be true to their scientific name as specified.

B. Detailed live native herbaceous plant order should also convey potted, two-year or equivalent, nursery-grown stock unless approved in writing by the Owner. Minimum plug container size is 4" pots or 2" wide and 11 cubic inches. All plants must meet ASTM standards for specified size and condition.

WARRANTY PERIOD

The project specifications should define the terms of the warranty period, when the materials will be inspected at the end of that period and the process for replacing plant materials, reseeding or otherwise compensating the owner for plant materials or seeding that aren't in compliance at the end of the warranty period. For trees and shrubs, a warranty period of 1 year may commonly be used. For native seeding and planting activities, the warranty period may need to be extended to cover the establishment and maintenance period. SUDAS Section 9010, Part 3.10 and 9030, Part 3.13 can be used as references for warranty requirements.

MONITORING

Monitoring is critical during site preparation, seed and plant installation, and short-term (establishment) management of all native landscaping projects - especially when native seeding is conducted. Long-term (perpetual) management should also be guided by ongoing monitoring. General monitoring guidelines follow.

A. Prior to initiating restoration activities, a qualified individual (e.g., restoration ecologist, landscape ecologist, landscape architect, etc. intimately familiar with native plant establishment) should inspect the entire project area confirming existing conditions and validating restoration goals are appropriate. Notes should include invasive species, other stressors, erosion features, rare species observations, etc.

B. Prior to installing native seed/plants, a qualified ecologist should inspect the entire project area confirming site preparation was done properly before installation of plant materials.

C. During restoration activities, a qualified ecologist should oversee contractors, volunteers, and other personnel. Any concerns should be conveyed promptly to the Owner.

D. Variables such as the effectiveness of site preparation, soil and moisture conditions, season of seeding and/or planting, and other factors can influence the frequency and type of monitoring warranted; however, typical monitoring visits are:

   a. Year 1: 3-4 times

   b. Year 2: 2-3 times

   c. Year 3: 2-3 times

E. Following each of the first three or more growing seasons (depending on establishment success), a qualified ecologist should conduct a minimum of annual assessment of vegetation, invasive species, erosion, or other concerns. Observations should be reported to the Owner, and concerns should be addressed promptly.

EVALUATION OF ESTABLISHMENT

In order to establish clear project goals and ensure Contractor performance, project plans and bid packages should include detailed performance standards. Performance standards are meaningful metrics of success that typically provide measurable goals at various points in time during the short-term (establishment) phase of a native landscaping or restoration project. While performance standards may limit the number of bidders and/or increase the cost of bids, they provide clear, measurable expectations of the project proponent and help ensure better project outcomes overall.

An example of performance standards for a typical native seeding project follows:

A. The Contractor should guarantee seeded areas meet or exceed the following performance standards:

   a. One full growing season after installation and provisional acceptance: ≥70% total plant cover (including nurse crop), bare spots not exceeding 1 ft by 1 ft, and seedlings of ≥2 planted grass/sedge species and ≥4 planted forb species present and widely dispersed; invasive and weedy vegetation should not exceed 10% cover within any given 10 ft by 10 ft area.

   b. Two full growing seasons after installation and provisional acceptance: ≥90% total plant cover, bare spots not exceeding 1 ft by 1 ft, ≥70% cover by planted native species, and seedlings of ≥4 planted grass/sedge species and ≥8 planted forb species present and widely dispersed; should invasive and weedy vegetation should not exceed 5% cover within any given 10 ft by 10 ft area.

   c. Three full growing seasons after installation and provisional acceptance: ≥95% total plant cover, bare spots not exceeding 1 ft by 1 ft, ≥90% cover by planted native species, seedlings of ≥6 planted grass/sedge species and ≥12 planted forb species present and widely dispersed; invasive and weedy vegetation should not exceed 5% cover within any given 10 ft by 10 ft area.

An example of performance standards for a typical native live planting project follows:

A. The Contractor should guarantee live plantings meet or exceed the following performance standards:

   a. One full growing season after installation and provisional acceptance: 100% survivorship of all tree and shrub plantings; 80% survivorship of all live herbaceous plantings.

   b. The survivorship metrics may need to be adjusted based on the scale of the project. A lower rate may be acceptable in larger projects (such as a multi-acre prairie planting). 100% survivorship may be desired in smaller site applications (such as a small bioretention cell).

A warranty typically entails conducting remedial seeding and/or remedial live plantings as necessary to ensure that performance standards are met. See FINAL ACCEPTANCE below.

MAINTENANCE AND ESTABLISHMENT ACTIVITIES

It often takes three to five years for native prairie grasses and forbs to fully establish themselves from seed; live plantings obviously expedite this process significantly. Section 11-4 details ongoing maintenance activities that could be completed by the owner or a contractor to promote establishment and continued maintenance.

FINAL ACCEPTANCE

The project can be accepted when all work has been completed to the satisfaction of the Owner. If a warranty is specified as included in the project, provisional acceptance typically establishes the beginning of the warranty period. Acceptance will occur at the end of the short-term (establishment) phase (usually at least three years after installation) if seeded areas and plantings are in a live, healthy, growing, and well-established condition without eroded areas, bare spots, weeds, undesirable species, disease, or insects (i.e., performance standards are met). If no warranty is specified, projects should be accepted no sooner than 60 days from the date that all permanent seeding activities were completed.

NOTE

See page 34 for more information about Maintenance and Establishment Contract Work. If a separate contract for establishment and maintenance is used, those services may supersede the need for a traditional warranty period after construction.

SUDAS specifications state when the warranty period (or establishment and maintenance contract work) exceeds 60 days, projects may be accepted after all specified work, excluding the warranty (or establishment and maintenance contract), is satisfactorily completed. A supplemental contract for the warranty period (or establishment and maintenance contract) would be required.

SUDAS Specification 9010, Part 3.10 and 9030, Part 3.13 can be used as references for final acceptance.

The Contractor should perform maintenance as specified in the contract until Final Acceptance. The Contractor should notify the Owner of pending project acceptance so they can both participate in a final site inspection. If performance standards are not met or site conditions are otherwise not consistent with the plans and specifications, the Owner may chose to negotiate corrective actions with the Contractor, including but not limited to remedial seeding and/or planting, an extended duration of maintenance, or payment reduction. Following final contract close-out with the establishment and maintenance Contractor, the Owner should commence with perpetual management of the site.

Note: "Establishment" is defined as:

1) The plant has a sufficient root system that it does not require supplemental water other than natural precipitation. (This assumes natural precipitation is regular in it's frequency and quantity for the region, which may be altered due to climate change. This applies to seed and transplanted plants. It can be somewhat difficult to estimate root system size, so a top-growth proxy is used, see definition 2 below).

2) Resumption of growth rate post-transplanting as prior to transplanting. (This may be used with tree twig elongation from terminal bud scar to terminal bud scar or candle lengths in conifers. To achieve resumption of twig growth, a sufficient root system is needed that satisfies definition 1 above).

11-4 ESTABLISHMENT AND MAINTENANCE

A. SUMMARY

The "lower maintenance" demands of native landscapes doesn't mean "no maintenance". Many species of **native plants** spend their first few growing seasons establishing their root systems. It may take a full growing season (or several seasons) for some species to establish themselves. Therefore, regular maintenance is often essential during the initial years of establishment; however, over time, native landscapes typically require much less maintenance than turf and conventional landscaping.

MAINTENANCE AND ESTABLISHMENT CONTRACT WORK

If the landowner or party responsible for maintenance has limited staff, equipment or experience available to complete the described activities, it is recommended to enter into a maintenance contract with experienced, qualified contractors (ideally the same entity that did the installation) **for a period of at least three calendar years after initial seeding or planting.** For publicly funded or administered projects, these may need to be structured as separate contracts from any major construction operations (grading, utility construction, other site development, etc.). This would allow the "primary" contractor (often an earth-moving company) to complete their work, have it accepted, and retainage paid while the maintenance and establishment period continues under a second contract. These projects can be bid concurrently so that the owner understands the total cost of the project, and it is strongly recommended that the installing contractor be retained for short-term (establishment) maintenance.

This part of this Section outlines a recommended program for maintenance during the first years after installation and beyond. Much of this part of this Section is quoted or adapted from the Iowa Native Planting Guide. These recommendations are adapted for use in urban landscaping and stormwater management facilities. Other guidelines and requirements may be applicable when establishing native vegetation through agricultural programs, which are not covered in this manual. (13)

COORDINATION

If separate contracts are issued for installation and maintenance period services, each contract would need to have language about coordination and hand-off of sediment and erosion control responsibilities when the "primary" contract is about to be completed or when seeding or planting operations need to commence. The schedule of such coordination will vary from project to project, depending on the completion schedule for most construction work, the expected timing of installation of permanent seeding and planting, and the anticipated short-term (establishment) period needed to ensure the project is on track for success.

PRESCRIBED BURNING

Prescribed burning is a cost-effective long-term **ecological restoration** and management tool for maintaining many native plant communities, including prairies, savannas, many wetlands, and some woodlands/forests. Prescribed burning can also be used to facilitate site preparation (e.g., removal of weedy/invasive vegetation) prior to installation of native seed and live plants. Some general guidelines for prescribed burning follow.

Sources:
(13) Native Prairie Establishing & Managing Native Plantings. 2018.

- Always develop a well-designed burn plan, coordinate with local jurisdiction (and fire department), secure necessary permits, notify nearby landowners, and execute the burn plan using a qualified, trained, and insured burn crew. A burn plan should be developed that details:
  - Fire break locations
  - Ignition plan
  - Equipment, personnel
  - Fire escape areas
  - Potential damage risks (and strategies for protecting desirable vegetation (e.g., native trees and shrubs) and combustible structures or materials (e.g., plastic culverts or intakes, permanent turf reinforcement mat (TRM) materials).
  - Check with local jurisdictions about their requirements prior to developing a burn plan.
  - Trained or certified staff will be needed to oversee the implementation of the burn plan.
- Prescribed burns are typically conducted in units that are constrained by existing or created fire breaks. Fire breaks consist of mineral breaks (e.g., roads, trails) or short plants resistant to combustion (e.g., live turf, mowed cool-season grasses, or low-growing ground covers such as alfalfa or clover). To contain fire within a burn unit, fire breaks should generally be four times as wide as the tallest plant species in the adjacent area. For example, big bluestem can reach eight feet tall. If bluestem were the tallest plant species in the area to be controlled with fire, the fire break border would need to be at least 32 feet (4 x 8 feet) wide.
- Consider burning only a portion of the plant community each year. This provides **"refugia"** for wildlife to escape to and continue their life cycles, and can help promote more diverse habitats and landscapes.
- Consider burning prairies after the third season, then at least every 3-5 years to promote a healthy plant community. In some locations, more frequent burning may be needed to control volunteer trees, shrubs and **invasive species**. Fire-dependent plant communities other than prairies may be burned at a different interval, depending on site conditions and project goals.
- Prescribed burns are typically conducted in the spring or fall; however, some burns are conducted during the late summer or during the evening to accomplish project goals. Do not burn during the primary nesting season between May 15 to Aug 1. Varying burn seasons and schedules can help promote more diverse habitats and landscapes. See Exhibit 11-4-1 for how mowing schedules may have positive or negative impacts on certain plant communities.
- Utilize the Prescribed Burning Iowa Job Sheet when planning and completing prescribed burns.

ADAPTIVE MANAGEMENT

Establishing native vegetation takes time, and every site responds differently to the installation of native seed and plants. Variables that can influence vegetation establishment and development include land use history (e.g., existing vegetation, species present in the seed bank), weather conditions, local soils, management practices, and many other factors. For these reasons, native landscaping (and naturalized stormwater BMP projects) need to be flexible – often in the planning phase as well as the management phases. New threats and conditions may arise, and new scientific findings and insights also may change restoration management practices.

The most successful native landscaping and restoration projects use regular monitoring and reporting as feedback on the program's effectiveness. Monitoring also generates information to justify changes in the restoration and management program. **Adaptive management** is an approach to structured decision making in the face of uncertainty, with an aim to reducing uncertainty over time by using a cycle of planning, implementation, monitoring, evaluation, adjustment, and further implementation. Adaptive management is used in the best restoration programs, begins with the initial restoration work, and continues indefinitely as natural areas are managed over time.

B. SHORT-TERM (ESTABLISHMENT) MAINTENANCE

Native landscaping maintenance needs and methods vary significantly depending on a site's history, site preparation (e.g., removal of weeds and **invasive species**), the types of plant communities being established, methods of native plant installation (e.g., seeding versus live plantings), and environmental stressors (e.g., site disturbances, varying water levels, pressure by invasive vegetation). Live plantings (as are used in most conventional landscaping projects) are generally easier to manage than native seeding areas; therefore, the following general guidelines are focused on managing native seeding areas.

YEAR 1 (THE GROWING SEASON IMMEDIATELY FOLLOWING SEEDING)

As discussed previously in this chapter, native seedings take time to become established. Weeds, and even installed nurse crop plants, block sunlight and can smother out natives, preventing them from germinating or surviving. During the short-term (establishment) phase, it is critical to limit competition by weeds and to prevent them from generating and dropping viable seed.

Management mowing (conducted higher than conventional lawn mowing) is a key management technique used after native seedings. Herbicide use should be minimized, especially during the first year of seedling establishment. Plan to conduct management mowing of native seeding areas at least twice the first growing season and provide additional weed control as necessary, following an **Integrated Pest Management** (IPM) approach.

- Scout the area frequently during the establishment period for weed and nurse crop growth and pressure. Some weeds can double their height in a week.
- Mow the area before weeds get "knee high" or before they flower and set seed, ideally removing the clippings or using a "flail" mower that shreds the cut plant material. This will help prevent smothering of native seedlings and ensure sufficient light reaches the soil to encourage native seed to germinate and seedlings to grow. Mowing before invasive and weedy vegetation sets seed is critical during the establishment of native seed projects.
- Mow vegetation (weeds, temporary cover crop, and/or nurse crop) to a height of 3-6 inches with the first mowing after seeding (height depending on site conditions and project goals). With subsequent mowing, the mowing height can be raised to 6-12 inches (again, depending on site conditions and project goals). Note that most conventional mowers cannot accommodate these taller management mowing heights.
- Mow weeds at least twice between June and July. More frequent or continued mowing may be necessary if they reach "knee height" more rapidly.
- August may be a good time to mow to control late season annuals such as ragweed and foxtail.
- If weeds are allowed to reach a height of over 4 feet, do not mow. Instead, cut and harvest the material, or use a flail mower (that shreds the vegetation) to prevent cuttings from smothering native seed and seedlings.
- Use herbicides sparingly, if at all, the first growing season in order to avoid harm to native seedlings and other desirable vegetation.
- Evaluate the seeding area in the early fall. Practice adaptive management.

YEAR 2 AFTER SEEDING

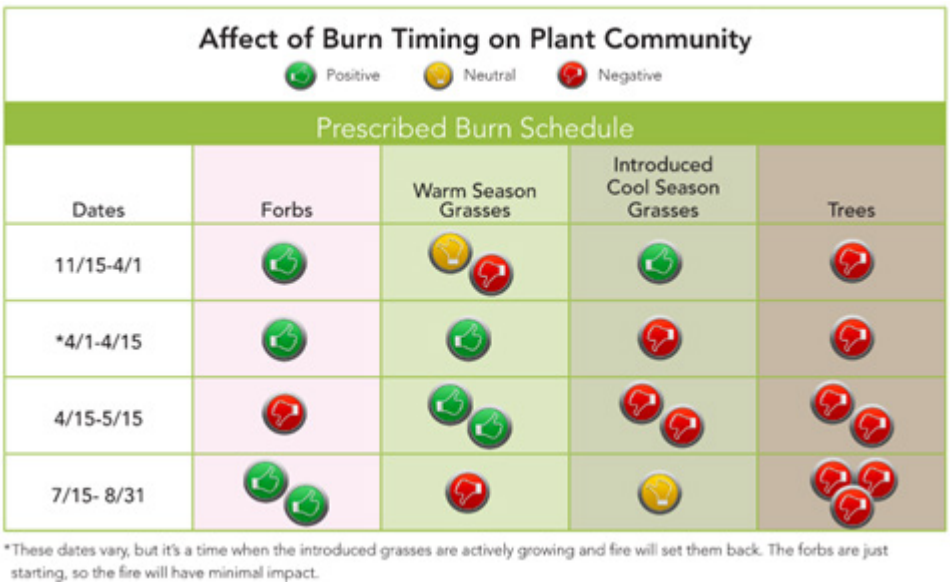
- Less frequent mowing is needed but continued weed and invasive species control is important.
- Mow the installation once to a height of 8-12 inches to prevent weeds and invasive vegetation from shade-suppressing native vegetation and to prevent development of viable weed seed. Monitor native seeding areas to see if additional mowing is needed.
- Practice IPM to control weeds and invasive vegetation, using herbicides sparingly to the extent feasible (but they are often used during Year 2). Spot mowing or trimming of established stands is preferred over chemical use for weed control, as chemicals can cause collateral damage to native vegetation and the environment.
- By mid-July there should be a moderate cover of native vegetation, although it will likely have a weedy appearance. Forbs will often start to bloom in this period.

- A prairie stand may be considered "established" if there is an average of 1 plant per square foot of surface area. This may take until Year 3 to reach that level of density.
- Practice adaptive management.

YEAR 3 AFTER SEEDING

- Continue to monitor the seeding area, using an IPM approach to control weeds and invasive vegetation.
- A prescribed burn is often appropriate after the third growing season of a native seeding project. Burning helps control unwanted trees, remove duff, and stimulate native plantings.
- When prescribed burning is not feasible, mowing and haying can help sustain healthy prairies by preventing the accumulation of thatch and nutrients, which can favor weedy species over time. Mowing and haying from July 15 to August 31 can reduce the tall grass components and encourage growth of forbs. Waiting to mow until after July 15 helps to protect ground-nesting birds and prevent nest destruction.
- Practice adaptive management. (13)

Exhibit 11-4-1. Prescribed Burn Schedule



*These dates vary, but it's a time when the introduced grasses are actively growing and fire will set them back. The forbs are just starting, so the fire will have minimal impact.

C. LONG-TERM (PERPETUAL) MAINTENANCE

YEAR 4 AFTER SEEDING (AND BEYOND)

Continue monitoring (at least annually, but ideally multiple times each year), using IPM methods, and practicing adaptive management. As mentioned above, consider prescribed burning during a variety of seasons to promote more diverse habitats and landscapes. Skipping monitoring and/or maintenance tasks to save money will often result in the decrease of native landscape health, which if neglected, can result in a failed seeding or planting and significant cost to repair (or completely restore).

11-5 SIGNAGE RECOMMENDATIONS

TEMPORARY SIGNAGE

Temporary "PRAIRIE UNDER CONSTRUCTION" educational signs may be advisable during the establishment and maintenance period. This can help the public to understand the longer time expected for the native plantings to be established.

Example of temporary signage.

Example of educational signage.

PERMANENT SIGNAGE

Signage may be provided as an educational tool to explain the native landscape and/or the naturalized stormwater BMP to the public. Signage may also be used to advise maintenance staff against discouraged practices, such as frequent mowing of native planting areas and broad application of herbicides. It may also be used to direct the public along access paths or provide warnings about any safety risks, or limitations of public use.

MAINTENANCE MARKERS

The boundary of the native planting area can be marked by posts, fences, bounders or other permanent markers to reduce the potential for "mower creep". These are even more important if the native area is adjacent to private residential lots or other properties that are outside of the control of the owner of the native planted area.

Fences used to protect vegetation from geese during construction.

11-6 GLOSSARY

Adaptive Management	Structured decision making in the face of uncertainty, with an aim to reducing uncertainty over time by a cycle of implementation, monitoring, evaluation, and adjustment.
Biocontrol	The use of natural enemies to reduce invasive species populations.
Ecological Enhancement	Improving an existing natural area, such as adding more native flower species to a prairie or removing an undesirable tree like Boxelder from an oak forest.
Ecological Restoration	As a general term, improving the natural environment by stabilizing and enhancing biodiversity, resilience, and ecosystem services. In contrast to Ecological Enhancement, Ecological Restoration typically refers to converting a non-natural area (e.g., turf grass or cropland) to a native plant community (e.g., prairie or wetland).
Ecosystem Services	The natural outputs of healthy ecosystems that benefit people—air and water purification, flood control, groundwater recharge, fish and wildlife production, soil building, recreation, food and fiber production, and spiritual renewal and recreational pleasure. Ecosystem services are worth trillions of dollars annually worldwide.
Genetic Origin	The geographic location (usually documented at the county level) that a seed or plant originated from. This is not the location of the nursery that grew or provided the plant material. Also known as provenance.
Integrated Pest Management	(IPM) Integrated Pest Management is an ecosystem-based approach that uses a combination of practices that minimize risk to beneficial insects and organisms, wildlife, humans, and the environment. Pesticides and herbicides are used only after monitoring indicates they are necessary and applied with the goal of removing only the target pest or species.
Invasive Species	Aggressive species whose introduction does or is likely to cause economic or environmental harm or harm to human health.
Mesic	Moist, typically referring to soil conditions (as opposed to dry or wet).
Native Plants	Plants indigenous to a given area in geologic time. This includes plants that have developed, occur naturally, or existed for many years in an area.
Refugia	An area that can help a population survive periods of adverse conditions (e.g., unburned portion of a prairie where insects can continue to thrive after other portions have been burned).
Xeric	Dry, as referring to soil conditions (as opposed to moist or wet).

11-7 RESOURCE LIST

Arbuckle, Kelly and Pease, James L. 1999. *Managing Iowa Habitats: Restoring Iowa Prairies.* Department of Animal Ecology, Iowa State University.

Assessing outcome predictability in prairie strip establishment. 2021. Tallgrass Prairie Center.

Burack, Thomas S., Walls, Michael J. and Stewart, Harry. 2008. *New Hampshire Stormwater Manual. Volume 2: Post-Construction Best Management Practices: Selection and Design.*

Char, Michael L., Barfield, Billy J. and O'Connor, Thomas P. 2004. Vegetative Biofilters. Stormwater Best Management Practice Design Guide Volume 2. 2004. National Service Center for Environmental Publications (NSCEP).

Clawson, Beth. 2018. *Could you please tell me what native plants I can plant on the drain field?* Landscaping, MSU Extension. Michigan State University.

https://www.canr.msu.edu/news/could-you-please-tell-me-what-native-plants-i-can-plant-on-the-drain-field#About%20Septic%20Systems

Conservation Planner Guide, Planning and Understanding Diverse Native Seed Mixes. Iowa Native Prairie Planting Guide. Natural Resources Conservation Service. Des Moines, IA.

Landscape Carbon Calculator/Pathfinder. 2020. Methodology, Data Sources and Metrics Summary.

https://climatepositivedesign.com/wp-content/uploads/2020/08/200731_landscape-carbon-calculator-v2-report.pdf

https://www.nature.com/articles/s41467-019-08636-w)

Law, Nelly L. 2014. *Recommendations of the Expert Panel to Define Removal Rates for Urban Filter Strips and Stream Buffer Upgrade Practices.* Center for Watershed Protection, Inc.

Long, Rebecca. 2022. *What are some native wildflowers to plant over a septic leach field?* Cooperative Extension: Garden and Yard. The University of Maine.

https://extension.umaine.edu/gardening/2022/07/27/native-wildflowers-for-septic-leach-field/

Hoffmann, Greg, Gardner, Laura, Espie, Matthew and Dunbar, James. 2020. *Stormwater Management Guidebook.* Department of Energy & Environment, District of Columbia.

Houseal, Greg. 2015. *Recognizing and Appreciating Tallgrass Prairie Remnants* - Prairie Restoration Series. Tallgrass Prairie Center, University of Northern Iowa. Cedar Falls, IA.

Managing Rain on Your Property. 2020. Stormwater Management Manual. Environmental Services Office, Portland, OR.

Massachusetts Stormwater Handbook and Stormwater Standards. 2008. Massachusetts Department of Environmental Protection.

Minnesota Stormwater Manual. Online manual, including the following sections:

https://stormwater.pca.state.mn.us/index.php?title=Minnesota_plant_lists

https://stormwater.pca.state.mn.us/index.php?title=Plant_and_vegetation_information_for_stormwater_management

Minnesota Wildflowers. 2022. A field guide to the flora of Minnesota.

https://www.minnesotawildflowers.info/

Native Prairie Establishing & Managing Native Plantings. 2018. Iowa Native Prairie Planting Guide. Natural Resources Conservation Service. Des Moines, IA.

Natural Resource Stewardship - Landscaping for Wildlife. Iowa State University Extension and Outreach.

Post-Construction Stormwater Management. New Jersey Stormwater Best Management Practices Manual. Department of Environmental Protection, New Jersey.

Silver Creek Stream Stabilization - Inspection and Maintenance Form. City of Davenport, IA.

Silver Creek Stream Stabilization - Permanent Project Seeding. Division 1 - Special Provisions. City of Davenport, IA.

Shaw, Daniel and R. Schmidt. 2003. *Plants for Stormwater Design – Species Selection for the Upper Midwest.* Minnesota Pollution Control Agency. St. Paul, MN.

Stanton, Kelly, Mickelbart, Michael V., Lee, Brad and Jones, Don. 2008. *Landscaping Over Septic Systems with Native Plants.* Home & Environment, Purdue Extension, Purdue University.

Williams, Dave. 2018. *Evaluating Stand Establishment.* Prairie Restoration Series. Tallgrass Prairie Center, University of Northern Iowa. Cedar Falls, IA.

Williams, Dave. 2018. *Initial Post Seeding and Early Reconstruction Management.* Prairie Restoration Series. Tallgrass Prairie Center, University of Northern Iowa. Cedar Falls, IA.

Williams, Dave. 2018. *Seeding.* Prairie Restoration Series. Tallgrass Prairie Center, University of Northern Iowa. Cedar Falls, IA.

Williams, Dave. 2018. *Site Preparation.* Prairie Restoration Series. Tallgrass Prairie Center, University of Northern Iowa. Cedar Falls, IA.

Xerces Society, USDA/NRCS, Tallgrass Prairie Center. 2022. Conservation Planner Guide - Planning and Understanding Diverse Native Seed Mixes.

https://www.nrcs.usda.gov/sites/default/files/2022-09/DiverseNativeSeedMixesGuide.pdf

Yang, Yi, Tilman, David, Furey, George and Lehman, Clarence. 2019. *Soil Carbon Sequestration Accelerated by Restoration of Grassland Biodiversity.* Nature Communications, Article number 718.

11-8 APPENDIX

INCLUDED ITEMS

1. Example Seed Mixes
2. Seed Mix Selections
3. Nurse Crop (Cover Crop) Recommendations
4. IDALS Practice Checklists

EXAMPLE SEED MIXES

The following example native seed mixes were developed for creating, restoring, or enhancing a variety of native plant communities. Many of these seed mixes are also appropriate for vegetated elements of naturalized stormwater BMPs; however, special attention should be given to the hydrologic regime of BMPs so that plant species will persist given the anticipated depth of water and/or the magnitude, frequency, and duration of intermittent inundation.

The seed mixes were developed using plant species determined by the USDA/NRCS as being native throughout the entire state of Iowa. Additional, more regionally-specific native species could be added to many of these mixes if additional species diversity is desired. In addition to the fundamental environmental conditions of moisture regime and amount of sunlight, other design criteria considered in the development of these example seed mixes include:

- Hight of vegetation (short mixes are designed so the majority of vegetation is <4 feet tall)
- Species richness/diversity (seed mixes range from 31 to 65 species each, with the exception of the Woodland/Forest mix at 19 species due to the limited availability, viability, and cost of native woodland seed)
- A variety of bloom times and colors to provide good habitat (for pollinators and other wildlife) as well as attractive blossoms throughout the growing season
- A variety of early-, mid-, and late-successional species, to help ensure quick initial establishment but also long persistence of a diverse and healthy native plant community
- An appropriate balance between graminoids (grass-like plants) and forbs (wildflowers)
- Seeds per square foot (seed mixes range from ~50-90 seeds/sq ft, with the exception of the Woodland/Forest mix closer to 40 seeds/sq ft)
- Nursery availability of species (avoidance of species not generally available as seed from commercial native plant nurseries)
- Cost (seed mixes range from ~$700-$850 per acre, with the exception of the Woodland/Forest mix closer to $900/ac)

SEED MIX SELECTIONS

The designer should select their desired seed mix based on site conditions and aesthetic preference. Fifteen seed mixes have been developed, grouped based on:

- Expected moisture conditions
- Shade condition
- Mature plant height

The following tables can be used as a guide to selecting seed mixes based on the vegetation zones that are identified in each related ISWMM section. Green boxes mean typically applicable, yellow boxes mean sometimes applicable

Table 11-8-1. Seed and plant mix selections for pre-treatment and infiltration BMPs.

Practice / Location	#1 - Dry Prairie (SHORT)	# 2 – Dry Prairie / Savanna (SHORT)	# 3 – Dry Prairie (MED - TALL)	# 4 – Dry Prairie / Savanna (MED - TALL)	# 5 – Mesic Prairie (SHORT)	# 6 – Mesic Prairie / Savanna (SHORT)	# 7 – Mesic Prairie (MED-TALL)	# 8 – Mesic Prairie / Savanna (MED-TALL)	# 9 – Wet Prairie (SHORT)	# 10 – Wet Prairie / Savanna (SHORT)	# 11 – Wet Prairie (MED-TALL)	# 12 – Wet Prairie / Savanna (MED-TALL)	# 13 – High & Low Marsh	# 14 – Woodland / Forest	#15 – Urban Small Area Mix
Grass swales Wet Prairie Zone									B	B	B	B			
Grass swales - Mesic prairie zone					B	B	B	B							
Grass swales- Dry prairie zone	B	B	B	B											
Vegetative Filter Strip	P	P	P	P	B	B	B	B							
Bioretention Level ponding area *	P	P	P	P	B	B	B	B							
Bioretention Outside level ponding area & Below 1-year high water level					B	B	B	B							
Bioretention Above 1-year high water level	P	P	P	P	B	B	B	B							
Bioswales Above modified soil mix	P	P	P	P	B	B	B	B							
Bioswales Below 1-year high water	P	P	P	P	B	B	B	B							
Bioswales Above 1-year high water level	P	P	P	P	B	B	B	B							
Infiltration Basin Wet Prairie									B	B	B	B			
Infiltration Basin Mesic Prairie					B	B	B	B							
Infiltration Basin Dry Prairie	B	B	B	B											
Generic Small Urban Sites															B

KEY:

= Not Recommended
P = Potential Option
B = Best Practice

NOTE

* The ponding area within bioretention cell is often planted instead of seeded. However, the species included within this seed mix are typically appropriate to be used in bioretention cells as live plug or plant materials.

Table 11-8-2. Seed mix selections for stormwater wetland and detention BMPs.

Practice / Location	# 1 – Dry Prairie (SHORT)	# 2 – Dry Prairie / Savanna (SHORT)	# 3 – Dry Prairie (MED - TALL)	# 4 – Dry Prairie / Savanna (MED - TALL)	# 5 – Mesic Prairie (SHORT)	# 6 – Mesic Prairie / Savanna (SHORT)	# 7 – Mesic Prairie (MED-TALL)	# 8 – Mesic Prairie / Savanna (MED-TALL)	# 9 – Wet Prairie (SHORT)	# 10 – Wet Prairie / Savanna (SHORT)	# 11 – Wet Prairie (MED-TALL)	# 12 – Wet Prairie / Savanna (MED-TALL)	# 13 – High & Low Marsh	# 14 – Woodland / Forest
Stormwater wetland Low marsh													B	
Stormwater wetland High marsh													B	
Stormwater wetland Semi-wet (ED) zone									B	B	B	B	P	
Stormwater wetland Detention zone					B	B	B	B	P	P	P	P		
Stormwater wetland Perimeter areas	P	P	P	P	B	B	B	B						
Dry detention Wet mesic zone					P	P	P	P	B	B	B	B		
Dry detention Mesic prairie zone					B	B	B	B						
Dry detention Upland prairie zone	P	P	P	P	B	B	B	B						
Extended dry detention Wet mesic zone					P	P	P	P	B	B	B	B		
Extended dry detention Upland prairie zone	P	P	P	P	B	B	B	B						
Wet ponds Wetland zone									P	P	P	P	B	
Wet ponds Wet mesic zone					P	P	P	P	B	B	B	B		
Wet ponds Upland prairie zone	P	P	P	P	B	B	B	B						

Table 11-8-3. Seed mix selections for other potential applications.

Practice / Location	# 1 – Dry Prairie (SHORT)	# 2 – Dry Prairie / Savanna (SHORT)	# 3 – Dry Prairie (MED - TALL)	# 4 – Dry Prairie / Savanna (MED - TALL)	# 5 – Mesic Prairie (SHORT)	# 6 – Mesic Prairie / Savanna (SHORT)	# 7 – Mesic Prairie (MED-TALL)	# 8 – Mesic Prairie / Savanna (MED-TALL)	# 9 – Wet Prairie (SHORT)	# 10 – Wet Prairie / Savanna (SHORT)	# 11 – Wet Prairie (MED-TALL)	# 12 – Wet Prairie / Savanna (MED-TALL)	# 13 – High & Low Marsh	# 14 – Woodland / Forest	#15 – Urban Small Area Mix
Prairie	P		P		B		B		B		B				
Prairie / savanna		P		P		B		B		B		B			
Woodlands														B	
Saturated Wetlands									B	B	B	B		B	
Emergent Wetlands													B	B	
Prairie Outlots	P	P	P	P	B	B	B	B	B	B	B	B		P	
Conservation Buffers	P	P	P	P	B	B	B	B	B	B	B	B		B	
Perimeter Edges	P	P			B	B			B	B				B	
Septic Fields	B		B												
Generic Small Urban Sites															B

NOTE: The example seed mixes contain native species only.

NURSE CROP (COVER CROP) RECOMMENDATIONS

A (typically non-native, annual) nurse crop (or cover crop) is recommended along with most native seedings to ensure rapid vegetation growth, which helps stabilize soils and facilitate establishment of the native seed. Too much nurse crop can actually impede establishment of native seedings. See Permanent Seeding section above for more details and recommendations.

April 2024

Native Live Plant Design Review Check List

Applicant: _____ Date: _____

Submitted By: _____ Project Location: _____ _

1) Describe the area to be planted. _____
2) What is the current land use?_____
3) Planting area size _____SF or _____ Ac
4) Slope of the area _____%
5) Method to kill existing vegetation _____
6) Seedbed preparation method _____
7) Site light conditions: _____ Sunny _____ Partial Sun _____ Shade
8) Site soil conditions: _____ Dry _____ Mesic _____ Wet
9) Live plants: _____ plugs _____ potted (Attach a list showing each species in Common Name and Scientific Name. Identify height of each plant. Show the number of each species planted.)
10) Plant supplier_____
11) Are plants grown from local ecotype seed? _____ Yes _____ No
12) Plant spacing: _____
13) Planting date: Spring (Apr 1-Sept 30) Date completed_____
14) Erosion control: _____ mats _____ mulch _____ other_____
15) If using mulch, what type and how thick_____
16) Describe erosion control_____
    _____
17) Does site have mowed border? ____ Yes ____ No What is width?_____
18) Who will perform maintenance during plant establishment (first year)?
    _____
19) Please attach the following:
    - ____ Aerial photo or map with plan view of planting area in relationship to existing/new infrastructure (buildings, sidewalks, and overhead utilities)
    - ____ Detailed plant layout plan showing plant location by species in relationship to existing/new infrastructure
    - ____ Soils map
    - ____ Topography map
    - ____ Establishment and Maintenance plan (watering, etc)

December 2018

Native Seeding Design Review Check List

Applicant: _____ Date: _____

Submitted By: _____ Project Location: _____ _

1) Describe the area to be seeded. _____
2) What is the current landuse? _____
3) Planting area size _____SF or _____ Ac
4) Slope of the area _____%
5) Method to kill existing vegetation _____
6) Seedbed preparation method _____
7) Site light conditions: _____ Sunny _____ Partial Sun _____ Shade
8) Site soil conditions: _____ Dry _____ Mesic _____ Wet
9) Seeding mix (Attach a list showing each species in Common Name and Scientific Name. Show the amount of each species as pure live seed in ounces or pounds. Identify height of each species. Identify percent ratio of grasses to forbs.)
10) Seed Supplier_____
11) Is seed a local ecotype (attach seed tags)? _____ Yes _____ No
12) Seeding date:
    ☐ Spring (Apr 1-June 30) ☐ Dormant (Nov 15-March 31) ☐ Frost (Feb 1-March 31)
    Date seeding completed _____
13) Erosion control: ___ mats ___ nurse crop ___ hydromulch ___ other_____
14) Describe erosion control_____
    _____
15) Nurse crop details:
    ☐ Oats (spring 32#/ac) ☐ Winter Wheat (fall 30#/ac) ☐ Other_____
16) Does site have mowed border? ____ Yes ____ No What is width? _____
17) Who will perform maintenance during seeding establishment (first two years)?
    _____
18) Please attach the following:
    ____ Aerial photo or map with plan view of planting area in relationship to existing/new infrastructure (buildings, sidewalks, and overhead utilities)
    ____ Soils map
    ____ Topography map
    ____ Seeding plan
    ____ Establishment and Maintenance plan

NATIVE SEED MIXES

SEED MIX #1 DRY PRAIRIE (SHORT)

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Sideoats Grama	Bouteloua curtipendula	58.08	3.63	8.00
Shortbeak Sedge	Carex brevior	3.00	0.19	2.00
Heavy Sedge	Carex gravida	0.36	0.02	0.10
Purple Lovegrass	Eragrostis spectabilis	0.62	0.04	4.00
Prairie Junegrass	Koeleria macrantha	1.74	0.11	8.00
Marsh Muhly	Muhlenbergia racemosa	1.09	0.07	2.00
Western Wheatgrass	Pascopyrum smithii	24.24	1.52	4.00
Little Bluestem	Schizachyrium scoparium	23.23	1.45	8.00
Sand Dropseed	Sporobolus cryptandrus	1.00	0.06	8.00
	Total Graminoids	**113.37**	**7.09**	**44.10**
Western Yarrow	Achillea millefolium	0.49	0.03	2.00
Meadow Garlic	Allium canadense	0.78	0.05	0.01
Candle Anemone	Anemone cylindrica	0.42	0.03	0.25
White Sagebrush	Artemisia ludoviciana	0.04	0.00	0.25
Butterfly Milkweed	Asclepias tuberosa	2.03	0.13	0.20
Whorled Milkweed	Asclepias verticillata	0.40	0.02	0.10
Canadian Milkvetch	Astragalus canadensis	2.56	0.16	1.00
White Wild Indigo	Baptisia alba	0.77	0.05	0.03
Partridge Pea	Chamaecrista fasciculata	8.07	0.50	0.50
Prairie Coreopsis	Coreopsis palmata	0.44	0.03	0.10
White Prairie Clover	Dalea candida	2.29	0.14	1.00
Purple Prairie Clover	Dalea purpurea	4.84	0.30	2.00
Flowering Spurge	Euphorbia corollata	0.54	0.03	0.10
Alumroot	Heuchera richardsonii	0.19	0.01	3.00
Tall Blazing Star	Liatris aspera	0.68	0.04	0.25
Prairie Cinquefoil	Potentilla arguta	0.76	0.05	4.00
Slender Mountain Mint	Pycnanthemum tenuifolium	0.06	0.00	0.50
Black-eyed Susan	Rudbeckia hirta	1.89	0.12	4.00
Field Goldenrod	Solidago nemoralis	0.29	0.02	2.00
Smooth Blue Aster	Symphyotrichum laeve	0.79	0.05	1.00
Western Silver Aster	Symphyotrichum sericeum	0.19	0.01	0.25
Hoary Vervain	Verbena stricta	3.11	0.19	2.00
	Total Forbs	**31.63**	**1.98**	**24.54**
Mix Totals (nurse or cover crop not included)		**145.00**	**9.06**	**68.64**

SEED MIX #2 DRY PRAIRIE/SAVANNA (SHORT)

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Sideoats Grama	Bouteloua curtipendula	58.08	3.63	8.00
Shortbeak Sedge	Carex brevior	3.00	0.19	2.00
Heavy Sedge	Carex gravida	0.36	0.02	0.10
Purple Lovegrass	Eragrostis spectabilis	0.62	0.04	4.00
Prairie Junegrass	Koeleria macrantha	1.74	0.11	8.00
Marsh Muhly	Muhlenbergia racemosa	1.09	0.07	2.00
Western Wheatgrass	Pascopyrum smithii	24.24	1.52	4.00
Little Bluestem	Schizachyrium scoparium	23.23	1.45	8.00
Sand Dropseed	Sporobolus cryptandrus	1.00	0.06	8.00
	Total Graminoids	**113.37**	**7.09**	**44.10**
Western Yarrow	Achillea millefolium	0.49	0.03	2.00
Meadow Garlic	Allium canadense	0.78	0.05	0.01
Candle Anemone	Anemone cylindrica	0.34	0.02	0.20
Red Columbine	Aquilegia canadensis	0.57	0.04	0.50
White Sagebrush	Artemisia ludoviciana	0.04	0.00	0.25
Butterfly Milkweed	Asclepias tuberosa	1.01	0.06	0.10
Whorled Milkweed	Asclepias verticillata	0.40	0.02	0.10
Canadian Milkvetch	Astragalus canadensis	2.56	0.16	1.00
White Wild Indigo	Baptisia alba	0.77	0.05	0.03
Partridge Pea	Chamaecrista fasciculata	8.07	0.50	0.50
Prairie Coreopsis	Coreopsis palmata	0.44	0.03	0.10
White Prairie Clover	Dalea candida	2.29	0.14	1.00
Purple Prairie Clover	Dalea purpurea	4.84	0.30	2.00
Flowering Spurge	Euphorbia corollata	0.54	0.03	0.10
Alumroot	Heuchera richardsonii	0.19	0.01	3.00
Tall Blazing Star	Liatris aspera	0.68	0.04	0.25
Prairie Cinquefoil	Potentilla arguta	0.76	0.05	4.00
Slender Mountain Mint	Pycnanthemum tenuifolium	0.06	0.00	0.50
Black-eyed Susan	Rudbeckia hirta	1.89	0.12	4.00
Field Goldenrod	Solidago nemoralis	0.29	0.02	2.00
Elm-leaved Goldenrod	Solidago ulmifolia	0.67	0.04	2.00
Smooth Blue Aster	Symphyotrichum laeve	0.79	0.05	1.00
Western Silver Aster	Symphyotrichum sericeum	0.19	0.01	0.25
Hoary Vervain	Verbena stricta	1.56	0.10	1.00
	Total Forbs	**30.22**	**1.89**	**25.89**
Mix Totals (nurse or cover crop not included)		**143.59**	**8.97**	**69.99**

SEED MIX #3 DRY PRAIRIE (MED-TALL), CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Big Bluestem	Andropogon gerardii	8.71	0.54	2.00
Sideoats Grama	Bouteloua curtipendula	29.04	1.82	4.00
Shortbeak Sedge	Carex brevior	1.50	0.09	1.00
Heavy Sedge	Carex gravida	0.36	0.02	0.10
Canada Wildrye	Elymus canadensis	16.75	1.05	2.00
Purple Lovegrass	Eragrostis spectabilis	0.31	0.02	2.00
Porcupinegrass	Hesperostipa spartea	0.64	0.04	0.01
Prairie Junegrass	Koeleria macrantha	0.87	0.05	4.00
Marsh Muhly	Muhlenbergia racemosa	0.54	0.03	1.00
Switchgrass	Panicum virgatum	6.22	0.39	2.00
Western Wheatgrass	Pascopyrum smithii	12.12	0.76	2.00
Little Bluestem	Schizachyrium scoparium	17.42	1.09	6.00
Indiangrass	Sorghastrum nutans	14.52	0.91	4.00
Sand Dropseed	Sporobolus cryptandrus	0.50	0.03	4.00
	Total Graminoids	**109.52**	**6.85**	**34.11**

SEED MIX #3 DRY PRAIRIE (MED-TALL), CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Western Yarrow	Achillea millefolium	0.24	0.02	1.00
Meadow Garlic	Allium canadense	0.78	0.05	0.01
Candle Anemone	Anemone cylindrica	0.34	0.02	0.20
White Sagebrush	Artemisia ludoviciana	0.04	0.00	0.25
Common Milkweed	Asclepias syriaca	1.02	0.06	0.10
Butterfly Milkweed	Asclepias tuberosa	1.01	0.06	0.10
Whorled Milkweed	Asclepias verticillata	0.40	0.02	0.10
Canadian Milkvetch	Astragalus canadensis	1.28	0.08	0.50
White Wild Indigo	Baptisia alba	0.77	0.05	0.03
False Boneset	Brickellia eupatorioides	0.34	0.02	0.25
Partridge Pea	Chamaecrista fasciculata	8.07	0.50	0.50
Prairie Coreopsis	Coreopsis palmata	0.44	0.03	0.10
White Prairie Clover	Dalea candida	1.15	0.07	0.50
Purple Prairie Clover	Dalea purpurea	1.21	0.08	0.50
Illinois Ticktrefoil	Desmodium illinoense	1.01	0.06	0.10
Pale Coneflower	Echinacea pallida	3.35	0.21	0.40
Tall Thoroughwort	Eupatorium altissimum	0.44	0.03	0.50
Flowering Spurge	Euphorbia corollata	0.27	0.02	0.05
Prairie Sunflower	Helianthus rigidum	0.54	0.03	0.05
Ox-eye	Heliopsis helianthoides	3.46	0.22	0.50
Alumroot	Heuchera richardsonii	0.12	0.01	2.00
Round-headed Bush Clover	Lespedeza capitata	1.09	0.07	0.20
Tall Blazing Star	Liatris aspera	0.54	0.03	0.20
Wild Bergamot	Monarda fistulosa	0.62	0.04	1.00
Common Evening Primrose	Oenothera biennis	0.97	0.06	2.00
Stiff Goldenrod	Oligoneuron rigidum	0.53	0.03	0.50
Prairie Cinquefoil	Potentilla arguta	0.19	0.01	1.00
Slender Mountain Mint	Pycnanthemum tenuifolium	0.06	0.00	0.50
Gray-headed Coneflower	Ratibida pinnata	1.45	0.09	1.00
Black-eyed Susan	Rudbeckia hirta	1.89	0.12	4.00
Rosinweed	Silphium integrifolium	0.73	0.05	0.02
Compass Plant	Silphium laciniatum	0.66	0.04	0.01
Field Goldenrod	Solidago nemoralis	0.15	0.01	1.00
Showy Goldenrod	Solidago speciosa	0.46	0.03	1.00
Smooth Blue Aster	Symphyotrichum laeve	0.79	0.05	1.00
Western Silver Aster	Symphyotrichum sericeum	0.08	0.00	0.10
Hoary Vervain	Verbena stricta	1.56	0.10	1.00
	Total Forbs	**38.04**	**2.38**	**22.27**
Mix Totals (nurse or cover crop not included)		**147.56**	**9.22**	**56.38**

SEED MIX #4 DRY PRAIRIE/SAVANNA (MED-TALL), CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Big Bluestem	Andropogon gerardii	8.71	0.54	2.00
Sideoats Grama	Bouteloua curtipendula	29.04	1.82	4.00
Shortbeak Sedge	Carex brevior	1.50	0.09	1.00
Heavy Sedge	Carex gravida	0.36	0.02	0.10
Canada Wildrye	Elymus canadensis	16.75	1.05	2.00
Purple Lovegrass	Eragrostis spectabilis	0.31	0.02	2.00
Porcupinegrass	Hesperostipa spartea	0.64	0.04	0.01
Prairie Junegrass	Koeleria macrantha	0.87	0.05	4.00
Marsh Muhly	Muhlenbergia racemosa	0.54	0.03	1.00
Switchgrass	Panicum virgatum	6.22	0.39	2.00
Western Wheatgrass	Pascopyrum smithii	12.12	0.76	2.00
Little Bluestem	Schizachyrium scoparium	17.42	1.09	6.00
Indiangrass	Sorghastrum nutans	14.52	0.91	4.00
Composite Dropseed	Sporobolus compositus	1.45	0.09	1.00
Sand Dropseed	Sporobolus cryptandrus	0.50	0.03	4.00
Prairie Dropseed	Sporobolus heterolepis	0.68	0.04	0.25
	Total Graminoids	**111.66**	**6.98**	**35.36**

SEED MIX #4 DRY PRAIRIE/SAVANNA (MED-TALL), CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Western Yarrow	Achillea millefolium	0.24	0.02	1.00
Meadow Garlic	Allium canadense	0.78	0.05	0.01
Candle Anemone	Anemone cylindrica	0.17	0.01	0.10
Red Columbine	Aquilegia canadensis	0.46	0.03	0.40
White Sagebrush	Artemisia ludoviciana	0.04	0.00	0.25
Common Milkweed	Asclepias syriaca	1.02	0.06	0.10
Butterfly Milkweed	Asclepias tuberosa	1.01	0.06	0.10
Whorled Milkweed	Asclepias verticillata	0.20	0.01	0.05
Canadian Milkvetch	Astragalus canadensis	1.28	0.08	0.50
White Wild Indigo	Baptisia alba	0.77	0.05	0.03
False Boneset	Brickellia eupatorioides	0.34	0.02	0.25
Partridge Pea	Chamaecrista fasciculata	4.03	0.25	0.25
Prairie Coreopsis	Coreopsis palmata	0.22	0.01	0.05
White Prairie Clover	Dalea candida	0.57	0.04	0.25
Purple Prairie Clover	Dalea purpurea	1.21	0.08	0.50
Illinois Ticktrefoil	Desmodium illinoense	1.01	0.06	0.10
Pale Coneflower	Echinacea pallida	2.51	0.16	0.30
Tall Thoroughwort	Eupatorium altissimum	0.44	0.03	0.50
Flowering Spurge	Euphorbia corollata	0.27	0.02	0.05
Prairie Sunflower	Helianthus rigidum	0.54	0.03	0.05
Paleleaf Woodland Sunflower	Helianthus strumosus	0.52	0.03	0.05
Ox-eye	Heliopsis helianthoides	3.46	0.22	0.50
Alumroot	Heuchera richardsonii	0.12	0.01	2.00
Round-headed Bush Clover	Lespedeza capitata	1.09	0.07	0.20
Tall Blazing Star	Liatris aspera	0.27	0.02	0.10
Wild Bergamot	Monarda fistulosa	0.62	0.04	1.00
Common Evening Primrose	Oenothera biennis	0.97	0.06	2.00
Stiff Goldenrod	Oligoneuron rigidum	0.53	0.03	0.50
Prairie Cinquefoil	Potentilla arguta	0.19	0.01	1.00
Slender Mountain Mint	Pycnanthemum tenuifolium	0.06	0.00	0.50
Gray-headed Coneflower	Ratibida pinnata	1.45	0.09	1.00
Black-eyed Susan	Rudbeckia hirta	1.89	0.12	4.00
Rosinweed	Silphium integrifolium	0.73	0.05	0.02
Compass Plant	Silphium laciniatum	0.66	0.04	0.01
Field Goldenrod	Solidago nemoralis	0.15	0.01	1.00
Showy Goldenrod	Solidago speciosa	0.46	0.03	1.00
Elm-leaved Goldenrod	Solidago ulmifolia	0.34	0.02	1.00
Smooth Blue Aster	Symphyotrichum laeve	0.79	0.05	1.00
Western Silver Aster	Symphyotrichum sericeum	0.08	0.00	0.10
Hoary Vervain	Verbena stricta	1.56	0.10	1.00
	Total Forbs	**33.05**	**2.07**	**22.82**
Mix Totals (nurse or cover crop not included)		**144.70**	**9.04**	**58.18**

SEED MIX #5 MESIC PRAIRIE (SHORT)

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Sideoats Grama	Bouteloua curtipendula	43.56	2.72	6.00
Bebb's Sedge	Carex bebbii	1.92	0.12	1.50
Bicknell's Sedge	Carex bicknellii	1.28	0.08	0.50
Heavy Sedge	Carex gravida	0.36	0.02	0.10
Sprengel's Sedge	Carex sprengelii	0.87	0.05	0.20
Fox Sedge	Carex vulpinoidea	0.87	0.05	2.00
Dudley's Rush	Juncus dudleyi	0.08	0.01	6.00
Inland Rush	Juncus interior	0.02	0.00	1.00
Knotted Rush	Juncus nodosus	0.02	0.00	1.00
Poverty Rush	Juncus tenuis	0.17	0.01	4.00
Prairie Junegrass	Koeleria macrantha	1.31	0.08	6.00
Marsh Muhly	Muhlenbergia racemosa	1.09	0.07	2.00
Western Wheatgrass	Pascopyrum smithii	24.24	1.52	4.00
Little Bluestem	Schizachyrium scoparium	29.04	1.82	10.00
	Total Graminoids	**104.84**	**6.55**	**44.30**
Western Yarrow	Achillea millefolium	0.49	0.03	2.00
Meadow Garlic	Allium canadense	0.78	0.05	0.01
Canadian Anemone	Anemone canadensis	0.54	0.03	0.10
Candle Anemone	Anemone cylindrica	0.34	0.02	0.20
Tall Thimbleweed	Anemone virginiana	0.31	0.02	0.20
Butterfly Milkweed	Asclepias tuberosa	1.01	0.06	0.10
Prairie Coreopsis	Coreopsis palmata	0.44	0.03	0.10
White Prairie Clover	Dalea candida	1.15	0.07	0.50
Purple Prairie Clover	Dalea purpurea	2.42	0.15	1.00
Flowering Spurge	Euphorbia corollata	0.54	0.03	0.10
Northern Bedstraw	Galium boreale	0.31	0.02	0.50
Alumroot	Heuchera richardsonii	0.12	0.01	2.00
Tall Blazing Star	Liatris aspera	0.68	0.04	0.25
Prairie Cinquefoil	Potentilla arguta	0.38	0.02	2.00
Slender Mountain Mint	Pycnanthemum tenuifolium	0.06	0.00	0.50
Common Mountain Mint	Pycnanthemum virginianum	0.20	0.01	1.00
Black-eyed Susan	Rudbeckia hirta	2.84	0.18	6.00
Field Goldenrod	Solidago nemoralis	0.29	0.02	2.00
Smooth Blue Aster	Symphyotrichum laeve	0.79	0.05	1.00
Skyblue Aster	Symphyotrichum oolentangiense	0.27	0.02	0.50
Ohio Spiderwort	Tradescantia ohiensis	1.09	0.07	0.20
Hoary Vervain	Verbena stricta	1.56	0.10	1.00
Golden Alexander's	Zizia aurea	1.98	0.12	0.50
	Total Forbs	**29.22**	**1.83**	**23.26**
Mix Totals (nurse or cover crop not included)		**134.06**	**8.38**	**67.56**

SEED MIX #6 MESIC PRAIRIE/SAVANNA (SHORT), CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Sideoats Grama	Bouteloua curtipendula	43.56	2.72	6.00
Bebb's Sedge	Carex bebbii	1.92	0.12	1.50
Bicknell's Sedge	Carex bicknellii	1.28	0.08	0.50
Heavy Sedge	Carex gravida	0.36	0.02	0.10
Sprengel's Sedge	Carex sprengelii	0.87	0.05	0.20
Fox Sedge	Carex vulpinoidea	0.87	0.05	2.00
Eastern Bottlebrush Grass	Elymus hystrix	2.87	0.18	0.50
Nodding Fescue	Festuca subverticillata	0.44	0.03	0.20
Dudley's Rush	Juncus dudleyi	0.08	0.01	6.00
Inland Rush	Juncus interior	0.02	0.00	1.00
Knotted Rush	Juncus nodosus	0.02	0.00	1.00
Poverty Rush	Juncus tenuis	0.17	0.01	4.00
Prairie Junegrass	Koeleria macrantha	1.31	0.08	6.00
Marsh Muhly	Muhlenbergia racemosa	1.09	0.07	2.00
Western Wheatgrass	Pascopyrum smithii	24.24	1.52	4.00
Little Bluestem	Schizachyrium scoparium	29.04	1.82	10.00
	Total Graminoids	**108.14**	**6.76**	**45.00**

SEED MIX #6 MESIC PRAIRIE/SAVANNA (SHORT), CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Western Yarrow	Achillea millefolium	0.49	0.03	2.00
Meadow Garlic	Allium canadense	0.78	0.05	0.01
Wild Leek	Allium tricoccum	0.31	0.02	0.01
Canadian Anemone	Anemone canadensis	0.27	0.02	0.05
Candle Anemone	Anemone cylindrica	0.17	0.01	0.10
Tall Thimbleweed	Anemone virginiana	0.31	0.02	0.20
Red Columbine	Aquilegia canadensis	0.29	0.02	0.25
Jack In The Pulpit	Arisaema triphyllum	0.87	0.05	0.01
Butterfly Milkweed	Asclepias tuberosa	0.51	0.03	0.05
Canadian Milkvetch	Astragalus canadensis	1.28	0.08	0.50
White Prairie Clover	Dalea candida	1.15	0.07	0.50
Purple Prairie Clover	Dalea purpurea	2.42	0.15	1.00
Flowering Spurge	Euphorbia corollata	0.27	0.02	0.05
Northern Bedstraw	Galium boreale	0.31	0.02	0.50
Wild Geranium	Geranium maculatum	0.16	0.01	0.02
Alumroot	Heuchera richardsonii	0.12	0.01	2.00
Tall Blazing Star	Liatris aspera	0.54	0.03	0.20
False Solomon's Seal	Maianthemum racemosum	1.09	0.07	0.01
Solomon's Seal	Polygonatum biflorum	0.54	0.03	0.01
Prairie Cinquefoil	Potentilla arguta	0.38	0.02	2.00
Slender Mountain Mint	Pycnanthemum tenuifolium	0.06	0.00	0.50
Common Mountain Mint	Pycnanthemum virginianum	0.20	0.01	1.00
Black-eyed Susan	Rudbeckia hirta	2.84	0.18	6.00
Wild Petunia	Ruellia humilis	0.42	0.03	0.05
Field Goldenrod	Solidago nemoralis	0.29	0.02	2.00
Elm-leaved Goldenrod	Solidago ulmifolia	0.34	0.02	1.00
Smooth Blue Aster	Symphyotrichum laeve	0.79	0.05	1.00
Skyblue Aster	Symphyotrichum oolentangiense	0.27	0.02	0.50
Ohio Spiderwort	Tradescantia ohiensis	0.54	0.03	0.10
Hoary Vervain	Verbena stricta	1.56	0.10	1.00
Golden Alexander's	Zizia aurea	1.98	0.12	0.50
	Total Forbs	**28.22**	**1.76**	**23.57**
Mix Totals (nurse or cover crop not included)		**136.36**	**8.52**	**68.57**

SEED MIX #7 MESIC PRAIRIE (MED-TALL), CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Big Bluestem	Andropogon gerardii	8.71	0.54	2.00
Sideoats Grama	Bouteloua curtipendula	29.04	1.82	4.00
Bicknell's Sedge	Carex bicknellii	0.64	0.04	0.25
Shortbeak Sedge	Carex brevior	1.13	0.07	0.75
Heavy Sedge	Carex gravida	0.18	0.01	0.05
Greater Straw Sedge	Carex normalis	0.87	0.05	0.50
Canada Wildrye	Elymus canadensis	25.13	1.57	3.00
Switchgrass	Panicum virgatum	12.45	0.78	4.00
Little Bluestem	Schizachyrium scoparium	23.23	1.45	8.00
Indiangrass	Sorghastrum nutans	14.52	0.91	4.00
Prairie Dropseed	Sporobolus heterolepis	1.36	0.09	0.50
	Total Graminoids	**117.26**	**7.33**	**27.05**

SEED MIX #7 MESIC PRAIRIE (MED-TALL), CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Western Yarrow	Achillea millefolium	0.24	0.02	1.00
Meadow Garlic	Allium canadense	0.78	0.05	0.01
Canadian Anemone	Anemone canadensis	0.27	0.02	0.05
Candle Anemone	Anemone cylindrica	0.16	0.01	0.10
Common Milkweed	Asclepias syriaca	2.03	0.13	0.20
Butterfly Milkweed	Asclepias tuberosa	0.51	0.03	0.05
Canadian Milkvetch	Astragalus canadensis	0.64	0.04	0.25
White Wild Indigo	Baptisia alba	0.77	0.05	0.03
Partridge Pea	Chamaecrista fasciculata	8.07	0.50	0.50
Prairie Coreopsis	Coreopsis palmata	0.44	0.03	0.10
White Prairie Clover	Dalea candida	1.15	0.07	0.50
Purple Prairie Clover	Dalea purpurea	2.42	0.15	1.00
Prairie Mimosa	Desmanthus illinoensis	5.19	0.32	0.50
Showy Ticktrefoil	Desmodium canadense	0.79	0.05	0.10
Illinois Ticktrefoil	Desmodium illinoense	1.01	0.06	0.10
Pale Coneflower	Echinacea pallida	4.19	0.26	0.50
Rattlesnake Master	Eryngium yuccifolium	0.58	0.04	0.10
Tall Thoroughwort	Eupatorium altissimum	0.44	0.03	0.50
Flowering Spurge	Euphorbia corollata	0.16	0.01	0.03
Ox-eye	Heliopsis helianthoides	3.46	0.22	0.50
Alumroot	Heuchera richardsonii	0.06	0.00	1.00
Round-headed Bush Clover	Lespedeza capitata	1.36	0.09	0.25
Prairie Blazing Star	Liatris pycnostachya	0.99	0.06	0.25
Wild Bergamot	Monarda fistulosa	1.24	0.08	2.00
Common Evening Primrose	Oenothera biennis	1.94	0.12	4.00
Stiff Goldenrod	Oligoneuron rigidum	1.06	0.07	1.00
Prairie Cinquefoil	Potentilla arguta	0.19	0.01	1.00
Slender Mountain Mint	Pycnanthemum tenuifolium	0.06	0.00	0.50
Common Mountain Mint	Pycnanthemum virginianum	0.20	0.01	1.00
Gray-headed Coneflower	Ratibida pinnata	2.90	0.18	2.00
Black-eyed Susan	Rudbeckia hirta	3.79	0.24	8.00
Rosinweed	Silphium integrifolium	1.09	0.07	0.03
Compass Plant	Silphium laciniatum	0.66	0.04	0.01
Showy Goldenrod	Solidago speciosa	0.92	0.06	2.00
Smooth Blue Aster	Symphyotrichum laeve	0.79	0.05	1.00
New England Aster	Symphyotrichum novae-angliae	0.50	0.03	0.75
Skyblue Aster	Symphyotrichum oolentangiense	0.14	0.01	0.25
Ohio Spiderwort	Tradescantia ohiensis	1.09	0.07	0.20
Hoary Vervain	Verbena stricta	1.56	0.10	1.00
Culver's Root	Veronicastrum virginicum	0.05	0.00	1.00
Golden Alexander's	Zizia aurea	1.98	0.12	0.50
	Total Forbs	**55.84**	**3.49**	**33.85**
Mix Totals (nurse or cover crop not included)		**173.10**	**10.82**	**60.90**

SEED MIX #8 MESIC PRAIRIE/SAVANNA (MED-TALL), CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Big Bluestem	Andropogon gerardii	8.71	0.54	2.00
Sideoats Grama	Bouteloua curtipendula	14.52	0.91	2.00
Bicknell's Sedge	Carex bicknellii	0.64	0.04	0.25
Shortbeak Sedge	Carex brevior	1.13	0.07	0.75
Heavy Sedge	Carex gravida	0.18	0.01	0.05
Greater Straw Sedge	Carex normalis	0.87	0.05	0.50
Broom Sedge	Carex scoparia	0.52	0.03	1.00
Canada Wildrye	Elymus canadensis	25.13	1.57	3.00
Hairy Wildrye	Elymus villosus	3.96	0.25	0.50
Virginia Wildrye	Elymus virginicus	20.74	1.30	2.00
Nodding Fescue	Festuca subverticillata	0.44	0.03	0.20
Switchgrass	Panicum virgatum	12.45	0.78	4.00
Little Bluestem	Schizachyrium scoparium	17.42	1.09	6.00
Indiangrass	Sorghastrum nutans	14.52	0.91	4.00
Composite Dropseed	Sporobolus compositus	0.73	0.05	0.50
Prairie Dropseed	Sporobolus heterolepis	1.36	0.09	0.50
	Total Graminoids	**123.32**	**7.71**	**27.25**
Common Name	**Scientific Name**	**Rate (oz/ac)**	**Rate (lbs/ac)**	**Seeds/ sq ft**
Western Yarrow	Achillea millefolium	0.24	0.02	1.00
Meadow Garlic	Allium canadense	0.78	0.05	0.01
Wild Leek	Allium tricoccum	0.31	0.02	0.01
Canadian Anemone	Anemone canadensis	0.27	0.02	0.05
Candle Anemone	Anemone cylindrica	0.16	0.01	0.10
Tall Thimbleweed	Anemone virginiana	0.31	0.02	0.20
Red Columbine	Aquilegia canadensis	0.34	0.02	0.30
Common Milkweed	Asclepias syriaca	1.02	0.06	0.10
Butterfly Milkweed	Asclepias tuberosa	0.51	0.03	0.05
Canadian Milkvetch	Astragalus canadensis	0.64	0.04	0.25
White Wild Indigo	Baptisia alba	0.77	0.05	0.03
Tall Bellflower	Campanula americana	0.26	0.02	1.00
Partridge Pea	Chamaecrista fasciculata	4.03	0.25	0.25
Prairie Coreopsis	Coreopsis palmata	0.22	0.01	0.05
White Prairie Clover	Dalea candida	0.57	0.04	0.25
Purple Prairie Clover	Dalea purpurea	1.21	0.08	0.50
Prairie Mimosa	Desmanthus illinoensis	5.19	0.32	0.50
Showy Ticktrefoil	Desmodium canadense	0.79	0.05	0.10
Illinois Ticktrefoil	Desmodium illinoense	1.01	0.06	0.10
Pale Coneflower	Echinacea pallida	2.51	0.16	0.30

SEED MIX #8 MESIC PRAIRIE/SAVANNA (MED-TALL), CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Rattlesnake Master	Eryngium yuccifolium	0.58	0.04	0.10
Tall Thoroughwort	Eupatorium altissimum	0.44	0.03	0.50
Sweetscented Joe Pye Weed	Eupatorium purpureum	0.78	0.05	0.75
Flowering Spurge	Euphorbia corollata	0.16	0.01	0.03
Ox-eye	Heliopsis helianthoides	3.46	0.22	0.50
Alumroot	Heuchera richardsonii	0.06	0.00	1.00
Round-headed Bush Clover	Lespedeza capitata	1.36	0.09	0.25
Prairie Blazing Star	Liatris pycnostachya	0.99	0.06	0.25
Wild Bergamot	Monarda fistulosa	0.62	0.04	1.00
Common Evening Primrose	Oenothera biennis	0.97	0.06	2.00
Stiff Goldenrod	Oligoneuron rigidum	0.53	0.03	0.50
False Dragonhead	Physostegia virginiana	0.79	0.05	0.20
Prairie Cinquefoil	Potentilla arguta	0.19	0.01	1.00
Slender Mountain Mint	Pycnanthemum tenuifolium	0.06	0.00	0.50
Common Mountain Mint	Pycnanthemum virginianum	0.20	0.01	1.00
Gray-headed Coneflower	Ratibida pinnata	2.90	0.18	2.00
Black-eyed Susan	Rudbeckia hirta	2.84	0.18	6.00
Rosinweed	Silphium integrifolium	1.09	0.07	0.03
Compass Plant	Silphium laciniatum	0.66	0.04	0.01
Showy Goldenrod	Solidago speciosa	0.46	0.03	1.00
Elm-leaved Goldenrod	Solidago ulmifolia	0.34	0.02	1.00
Smooth Blue Aster	Symphyotrichum laeve	0.40	0.02	0.50
New England Aster	Symphyotrichum novae-angliae	0.33	0.02	0.50
Skyblue Aster	Symphyotrichum oolentangiense	0.14	0.01	0.25
Ohio Spiderwort	Tradescantia ohiensis	0.54	0.03	0.10
Hoary Vervain	Verbena stricta	1.17	0.07	0.75
Culver's Root	Veronicastrum virginicum	0.04	0.00	0.75
Golden Alexander's	Zizia aurea	0.99	0.06	0.25
	Total Forbs	**44.22**	**2.76**	**27.86**
Mix Totals (nurse or cover crop not included)		**167.54**	**10.47**	**55.11**

SEED MIX #9 WET PRAIRIE (SHORT)

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Bebb's Sedge	Carex bebbii	2.56	0.16	2.00
Bottlebrush Sedge	Carex hystericina	2.90	0.18	2.00
Hop Sedge	Carex lupulina	1.32	0.08	0.10
Woolly Sedge	Carex pellita	0.31	0.02	0.20
Owlfruit Sedge	Carex stipata	1.28	0.08	1.00
Blister Sedge	Carex vesicaria	0.36	0.02	0.10
Fox Sedge	Carex vulpinoidea	5.23	0.33	12.00
Needle Spikerush	Eleocharis acicularis	0.62	0.04	1.00
Bald Spikerush	Eleocharis erythropoda	0.56	0.03	1.00
Blunt Spikerush	Eleocharis obtusa	0.44	0.03	1.00
Dudley's Rush	Juncus dudleyi	0.14	0.01	10.00
Poverty Rush	Juncus tenuis	0.35	0.02	8.00
Torrey's Rush	Juncus torreyi	0.22	0.01	8.00
Rice Cutgrass	Leersia oryzoides	2.56	0.16	2.00
Mexican Muhly	Muhlenbergia mexicana	1.99	0.12	8.00
	Total Graminoids	**20.84**	**1.30**	**56.40**
Slenderleaf False Foxglove	Agalinis tenuifolia	0.22	0.01	4.00
Canadian Anemone	Anemone canadensis	0.54	0.03	0.10
Nodding Beggartick	Bidens cernua	2.07	0.13	1.00
Northern Willow Herb	Epilobium ciliatum	0.18	0.01	0.25
Purpleleaf Willowherb	Epilobium coloratum	0.17	0.01	1.00
Boneset	Eupatorium perfoliatum	0.27	0.02	1.00
Grass-leaved Goldenrod	Euthamia graminifolia	0.12	0.01	1.00
Northern Bedstraw	Galium boreale	0.31	0.02	0.50
Blue Flag	Iris shrevei	1.31	0.08	0.03
Cardinal Flower	Lobelia cardinalis	0.22	0.01	2.00
Great Lobelia	Lobelia siphilitica	0.26	0.02	3.00
Water Horehound	Lycopus americanus	0.67	0.04	2.00
Winged Loosestrife	Lythrum alatum	0.06	0.00	4.00
Wild Mint	Mentha arvensis	0.07	0.00	0.50
Monkey Flower	Mimulus ringens	0.08	0.00	4.00
Ditch Stonecrop	Penthorum sedoides	0.13	0.01	4.00
Pennsylvania Smartweed	Polygonum pensylvanicum	6.70	0.42	2.00
Water Smartweed	Polygonum punctatum	0.28	0.02	0.05
Common Mountain Mint	Pycnanthemum virginianum	0.20	0.01	1.00
White Panicle Aster	Symphyotrichum lanceolatum	0.50	0.03	0.50
Blue Vervain	Verbena hastata	0.94	0.06	2.00
Golden Alexander's	Zizia aurea	1.98	0.12	0.50
	Total Forbs	**17.29**	**1.08**	**34.43**
Mix Totals (nurse or cover crop not included)		**38.13**	**2.38**	**90.83**

SEED MIX #10 WET PRAIRIE/SAVANNA (SHORT), CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Bebb's Sedge	Carex bebbii	2.56	0.16	2.00
Bottlebrush Sedge	Carex hystericina	2.90	0.18	2.00
Hop Sedge	Carex lupulina	1.32	0.08	0.10
Woolly Sedge	Carex pellita	0.31	0.02	0.20
Muskingum Sedge	Carex muskingumensis	0.58	0.04	0.10
Owlfruit Sedge	Carex stipata	1.28	0.08	1.00
Blister Sedge	Carex vesicaria	0.36	0.02	0.10
Fox Sedge	Carex vulpinoidea	4.36	0.27	10.00
Needle Spikerush	Eleocharis acicularis	0.62	0.04	1.00
Bald Spikerush	Eleocharis erythropoda	0.56	0.03	1.00
Blunt Spikerush	Eleocharis obtusa	0.44	0.03	1.00
Dudley's Rush	Juncus dudleyi	0.08	0.01	6.00
Poverty Rush	Juncus tenuis	0.17	0.01	4.00
Torrey's Rush	Juncus torreyi	0.11	0.01	4.00
Rice Cutgrass	Leersia oryzoides	1.28	0.08	1.00
Mexican Muhly	Muhlenbergia mexicana	1.49	0.09	6.00
	Total Graminoids	**18.43**	**1.15**	**39.50**

SEED MIX #10 WET PRAIRIE/SAVANNA (SHORT), CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Slenderleaf False Foxglove	Agalinis tenuifolia	0.22	0.01	4.00
Canadian Anemone	Anemone canadensis	0.54	0.03	0.10
Jack In The Pulpit	Arisaema triphyllum	0.87	0.05	0.01
Nodding Beggartick	Bidens cernua	2.07	0.13	1.00
Northern Willow Herb	Epilobium ciliatum	0.18	0.01	0.25
Purpleleaf Willowherb	Epilobium coloratum	0.17	0.01	1.00
Boneset	Eupatorium perfoliatum	0.27	0.02	1.00
Grass-leaved Goldenrod	Euthamia graminifolia	0.12	0.01	1.00
Northern Bedstraw	Galium boreale	0.31	0.02	0.50
Sneezeweed	Helenium autumnale	0.67	0.04	2.00
Blue Flag	Iris shrevei	1.31	0.08	0.03
Cardinal Flower	Lobelia cardinalis	0.22	0.01	2.00
Great Lobelia	Lobelia siphilitica	0.26	0.02	3.00
Water Horehound	Lycopus americanus	0.67	0.04	2.00
Winged Loosestrife	Lythrum alatum	0.06	0.00	4.00
Wild Mint	Mentha arvensis	0.07	0.00	0.50
Monkey Flower	Mimulus ringens	0.08	0.00	4.00
Ditch Stonecrop	Penthorum sedoides	0.13	0.01	4.00
Pennsylvania Smartweed	Polygonum pensylvanicum	6.70	0.42	2.00
Water Smartweed	Polygonum punctatum	0.28	0.02	0.05
Common Mountain Mint	Pycnanthemum virginianum	0.20	0.01	1.00
Swamp Buttercup	Ranunculus septentrionalis	0.36	0.02	0.10
White Panicle Aster	Symphyotrichum lanceolatum	0.50	0.03	0.50
Blue Vervain	Verbena hastata	0.94	0.06	2.00
Golden Alexander's	Zizia aurea	1.98	0.12	0.50
	Total Forbs	**19.19**	**1.20**	**36.54**
Mix Totals (nurse or cover crop not included)		**37.63**	**2.35**	**76.04**

SEED MIX #11 WET PRAIRIE (MED-TALL), CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Big Bluestem	Andropogon gerardii	8.71	0.54	2.00
Bluejoint	Calamagrostis canadensis	0.31	0.02	2.00
Broom Sedge	Carex scoparia	1.56	0.10	3.00
Owlfruit Sedge	Carex stipata	0.64	0.04	0.50
Upright Sedge	Carex stricta	0.08	0.01	0.10
Northwest Territory Sedge	Carex utriculata	0.44	0.03	0.10
Fox Sedge	Carex vulpinoidea	1.74	0.11	4.00
Virginia Wildrye	Elymus virginicus	41.49	2.59	4.00
Fowl Mannagrass	Glyceria striata	1.09	0.07	4.00
Dudley's Rush	Juncus dudleyi	0.08	0.01	6.00
Rice Cutgrass	Leersia oryzoides	0.64	0.04	0.50
Switchgrass	Panicum virgatum	18.67	1.17	6.00
Fowl Bluegrass	Poa palustris	1.34	0.08	4.00
Green Bulrush	Scirpus atrovirens	0.38	0.02	4.00
Prairie Cordgrass	Spartina pectinata	0.66	0.04	0.10
	Total Graminoids	**77.82**	**4.86**	**40.30**

SEED MIX #11 WET PRAIRIE (MED-TALL), CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Slenderleaf False Foxglove	Agalinis tenuifolia	0.05	0.00	1.00
Canadian Anemone	Anemone canadensis	0.54	0.03	0.10
Groovestem Indian Plaintain	Arnoglossum plantagineum	0.19	0.01	0.02
Swamp Milkweed	Asclepias incarnata	1.36	0.09	0.15
Nodding Beggartick	Bidens cernua	1.04	0.06	0.50
Purplestem Beggarticks	Bidens connata	1.09	0.07	0.25
Showy Ticktrefoil	Desmodium canadense	0.79	0.05	0.10
Flat-Topped Aster, White Aster	Doellingeria umbellata	0.33	0.02	0.50
Purpleleaf Willowherb	Epilobium coloratum	0.04	0.00	0.25
Boneset	Eupatorium perfoliatum	0.27	0.02	1.00
Grass-leaved Goldenrod	Euthamia graminifolia	0.12	0.01	1.00
Sneezeweed	Helenium autumnale	0.67	0.04	2.00
Saw-tooth Sunflower	Helianthus grosseserratus	0.29	0.02	0.10
Giant St. Johnswort	Hypericum ascyron	0.46	0.03	2.00
Blue Flag	Iris shrevei	1.31	0.08	0.03
Prairie Blazing Star	Liatris pycnostachya	1.98	0.12	0.50
Cardinal Flower	Lobelia cardinalis	0.22	0.01	2.00
Great Lobelia	Lobelia siphilitica	0.26	0.02	3.00
Water Horehound	Lycopus americanus	0.34	0.02	1.00
Winged Loosestrife	Lythrum alatum	0.06	0.00	4.00
Wild Mint	Mentha arvensis	0.15	0.01	1.00
Monkey Flower	Mimulus ringens	0.06	0.00	3.00
False Dragonhead	Physostegia virginiana	0.99	0.06	0.25
Common Mountain Mint	Pycnanthemum virginianum	0.20	0.01	1.00
Pale Dock	Rumex altissimus	0.84	0.05	0.10
Great Water Dock	Rumex orbiculatus	0.92	0.06	0.25
Water Parsnip	Sium suave	0.22	0.01	0.25
White Panicle Aster	Symphyotrichum lanceolatum	0.50	0.03	0.50
New England Aster	Symphyotrichum novae-angliae	0.50	0.03	0.75
American Germander	Teucrium canadense	0.22	0.01	0.10
Purple Meadow-rue	Thalictrum dasycarpum	0.99	0.06	0.25
Blue Vervain	Verbena hastata	0.94	0.06	2.00
Ironweed	Vernonia fasciculata	0.91	0.06	0.50
Culver's Root	Veronicastrum virginicum	0.11	0.01	2.00
Golden Alexander's	Zizia aurea	0.99	0.06	0.25
	Total Forbs	**19.90**	**1.24**	**31.70**
Mix Totals (nurse or cover crop not included)		**97.73**	**6.10**	**72.00**

SEED MIX #12 WET PRAIRIE/SAVANNA (MED-TALL), CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Big Bluestem	Andropogon gerardii	8.71	0.54	2.00
Bluejoint	Calamagrostis canadensis	0.16	0.01	1.00
Broom Sedge	Carex scoparia	1.56	0.10	3.00
Owlfruit Sedge	Carex stipata	0.64	0.04	0.50
Upright Sedge	Carex stricta	0.08	0.01	0.10
Northwest Territory Sedge	Carex utriculata	0.44	0.03	0.10
Fox Sedge	Carex vulpinoidea	1.74	0.11	4.00
Virginia Wildrye	Elymus virginicus	20.74	1.30	2.00
Fowl Mannagrass	Glyceria striata	1.09	0.07	4.00
Dudley's Rush	Juncus dudleyi	0.08	0.01	6.00
Rice Cutgrass	Leersia oryzoides	0.64	0.04	0.50
Switchgrass	Panicum virgatum	18.67	1.17	6.00
Fowl Bluegrass	Poa palustris	1.34	0.08	4.00
Green Bulrush	Scirpus atrovirens	0.38	0.02	4.00
Prairie Cordgrass	Spartina pectinata	0.66	0.04	0.10
	Total Graminoids	**56.93**	**3.56**	**37.30**

SEED MIX #12 WET PRAIRIE/SAVANNA (MED-TALL), CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Slenderleaf False Foxglove	Agalinis tenuifolia	0.05	0.00	1.00
Canadian Anemone	Anemone canadensis	0.54	0.03	0.10
Jack In The Pulpit	Arisaema triphyllum	0.87	0.05	0.01
Groovestem Indian Plaintain	Arnoglossum plantagineum	0.19	0.01	0.02
Swamp Milkweed	Asclepias incarnata	0.91	0.06	0.10
Nodding Beggartick	Bidens cernua	1.04	0.06	0.50
Purplestem Beggarticks	Bidens connata	1.09	0.07	0.25
Showy Ticktrefoil	Desmodium canadense	0.79	0.05	0.10
Flat-Topped Aster, White Aster	Doellingeria umbellata	0.33	0.02	0.50
Purpleleaf Willowherb	Epilobium coloratum	0.04	0.00	0.25
Boneset	Eupatorium perfoliatum	0.27	0.02	1.00
Grass-leaved Goldenrod	Euthamia graminifolia	0.12	0.01	1.00
Sneezeweed	Helenium autumnale	0.67	0.04	2.00
Saw-tooth Sunflower	Helianthus grosseserratus	0.29	0.02	0.10
Giant St. Johnswort	Hypericum ascyron	0.46	0.03	2.00
Blue Flag	Iris shrevei	1.31	0.08	0.03
Prairie Blazing Star	Liatris pycnostachya	1.98	0.12	0.50
Cardinal Flower	Lobelia cardinalis	0.22	0.01	2.00
Great Lobelia	Lobelia siphilitica	0.26	0.02	3.00
Water Horehound	Lycopus americanus	0.34	0.02	1.00
Fringed Loosestrife	Lysimachia ciliata	0.28	0.02	0.25
Winged Loosestrife	Lythrum alatum	0.06	0.00	4.00
Wild Mint	Mentha arvensis	0.15	0.01	1.00
Monkey Flower	Mimulus ringens	0.06	0.00	3.00
False Dragonhead	Physostegia virginiana	0.99	0.06	0.25
Common Mountain Mint	Pycnanthemum virginianum	0.20	0.01	1.00
Tall Coneflower	Rudbeckia laciniata	0.78	0.05	0.25
Pale Dock	Rumex altissimus	0.84	0.05	0.10
Great Water Dock	Rumex orbiculatus	0.92	0.06	0.25
Water Parsnip	Sium suave	0.22	0.01	0.25
White Panicle Aster	Symphyotrichum lanceolatum	0.50	0.03	0.50
New England Aster	Symphyotrichum novae-angliae	0.50	0.03	0.75
Purple Meadow-rue	Thalictrum dasycarpum	0.99	0.06	0.25
Bunch flower	Veratrum virginicum	1.21	0.08	0.25
Blue Vervain	Verbena hastata	0.94	0.06	2.00
Ironweed	Vernonia fasciculata	0.91	0.06	0.50
Culver's Root	Veronicastrum virginicum	0.11	0.01	2.00
Golden Alexander's	Zizia aurea	0.99	0.06	0.25
	Total Forbs	**22.37**	**1.39**	**32.31**
Mix Totals (nurse or cover crop not included)		**79.30**	**4.95**	**69.61**

SEED MIX #13 HIGH & LOW MARSH (USED WHEN WATER LEVEL CONTROL ALLOWS USE OF SEED)

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Bluejoint	Calamagrostis canadensis	0.31	0.02	2.00
Bebb's Sedge	Carex bebbii	1.28	0.08	1.00
Bottlebrush Sedge	Carex hystericina	2.90	0.18	2.00
Hop Sedge	Carex lupulina	1.32	0.08	0.10
Muskingum Sedge	Carex muskingumensis	0.58	0.04	0.10
Woolly Sedge	Carex pellita	0.31	0.02	0.20
Sartwell's Sedge	Carex sartwellii	0.21	0.01	0.20
Owlfruit Sedge	Carex stipata	0.96	0.06	0.75
Upright Sedge	Carex stricta	0.41	0.03	0.50
Needle Spikerush	Eleocharis acicularis	0.31	0.02	0.50
Bald Spikerush	Eleocharis erythropoda	0.56	0.03	1.00
Blunt Spikerush	Eleocharis obtusa	0.33	0.02	0.75
Fowl Mannagrass	Glyceria striata	1.63	0.10	6.00
Torrey's Rush	Juncus torreyi	0.22	0.01	8.00
Rice Cutgrass	Leersia oryzoides	1.28	0.08	1.00
Hardstem Bulrush	Schoenoplectus acutus	0.84	0.05	0.25
River Bulrush	Schoenoplectus fluviatilis	2.03	0.13	0.20
Softstem Bulrush	Schoenoplectus tabernaemontani	2.11	0.13	1.50
Green Bulrush	Scirpus atrovirens	0.95	0.06	10.00
	Total Graminoids	**18.55**	**1.16**	**36.05**
Water Plantain	Alisma subcordatum	4.36	0.27	6.00
Swamp Milkweed	Asclepias incarnata	1.82	0.11	0.20
Nodding Beggartick	Bidens cernua	1.04	0.06	0.50
Purplestem Beggarticks	Bidens connata	1.09	0.07	0.25
Blue Flag	Iris shrevei	2.18	0.14	0.05
False Dragonhead	Physostegia virginiana	0.99	0.06	0.25
Pennsylvania Smartweed	Polygonum pensylvanicum	13.40	0.84	4.00
Water Smartweed	Polygonum punctatum	0.28	0.02	0.05
Great Water Dock	Rumex orbiculatus	1.83	0.11	0.50
Common Arrowhead	Sagittaria latifolia	1.43	0.09	2.00
Water Parsnip	Sium suave	0.22	0.01	0.25
Common Bur Reed	Sparganium eurycarpum	2.61	0.16	0.03
	Total Forbs	**31.23**	**1.95**	**14.08**
Mix Totals (nurse or cover crop not included)		**49.78**	**3.11**	**50.13**

SEED MIX #14 WOODLAND/FOREST

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Hairy Woodland Brome	Bromus pubescens	8.00	0.50	1.40
Greater Straw Sedge	Carex normalis	3.52	0.22	2.00
Sprengel's Sedge	Carex sprengelii	3.20	0.20	0.74
Canada Wildrye	Elymus canadensis	40.00	2.50	4.77
Eastern Bottlebrush Grass	Elymus hystrix	6.40	0.40	1.12
Hairy Wildrye	Elymus villosus	8.00	0.50	1.00
Virginia Wildrye	Elymus virginicus	41.60	2.60	4.00
Nodding Fescue	Festuca subverticillata	1.60	0.10	0.74
	Total Graminoids	**112.32**	**7.02**	**15.77**
Tall Thimbleweed	Anemone virginiana	0.96	0.06	0.62
Red Columbine	Aquilegia canadensis	1.20	0.08	1.05
Tall Bellflower	Campanula americana	0.96	0.06	3.75
Illinois Ticktrefoil	Desmodium illinoense	3.20	0.20	0.32
Sweetscented Joe Pye Weed	Eupatorium purpureum	2.40	0.15	2.31
Wild Bergamot	Monarda fistulosa	3.20	0.20	5.14
Sweet Cicely	Osmorhiza claytonii	3.52	0.22	0.20
Tall Coneflower	Rudbeckia laciniata	3.20	0.20	1.03
Elm-leaved Goldenrod	Solidago ulmifolia	0.80	0.05	2.39
Culver's Root	Veronicastrum virginicum	0.32	0.02	5.88
Golden Alexander's	Zizia aurea	6.40	0.40	1.62
	Total Forbs	**26.16**	**1.64**	**24.31**
Mix Totals (nurse or cover crop not included)		**138.48**	**8.66**	**40.08**

SEED MIX #15 URBAN SMALL AREA, CONTINUED ON NEXT PAGE

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Sideoats Grama	Bouteloua curtipendula	27.200	1.700	3.747
Prairie Oval Sedge	Carex brevior	1.120	0.070	0.746
Broom Sedge	Carex scoparia	0.160	0.010	0.309
Fox Sedge	Carex vulpinoidea	1.120	0.070	2.571
Virginia Wildrye	Elymus virginicus	9.600	0.600	0.926
Prairie Junegrass	Koeleria macrantha	0.960	0.060	4.408
Little Bluestem	Schizachyrium scoparium	12.800	0.800	4.408
Rough Dropseed	Sporobolus compositus	4.000	0.250	2.755
Prairie Dropseed	Sporobolus heterolepis	1.200	0.075	0.441
	Total Graminoids	**58.160**	**3.635**	**20.311**
Common Yarrow	Achillea millefolium	0.160	0.010	0.655
Wild Garlic	Allium canadense	0.640	0.040	0.008
Wild Prairie Onion	Allium stellatum	0.480	0.030	0.121
Lead Plant	Amorpha canescens	0.320	0.020	0.118
Canada Anemone	Anemone canadensis	0.160	0.010	0.029
Columbine	Aquilegia canadensis	0.160	0.010	0.140
Common Milkweed	Asclepias syriaca	0.480	0.030	0.047
Butterfly Weed	Asclepias tuberosa	0.800	0.050	0.079
Canadian Milkvetch	Astragalus canadensis	3.200	0.200	1.249
Partridge Pea	Chamaecrista fasciculata	6.400	0.400	0.397
Prairie Coreopsis	Coreopsis palmata	0.080	0.005	0.018
White Prairie Clover	Dalea candida	2.400	0.150	1.047
Purple Prairie Clover	Dalea purpurea	3.200	0.200	1.322
Pale Purple Coneflower	Echinacea pallida	0.960	0.060	0.115
Purple Coneflower	Echinacea purpurea	1.600	0.100	0.242
Rattlesnake Master	Eryngium yuccifolium	0.800	0.050	0.138
Boneset	Eupatorium perfoliatum	0.080	0.005	0.294
Flowering Spurge	Euphorbia corollata	0.160	0.010	0.029
Cream Gentian	Gentiana alba	0.080	0.005	0.257
Wild Geranium	Geranium maculatum	0.080	0.005	0.009
Alumroot	Heuchera richardsonii	0.048	0.003	0.771
Round-headed Bush Clover	Lespedeza capitata	0.640	0.040	0.118
Rough Blazing Star	Liatris aspera	0.320	0.020	0.118
Prairie Blazing Star	Liatris pycnostachya	0.480	0.030	0.121
Great Blue Lobelia	Lobelia siphilitica	0.160	0.010	1.837
Square-stemmed Monkeyflower	Mimulus ringens	0.032	0.002	1.690
Wild Bergamot	Monarda fistulosa	0.640	0.040	1.028

SEED MIX #15 URBAN SMALL AREA, CONTINUED

Common Name	Scientific Name	Rate (oz/ac)	Rate (lbs/ac)	Seeds/ sq ft
Stiff Goldenrod	Oligoneuron rigidum	0.640	0.040	0.602
Foxglove Beardtongue	Penstemon digitalis	0.320	0.020	0.955
Prairie Cinquefoil	Potentilla arguta	0.160	0.010	0.845
Virginia Mountain Mint	Pycnanthemum virginianum	0.080	0.005	0.404
Long-headed Coneflower	Ratibida columnifera	0.960	0.060	0.926
Gray-headed Coneflower	Ratibida pinnata	1.280	0.080	0.882
Black-eyed Susan	Rudbeckia hirta	0.480	0.030	1.014
Old Field Goldenrod	Solidago nemoralis	0.160	0.010	1.102
Heath Aster	Symphyotrichum ericoides	0.032	0.002	0.147
Smooth Blue Aster	Symphyotrichum laeve	0.160	0.010	0.202
Blue Sky Aster	Symphyotrichum oolentangiense	0.160	0.010	0.294
Prairie Spiderwort	Tradescantia bracteata	0.160	0.010	0.037
Ohio Spiderwort	Tradescantia ohiensis	0.160	0.010	0.029
Hoary Vervain	Verbena stricta	0.800	0.050	0.514
Golden Alexander's	Zizia aurea	1.600	0.100	0.404
	Total Forbs	**31.712**	**1.982**	**20.354**
Mix Totals (nurse or cover crop not included)		**89.872**	**5.617**	**40.665**