Restoring Your Crop Field to Utility Meadow

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Cover photo taken at Pankratz Prairie by Justin Meissen.

Restoring Your Crop Field to "Utility Meadow"

In this guide, you will learn the basic steps to restore a crop field to a utility meadow. 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 utility meadow?

Utility meadow is a wet grassland designed to maximize production and palatability for forage, while still supporting basic conservation goals. It occurs on poorly-drained, wet to moderately wet soils that are saturated up to 8 weeks following snowmelt and are prone to temporary ponding after large rainfall events. Utility meadow often occurs in a transition zone between emergent marsh and upland prairie and may be either sedge-dominated ("sedge meadow") or grass-dominated ("wet prairie") depending on the duration of soil saturation. Utility meadow is distinguished from conventional hay fields and pasture by its emphasis on native species and high diversity.

Compatible land uses include:

- Conservation grazing using cattle or bison[1]
- Hay production
- Commercial seed harvest
- Recreational activities such as hunting

Conservation benefits include improved water quality, flood control, and habitat for birds, animals and insects. Utility meadow can also serve as a buffer for other high-quality native meadows and prairies and support threatened and endangered plants and animals that depend on large contiguous areas of grassland.

Why restore crop fields?

Crop fields are an excellent "blank slate" start point for restoring meadow. They offer a ready-to-seed seedbed, and the ground is essentially bare, with minimal weeds and no existing native species that need to be preserved. Restorations of crop fields are generally the most cost-effective, because they require relatively little labor to prepare the site for seeding. However, many wetter crop sites are drained with drainage tiles or ditches, so restoring hydrology by breaking tiles, plugging ditches, and—in some cases—installing water control devices, may be required.

The restoration steps in this guide assume that you are restoring a field that has been in corn-soybean rotations, but the steps may also apply to other common annual crops[2]. When possible, we recommend ending on a soybean rotation, because it is easier to drill into a field with minimal crop residue.

This guide also assumes that your site is wet to moderately wet and has been drained via tiles or ditches[3]. Sites that have not been drained will not require the additional steps to restore the hydrology.

Cattle on utility meadow near Bluestem Prairie ©TNC\Steve Chaplin

[1] Very wet sites are vulnerable to damage by trampling and are dominated by sedges, which are not preferred forage for cattle. Moderately wet sites, which are dominated by grasses and have a shorter duration of seasonal ponding, will generally be more suitable for grazing.

[2] For perennial crops (e.g. alfalfa), refer to the restoration guide "Restoring your Invasive Perennial-Dominated Fields to Utility Meadow", which includes methods for controlling existing herbaceous vegetation.

[3] For sites with moderate to dry soil moisture, refer to the restoration guide "Restoring your Crop Field to Utility Prairie".

What will it involve?

Meadow 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 meadow plants[4].

- **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 results

- **Hydrologic Restoration** – Remove drainage features by breaking tile or plugging ditches to restore the site's original soil moisture and seasonal flooding patterns.

- **Establishment & Aftercare** – Control weeds and promote the establishment and growth of meadow plants through the first few years after seeding.

- **Long-term Management** – Maintain the health and diversity of native meadow into the future.

How long will it take?

On a crop 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 years on aftercare to ensure good establishment of the utility meadow. This period is referred to as the establishment phase of restoration.

After establishment, often around year 4, 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 meadow 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
- Hydrologic factors, such as drainage type, size and depth; soil type and sediment deposits; and whether management of wetland discharge is required
- 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 initial 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 meadow will be more resilient to disturbance, invasion by exotic species, and extreme weather events such as drought.

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[4] 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.

Former corn field in the Agassiz Beach Ridges © Laura Phillips-Mao

Crop to Utility Meadow Restoration Guidelines

Site assessment

A successful meadow 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?
- How long are the soils saturated in the spring?
- Has the site been drained with drainage tiles or ditches?
- Is there a substantial build-up of sediments on site that may require excavation?
- Are there steep slopes that may be vulnerable to erosion?

If you are new to meadow 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

Vegetation removal is not necessary on annual crop fields, provided seed is planted in the winter following harvest. If the planting is planned for the spring following harvest, a round of herbicide is generally necessary to control annual weeds prior to planting.[5]

Seedbed preparations

Crop fields require little seedbed preparation, unless crop residue is heavy enough to interfere with seeding. Soybean fields are the preferred crop "start state" for restoration, because they are essentially ready to seed. However, wet sites tend to be less suitable for soybean

[5] If the crop field is left fallow for one or more growing seasons and has become dominated by annual weeds, refer to the "Restoring your Annual Dominated Field to Utility Meadow" guide for information on using herbicide to control annual weeds.

cultivation, so ending on a soybean rotation will not be possible for every site. The best method of seedbed preparation is influenced by the intended seeding method, as well as site conditions. For this utility meadow restoration plan, broadcast seeding is the recommended seeding method. Late summer or fall is the best time for seedbed preparations in wet sites, as the soils are more likely to be firm and dry.

Recommended protocol:

- If light crop residue is present, such as with a soybean field:
    - Lightly harrow the field, for example with a spike tooth harrow.
    - No site preparation needed if frost seeding or no-till drilling.
- If heavy crop residue is present, such as with a corn field:
    - Mow stalks.
    - Lightly disk site to incorporate residue into soil. Disking should be avoided if not necessary for the site conditions, as it can replant weed seeds and lead to greater weed problems during the prairie establishment phase.
    - Cultipack or roll the site to create a firm seedbed.
- 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.

Broadcast seeding with a light drag at Grace Marshes WMA©DNR\Cory Netland

Seeding

The key to establishing a successful meadow is to maximize seed-to-soil contact during planting. Broadcast seeding with a spreader mounted to a tractor or ATV is recommended for meadows, because wet soils often cannot support heavy machinery such as seed drills, and many wet meadow species have very small, light-sensitive seeds that can be buried too deeply by a seed drill. However, if the seedbed is dry and firm, grasses may be seeded with a no-till drill, followed by broadcasting forbs (flowering plants) and sedges. In some cases, the wettest areas may need to be hand-seeded or planted with plugs.

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.

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.
    - Alternative seeding method: If seedbed is dry and firm, drill grass seeds directly into crop residue, or prepared seedbed, using a no-till drill such as a Truax. Additional mechanical incorporation or

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

packing is not required when using a no-till drill. Broadcast forb and sedge seed.

- For areas that are too wet for a tractor or ATV, a second alternative seeding method is to broadcast seed by hand.

- 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.
  - Dormant seeding is recommended for meadows, because the ground is more likely to be dry and firm in the late fall and early winter[6]. Dormant seeding should occur Dec. 1 to April 1 OR after soil temperatures fall below 50 degrees F for a consistent period of time. Dormant seeding before the ground is frozen, sometimes called "frost seeding", can be done with a seed drill or by broadcasting. When possible, timing the seeding before a snowfall may help prevent seed loss to birds and wildlife. After the ground is frozen in winter/early spring, seed can also be broadcast over snow, although results of snow seeding are more variable and dependent on weather conditions. Dormant seeding promotes cool season grasses, sedges and flowering plants.
  - Spring and growing season plantings (April 1 – July 1) are not typically recommended for wet meadows because the soils are often too saturated to support equipment, spring flooding may wash seeds away, and overwintering is necessary to trigger germination in many wetland sedges and flowering plants. However, when conditions allow, growing season seeding can yield satisfactory results, particularly for wetland grasses[7].
- Seed mixes will vary but should take into account:
  - Consider soil moisture conditions of the site.
  - Choose palatable species that can tolerate grazing or haying.
  - Select a mix of both warm- and cool-season species to ensure availability of forage throughout the season[8].
  - Cover/nurse crops such as oats are optional, but should be included with

[6] Early fall seeding is not recommended for meadows, because seed may germinate too early and not survive over winter.
[7] Summer seeding after July 1 leads to poor seedling survival and is not recommended for wet meadows.
[8] See nature.org/MNPrairieRestorationGuides for more information on seed mix design and examples of utility meadow mixes.

the seed mix when seeding steep slopes.

- Design:
  - Apply seed mixes to "seeding zones" on site based on soil moisture conditions and hydrology; for example: seed a wet prairie mix into areas that are saturated 3-4 weeks annually, and a sedge meadow mix into areas that are saturated 6-8 weeks annually.
  - Wet prairie and sedge meadow mixes can be combined and seeded across the entire site if seed zones are closely intermixed and seeding individual zones is not feasible.
  - If there are dry to moderately moist soils on the site, select a separate utility prairie seed mix for each seeding zone[9].
- Seed rate:
  - Plant at a minimum of 160 seeds/sq. foot to reduce risk of weed invasion.
  - Seeding rates may need to be increased by 25% for dormant seedings to account for lower germination rates and loss of seed to wildlife.

Hydrologic restoration

Nearly all wet meadow sites in western Minnesota have been impacted by altered hydrology. Restoring hydrology by removing drainage features is a critical component of wet meadow restoration. When planning a meadow restoration, take note of the following recommendations and refer to the Minnesota Wetland Restoration Guide (BWSR) or Restoring Prairie Wetlands: an ecological approach (Galatowitsch and van der Valk 1994) for additional information. For further guidance on evaluating and implementing the engineering aspects of hydrologic restoration, consult with experienced restoration professionals or local Soil and Water Conservation District staff (www.maswcd.org).

Recommended protocol:

- Use a backhoe to break drainage tiles and/or plug drainage ditches.
- Break tile in strategic locations, for example: at the wetland's outlet (it is usually not necessary to remove the entire length of tile).
- Hydrologic restoration should be implemented after vegetation removal. After the site is flooded, access will be limited and herbicide options are restricted to aquatic-approved formulas such as Rodeo.
- Time hydrologic restoration to occur in the fall or early winter in close conjunction with seeding, preferably 1-2 weeks following seeding (after flooding, site access will be limited).
- Reserve a small amount of seed to hand-broadcast over areas disturbed by backhoe operations.
- If transplanting live plant material or plugs, this can be done in the late spring following hydrologic restoration.

Breaking tile can restore hydrologic function for prairie restoration© DNR\Phil Doll

[9] See nature.org/MNPrairieRestorationGuides for examples of utility prairie seed mixes appropriate for dry to moderately moist soils.

Prescribed fire is an important tool in maintaining a utility meadow ©Chris Helzer/TNC

Post-seeding aftercare and long-term management

Utility meadow establishment generally takes 3 to 5 years, but will vary depending on soil moisture and climate conditions. Early management (aftercare) is critical for preventing perennial weeds, particularly reed canary grass, and woody species from invading and displacing establishing meadow species. However, saturated conditions may limit management options, preventing access by heavy equipment.

Annual weeds can also be problematic in the early stages of restoration from crop fields. They can quickly overtop and shade meadow seedlings, resulting in decreased growth and survival. Frequent mowing, particularly in the wet prairie zones, 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 that can sustain grazing, haying and other uses. Management strategies during the establishment phase include:

- Mowing annual weeds
- Selective use of appropriately-timed aquatic-approved herbicide to control reed canary grass and other invasive perennials
- Prescribed fire to promote native meadow species and discourage further invasion, particularly in the wet prairie zone
- Monitoring vegetation to evaluate establishment of meadow seedlings and detect invasive species problems. This is particularly important in wet sites, because site conditions may prevent management in some years.

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:

- When the site is dry and firm enough (early to mid-summer), spot-mow annual weeds and cover crops in wet prairie zone to a height of 4-6 inches when canopy reaches a height of 12-18 inches. Most meadow plants will not reach this height in the first year and will not be damaged by a mower.
- Avoid mowing reed canary grass except to prevent going to seed. Mowing may reduce effectiveness of herbicide and stimulate seed germination.
- If reed canary grass is present, spot-spray in September using aquatic-approved glyphosate, such as Rodeo, using methods that will minimize damage to native seedlings. For example, use a backpack sprayer or wick applicator and avoid windy days to minimize drift.

Year 2:

- Mow annual weeds in wet prairie zone to a height of 12 inches as needed to reduce cover and seed set.
- If annual weeds are limited to individual patches, may spot-mow, perhaps even with a string trimmer, instead of mowing whole field.
- Spot-spray reed canary grass in September using methods that will minimize damage to native meadow species.

Year 3:

- Begin prescribed burns after three growing seasons, or as soon as biomass accumulation is sufficient to carry a burn.
- Begin grazing or haying after three growing seasons, or when native grasses and sedges have achieved dominance.
- Spot-treat reed canary grass (in September) and other weeds as necessary with aquatic-approved herbicide.
- 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 4 & beyond (long-term management phase):

- Burn every 4-7 years to stimulate productivity of native meadow plants (particularly in the wet prairie zone) and prevent invasion of perennial weeds and woody trees and shrubs. Note: burning more frequently may negatively impact sedges.
- Burn and hay in rotations, disturbing no more than one half of a field at a given time, to maintain diversity and a local refuge for wildlife.
- Graze at low to moderate intensities, or at stocking rates prescribed by a grazing management plan written to meet the objectives of the utility prairie. Avoid grazing in saturated conditions.
- Time burning, haying and grazing to allow sufficient biomass accumulation for each activity, for example: an alternating biennial rotation of grazing and haying with a 4-7 year burn rotation.
- Hay in late July or August to promote diversity and avoid grassland bird nesting season. Leave 6-8 inch stubble and regrowth for winter cover/spring nesting habitat.
- Adjust timing and intensity of burning, grazing and haying to maximize diversity and adjust species composition.
    - Grazing in late spring or early summer will favor warm season grasses.
    - Mid-late summer grazing will favor cool season grasses.
- 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, haying, or grazing, if:
        - cover of native species is declining
        - desired composition is not being maintained
        - cover of invasive species is increasing
    - Spot-treat reed canary grass and other weeds as needed by hand-pulling, back-pack sprayer, wick-applicator or dormant-season application. Note that reed canary grass may continue to emerge from the seed bank for 10 years!
    - Temporarily increase burn frequency if woody invasions increase in cover. Note that sustained burn intervals of less than 3 years will negatively impact cool-season natives and wildlife.


Restored meadow at Glacial Ridge © Gail Gilliland

Estimated Cost

The estimated cost to restore a crop field to utility meadow in Minnesota is $1,096 per acre plus a $700 flat rate, for a minimum total of $1,796 (based on 2013 prices). Costs associated with site assessment and project planning are excluded from this estimate. This cost estimate assumes the site is harrowed, broadcast seeded and cultipacked. The $700 flat rate is a low-end estimate of hydrologic restoration (e.g. tile removal) that assumes a modest mobilization fee and includes the costs to excavate, remove tile, seal the ends, and backfill and compact the trench.

Post-seeding management costs include aftercare activities through year 3, specifically: mowing the wet prairie portions of the site five times, spot-spraying re-invading perennial weeds one time, and conducting two prescribed burns (burning no more than one half 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

Invasive Plant Species Management & Identification – MN Dept. of Natural Resources
www.dnr.state.mn.us/invasives/terrestrialplants

Minnesota Noxious Weeds – MN Dept. of Transportation
www.dot.state.mn.us/roadsides/vegetation/pdf/noxiousweeds.pdf

Minnesota Wetland Restoration Guide – MN Board of Water & Soil Resources
www.bwsr.state.mn.us/restoration

Native Vegetation / Seed Mixes – MN Board of Water & Soil Resources
www.bwsr.state.mn.us/native_vegetation

Planting and Maintenance Recommendations for Wetland Restoration and Buffer Projects – MN Board of Water and Soil Resources.
www.bwsr.state.mn.us/native_vegetation/planting-maintenence-recs.pdf

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