

Restoring Your Annual-Dominated Field to Conservation Prairie



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Cover photo taken at Bluestem Prairie by Justin Meissen.



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In this guide, you will learn the basic steps to restore a field dominated by annual weeds to a conservation prairie. The precise restoration actions will depend on the particular features of your site as well as your budget, preferences and project goals.

When planning your restoration, we recommend you consult with restoration professionals to evaluate your site's unique characteristics. Please visit nature.org/MNPrairieRestorationGuides for more information on who to contact or other publications that cover site assessment protocols.

What is conservation prairie?

Conservation prairie is designed to closely mimic native prairie using a seed mix that has many different native species adapted to the restoration site. This diversity provides habitat and food for native insects, including pollinators, and wildlife. A wide variety of flowering plants and grasses is also visually interesting to people. Conservation prairie is not suitable for forage production, commercial uses or high-impact recreational activities such as driving ATVs.

Compatible land uses include:

- Carefully managed grazing for habitat goals
- Haying for habitat goals
- Occasional seed harvest
- Low-impact recreational activities, such as hiking, photography, or hunting

Conservation benefits include improved water quality, soil stabilization, and habitat for birds, animals and insects. Conservation prairie can also buffer high-quality native prairies and support threatened and endangered plants and animals that depend on large contiguous areas of grassland.

Why restore annual-dominated fields?

Annual-dominated fields (>75% coverage by annual weeds) are often previously cropped fields that have been left fallow. They have been colonized by annual weeds, such as foxtail, barnyard grass and lambs-quarters. Native weedy annuals such as ragweed may also be present, but desirable native prairie species are either absent or very minimal.

Controlling annual weeds and their seed bank will be an important step in restoration, and seedbed preparation is typically required prior to seeding. These fields are relatively straightforward to restore to prairie, and they require less investment in weed control than sites that have become invaded by aggressive perennial weeds.

This guide assumes that your site has moderate to dry soil moisture and has not been drained. Relatively wet fields that have been drained via drainage tiles or ditches are better suited for restoring to wet meadow. This may require additional steps to restore the hydrology¹.

¹ Refer to the restoration guide "Restoring your Crop Field to Conservation Wet Meadow" for more information on hydrologic restoration.

What will it involve?

Prairie restoration typically includes these basic steps:

- **Site Assessment**— Identify the site characteristics and define goals for the restoration.
- **Vegetation Removal** – Remove existing weeds and undesired vegetation from the site to prevent aggressive weedy species from out-competing native prairie plants.
- **Seedbed Preparation** – Prepare a seedbed to ensure good seed-soil contact and promote germination of planted seeds.
- **Seeding/Planting** – Select seed mixes and seeding methods that are well suited to the site and project goals. Or, in the case of small sites of less than half an acre, consider hand planting plugs for quicker results².
- **Establishment and Aftercare** – Control weeds and promote the establishment and growth of prairie plants through the first few years after seeding.
- **Long-term Management** – Maintain the health and diversity of native prairie into the future.

How long will it take?

On an annual weed-dominated field, the initial phases of site preparation and seeding can be completed within a single growing season. After the year it's seeded, expect to spend at least three to five years on aftercare to ensure good establishment of the conservation prairie. This period is referred to as the establishment phase of restoration.

After establishment, often after year 5 for conservation prairie, the long-term management phase begins. Management

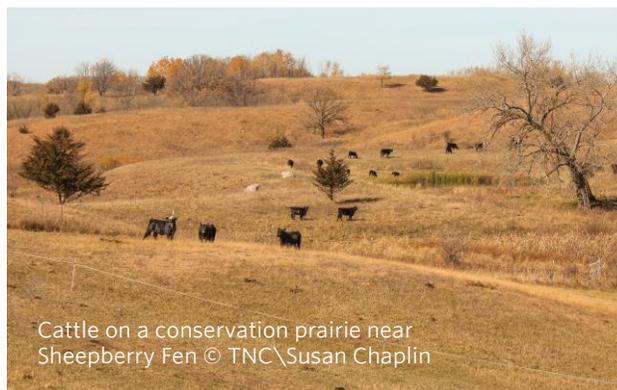
actions are typically less frequent and intensive than during the establishment phase, but are critical for maintaining the health and diversity of the prairie into the future.

What will it cost?

The cost of the restoration will be influenced by:

- Management level required to control weeds
- Species and number of species selected for the seed mix
- Cost of seed, which fluctuates from year to year
- Labor and equipment available for the project

The cost estimate in this document will give you a baseline for what you can expect to spend through the early establishment phase of your restoration (i.e. through three years after seeding). It may be tempting to cut costs by reducing the number of species planted or the frequency of weed control activities. Be aware that these investments on the front end can actually save costs in the long run. A healthy and diverse prairie will be more resilient to disturbance, invasion by exotic species, and extreme weather events such as drought.



Cattle on a conservation prairie near Sheepberry Fen © TNC\Susan Chaplin

² Plugs are young plants sold in 4- or 6-packs. Plugs cost substantially more than seed, but they establish rapidly and can produce a resilient and visually appealing meadow more quickly than seeding, so it is often a preferred option for smaller sites.



Annual-Dominated Field to Conservation Prairie Restoration Guidelines

Site assessment

A successful prairie restoration is highly dependent on specific characteristics of a site. Important considerations when planning a restoration include:

- Has the site had herbicide treatments that would prohibit seed from germinating?
- Is there a risk of herbicide drift from neighboring cropfields?
- Are the soils dry, moderate or wet?
- Are there steep slopes that may be vulnerable to erosion?
- What types of vegetation are currently present on the site?

If you are new to prairie restoration, we strongly encourage enlisting someone who has restoration experience to help you assess the

characteristics of the site and develop a restoration plan suited to your site's specific features and your project goals.

Vegetation removal

Annual weeds are common in disturbed sites, such as fallow crop fields. If not properly managed, annual weeds can overtop and shade newly planted prairie seedlings, resulting in reduced survival and growth. Controlling annual weeds and reducing their seed bank prior to seeding and in the early establishment phase will typically result in faster and more complete establishment of planted natives. Annual weeds are commonly controlled with combinations of mowing/burning and herbicide applications.

Recommended protocol:

- Burn site to remove thatch. Or, if fuel load cannot carry a fire, mow site instead.



Native seed mixes should be planted with equipment designed to handle different-sized seeds ©Justin Meissen.

- When weed regrowth reaches 4-6 inches (2-4 weeks), apply appropriate herbicide, such as glyphosate.
 - See Smith 2010 (Chapter 4) and Packard and Mutel 2007 (Chapter 16) for lists of recommended herbicides.
- Reapply herbicide (broadcast or spot-treatment) to remaining green vegetation after 2 weeks.
- For maximum weed control, repeat herbicide applications as needed throughout growing season.
- Wait at least 2 weeks following herbicide application to seed.
- An alternative to the above sequence is to harrow or disk the site to bring seeds to soil surface and then apply repeated herbicide applications to emerging vegetation and regrowth.
 - This risks bringing the seeds of additional undesired species such as invasive perennial weeds to the soil as well.
 - Not recommended for highly erodible sites.

Seedbed preparations

The best method of seedbed preparation is influenced by the intended seeding method, as well as site conditions. For this conservation prairie restoration plan, broadcast seeding is the recommended seeding method.

Recommended protocol:

- Lightly harrow site, for example with a spike-tooth harrow, to loosen the soil and remove thatch.
- If site was burned (thatch removed) and if planning to frost-seed, no additional site preparation is necessary.
- If soils are severely compacted, till to 4-inch depth and harrow with something like a drag harrow or chain link fence to break up soil clods. Note that soil disturbance may bring weed seeds to the soil surface. Herbicide applications may be required prior to native seed establishment.

Seeding

The key to establishing a successful prairie is to maximize seed-to-soil contact during planting. Upland prairies can be seeded either using a no-till drill or broadcasting using a spreader mounted to a tractor or ATV. Broadcast seeding is recommended for conservation prairies, because it produces a more natural appearance and favors forb (flowering plant) species, which contribute much of the diversity and value in a conservation prairie.

If broadcasting seed, native-seed broadcasters such as a Vicon seeder should be used. They are designed to spread mixes with different sized seeds. If planting with a drill, use a seed drill designed specifically to plant prairie grasses and flowers. Persistent drill rows can be minimized by drilling the site in two passes at right angles to each other, producing a grid.

Recommended protocol:

- How to seed:
 - Broadcast seeds into prepared seedbed using an agitating spreader such as a Vicon seeder mounted to a tractor or ATV.
 - Incorporate the seeds into the soil with a light drag, such as a piece of chain link fence or packer pulled behind the tractor/ATV while broadcasting.
 - If frost or snow seeding (late fall through early spring) or ash seeding (sowing into ash immediately following a burn), mechanical incorporation may not be needed. Freeze-thaw, snowmelt and rainfall action may naturally incorporate seeds into the soil.
 - An alternative seeding method is to drill seeds directly into crop residue, or

prepared seedbed, with a no-till drill such as a Truax. Additional mechanical incorporation or packing is not required when using a no-till drill.



- When to seed:
 - Planting dates will vary depending on the weather and location within the state. Consult with native seed suppliers or restoration specialists to determine the best planting dates for the year.
 - Growing season plantings should occur May 1 to July 1 OR when the soil temperature is at least 60 degrees F³. Spring/early summer seeding promotes warm season grasses.
 - Dormant seeding should occur Dec. 1 to April 30 OR after soil temperatures fall below 50 degrees F for a consistent period of time⁴. When possible, timing the seeding before a snowfall may help prevent loss of seed that is consumed by wildlife over the winter months. Dormant seeding in late fall, also known as frost seeding, can be done with a seed drill or until the ground is frozen. Seed can also be broadcast over snow in winter/early spring, although results of snow seeding are more variable and dependent on weather conditions.

³ Summer seeding after July 1 leads to poor seedling survival and is not recommended for prairies.

⁴ Early fall seeding is not recommended for prairies, because seed may germinate too early and not survive over winter.

Dormant seeding promotes cool season grasses and flowering plants.

- Seed mixes will vary but should take into account:
 - Consider soil moisture conditions of the site.
 - Include species that provide habitat value for wildlife and insects, including mixed-height grasses and a diversity of flowering plants.
 - Select a mix of both warm- and cool-season species and species that bloom in spring, summer, and early fall to encourage resilience to disturbances and ensure year-round habitat resources and visual interest⁵.
 - Cover/nurse crops such as oats are optional, but should be included with the seed mix when seeding steep slopes.
- Design:
 - If the site has either dry or mesic soils throughout, sow a single seed mix evenly across the site.
 - If soil moisture varies across the site, apply separate seed mixes suited to the different soil moisture conditions. For example:
 - Sow a dry conservation prairie mix onto dry ridge tops.
 - Sow a mesic mix into areas of more moderate soil moisture.
 - If there are wet to wet-mesic soils on the site, select a wet prairie or meadow seed mix for these seeding zones⁶.

- Seed rate:
 - Plant at a minimum of 40 seeds/sq. foot to reduce risk of weed invasion.
 - If there is minimal weed pressure and excellent site preparation, the rate can be reduced to 30 seeds/sq. foot.
 - Increase rate to 50 seeds/sq. foot on steep slopes (3:1 grade).
 - Seeding rates may need to be increased by 25% for dormant seedings to account for lower germination rates and loss of seed to wildlife.

Post-seeding aftercare and long-term management

Conservation prairie establishment generally takes 5 to 7 years, but will vary depending on soil moisture and climate conditions. Early management (aftercare) is critical to prevent re-invading weeds and woody species from out-competing and displacing establishing natives.

Reinvading annual weeds are the biggest management problem in the early stages of restoration from annual-dominated fields. They can quickly overtop and shade prairie seedlings, resulting in decreased growth and survival. Frequent mowing can prevent annuals from forming a dense canopy and building up thatch that can further suppress native seedlings.

Post-seeding aftercare goals include discouraging weeds and encouraging rapid and robust establishment of native species. The restoration site should be divided into management units for burning on a rotational basis to maintain diversity and wildlife refuges.

⁵ See [nature.org/MNPrairieRestorationGuides](https://www.nature.org/MNPrairieRestorationGuides) for more information on seed mix design and examples of conservation prairie seed mixes for different regions and soil moisture.

⁶ See [nature.org/MNPrairieRestorationGuides](https://www.nature.org/MNPrairieRestorationGuides) for examples of conservation meadow seed mixes appropriate for wetter soils.

Management strategies during the establishment phase include:

- Mowing annual weeds
- Selective use of herbicide to control invasive perennials
- Prescribed fire to promote native prairie species and discourage further invasion
- Monitoring vegetation to evaluate establishment of prairie seedlings

Throughout the establishment phase and beyond, adjust management plans as necessary, including the option to reseed, to achieve the desired species composition and diversity.

Recommended management protocol:

Year 1:

- Mow the field to a height of 4-6 inches when the annual weed canopy reaches a height of 12-18 inches. Most prairie plants will not reach this height in first year and will not be damaged by a mower. The frequency of mowing will depend on the height and density of weeds, and how much they are competing with the prairie seedlings for light and moisture.

Year 2:

- Mow the field to a 12-inch height as needed.
- If annual weeds are limited to individual patches, may spot-mow, perhaps even with a string trimmer, instead of mowing whole field.
- If there is flush of annual/biennial noxious weeds, mow, pull, or spot-treat prior to flowering to prevent seed-set.

Years 3-5:

- Begin prescribed burns after three growing seasons or as soon as biomass accumulation is sufficient to carry a burn.
- Rotate burns in management units, burning no more than one third of site (one half for small sites) at a time to maintain diversity and a local refuge for wildlife.
- Burn at an interval of every 3-5 years. If desired, burn each management unit more frequently (every 1-2 years) through the initial establishment phase in order to promote rapid establishment of prairie plants.
- Mowing should no longer be needed. Spot-treat weeds as necessary using dormant season applications and/or back-pack sprayer/wick applicator to minimize damage to native species.
- Conduct a stand evaluation to assess seedling establishment outcomes. If native plant density is less than 1 plant per square foot, interseed to increase cover and diversity.



Year 6 & beyond (long-term management phase):

- Burn every 3-5 years to stimulate productivity of native prairie plants and prevent invasion of herbaceous perennial weeds and woody trees and shrubs.
- Continue to burn in rotations, up to one third of site per season.
- Adjust seasonality of burning to maximize diversity. For example, alternate between spring and fall burns on individual management units.
- If conservation grazing is used, graze in rotations at low to moderate intensities, or at stocking rates prescribed by a grazing management plan written to meet the objectives of the conservation prairie. Avoid grazing in saturated conditions.
- Every 1 to 3 years, monitor vegetation composition and diversity.

- Interseed as needed to increase native cover and diversity if native species are declining.
- Adjust management plan, such as frequency and intensity of burning or grazing, if:
 - cover of native species is declining
 - desired composition is not being maintained
 - cover of invasive species is increasing
- Spot-treat weeds as needed by hand-pulling, back-pack sprayer, wick-applicator or dormant-season application.
- Temporarily increase burn frequency, such as annual burns for 2 years, if woody invasions increase in cover. Note that sustained burn intervals of less than 3 years will negatively impact cool-season natives and wildlife.



Prescribed fire is an important tool in maintaining a conservation prairie
©Chris Helzer/TNC



Cost Estimate

The estimated cost to restore an annual-dominated field to conservation prairie is \$1707 per acre, based on 2013 prices. Costs associated with site assessment and project planning are excluded from this estimate. This cost estimate assumes vegetation removal includes two broadcast herbicide applications and one controlled burn, and the site is broadcast-seeded and cultipacked.

Post-seeding management costs include a total of eight mowing treatments and three controlled burns (burning no more than one third of the site per season). Actual project costs will be lower if a less-frequent mowing schedule is required. Long-term management costs are not included in this cost estimate but can be quite variable depending on site needs. Costs assume services and seed are purchased from restoration contractors and native seed nurseries.

Useful references

Going Native: A prairie restoration handbook for MN Landowners - MN Dept. of Natural Resources

<http://files.dnr.state.mn.us/assistance/backyard/prairierestoration/goingnative.pdf>

Native Vegetation / Seed Mixes - MN Board of Water & Soil Resources

www.bwsr.state.mn.us/native_vegetation

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