

Building Meadows

a Practitioner's Guidebook



ARCH(Σ)WILD

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About Pennsylvania Environmental Council

The Pennsylvania Environmental Council (PEC) works to protect, restore, and enhance the Commonwealth's natural and built environments through innovation, collaboration, and strategic leadership. For more than half a century, PEC has brought together communities, land managers, scientists, and policymakers to advance practical, science-based solutions that strengthen Pennsylvania's landscapes and the people who depend on them. This meadow-building guide, commissioned by PEC and developed by ArcheWild®, reflects that commitment—providing clear, actionable guidance to help land stewards create resilient, biodiverse meadows that support wildlife, enrich public spaces, and contribute to a healthier ecological future for Pennsylvania.

About ArcheWild®

ArcheWild® is a leading ecological restoration firm known for its scientific rigor, authenticity, and deep practical experience across the landscapes of the Mid-Atlantic. Drawing on decades of fieldwork, applied research, and hands-on project delivery, ArcheWild® helps land stewards design, build, and sustain resilient native ecosystems that reflect both ecological integrity and real-world constraints. Their team brings a rare combination of technical expertise, horticultural precision, and operational pragmatism—ensuring that every meadow, forest, wetland and specific habitat they help create is grounded in sound science, shaped by place, and built to thrive.

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INTRODUCTION

Who is this document written for?

This document is written for land managers, park managers, natural resource managers, and anyone else that is responsible for large land parcels who wants more information and guidance on the meadow building process than what is currently available in the available literature, or online.

How does this document complement the existing literature?

Existing literature frequently focuses on “why” someone might want to build a meadow and only briefly on the steps that a person should follow to build one. The literature accurately describes the importance of selecting an appropriate site, but not how to select one. Most existing meadow guides describe the need for controlling weeds and invasives, but few provide enough information for someone to confidently perform the work on their own. Selecting species for a meadow is a critical step, but few guides describe the process for doing so, outside of buying a premade seed mix on the internet. Even fewer guides talk about how to choose a sowing method or the exact steps required to operate a seed drill, partly because there are so many seed drill models available.

This guide is designed to go behind the scenes and take a close look at how an experienced meadow building team performs their work step-by-step, to reveal key decision points, nuanced techniques, and the technology they use to deliver professional results.

Note: this tool kit is not a meadow “design” guidebook. There is limited information in this document about individual species, there are no plant lists, and no seed mix recommendations. There are no tables of bloom time and color, leaf texture, or height. Please refer to other sources for horticultural information.

How was this document written?

This document was written to mirror the thought processes, decisions, and actions that professional meadow builders follow every day; this document reveals their processes and their technology. In some cases, alternative forms of technology or processes may be viable, but we can’t speak to their relevance or quality.

Links are provided to third-party information sources where a topic is well-covered elsewhere, such as how to obtain your pesticide applicators’ license. The references used throughout are sources that professionals rely on and that can be trusted by other practitioners.

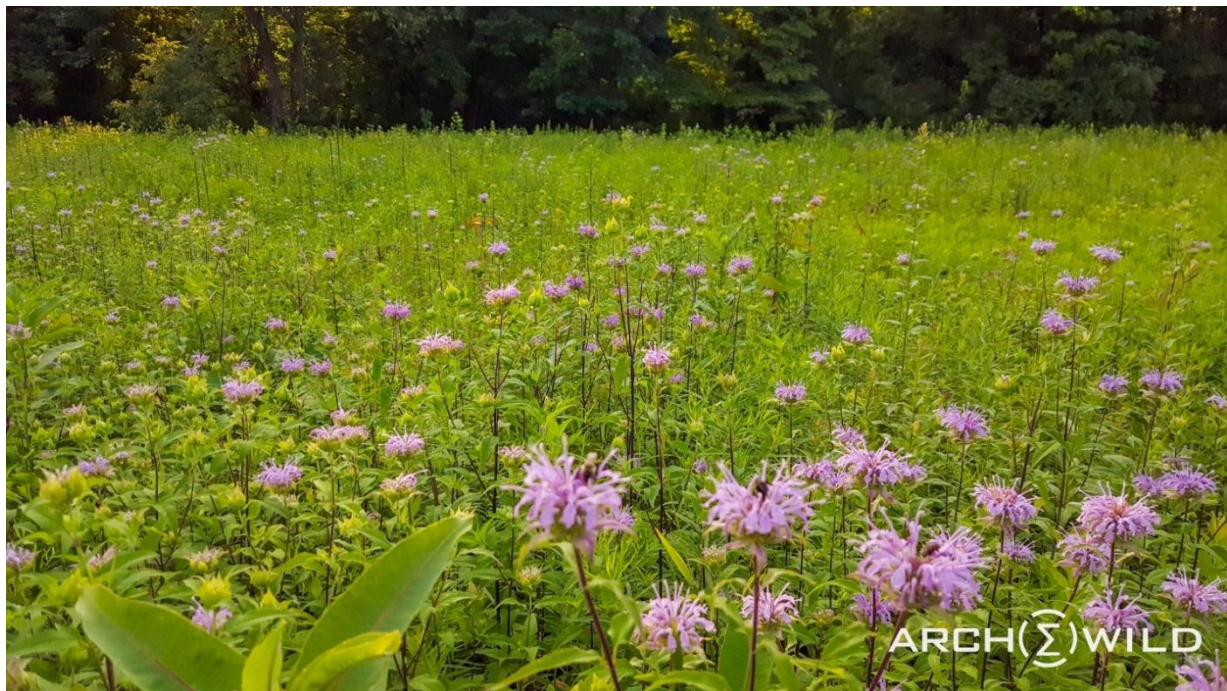
KEY CONCEPTS

Our role as meadow-builders is to restart the ecological processes and put native meadow species back into the environment to heal the soil, protect our water, and support our wildlife, but not necessarily to create visually stunning landscapes, which we refer to as “gardening.” The ultimate meadow-building success story is when a meadow built in one place naturally becomes the seed source for a new meadow somewhere else, by wind or by bird. We want meadows to take the place of weeds and invasive species at the margins of our forests, farms, roads, and cities.

Before beginning to understand the work that goes into creating a meadow, it’s important to understand key terms and ideas. This way, you will know why these ecosystems are so important and therefore why there is a push for more of them to be installed throughout the Mid-Atlantic, and in Pennsylvania.

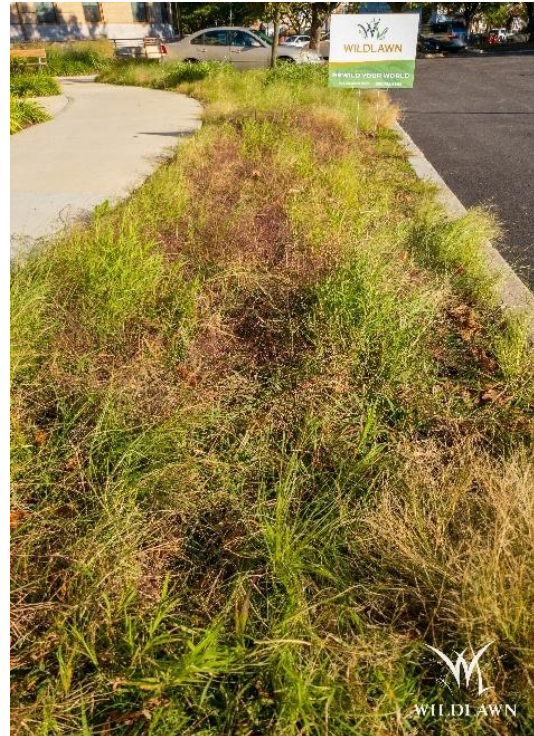
Definitions

A plant species that is ‘[Native](#)’ to a particular geographical area has evolved in response to the unique conditions present in that area over a period of hundreds or thousands of years. An example of a common native plant here in Pennsylvania is Common Milkweed, *Asclepias syriaca*. This species has thrived in much of the Eastern U.S. and Canada for millennia and in that time has become a vital host plant to Monarch caterpillars, helping them to complete their life cycle. On the other hand, a popular plant in large nursery centers, Burning Bush, *Euonymus alatus*, is considered ‘[Invasive](#)’ in much of the U.S. because it is originally from Eurasia but unfortunately easily spreads into wild spaces here, creating conditions that exclude important native species.



Just because a native plant grows in Pennsylvania, though, does not mean that it grows just anywhere. Remember, all plant species have evolved to survive under certain ecological conditions, and these conditions are only found in certain ‘[Ecoregions](#),’ or geographical areas defined by their physical and environmental conditions including geology, soils, hydrology, altitude, and climate. Within each ecoregion, different species, or varieties of the same species, have adapted to the unique ecological characteristics in each ecoregion and make up the unique [Plant Communities](#) that are important for other flora and fauna that have evolved alongside them.

Pennsylvania isn’t called “Penn’s Woods” just for fun. While plants differ across different ecoregions throughout the state, Pennsylvania is dominated by forest (and farms) with little room for much else. For a natural ‘[Meadow](#)’ to exist as an ecosystem, several underlying conditions need to be met. For one, meadows need a lot of sun, more than eight hours of direct sunlight every day. Secondly, they should be relatively flat to allow for safe mowing. And thirdly, they need to be exposed to a combination of ecological constraints, including soil moisture, soil depth, and soil makeup (acidity, alkalinity, and/or minerality), that naturally excludes trees and shrubs. Only under these conditions can a natural meadow, or a built one, survive without constant intervention.



Benefits of a Meadow

Self-sustaining meadows are exceptionally rare in Pennsylvania; so, why are we building them? Historically, meadows existed briefly and only after when major disturbances – fires, floods, hurricanes – opened large gaps in the forest canopy. Seeds of grasses and forbs can persist in the soil for decades, waiting for sunlight, so these gaps created opportunities for herbaceous plants to quickly germinate and create short-lived meadows until trees and shrubs returned.

Those meadows that did occur naturally in Pennsylvania were mostly replaced by a different type of meadow type – the farm. In the Mid-Atlantic, every acre that was marginally suitable for farming became a farm, and those areas too rocky, wet, or steep were allowed to develop into forests or wetlands. This combination – farms and forest – led to the loss of most natural meadows in the state, and the species and local genetic strains that comprised them. But some meadow fragments remain, here and there, maintained by accidental fire on army bases or hidden away in some inaccessible and inhospitable location.

It's also important to distinguish a meadow from a garden. Meadows are larger (typically at least ½-acre), appear more naturalized, contain only regionally native species, and are installed without altering soil conditions. Meadows allowed to develop on their own, while meadow “gardens” often carry specific aesthetic goals.

Meadows are Different from Gardens

First, meadows are larger than gardens, spanning a space of at least a ½-acre.

Second, meadows also appear ‘naturalized,’ whereas gardens tend to be manicured to achieve a cleaner aesthetic. Gardens are managed for maximum blooming periods or other specific aesthetic goal, while meadows are managed for their soil, water, and wildlife benefits.

Third, meadows are meant to be regionally authentic seed banks, only containing species and genetics that naturally occur in the area, and that can naturally expand beyond the built meadow to improve the region’s biological resiliency.

And fourth, the conditions of the site for a meadow are not altered in any way, while often garden creation includes tasks such as adding fertilizers or soil amendments.



These four factors together increase all the benefits of these habitats. Aside from wildlife benefits, meadows help to meet important climate goals by sequestering carbon and other greenhouse gases and slowing down water runoff, leading to reduced downstream flooding and increased water filtration. They also reduce long-term maintenance costs associated with lawns such as the need for fertilization, aeration, or irrigation, the need for regular mowing, and large pesticide inputs. And of course, they also open areas for recreational opportunities like hiking/exploring, wildlife observation, and environmental education, among many others.

Creating a meadow can feel daunting at first, but with thoughtful planning and realistic expectations, the long-term benefits far outweigh the challenges. The steps outlined in this guidebook, and the accompanying, shorter toolkit, were written not to discourage you from building a meadow, but to give you a step-by-step process that has shown to produce real results. Too many people have been “guessing” about how and where to build a meadow, and about which species to use, and when to treat the inevitable weeds. Guessing rarely produces authentic, durable, and sustainable results.

These days, meadow ecosystems are even more rare than they were historically, and those that persist are highly threatened because of habitat loss, invasive species encroachment, and climate change. This is leading to a loss in biodiversity (variety of life) on all sides, which in turn makes meadows less productive. Restoring high quality meadows, and other natural ecosystems throughout Pennsylvania can help to slow this loss or even reverse it. And these ecosystems come with many other benefits, for man and wildlife alike.



Use this guide with confidence and seek help when you need it.

Example Mid-Atlantic Meadow Types

Not all meadow types can grow everywhere. Each ecological region, or ecoregion, of the country tends to have one or two meadow types that could be considered “appropriate” or “accurate.”

The best meadow is one that is durable in the existing site conditions and uses locally adapted genetics, which means that the species within them grow healthily, flower and set seed, successfully reproduce, and ideally spread to new areas.

The meadow designer can, of course, craft their own custom meadow but they risk natural ecological forces overwhelming their best efforts.

Trying to maintain a meadow of a “desired” character or trying to force a set of species into a meadow that would not naturally occur in it can be expensive. Herbicide applications, frequent burning, regular mowing, and occasional reseeding are all valid techniques that land managers use to maintain a meadow in a condition that they want. But those constant inputs are increasingly difficult to justify.

A more sustainable approach is simply to figure out ahead of time which meadow type, or set of meadow types, that a site can naturally support and then just go plant them, leaving the design book at home.

Here are images of some commonly occurring meadow types in or near Pennsylvania. Most are natural meadows, but some are the result of human intervention, as noted.

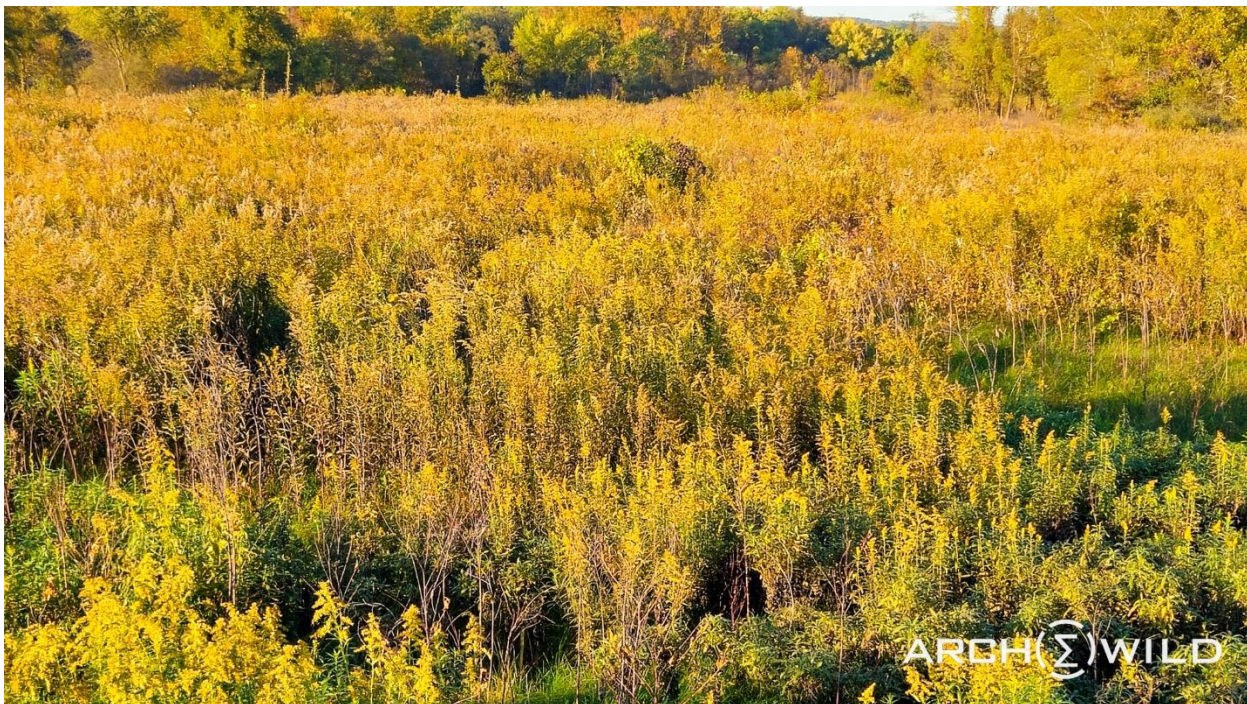


Figure 1 - This meadow type is the most common in Pennsylvania, central and northern New Jersey, New York, and eastern Ohio. It dominates mesic sites that receive ample moisture from riparian systems or from frequent precipitation. This goldenrod meadow was seeded with an online seed mix featuring native grasses and showy wildflowers.



Figure 2 - This is one of the most famous meadows in western Pennsylvania. Located on thin soils over a deep bed of clay, it resists trees but remains highly susceptible to pasture grass and shrub incursions.



Figure 3 - This naturally occurring warm season grassland in Pennsylvania is perched on a head slope overlooking the Delaware River in Bucks County. The soil is thin, rocky, and dry. The meadow is maintained through an annual mowing to keep it clear of eastern red cedars



Figure 4 - Here is a special kind of meadow featuring dewberry, cranberry, grasses, and mosses. It is created by rainwater collecting in a slight rocky depression, simulating bog-like conditions.



Figure 5 - This meadow of sedges, blue vervain, and joe pye occurs in a low spot near a stream in Central Bucks County. Constant moisture supports these species while excluding turfgrasses.



Figure 4 - This beautiful meadow is the result of natural processes in northcentral Pennsylvania. Thin, rocky soils combine with cool temperatures and ample rainfall to create a naturally short and biologically important native grassland.



Figure 5 - Two meadows in one, and a good example of different ecological zones in the same place. The drier upland areas feature purpletop grass while the moister foot slope features goldenrods and dewberry. A single annual mowing maintains both. In Upper Bucks County.

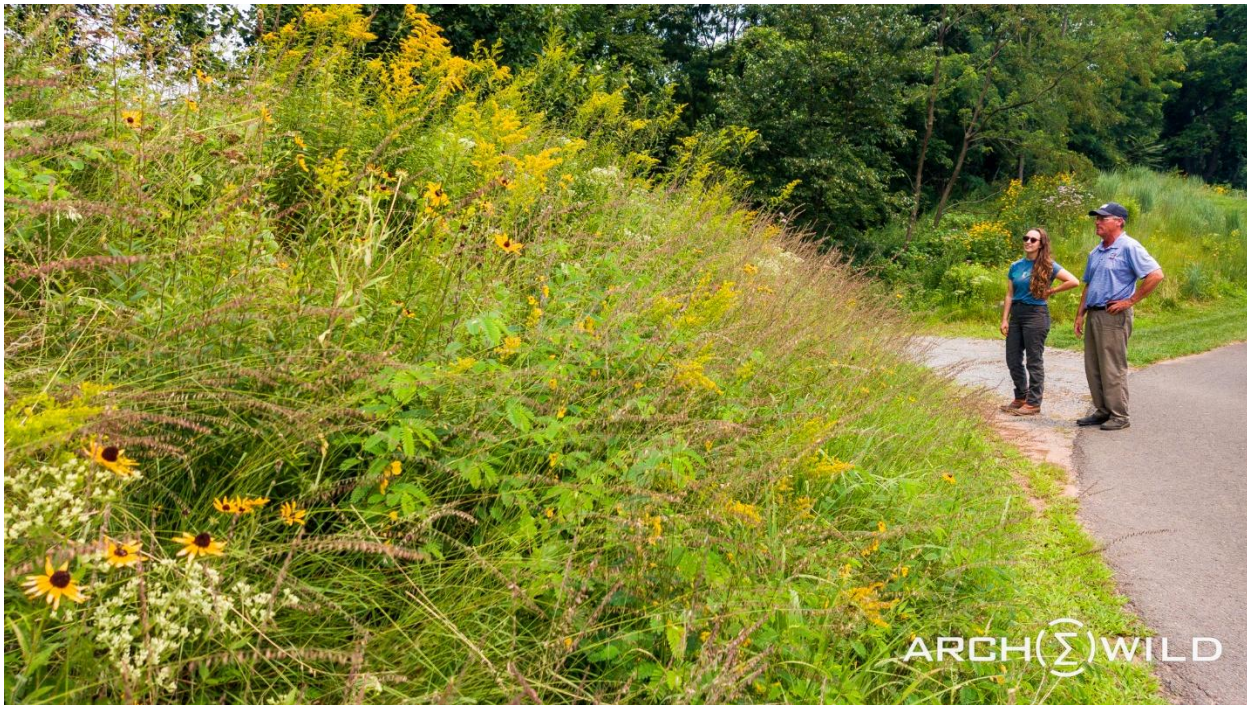


Figure 7 - This is an example of a built meadow, featuring species well-matched to a dry, sandy berm on a golf course near New York City. Sideoats grama, grey goldenrod, and bushclover are featured in the dry, well-draining soils. The meadow looks the same ten years after construction because the species were properly matched to the site conditions.



Figure 6 - This naturally occurring meadow in southern New York is sustained by the soils becoming excessively dry for about 30 weeks in summer. It receives no maintenance. Vegetation patterns follow the moisture patterns in the soil.



Figure 9 - A typical wet meadow complex in eastern Pennsylvania. A combination of sedges, ferns, some grasses, and a few flowers endure a sandy/gravelly site being kept moist by a small stream.



Figure 8 - This beautiful New York meadow featuring prairie dropseed and ragwort occurs where the soil is fully saturated in winter and completely dry for a short period in summer. The oscillating conditions exclude all species except for these two.



Figure 11 - This is probably the most famous meadow in eastern Pennsylvania. Dominated by warm season grasses and some rare species, it is often used as an example of what meadows can look like. But, alas, it occurs only on rocky, clayey, metallic soils in a low rainfall location. Hard to replicate elsewhere.

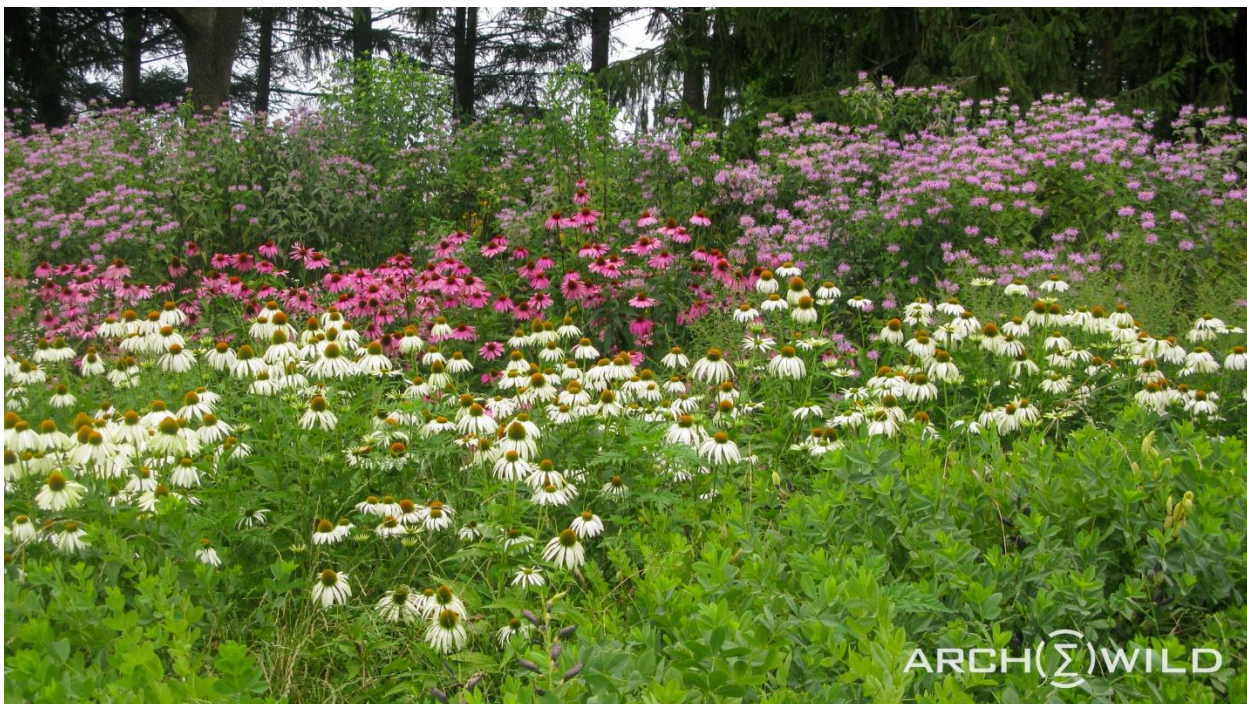


Figure 10 - An excellent example of a "designer" meadow carefully crafted to provide visual sweeps of color and texture. It lasted for about three years before Nature replaced them with the species that wanted to be there instead.

How to Use This Guidebook

This guidebook is designed to function as a practical, step-by-step workflow that mirrors the exact processes that professional meadow builders use. Each section presents key concepts, essential questions, and checklists that help you assess conditions, make informed decisions, and document your progress. These sections are supported by technical guides written by meadow experts as well as links to supplemental online resources. You do not need to be an expert to use this guide – but moving through sections in order will give you the same structured approach practitioners use to avoid common mistakes.

As you read, think of each chapter as a stage in a larger project arc: evaluating whether your site is viable, planning your species mix, preparing the land, and finally installing and stewarding the meadow over time. The checklist tables summarize the tangible outputs you should complete at each stage, and the decision points help you determine whether you're truly ready to move forward.

Please use this guide sequentially and you'll build a clear, defensible plan for your meadow and set yourself up for long-term success.

This guidebook is accompanied by a shorter [Practitioner's Toolkit](#) that provides more hands-on instructions and images. The structure of the [Toolkit](#) mirrors this book.



IS THIS A VIABLE MEADOW OPPORTUNITY?

A

KEY QUESTIONS

- Have you familiarized yourself with the definition of a meadow, and understand the differences between meadow and garden?
- Does the site have the ecological factors to support a meadow?
- Is there room for a continuing maintenance budget for the meadow?
- Is there support from right people to build the meadow?
- What are the goals behind creating a meadow?

OVERVIEW

Before deciding to install a meadow in a yard or open parcel of township land, it is imperative to understand the steps involved in establishing a meadow by reading this and other supporting documents.

First and foremost, in this decision there are the following factors: ecology, support, and goals. This is an iterative process to arrive at a conclusion.

CHECKLIST

STEP	TITLE	SUMMARY NOTES	DATE
1	Cultural Support	Verbal consent from neighbors, staff, board members, and other relevant stakeholders. Written consent preferred.	
2	Preliminary Research	Reviewed enough literature or have enough experience to be able to describe multiple natural PA plant communities.	
3	Ecological Conditions	Evidence from multiple visits that the site can support a functional meadow system.	
4	Environmental Goals	Evaluate the environmental goals (wildlife, stormwater, etc.) for this project against ALL alternative projects (forests, basins, etc.).	
5	Cultural Goals	Receive consensus from stakeholders on cultural goals which align with the expected meadow conditions.	
6	Financial Support	Develop order of magnitude budgets and discuss with decision-makers. Identify sufficient sources of funding for all phases of the project.	
7	Partner Support	Spoke with at least three (3) professional organizations about your project and ways they can help, if needed.	
8	Landowner Commitment	Verbal commitment from the landowner to fulfill their obligation through the life of the project. Written commitment preferred.	
9	Decide	You have asked all stakeholders this questions: is this a viable meadow opportunity?	

SUMMARY

HOW TO KNOW WHEN YOU ARE FINISHED

You have conducted enough independent research to describe key differences between meadow types.

A meadow professional, or similar, has reviewed and approved the baseline ecological conditions.

You have verbal (minimum) commitments for financial, cultural, and partner support.

You have consensus among stakeholders on the goals for the meadow that align with the ecological, financial, and cultural context.

Ecology

Decide if Conditions Exist for a Meadow

Naturally occurring meadows are rare in Pennsylvania because the ecological conditions in which they thrive are rare. Indeed, meadows only persist where conditions are too dry, too wet, or where soils are thin, or too acidic or calcareous, or a combination of the these, for larger species like trees and shrubs to survive.

This does not mean that you cannot establish a meadow if the site does not have these conditions. In fact, as mentioned in “Key Concepts”, meadows are generally part of the natural succession of a forest ecosystem. If a canopy opening is suddenly made, herbaceous species are the first to pop up. Nevertheless, that canopy gap will only last until new shrubs and eventually trees take over.

Because of this, if the desire is to maintain a long-term meadow where the proper conditions technically do not exist, this will involve continued management of the space for the foreseeable future.

Browse the PANHP link to gain more insight into the ecological conditions that are present at the six different “Terrestrial Herbaceous Openings” found in Pennsylvania.



Figure 12 - Dry, calcareous conditions support a naturally occurring meadow

Look for these Characteristics

When you are searching for or have a location in mind, there are several parameters that can quickly be observed at the site to decide if a meadow, even one that will need continued maintenance, will be possible:

- *Full Sunlight* – while meadows can and do exist in areas with canopy cover, this is a very difficult structure to maintain. Therefore, you want a location that receives full sun (at least six hours of direct sunlight/day) during the growing season
- *Varying Topography* – naturally occurring meadows look best and have a better chance of long-term success if there are a variety of site conditions. Hummocks, swales, depressions, rocky area, wet areas, and even different soil types all contribute to having a meadow complex that

[PA Natural Heritage List of Plant Communities](#)

	can recover from environmental shocks. A highly homogenous site generally support only a small number of species, which might or might not be what you want o <i>Limited Invasive Pressure</i> – this one may take some time for you to figure out when you first start this journey but is crucial. This is especially the case for the areas surrounding the possible meadow location. If the surrounding area is heavily invaded, and what’s more, if you are unable to treat these areas for budget or property reasons, this will decrease the success of your meadow as these species are likely to get a foothold while you are waiting for the seeds to germinate.	
Cultural Support	Do you have Broad Community and Municipal Support? Having ample support from the people around you to complete a meadow project is very important. For landowners, municipalities, conservation organizations, and other land managers, this means discovering whether direct neighbors, nearby residents, and even the staff that will be maintaining the meadow are on board with a project can help to ensure the implementation runs smoothly. If your Parks Board doesn’t want a meadow, for example, it is unlikely that they will invest the time to properly establish and steward a meadow through its early stages to maturity.  <i>Figure 13 - Infinitely-blooming meadows aren't possible in the long-term. Take care to properly educate your constituents about the type of meadow your site can realistically support</i> Has the Community been Counselling on Herbicides, Ticks, and Allergies? The last thing any project manager wants is to have everything put in place to implement a new meadow only to be caught off-guard by a last-minute concern and then have the work come to a stop. Common concerns include the use of herbicides, the harboring of ticks, and the meadow causing hay fever; it is generally better to hear out these concerns as early as possible. As will be repeated throughout this document, thoroughly communicating the plan and the process of a project needs to always be a priority.	

Preliminary Research	Literature Review If you have little experience working on meadow projects, your first step before anything else must be to review related literature that will give you a thorough idea of what it takes to complete such a project. Without this understanding it is easy to gloss over important steps in the meadow-building process, and this can lead to issues or project failure further down the line. Even if you do have experience with all facets of building meadows, it's always a good idea to review literature, especially something that you have not read before. Any new perspective can garner new insights and perhaps change the way you complete a part or parts of the process in a useful manner. This review also allows you to be prepared to have meaningful and productive discussions with those that you identify as stakeholders or partners in the development of this project. There are two useful links to the right to reference along with this guide. Be Careful! As with anything, there is quite a bit of variability in the suggested processes for building a meadow depending on the source. Therefore, it is important that you step back and consider this when reviewing literature and ensure that the source is credible, that the information relates to your situation and/or geography, and that the methods discussed work for your situation.	<u>Xerces Society Installation Guides</u> <u>Meadow Plants at Mt. Cuba Center</u> <u>PSU Lawn Alternatives</u>
Contractor Support	Do you have Contractor Support for Key Activities? While this guide has much of the information needed to successfully complete a meadow project, having an experienced contractor to consult with or to help with an implementation or two can take the worry out of the project. This can be especially helpful for some of the more technical tasks including Site Evaluation, Species Selection, and Choosing a Vegetation Management Strategy. This guide will be a great first step to ensure that establishment and maintenance of meadows are successful, but there is no getting around some of the nuances such as plant ID and proper vegetation management strategies and timing. Meadows are often perceived as one of the more accessible and easy-to-implement forms of environmental restoration. The truth is that meadows are the most technically demanding. While anyone can build a meadow, the skills to efficiently build an authentic, durable meadow come with time; this guide was conceived to help anyone improve their chances of success, along with additional training. Experienced contractors can assist with training or fill any gaps in your capabilities.	

	 <i>Figure 14 - Experienced contractors can help your project run smoothly by helping with site analysis, species selection, preparing your site, and providing crucial establishment support. Meadows are sometimes too risky to “go it alone.”</i> If there are questions remaining as to whether you have the necessary support to make the project a success, step back and think about if you are truly ready to begin. It is always better to wait until you are fully ready than to wing it and hope for the best.	
Maintenance Support	Do you Have Sufficient Knowledge and Equipment for Proper Maintenance? Meadows require constant stewardship once established, and often require specialized or dedicated equipment. Meadow maintenance requires skills beyond what most landscapers can provide. Key considerations include: ○ <i>Dedicated Mower Deck</i> – Do you have a mower deck that you can dedicate to maintaining meadows? These aren’t simple lawn-mowers but mulching brush hogs that are kept meticulously clean with sharpened blades. Landscaper mowers are probably the #1 source of new invasive plant infestations, so you’ll want total control over the equipment used to maintain your meadows ○ <i>Plant ID and Treatment Specialist</i> – Do you have access to someone that can assess the meadow at least once a season that can identify potential problems and prescribe an appropriate remedy? Meadows are constantly under threat from both invasive species and woody encroachment. Left alone for a few years, these threats can cause significant damage to a meadow or become a major expense. Regularly assessments and small treatments to keep a meadow healthy are important maintenance considerations	Establishment Maintenance

	○ <i>Wildlife Specialist Support</i> – While meadows provide important soil and water conservation services, they are also intended to provide wildlife habitat to protect our insect and bird populations. Access to someone with sufficient knowledge of the lifecycles of the wildlife your meadow is likely to support can help guide maintenance activities to maximize the meadow’s wildlife value. When to not mow? Which chemicals to avoid? Which bird or bat boxes to install, and where? When to avoid public use of the meadow? Which gamebirds to stock? Which shrubs to keep? A wildlife specialist can help teach and guide a wide range of maintenance activities.  <i>Figure 15 - Native shrub incursion into a meadow can become a real problem if ignored for a few years. Cultivate relationships with people that have specialized skills that can help guide meadow maintenance.</i>	
Environmental Goals	Is Building a Meadow the Best Use for your Space? This is a non-trivial question because most places on the East Coast want to become forests or shrubland, which provide their own ecological, environmental, and community benefits. The cost of establishing a high-quality meadow is on par with your other options, so be sure ask yourself and your community, “Why do I want a meadow here?” While there are many environmental benefits of building a meadow (as mentioned in “Key Concepts” and further discussed in the Xerces link to the right), there are other green projects that might be better able satisfy your conservation or environmental goals. For instance, if the goal of a meadow project is to mitigate downstream flooding or soil erosion along a stream, then performing a streambank restoration and shrubland and/or planting a riparian forest buffer planting could be a better fit. Or perhaps there is an interest in developing financial opportunities on the land, in which case a forestry management plan including plans to plant trees for timber harvesting may make more sense.	<u>Xerces</u> <u>Riparian Forest Buffers</u>

	If the main goals revolve around increasing bird habitat and pollinator populations then a meadow is probably the right decision.  <i>Figure 16 - This meadow was designed, built, and is maintained to support small bird populations</i> Ensure your Goals Match a Meadow Make sure to have a clear picture of the short and long-term plans for your space and document your decision that a meadow is in fact the best use of that space. Documenting the decision could help avoid premature abandonment or conversion to another land use in the future.	
Cultural Goals	Have you Documented any Cultural Goals? For municipalities and conservation organizations, while some preserved land is meant to stay protected as a sanctuary for wildlife, it is often the case that open spaces will need to provide access for human purposes, including recreation. You will need to talk to the community to discover their expectations and requirements. A meadow designed to be consistent with flying model airplanes or flying kits might be different from a meadow designed to support gamebird hunting. A meadow designed to attract the maximum number of migrating songbirds might be different from a meadow designed to support a maximum number of insect pollinator species. A meadow designed for dog-walkers might be different from a meadow designed for bird watchers. Building a tall meadow behind houses in an HOA might be inconsistent with children being able to find their soccer balls. Knowing your cultural (i.e., people) requirements, along with a thorough analysis of the type of meadow your site can support, can help you assess whether there is enough alignment to proceed with a meadow project.	

	Can you Afford Associated Amenities? The project might also require additions such as bird houses, trails, benches, educational signage, and trees planted along an existing path that borders the meadow, etc. These amenities, if required, can increase the cost of building a meadow that is beyond your means.	
Financial Support	Do you Have Sufficient Financial Resources to Build and Maintain a Meadow? There are multiple types of support that any land manager should have in place before beginning a new meadow project, the first of these being financial support. Thorough financial planning is fundamental to a successful meadow project. Meadows are natural infrastructure projects, like a solar farm project. A meadow project has a sizable upfront capital cost followed by a long tail of operational costs until it stabilizes. In the long-term, a meadow can save mowing expenses, but it's often an expense endeavor. While some maintenance will be needed every year, and the overall costs will differ based on whether you own the machinery needed for mowing. Still, too often meadow projects get installed with little or no plans for establishment and continued maintenance, eventually falling back to unkempt land that becomes home for invasive species, or becomes mowed regularly like a lawn again. To ensure that this does not happen, reading through this guide and getting an idea of what the overall costs are for creating and maintaining a meadow is crucial. Explore Grant Programs to Help with Funding There are several ways now to receive funding assistance with these projects from both the state and federal level, such as PA DCNR's Lawn to Habitat Program or the Community Conservation Partnerships Program (C2P2) grants, and these should be considered to make these and other green infrastructure projects more feasible. It often helps involved parties to hear that grant funding of some kind will help to fund the project as well.	<u>Costs of a Lawn vs. a Meadow</u> <u>Lawn to Habitat Programs</u> <u>C2P2 Grants</u>
Partner Support	There are quite a few resources out there nowadays that describe building meadows, which can be helpful but also harmful as suggestions can vary widely. When making the decision to start this process of meadow building, finding support from organizations that complete this type of work can help to guide you through these differences. You'll want to identify at least three possible partner organizations. Government Organizations Just as state and federal programs can support you financially, there are also some departments that can be hands-on and assist with	<u>DCNR Lawn-to-Habitat</u> <u>PACD Lawn Conversion</u>

	understanding and planning your project. When applying for grant programs be sure to ask your contact if they or another person within the organization can help you. Still, these folks are busy these days with large interest in programs like lawn-to-habitat. It may be that they cannot invest their own time, but they may know folks from other organizations that you can contact. Non-Profit Organizations Often non-profits such as conservancies can also be a partner, giving you insights into local, authentic meadow systems, insights into meadows they've helped to establish, and may even be able to go beyond just helping you with planning. Indeed, some larger conservancies have teams or partners themselves that help them establish new meadows. Private Contractors If neither of the above types of organizations can assist, they may give you the information of a reputable local contractor that also has experience with meadows. These specialized contractors can assist you with any part of the meadow building process, from understanding the process, to planning your meadow, to installing and maintaining it. Remember, though. Just as with your literature review, it is important to ensure that the organizations you are partnering with a credible and will complete the work both professionally and successfully. Garnering feedback on these organizations will possibly avoid setbacks down the road.	
Landowner Commitment	Does the Landowner Have Sufficient Knowledge and Equipment for Proper Maintenance? Meadows require constant stewardship once established and often require specialized or dedicated equipment. Meadow maintenance requires skills beyond what most landowners can provide. Key considerations include: ○ <i>Dedicated Mower Deck</i> – Do you have a mower deck that you can dedicate to maintaining meadows? These aren't simple lawn-mowers but mulching brush hogs that are kept meticulously clean with sharpened blades. Landscaper mowers are probably the #1 source of new invasive plant infestations, so you'll want total control over the equipment used to maintain your meadows ○ <i>Plant ID and Treatment Specialist</i> – Do you have access to someone that can assess the meadow at least once a season that can identify potential problems and prescribe an appropriate remedy? Meadows are constantly under threat from both invasive species and woody encroachment. Left alone for a few years, these threats can cause significant damage to a meadow or become a major expense. Regularly assessments and small	<u>Establishment</u> <u>Maintenance</u>

	treatments to keep a meadow healthy are important maintenance considerations ○ <i>Wildlife Specialist Support</i> – While meadows provide important soil and water conservation services, they are also intended to provide wildlife habitat to protect our insect and bird populations. Access to someone with sufficient knowledge of the lifecycles of the wildlife your meadow is likely to support can help guide maintenance activities to maximize the meadow’s wildlife value. When to not mow? Which chemicals to avoid? Which bird or bat boxes to install, and where? When to avoid public use of the meadow? Which gamebirds to stock? Which shrubs to keep? A wildlife specialist can help teach and guide a wide range of maintenance activities.	
Decide	Do you Have a Viable Meadow Opportunity? Review your answers to each question above and honestly assess whether a meadow is the best use of your space, time, and money.  <i>Figure 17 - This 25-acre state-funded meadow project ultimately failed due to a poor understanding of the type of meadow that was possible and the desire of the Park Manager to keep it short and avoid the use of herbicides. A very expensive mistake.</i>	

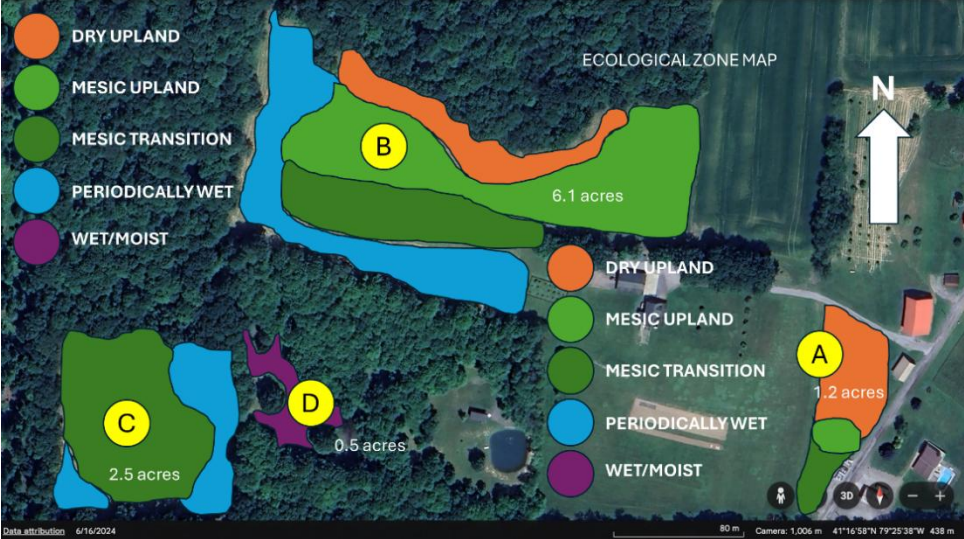
DECISION POINT #1

You have worked through all relevant needs for support and understand the goals that your stakeholders have for the space. Ideally, you will have also read through this document to understand what goes into building a successful meadow from start to finish. This brings up the first important decision: do you have all the necessary support to properly build this meadow?

SITE EVALUATION – ECOLOGICAL ZONES				A
KEY QUESTIONS			OVERVIEW	
○ What major ecological zones or eco-tones does your new meadow site currently have? ○ Where is the soil drier, and where is it wetter? ○ Do I have any shady edges, or sections near a road? ○ What is the history of the site? Is it an old factory or oiling station? An old strip mine? Or a filled wetland? ○ What are the existing vegetation patterns, if any? Sometimes even park lawns will reveal their different zones when you look close enough. ○ Have you visited the prospective meadow multiple times during multiple seasons?			Meadows are usually heterogeneous. They have low spots, high spots, sunny spots, and shady spots. Large meadow sites can flow up and down large grades and hills. And even small meadows can cross multiple underlying soil types, each with their own limitations. Each combination of soil type, moisture pattern, and light availability should receive its own seed mix, which often improves performance while reducing costs. But you need to find and map each zone.	
CHECKLIST				
STEP	TITLE	SUMMARY DELIVERABLE	DATE	
1	Light Map	A project map that indicates, with shapes, the different number of hours of daylight in July.		
2	Water Map	A project map that indicates, with shapes, any observable moisture conditions		
3	Soil Map	A copy of the USGS soil survey for the project. Pictures of shallow soil pits are helpful for each soil type.		
4	Plant Map	A project map that indicates, with shapes, where there are obvious differences in vegetation, including weeds		
5	Historical Map	Notes of any prior uses (e.g., farm, parking lot, ball field, etc.)		
6	Zone Map	A combination map that weaves the light, water, soil, and plant map together in clearly marked ecological zones		
7	Zone Data	Fill out a form to document each zone, and include at least one representative GPS coordinate for each zone		
8	Evaluate™	Set up your project zones in Collector™ or in Evaluate™. Alternatively, send your zone data sheets out for analysis		
SUMMARY				
HOW TO KNOW WHEN YOU ARE FINISHED				
You should have identified at least three different ecological zones for any meadow project under 10 acres. Larger meadow projects can have many more. You will know that you have the right ecological zones when you can take someone on a tour through the meadow site and easily point out and explain zone to someone else not closely involved with the project.				

SITE EVALUATION – ECOLOGICAL ZONES

B

TITLE	DESCRIPTION	LINKS
Introduction	Performing a Site Evaluation Your very first step in building a new meadow is identifying your Ecological Zones is primarily a mapping exercise. Google Earth is a suitable desktop useful tool that can be learned with a little bit of YouTube training. Paper maps can be just as effective. Using PowerPoint is also effective. Follow the steps below to evaluate your site and to define your ecological zones. An ecological zone is a type of area that functions in a particular way and that supports a different vegetation system growing in them (if not a lawn). There can be multiple instances of an ecological zone within a meadow project site.  <i>Figure 18 - Example of a meadow project with each of the ecological zones mapped and labelled. Very few meadows are so homogenous that only one seed mix is required.</i> The map above represents the culmination of a site evaluation exercise that identified five distinct ecological zones for a single meadow-building project. Each color represents a different ecological zone. An ecological zone can appear in multiple places, such as the DRY UPLAND [orange-colored] zone. This map was produced in PowerPoint, which is also useful as a mapping tool. Each ecological zone receives its own seed mix design. For example, the species that are appropriate for the DRY UPLAND zone would be quite different than the seed mix for the PERIODICALLY WET zone.	Google Earth Training PA GeoData Contour Maps
Light	Produce a Light Map While most of your meadow is likely in full sun, tree canopy often creates distinct ecological zones. Mark all the areas impacted by shade. Start the mapping process by printing out a screenshot of your meadow site (use Google Maps or Google Earth) and draw a thick line around the entire boundary. Alternatively, you can use an open-source or paid GIS system to indicate the	QGIS Google Earth

	boundaries of the project. Google Earth has some basic GIS functionality, and it is free, so try to use it instead of paper maps. Mark the Full-Sun Areas Mark out the areas of the meadow that you expect to be in full sun all day long, which are the areas well away from any trees or steep slopes. Most of your meadow projects should be in full sun.  <i>Figure 19 - This meadow was designed to feature warm-season grasses, but the designer failed to consider the role of trees along the southern edge. The amount of available light was insufficient for the warm-season grasses, and the meadow took a different direction on its own; the result is still beautiful but not what was intended.</i> Identify and Mark the Areas with Substantial Shade Then look for trees or shrub thickets inside the meadow area and look for forest or woods' edges. The areas to the north of such features will be in the shade for some part of the day and these are certainly a different ecological zone from the open, full sun areas. The same goes for buildings more than one story tall.	Evaluate™ Collector™ ArcGIS Shade Map
Moisture	Produce a Moisture Map Understanding the presence and role of moisture in your meadow is extremely important. The presence of water, and how much is present, can have major implications for your site preparation activities (e.g., herbicide choice and legal use), when you can use certain pieces of equipment (e.g., no tractors in wet soil), and on your seed mix design (e.g., very dry areas feature warm season grasses, while wet areas feature sedges). Visit Meadow in Early Spring The first visit should be in early spring; March is often ideal. You need to walk around the entirety of the project site and look for any place that is soft, squishy, or muddy underfoot. Sometimes you can even see standing water shortly after rain. Note these areas of elevated moisture so you can draw them on your paper or PowerPoint map or show them in Google Earth or your GIS system. Visit Meadow in Late Summer The second visit should be in August, or whenever the driest time of year is for your area. This is usually a great time to find those areas of the meadow that tend	QGIS Google Earth Evaluate™ Collector™ ArcGIS

to dry out severely in the summer. The best place to start is any place that is higher up than the rest of the meadow or find any south-facing steep slopes in the middle of the field (e.g., a berm or bump). And look for bare patches of soil caused by excessive mowing or walking, or where there is clearly a lot of excess gravel or stone in the soil. Another way to find your dry spots is to look for plants that don't occur anywhere else in the meadow area. These plants could be a certain type of weed, or a native dry-soil plant species (e.g., poverty oat grass), or where the plants are shorter.



Figure 20 - This dynamic meadow system features a mosaic of moisture zones, each of which will support a different type of meadow species

Late summer is also a great time to revisit the previously identified wet spots to see if they are still wet. If they remain wet, or moist, then you can label those zones as permanently moist. If the wet areas you identified in Spring are dry and cracked in the summer, then you have a bi-modal ecological zone and this must be noted on your maps to drive seed mix design; bi-modal ecological zones have unique challenges that require a specific set of species.

Record your Findings on Your Map

With practice, finding your wet spots and your dry spots becomes easier. Be sure to mark these two extremes on your map as these areas will perform very differently from the rest of the meadow.

Soil

Download the Soil Map

Soil maps are easy to download. Simply go to the California Soil Resource Lab (CaSoilWeb) website, find your project site, zoom in or out until you can see all the soil types in your meadow, and hit print screen.

If you use Google Earth or GIS, the USGS provides soil series layers free of charge. Simply download the layer for your part of the country as a base layer.

Different soil types can have wildly different characteristics that are important to plants. The soil map for your meadow will have embedded information related to soil depth, bulk density, depth to bedrock, the maximum amount of water it can

[CaSoilWeb](#)

[QGIS](#)

[Google Earth](#)

[Evaluate™](#)

[Collector™](#)

hold, the normal amount of organic matter, drainage capability, and lots of other things.

Read the Soil Map

Click on and look at each soil type. You are looking for a few key metrics to determine if you have a mosaic of different soil types or just one large homogenous soil layer. Find the pH, Ksat, PAW, hardpan depth, drainage class, and hydric rating for each soil type in your meadow.

Sometimes the only major difference between soil types is slope. Sometimes, the underlying chemistry is completely different. You might need to make a judgement call about whether each soil type is sufficiently different from the adjoining types to justify a different ecological zone.

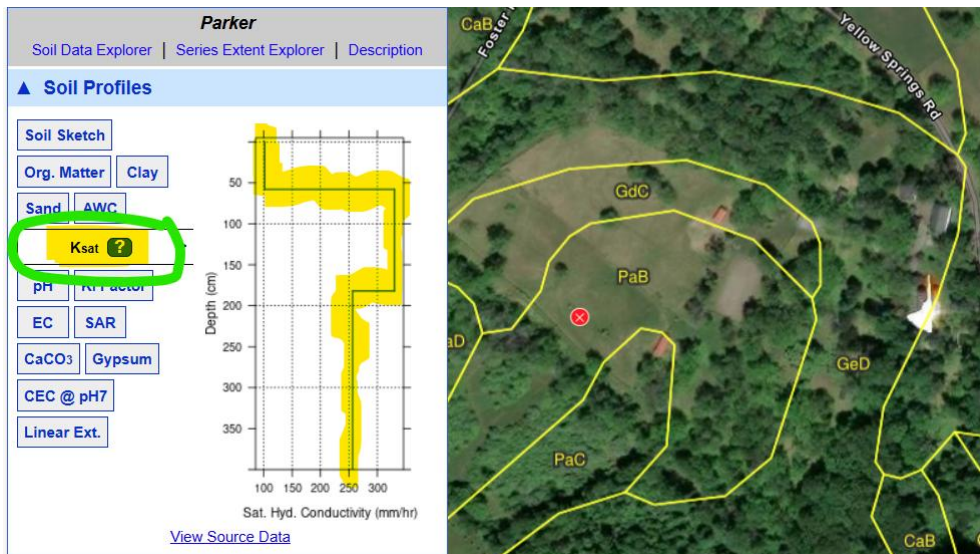


Figure 21 - This meadow site spans three different soil types, and each has its own mechanical, hydrologic and chemical attributes. These attributes play a large role in determining which species are appropriate for each.

Add a Soil Map Overlay to your Site Evaluation

Map the 'different' soil types onto your ecological zone map and see how the soil map boundaries line up with your moisture zones; often they line up fairly closely, and sometimes not at all. The importance here is that topography and point sources of water interact with different soils in different ways. Expect a new ecological zone each time a single soil map shape overlays a moisture zone.

Few people have PhDs in soil science, so you don't need to worry too much about mastering what the different soil characteristics mean. You are looking for key differentials. Soil map analysis is built into Collector™ and Evaluate™ if you are using those software products.

[ArcGIS](#)

[PA Wildlife
Action Map](#)

Plants	Produce a Vegetation Pattern Map Observing the plants that are already growing in a new meadow site is a fantastic diagnostic tool. This evaluation is best performed if the meadow area hasn't been mown for about six weeks, so you'll want to talk to the landowner and ask them to stop mowing around the middle to the end of June. Mapping the plants already growing in a future meadow can tell you a lot about where the ecological zones are located and how many you have. Each native plant species has a set of definable conditions that it performs best in and many more types of conditions in which it struggles or fails. Certain species will congregate into areas that are ideally suited for their reproductive success and retreat from areas that are not. The result is often a mosaic of different plants growing in different places. Go out into your meadow to detect and map these vegetation patterns and include them on your ecological zone map. Every time you see that the plants change substantially, even in a park setting, you are likely to observe a different ecological zone. The image below reveals several ecological zones, including a dry/mesic zone dominated by grasses (brown areas), an interior wet area (purple flowers), and weedy zone (foreground).  Record your observations in a notebook, take pictures, or set up your zones directly into Collector™ or Evaluate™. Overlay your vegetation maps onto your ecological zone map to detect the major ecological zones within your meadow. For IDing plants, we always recommend using a good guidebook like Newcomb's Wildflower Guide, but plant ID apps, like iNaturalist, or PictureThis are also available. QGIS Google Earth Evaluate™ Collector™ ArcGIS iNaturalist Picture this Newcomb's Wildflower Guide Peterson's Tree Guide
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Produce your Final Ecological Zone Map

For this step, there is no algorithm or software tool to help decide how many ecological zones you have, where they are, or what to call them.

But if you did your best to follow the steps outlined above, you should already have a pretty good sense of how your meadow site is currently functioning, how many truly distinct ecological zones you have, and where they are on a map.

Simply review your light, soil, water, and plant maps and use your best professional judgement to decide how many that you have and where they are. Try to identify at least three; nearly every meadow project has at least three ecological zones.

But try to be reasonable about how many ecological zones that you identify and represent on a map. Too many becomes difficult to manage and the seed mixes between zones that function very similarly won't be very different from another. As a rule of thumb, each ecological zone should be at least 0.5 acres in total size; any smaller doesn't make sense.

Zone Map

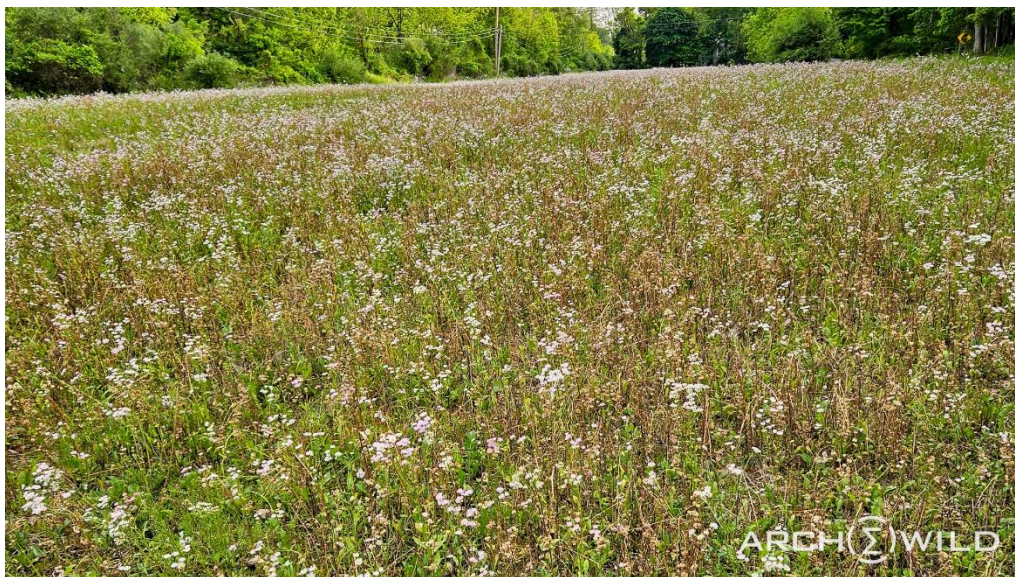


Figure 23 - This meadow is largely homogenous and has only one ecological zone throughout, hence the lack of diversity in its native vegetation.

Sometimes you will decide that your meadow only has one ecological zone, as depicted in the image above. There were no meaningful observational differences in soil type, light availability, moisture, or vegetation patterns in this meadow – it truly seemed to function identically throughout the entire 25 acres. This makes designing seed mixes easier (i.e., just one) but will likely make for a boring meadow.

Zone Data	Describe Each Ecological Zone After you have decided how many ecological zones you have, you must describe them using a standard form that ecologists use. The form is simple to use – answer about ten questions for each ecological zone. These zone descriptions allow you to communicate with others, including consultants, the core characteristics of each zone and what makes each ecological zone unique. Ecological Zone Data Form You should record and be prepared to share with others the following minimum information for each zone: ○ Size, ○ GPS coordinate, ○ Slope, ○ Aspect, ○ Canopy cover %, ○ The type of canopy ● Herbaceous = mostly grasses and flowers, ● Shrub = mostly shrubs, with grasses and flowers, ● Deciduous Forest = mostly trees with leaves, ● Conifer Forest = mostly trees with needles, ● Mixed Forest = a substantial mix of deciduous and conifer trees ○ The % of the forest that is comprised of conifers (approximate) ○ Height of the canopy cover (m), if any. Open lawns and pastures are recorded as 0.25m. Use a phone-based tree height app to measure the height of trees. ○ O/A soil layer depth, ○ Approximate % of aggregates, and aggregate size, in a few shovels full of soil, ○ Any nearby permanent sources of water A form for recording your ecological zone characteristics is in the Appendix of this guidebook. Feel free to share your ecological zone characteristic forms with your collaborators, your consultants, and your seed vendors to develop a seed mix design	<u>Appendix</u> <u>PA GeoData contour Map</u> <u>Arboreal Tree Height Measurement App</u> <u>PA Wildlife Action Map</u>
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Evaluate™

Users of [Evaluate™](#) can record their ecological zone characteristics directly into the software to facilitate analysis and seed mix design. The form below depicts a portion of the ecological zone form in Evaluate™.

[Evaluate™](#)

Watch the Evaluate™ training video to see if it right for you.



Figure 24 - A beautifully designed meadow with layers and sweeps of color. This meadow lasted three years before succumbing to natural forces. Today, a completely different set of plants now occupies this meadow, and the space does not resemble what was proposed, and sold, to the client. The designer ignored or overlooked several ecological realities.

SPECIES SELECTION – SEED MIX DESIGN				A
KEY QUESTIONS		OVERVIEW		
○ Do I want a native meadow, or a decorative meadow? ○ What is the core set of species for each ecological zone in the new meadow? ○ Can I find nearby and naturally occurring meadows (not seeded meadows) that closely resemble my site conditions and use the species growing there as the basis for my seed mix design, by zone? ○ How much am I willing to spend on a per-acre basis to establish a new meadow? What are my budget constraints? ○ How much do I care about genetics? ○ Do I have a consultant that can help with design?		Studies show that native species mismatched to a site’s conditions will be outcompeted by weeds sooner than later. Seasoned practitioners concur. Internet-sourced seed mixes with multiple dozens of species are designed to “mask” the site suitability problem by charging you for seed that will never be a part of your long-term meadow and that can mislead landowners. Instead, the preferred method is to focus on choosing the 8-12 species known to survive in each ecological zone of your future meadow.		
CHECKLIST				
STEP	TITLE	SUMMARY DELIVERABLE	DATE	
1	Stakeholder Communication	I have consulted with stakeholders, and they understand the meadow will be of the type that the site can naturally support.		
2	Literature Review	I have reviewed relevant academic publications that describe local meadows in detail enough to be useful for seed mix design.		
3	Reference Sites	I have visited nearby natural meadows to find reasonable comparative examples to my site and ecological zones.		
4	Genetics & Provenance	I have agreement on the guiding principles for meadow genetics.		
5	Setting a Budget	I have established a seed budget based on my grant or funding program, or on what my organization is willing to spend.		
6	Recommendations	I have solicited at least one recommendation from a meadow consultant or a local ecologist.		
7	Seed Mix Design	I have a distinct seed mix for each of my ecological zones.		
8	Carrier Selection	I have made a conscious decision about the use and selection of seed carriers.		
9	Finalize Species List	If you followed the above steps, you should have a final seed mix design, by zone.		
SUMMARY				
HOW TO KNOW WHEN YOU ARE FINISHED				
You are finished when you feel comfortable that you have an appropriate seed mix design for each of the major ecological zones that has, ideally, been validated by a third-party or by a decision-support software tool. Alternatively, you have selected a pre-designed seed mix based on the information provided on the vendors’ website and have decided the number of pounds that you can buy that is within your budget.				

SPECIES SELECTION – SEED MIX DESIGN		B
TITLE	DESCRIPTION	LINKS
Introduction	Contrary to contemporary meadow design philosophies (e.g., the kitchen-sink approach, or designing in layers), the harsh reality is that the only true meadow designer is Nature itself. Designing a seed mix is not an opportunity for self-expression. Your best chance at leaving your personal mark on a meadow is how well you prepare the site by ruthlessly removing all competing vegetation and performing an accurate ecological zone analysis. When it comes to seed mix design, you have few options and very little influence over how your future meadow evolves and matures. Your source of pride should derive from how well you performed your technical analysis and not from your personal choices of seeds. The goal here is to discover the species that can survive your meadow site’s conditions and successfully reproduce; that’s it. CAUTION: <i>Be wary of prepackaged, predesigned seed mixes. They often contain species that are unsuitable for your meadow. For example, purple coneflower (<i>Echinacea purpurea</i>) is a frequent seed mix component, yet it does not exist naturally on the east coast. The closest stable, natural population of purple coneflower is a dry, barren cedar glade on the Kentucky-Ohio border. So, unless your meadow functions nearly identically to a southern cedar glade barren, purple coneflower will struggle to persist in your meadow. See the Appendix for a list of species to avoid in your Northeast or Mid-Atlantic meadow.</i>	
Stakeholder Communication	Hold a Meeting and Get Stakeholder Input A general good practice is to consult with your stakeholders to get an understanding of what type of meadow they expect to see in the future. Expect a wide range of answers; here is a list of some common responses: ○ “I want to see a field full of color from early spring through the end of autumn,” ○ “I want only a short meadow because I am concerned about ticks,” ○ “Anything except goldenrods. I suffer from hay fever in the fall,” ○ “I want maximum biodiversity and botanical curiosities in the meadow,” Write down everything you hear. Take a keen interest in what people are sharing with you, and why. When finished, repeat back everything you heard and then say, “we’ll do the best we can to achieve these goals but we first need to build a meadow that can resist weeds without us having to treat it like a garden because we don’t have the time or money to treat it like a garden. Over time, we can make adjustments when the opportunity arises.” Remember that your meadow is going to mature into whatever your meadow wants to be and you have little control over the process. Try to avoid committing to any specific meadow design objective. And avoid publishing your stakeholders’ desires.	

Literature Review	Perform a Basic Literature Review A good first step in designing the seed mix for a meadow is to survey which well-documented natural, native meadows exist in your area. Conservancies are often a good resource as they tend to list any meadow easements or conservation areas on their website. County and state parks, too, can host native meadows of the type that your region can support. Make a list of where they are, because you are going to visit each one of them in the next step. Check online for botanical reports and species lists for the meadows on your list or ask the conservancy or park manager for a list, if they have one. JSTOR is a popular repository for academic papers, research articles, old reports and books that can have lists of species for your nearby meadows. An old-fashioned internet search can sometimes yield good results. search terms would be: [the name of the preserve] + “species list” + “botanical report” + “PDF”. You can also query one of the many online research tools available and ask for a species list. If you find literature about a nearby meadow, your next step will be to go visit it, at which point it becomes a “reference site.” [See Reference Sites] Check NRCS-ESD Descriptions The National Resources Conservation Service (NRCS) has been working towards defining vegetation types by US EPA Ecoregion. While not every ecoregion has been thoroughly profiled, there are quite a few provisional descriptions for the east coast. Becoming familiar with NRCS-ESD literature can be beneficial to your project. Note, however, that the NRCS-ESD cannot be used to predict which type of meadow your site is likely to support; it is more useful for understanding what your meadow cannot be. Use any species lists you find with caution. The NRCS-ESD profiles are not intended for designing a new ecosystem. Understand your State’s Natural Meadow Types Similarly, state Natural Heritage Programs (NHP) also provide some useful literature on the major, naturally occurring vegetation types that exist in each state. They define and describe the various “plant communities,” including meadows and grasslands, that occur throughout each state. If you don’t find the meadow type that you want in their plant community descriptions, then perhaps your site cannot support it. Note that NHP plant community types cannot be used to prescribe or design a meadow.	<u>JSTOR</u> <u>Gemini</u> <u>NRCS-ESD</u> <u>PNHP</u> <u>EPA Ecoregions</u>
Reference Sites	What is a Reference Site? Reference sites are places where native, natural vegetation already exists and persists with minimal human intervention. For a site to qualify as a reference site, it cannot have been previously sown as part of a meadow or restoration project. Studying seeded meadows, particularly ones that have been seeded recently, can provide many false signals and potentially even confuse. So, it’s best to only evaluate meadows that have been in their current state for a long time.	

Analyze the Reference Site

What you want to do while visiting a reference site is to perform another ecological zone analysis (See Site Evaluation – Ecological Zones), including filling out the provided form (see Appendix) or use Evaluate™.

Once you have completed your ecological analysis for the reference meadow, compare the zones you identify to all the zones for your new meadow project to see where there is some alignment. Be sure to pay close attention to the CaSoilWeb soil charts and data. Major differences between the soil series at your new meadow site and the reference site that you are studying could mean that the plant species growing at the reference site might be unsuitable for your new meadow.

You might need to visit many different reference sites until you find a set of ecological zones that closely match those in your new meadow.

See a list of [public meadows in the Appendix](#) that you can visit and study.

Celebrate if you find an ecological zone at a reference meadow that reasonably matches one or more zones at your new meadow because that means you can take the next step in the reference site analysis. Note that the farther away you travel from your meadow project site, the less likely you can find a close match. Meadows in North Carolina, for example, should not be used as reference sites for projects in Massachusetts.



Figure 25 - This naturally occurring meadow in Bucks County is a good reference site as it shows two ecological zones, with Eutrochium and Vernonia populating the moist swale (foreground) with more upland species in the background. Finding these can help you decide what is regionally appropriate and accurate for your meadow.

Document Species in Matching Ecological Zones

Here’s what you do when you find a match in ecological conditions at a reference site:

- 1. Have a copy of Newcomb’s Wildflower Guide in hand, or download your favorite plant ID app onto your phone,
- 2. Walk through the ecological zone and identify as many species as you can using Newcomb’s or your phone app. Take pictures and write down what

CaSoilWeb
NatureServe
iNaturalist
Collector™

- you think you are seeing in a notebook. If you know your natives well, you can record your observations in iNaturalist. If you are a botanist or ecologist, consider using Collector™ as your online notebook as it allows you to make more useful observations as you go than other applications,
3. Once you have written down the species that you see, write them down again in descending order of how common they are in the meadow, with the most common species at the top of the list and the least common species at the bottom. **This ranked list is very important so keep it safe,**
 4. The next step is to assign a letter value to each species on your list. This letter is sometimes called the “element occurrence” value and is an indicator of the viability of each species at that site. Here’s the scoring table, from NatureServe.

Table 5.1 - Basic EO Ranks

EO Rank	Description
A	excellent estimated viability
B	good estimated viability
C	fair estimated viability
D	poor estimated viability
E	verified extant (viability not assessed)
H	historical
F	failed to find
X	extirpated

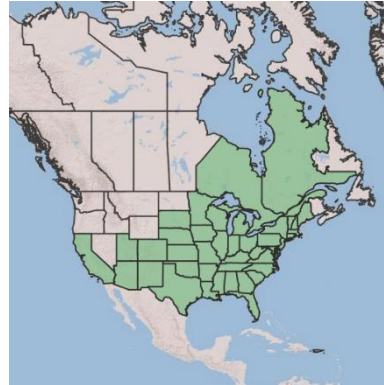
5. Repeat this process for other naturally occurring meadows that have candidate ecological zones,
6. After you have visited all the meadows you can visit, combine all the lists together into a master species list and assign an element occurrence score to each species, based on your notes and images. There is a methodology for how to combine the lists and assign an overall element occurrence score for each species, but that methodology is beyond the scope of this guide. For now, just do your best because it will be the best guidance you can obtain without hiring an ecologist.

Final Note: If you are designing an upland meadow in Westchester County NY, then your best reference site is going to be a naturally occurring meadow fragment from the same county or ecoregion. No need to rely on vendors; they don’t know your site. Resist the temptation to delegate the responsibility of meadow design to a seed mix marketing company.

**Decide the
Genetics and
Provenance
Policy**

Introduction to Native Plant Genetics

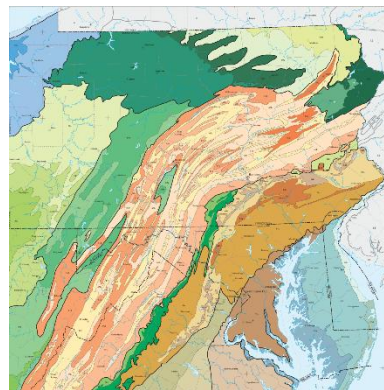
A successful, long-lasting meadow utilizes plant material with good genetics; species growing at a location will “tune” themselves genetically to its surroundings. For example, a butterfly milkweed population growing in Arizona might lose its ability to survive long, cold winters but develop an extra thick cuticle and deeper roots to survive in the desert. Alternatively, butterfly milkweed growing along the shores of the St. Lawrence River might have adapted to survive the conditions there, with a short growing season, and have lost its ability to survive any appreciable drought.



Learn more about [Genetics in the Appendix](#).

Set the Genetics and Provenance Policy

Your job is to think through these topics and decide the seed sourcing policy for your new meadow. Our recommendation is to use local native seed vendors as much as possible. The Northeast has several high-quality native seed growers with enough scale and scope to support most meadow projects:



EPA

- [Eco59/Northeast Seed Collective](#) – Works with a variety of local farmers to grow genotyped native seeds for the Northeast
- [Native Bee-Ginnings](#) – A highly experienced native seed farm focused on the genetics of western Pennsylvania and eastern Ohio
- [Pinelands Nursery](#) – A well-rounded native nursery with their own seed farm, focusing on the genetics of southeastern PA, New Jersey, Delaware, and Long Island
- [Ernst Conservation Seeds](#) – A large commercial native seed farm with a broad set of offerings frequently specified by engineers for large land recovery projects. Focused on central Pennsylvania grassland genetics but also offers species and genetics from around the country
- [Long Island Native Plant Initiative](#) – Grows seeds originating exclusively from the Island for local meadow restoration projects

Check online or your state’s native plant society to find low-volume specialty seed providers, of which there are many.

Setting a Budget	Introduction to Seed Prices Setting a budget for your new meadow can be challenging. Seeds are expensive because of how hard it is to grow, harvest, clean, store, and ship them. The cost for seeds per pound can range widely due to their ease or difficulty of processing before they are shipped to you. They can be as inexpensive as \$25/pound or as expensive as \$5,000/pound. It is important to note that more expensive seeds or a higher budget per acre don't necessarily create a better meadow. In fact, poor species selection is usually the #1 or #2 reason for a failed meadow, not budget. Introduction to Seed Budgeting Usually, seed budgets for meadows are established on a per-acre basis. Meadows built with grant funding will often come with documented budgetary limitations. Your grant contract might say that you are only allowed to spend up to \$500/acre on seeds for your meadow, or maybe even as low as \$50/acre in the case of some federal programs. Privately funded meadow projects have no predetermined budget but it's good to set an upper limit at the beginning so you have a clear limit to work within. Setting a Per-Acre Seed Budget Here are some rules of thumb for thinking about setting a budget limit for seeds per acre for your project: <i>NRCS-funded conservation meadows</i> – Expect to work within a \$100/acre cap, unless you have the money to buy seed on your own. These are generally for cornfield conversions to native grasses. <i>NGO-funded conservation meadows</i> – Expect to operate within a \$500/acre budget. A conservation meadow is a meadow project designed to simply start the meadow process with the correct species in a fiscally responsible manner. <i>Publicly-funded restoration meadows</i> – A good operating seed budget is around \$2000/acre. Restoration meadows differ from conservation meadows in that their objectives can be quite different. Rather than simply replacing a corn/soy rotation with native species, a restoration meadow usually has other objectives such as ecological value, wildlife value, and aesthetic value. These types of meadows usually require expensive seeds in higher proportions than conservation meadows. <i>Privately-funded restoration meadows</i> – These meadows usually have ambitious ecological goals and are normally meant to host uncommon or rare species that the planner wants to reintroduce to local ecosystems. The primary budget difference is the inclusion of some very expensive seed that can drive the overall seed budget per acre up to around \$5000/acre. \$5000/acre is considered the upper justifiable limit on seed purchases. Meadow designs that call for species whose seed is extremely expensive should probably consider using plugs instead of seed for those species. Contact your local native nursery to contract-grow these species. The Northeast and Mid-Atlantic have many native plant nurseries that specialize in growing local-ecotype species.	
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	Establish a Per-Acre Poundage Target Another key seed mix design parameter is how many total pounds of seed per-acre you should sow. There are no general-purpose guidelines for how many pounds of seed should be sown for a meadow because every context is different. Here are some rules of thumb that can be useful for deciding if you have budgeted for enough seed: <i>Conservation seeding, or up to 10#/acre</i> – suitable if you are seeding into an already-established meadow or are performing a pasture-to-meadow conversion or a corn-to-meadow conversion. This low application rate tends to leave ample room for weeds that will need to be treated out during establishment <i>Restoration seeding, or up to 20#/acre</i> – suitable for situations where you are seeding into a previously weedy area or where there are multiple pressures including deer, perimeter weeds, people walking, or other anticipated disturbances. Primarily used for restoration settings, public parks, and HOA meadows. This amount of seed per acre generally matures more quickly to better resist weeds and can support a higher number of species <i>Performance seeding, up to 40#/acre</i> – suitable for intentional meadows designed to function as core aesthetic landscaping elements, such as in front of an office building or on a college campus. This amount of seed is also suitable when follow-up herbicide applications are impossible or forbidden. The dense initial seedling emergence helps to prevent weeds and often allows for a generous amount of annual and biennial flowers during the first and second years If you are a user of Evaluate™, you will need to specify both a Target Per-Acre Budget and a Target Pounds Per-Acre in the workflow.	
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Getting Help

Consider Seeking Third-party Assistance

If you don't have the time to go through all the steps listed in this guide and don't want to risk using an online seed mix, then consider getting some professional assistance. Below is a list of sources we recommend:

- *A local organization* – often with many years of building meadows in your area. You might have to network around to find them, but they will likely have encountered many failures on their way to learning what works best for your region. There is no need to replicate their experiences on your own. These organizations can be watershed groups, environmental advisory councils, educational centers, and botanical gardens. You might even have a local contractor that specializes in building native meadows.
- *Local ecologists or academics* – Pennsylvania is blessed with many colleges and universities, and most have some kind of biology, ecology, or plant sciences programs. Often, there is at least one person at each institution that has built up enough experience to lend a hand with helping you design your meadow,
- *State and National organizations* – NRCS, Xerces Society, and the Pennsylvania Department of Conservation and Natural Resources (PA DCNR) frequently have representatives in your area that can help with designing a meadow, or they can recommend someone to you with specialized or local knowledge for your context

An alternative to seeking outside counsel is using the [Evaluate™](#) software designed and built by a company that builds meadows for a living. Seed mix recommendations are provided based solely on your observations about your new meadow site and on a vast library of naturally occurring meadows across the country. It uses the latest data models and scientific methods to narrow your seed choices to those species that are most likely to work.

But trusting a piece of software to design a new meadow carries its own risks. You'll probably want to involve an ecologist at some point, just to be safe.

WILDFLOWERS		
Botanical Name (Common Name)		% by wt.
Agastache foeniculum (Anise Hyssop)		0.88
Allium stellatum (Prairie Onion)		2.21
Antennaria neglecta (Prairie Pussytoes)		0.44
Aquilegia canadensis (Columbine)		0.44
Asclepias tuberosa (Butterfly Weed)		2.65
Asclepias verticillata (Whorled Milkweed)		0.88
Asclepias viridis (Spider Milkweed)		0.66
Baptisia bracteata (Cream Wild Indigo)		0.66
Callirhoe bushii (Bush's Poppy Mallow)		0.88
Camassia scilloides (Wild Hyacinth)		0.88
Chamaecrista fasciculata (Partridge Pea)		10.59
Coreopsis lanceolata (Lance-leaf Coreopsis)		3.53
Dalea candida (White Prairie Clover)		3.53
Dalea purpurea (Purple Prairie Clover)		6.62
Dodecatheon meadia (Midland Shooting Star)		0.35
Echinacea angustifolia (Narrow-leaved Coneflower)		3.97
Gentiana flavida (Cream Gentian)		0.44
Heuchera richardsonii (Prairie Alumroot)		0.33
Liatris scariosa var. nieuwlandii (Northern Blazing Star)		1.76
Lupinus perennis subsp. perennis (Sundial Lupine)		2.21
Monarda punctata (Spotted Bee Balm)		0.79
Pedicularis canadensis (Wood Betony)		0.44
Penstemon grandiflorus (Large-flowered Beardtongue)		1.32
Penstemon hirsutus (Hairy Beardtongue)		0.35
Phlox pilosa (Prairie Phlox)		0.35
Pycnanthemum verticillatum var. pilosum (Hairy Mountain Mint)		0.22
Rudbeckia hirta (Black-eyed Susan)		5.29
Ruellia humilis (Wild Petunia)		0.88
Solidago nemoralis (Old Field Goldenrod)		0.44
Symphyotrichum oblongifolium (Aromatic Aster)		0.53
Symphyotrichum turbidum (Prairie Aster)		0.88
Tradescantia ohimensis (Ohio Spiderwort)		1.32
Verbena stricta (Hoary Vervain)		1.76

Figure 26 - This actual seed mix design makes no ecological sense whatsoever; many of these species would never be found in the same place with the others on the list, and most are not even from the same parts of the country. Be extremely wary of seed mix designs assembled by non-ecologists

[Xerces Society](#)

[PA DCNR Lawn to Meadow](#)

[NRCS CRP](#)

[Evaluate™](#)

Seed Mix Design	Design your Seed Mixes Ultimately, and eventually, you will want to create a seed mix design for yourself or hire someone to create it for you. The process of designing the seed mix is relatively straight-forward at this point, if you followed all the previous steps. Here's what you do: 1. Open Excel or Google Sheets or your favorite spreadsheet program, 2. Put the name of the meadow project near the top, the GPS coordinates of the meadow, the list of zones, and the acres for each zone, 3. For each zone, do the following: 4. Type in all the species from your reference site analysis, literature search, or from your consultant, and sort them from top to bottom based on their element occurrence score (the most common species at the top and the least common at the bottom), 5. Create a new column for each of the seed vendors you plan to use, based on the decisions made related to meadow type and genetics. If you have three preferred vendors, create a column for each one, 6. Go to the vendor websites and look up their seed price list, which can take many forms. Key in the per-pound prices for each species in your sheet, for each vendor. If the vendor does not carry a species, leave the cell for the price blank; do not enter a '0' in the cell, 7. Create a new column to hold a %. This percentage will reflect the relative abundance or prevalence of that species in the overall design. Then key-in the starter %s for each species. Species at the top of the list should be in the 10-25% range. Species in the middle of the list should be between 5-10%. Species at the bottom should start at 2%, 8. Create a SUM() cell at the bottom of the column with the %s to see what all the percentages add up to. If over or under 100%, you will eventually need to adjust those %s to get to 100%, 9. Create a new column and key in the following formula (assumes you are using three vendors): $\text{MIN}(\text{PRICE A}, \text{PRICE B}, \text{PRICE C}) * (\text{SPECIES \%}) * (\text{ZONE ACRES})$ The resulting answer is how much the seed for that species will cost based on your list of species, the % of that species in the mix, and the size of the ecological zone, 10. Create a new SUM() cell at the bottom of that column to represent the total cost of all the seed, 11. Create a new cell below the SUM() and key in the following formula: $\text{SUM}() / \text{ZONE ACRES}$ This gives you the seed price per acre for your current seed mix design. You can use this value to compare to your budget limit set previously, 12. Now, go back and adjust the %s in the seed mix so that the total % = 100% and so that the total budget per acre is at or below the maximum that you previously established, 13. Congratulations! You now have a seed mix design that is based on your design parameters and that follows good ecological practices, 14. The next step is to create one more column to hold the seed weights. Use this formula: $(\text{SEED PRICE}) / \text{MIN}(\text{PRICE A}, \text{PRICE B}, \text{PRICE C})$. This calculates the total pounds of seed you need for each species, 15. Next, copy paste the species and pounds for each zone, into a new tab in the spreadsheet. This is what you are going to send to seed vendors for pricing and availability,	Evaluate™
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	16. When you get a reply from the seed vendors, update your spreadsheet accordingly with prices and availability. Update the price per pound based on what they quoted and [delete] any prices for species that they do not have available. If your seed vendors do not have a species in your design, be sure to delete the % for the species. Doing these steps will automatically update your spreadsheet, 17. Re-evaluate the entire seed mix and update %s so that you still have 100% and check that you are not exceeding your price/acre overall budget, 18. Your seed mix design is now ready for manager approval, 19. Upon approval, you can send your final species and poundage requirements to each seed vendor for a final quote, or you can just start ordering seed. 20. Remember to do this process for each ecological zone (see Site Evaluation – Ecological Zones). A simple example of a seed mix design spreadsheet is here. Be sure to double-check a few things before moving on from seed mix design: ○ Is the total number of species in the seed mix in the 8-12 range, more or less? ○ Is your seed mix design within the overall budget for the project? Have you satisfied any per-acre or per-pound budget requirements? ○ Is the total number of pounds per acre broadly suitable for your type of project? ○ Have you double-checked that foreign or far-away genetic strains have been removed from the seed mix? ○ Are you certain that there are no non-native, weedy native, or non-local species included in your seed mix? ○ Are you certain that the core species in your design will be available at the time of purchase? Users of Evaluate™ can use the software to automatically create and adjust seed mixes and to create PDFs with their seed mix design for easy communication with the community, managers, and seed vendors.	
Carrier Selection	Introduction to Seed Carriers Seed carriers help a native seed mix to “flow” more easily and consistently through a seed drill or broadcast seeder. Carriers can be inert or another seed product. Inert carriers generally do not interact with your seed or impact the performance of the seed, but they can be expensive. If you are planning to use an inert carrier (e.g., sand, kitty litter, rice hulls), please refer to the Calibrating a Seed Drill section, or watch the accompanying YouTube video. If you plan to use a type of seed as your carrier, please continue reading. Sometimes it makes sense to use another seed as a carrier for your seed mix. While recommending a specific seed carrier for your meadow is beyond the scope of this guide, here are some generally useful guidelines: Choose a Seed Carrier <i>Rolled or crimped oats</i> – this can be a good all-purpose carrier and is normally easy to buy locally. Rolled or crimped oats have been flattened, which creates a lot of	

surface area and a little bit of tack to hold your seeds as they flow through the drill. Oats are more nutritious than your native seeds and can act as a sacrificial seed to feed hungry birds, mice, and voles. Rolled or crimped oats usually do not germinate.

Whole oats, winter wheat, or rye – these live, intact grains are used to “bulk up” budget seed mixes because they mask the fact that relatively few native seeds are being planted. Their role is to germinate quickly in the spring to hold soil, give a little bit of shade to the native seeds, and to give the client something to look at while the rest of the meadow is still deciding if it wants to germinate. Live grain carriers can grow densely and become unsightly to the point of requiring additional mowings, so be cautious about over-using them.



Figure 27 - This low-poundage conservation native meadow mix was “bulked up” with winter rye to make up for the low seed count, and to help stabilize soil while slow-germinating species wait to grow

Annuals – adding inexpensive annual and biennial species to the seed mix is a common tactic used when building meadows in public parks, side yards, and along highways. They basically play the same functional role as oats and wheat but are more colorful. Adding annuals can greatly improve initial public reaction and acceptance. Non-native annuals are widely considered to be “ok” to use, even in a restoration setting because they are not expected to survive past year 2.

Inexpensive Natives – Sometimes the best carrier is another native seed itself and, ideally, a species that should anyway be a part of the seed mix. Native carriers should be species that germinate readily, which often means they don’t require conditioning beyond a dry storage period. Native seeds are much more expensive, however. Here are some useful examples:

- For upland, mesic sites, consider using path rush (*Juncus tenuis*) and black-eyed Susan (*Rudbeckia hirta*) as carriers,
- For upland, dry sites, consider using purpletop (*Tridens flavus*) or brown-eyed Susan (*Rudbeckia fulgida*) as carriers,
- For lowland mesic sites, consider using deertongue (*Dicanthelium clandestinum*) or broomsedge (*Andropogon virginicus*) as carriers,

	○ For lowland wet or nearly saturated sites, consider soft rush (<i>Juncus effusus</i>) and fox sedge (<i>Carex vulpinoidea</i>) as carriers  Figure 28 - <i>Rudbeckia hirta</i> is a great filler species on upland dry sites, but it can be expensive and it fades out of a meadow very quickly	
Finalize Species List	Finalize Your Seed Mix By the end of this extensive exercise, you should have a functional seed mix design with enough information to defend each selection. If, for any reason, changes occur between the creation of the list and the ordering of the seed, ensure these changes are properly accounted for and approved by all necessary parties. Maintain all your seed and seed mix purchase records and retain the labels from all bags of seed. Grant programs often require you to prove that you purchased the correct species in the proper amounts. Plus, you, or someone after you, will want to know exactly what was planted so that they can understand what worked or did not work.	

DECISION POINT #2

By this point it should be clear that designing and planning a meadow is not simple. But the core ecological analysis that you just completed makes it substantially easier because you now truly understand what species your site can support. This brings up a key decision point, though: Can you and your stakeholders get on board with planting the species in this list?

It is quite possible that this species list differs from what might have been in mind for your meadow. It is important to select meadow species that are appropriate for your ecoregion and are sourced as locally as possible.

For example: On the left below is an example of a project where the organization wanted a warm-season grassland meadow despite the conditions being far too wet for that to be successful. In the end, the grasses either rotted out, or the seed never even germinated, and it returned to invasive cool-season grasses. On the right, however, the conditions for these warm season grasses were perfect and now they dominate the landscape.

The same seed mix is installed in two different places. The seed mix was appropriate for one site but not the other.



The picture on the left is an example of a project where an organization wanted a warm-season grassland meadow despite the conditions being far too wet for that to be successful. In the end, the warm season grasses failed and the meadow returned to invasive cool-season grasses.

On the right, however, the conditions for these warm season grasses were perfect and now they dominate the landscape.

CHOOSE VEGETATION MANAGEMENT STRATEGY				A
KEY QUESTIONS		OVERVIEW		
○ Which noxious species are present? ○ If noxious species are present, what’s the age and scope of the infestation? ○ What’s the size of the project area and site preparation budget? ○ What’s the desired timeline for control? ○ Are there relevant environmental factors that would impact preparation strategies?		Comprehensive weed management and site preparation are critical to successful meadow building. Implementation strategies will differ by project, but the outcome should be a project area with near-complete control of non-desirable species. Weeds and invasive species can quickly overwhelm a new meadow. This section describes the process for developing vegetation management strategy for your site.		
CHECKLIST				
STEP	TITLE	SUMMARY DELIVERABLE		DATE
1	ID Noxious Weeds	Re-evaluate the site to ensure identification of all non-desirable vegetation at and/or near the site.		
2	Financial Review	Review high-level budgets with decision-makers prior to making vegetation management decisions to establish financial guard rails.		
3	Environmental Factors	List the environmental factors that could impact control strategies.		
4	Cultural Factors	Consider the stakeholders and the potential implications for each vegetation management strategy (e.g., will neighbors tolerate the use of herbicides?)		
5	Accessibility	Assess the accessibility of equipment (e.g., sprayers, misters)		
6	Build Vegetation Mgmt. Calendar	Create a mgmt. plan based on the weeds present in the project site, considering phenology, taxonomy, and effective control methods.		
7	Consider Alternative Approaches	Evaluate the tradeoffs between chemical suppress and ‘organic’ methods. Remember to evaluate both short- and long-term costs.		
8	Control Timelines	Evaluate the preferred control mechanism against the realistic timeline to complete site preparation, and your budget.		
9	Control Tools	Determine the most effective tool for eradicating noxious weeds.		
10	Consider Planting Strategy Impact	Review the project planting strategy sequence against the vegetation management strategy to identify potential conflict.		
11	Validate the Plan	Solicit feedback from other practitioners.		
12	Select/Modify	Choose a strategy and communicate with relevant stakeholders.		
SUMMARY				
HOW TO KNOW WHEN YOU ARE FINISHED				
You are finished with this step once you are confident that you have identified all the invasives in and around your meadow and have confirmed that you have the time, budget, and community support to treat them all effectively. The best practice is to keep all your constituents informed of your activities to avoid concerns and complaints.				

CHOOSE VEGETATION MANAGEMENT STRATEGY **B**

Introduction	Inadequate suppression of competing vegetation, particularly annual and perennial grasses, is often cited as a top cause of meadow project failures. Poor species selection is another common reason for failure. Vegetation management can be much more nuanced than it first appears. Interactions between the choice, timing, action, and efficacy of various control techniques directly impact when it is safe to consider seeding a meadow. Hence, the need for a plan. Economizing or experimenting with vegetation management is not recommended because it can put an entire project at risk. This section explores the use of synthetic herbicides and some other options for controlling unwanted vegetation. The effects of choosing a control method on the timing of follow-up activities, including seeding and establishment, are also discussed. The preferred vegetation management strategy is nearly always going to be the application of herbicides by licensed professionals with ample experience with building meadows; they know which herbicides to use, how much to use, how to apply them, and when. Hiring out the vegetation management to a professional meadow-building contractor is often the least expensive and least risky option.	
Noxious Weeds and Existing Natives	Identify All of your Noxious and Problematic Weeds Review your documentation from the Site Evaluation step to see what invasives and other weeds were present and make a list. If it has been more than a year since you performed the site evaluation, or you didn't record the weeds, go back to the meadow project site and create a list of all the noxious weeds, invasives, pasture grasses, and annual grasses present in each ecological zone. It is important to record weeds by ecological zone because of the implication of proximity to water or the presence of standing water or saturated soils. For help in understanding noxious and problematic weeds, consult your state extension agency or state Department of Agriculture websites. The Pennsylvania resources are listed in the column to the right. Each invasive that you identify poses a threat to your future meadow and will need to be thoroughly removed during site preparation activities. Some invasives require several years to fully suppress, so incorporate this time into your overall site preparation schedule. Weeds do not respect property lines, so it is in your interest to talk to and ask neighboring property owners if you can identify and control invasive and noxious weeds on their property, too.	<u>Herbaceous Weed Treatment</u> <u>Penn State Extension Invasive Plants</u> <u>PA Controlled Plant and Noxious Weed Lists</u>

Double Check for Existing Native Vegetation

List any existing native plant species in your meadow that you would like preserve. Many meadow projects already have ample native plant species populations that you might or might not recognize. It is generally considered to be a waste of resources to spend money to kill native plants in a meadow only to spend money to buy seed and replant them. The image above shows a field scheduled to become a native meadow, but it already had many desirable native meadow species present within it. A typically prescribed glyphosate application would have removed all the existing natives from this meadow and required replacement, benefiting only the chemical companies and the seed mix marketers. Always check for the presence of desirable natives in your new meadow before deciding your vegetation control strategy.



Figure 29 - This meadow was scheduled for a complete burndown using glyphosate before it was saved by a staff ecologist. The vegetation management strategy had to be completely changed to preserve the pre-existing native vegetation

Assess the Surrounding Vegetation

Assess the natives growing in the periphery of your new meadow and answer these questions because the answers could impact your control plan.

- Are there desirable native plants that should be protected from herbicide?
- Is there wildlife nearby that will be impacted by specific herbicides but not others, or by the addition of adjuvants (other additives used to aid application in some way)?
- Are native plants located separately from the invasives we are targeting or are they mixed in? There may be ways to avoid “friendly fire” through proper herbicide selection, adjusting timing, or choosing the right application method.

[Invasive.org](https://invasive.org)

[Invasive
Plant Cards](#)

[Plant
Invaders of
Mid-Atlantic
Natural
Areas](#)

[National
Invasive
Species
Information
Center](#)

Financial Review	Understand your Budget Before continuing through this section, it is a good idea to have a figure in mind for how much you are willing to spend on vegetation management, and even the whole project. As you delve into understanding the different approaches to vegetation management and different timelines for control, you will see that the cost of these strategies can vary greatly. Having your budget constraints in mind will help you to narrow down which options will work and which are beyond your means.	
Environmental Factors	Evaluate Potential Environmental Concerns In most terrestrial cases most herbicides labelled for use in turf and rangeland are suitable for weed suppression during meadow building, if there are no open water sources nearby or where groundwater does not approach the soil surface. But if you have ponds, streams, wetlands, vernal pools, or any areas within 500’ of permanent or temporary open water, your herbicide options will be restricted by law and the amount of time required to achieve effective control can take years using alternative techniques. Open water sources or ground water can also limit mechanical techniques as these activities may cause excessive soil erosion or may be wholly impossible due to machinery weight. NOTE: In some municipalities with high water tables, several herbicides are completely prohibited. You MUST thoroughly read the label of any herbicide that you plan to use. DEP fines and other associated legal costs are HIGH if you are found to have applied an herbicide in an area for which its use is restricted. Controlling weeds near open water sources often requires the use of herbicides with lower effectiveness than what might otherwise be used and can extend the amount of time required to achieve effective control by a season or two. For example, pre-emergent herbicides effective against annual weeds are prohibited for use near water. And, reed canary grass (<i>Phalaris arundinacea</i>) and phragmites (<i>Phragmites ssp.</i>) are challenging species to control effectively and their proximity to water limits your choice of herbicides. Repeated applications may be required, for up to two years with these two species, to achieve effective control. Remember to consider these factors when planning a meadow project and include an appropriate amount of time in your site preparation plan.	<u>Applying Herbicides in and Around Water</u>

Cultural Factors	Consult with Stakeholders Consult with the public or other interested stakeholders about the weed control plan that you are considering and solicit their feedback and support. You want to avoid the unpleasant situation of being confronted by an angry homeowner or resident during the application of synthetic herbicides. In some cases, a resident or user of the space can cause a temporary or permanent cessation of meadow building activities. Take the time to solicit public input and take their concerns seriously when planning your vegetation control.	
Accessibility	Assess Site Accessibility Evaluate any impact the site itself might impose on your vegetation control calendar. While the physical configuration of your new meadow site doesn't affect your choice of control methods much, certain features and limitations could affect HOW you implement your control plan. If the site has limited access in any way, you might be forced to downsize your control equipment from large spraying equipment to backpacks and hand work. Performing vegetation control using small equipment can greatly extend the amount of time required and drive costs up significantly and should be reflected in your control calendar. Common questions to ask include: What is the topography like? Is it flat or steep? Are there large rocks, downed trees, gully/depressions, or waterways that will be difficult to cross? How many acres are you treating? Are conditions uniform across the whole site or are some areas more accessible than others? Look at the landscape through the lens of a future version of yourself applying herbicide. Site accessibility will influence equipment choice, labor needs, application method, and overall feasibility of certain treatments.	
	Build Your Vegetation Management Calendar Confirm the invasives and weeds you will be targeting with an outside consultant. Missing a problematic plant in your control plan could be a costly mistake. Understand how the use of chemical controls might impact adjacent native plant populations and wildlife even if they are not directly treated. Make an EXCEL list that lists each species to be controlled and assign each to a category: annual graminoid, perennial graminoid, herbaceous plants (non-grasses/sedges/rushes), woody shrubs and vines, and trees. Consult external resources for preferred control methods for each species that you need to control, and which control methods you should	<u>Herbaceous Weed Treatment</u> <u>Penn State Extension Invasive Plants</u>

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	<i>Note: It is beyond the scope of this document to provide specific guidance on the most effective control technique for each invasive, noxious, or undesirable plant species. Consult with a regional meadow building consultant if you need assistance building your vegetation management calendar. Agricultural consultants might only be familiar with chemical controls used on farms and might not be sensitive to the unique needs of meadow builders.</i>	
Consider Alternative Approaches	Consider Alternatives to Chemical Control If building a meadow under 0.5-acres, consider alternatives to using synthetic chemicals to control unwanted vegetation. Please consult Xerces Society publications for more information on organic site preparation techniques. There are scenarios where stakeholder preferences, HOA rules, government regulations, and other factors might prohibit the use of herbicides to prepare a site for a new meadow. Or you might simply want to avoid the use of chemicals in building a small meadow. This section briefly evaluates the commonly cited alternatives to chemical controls: <i>Note: The most cost-effective and efficacious method for controlling unwanted vegetation is the proper use of herbicides applied by an experienced, licensed technician or specialized meadow building organization. Other methods do work but can be expensive or take many years to achieve effective control.</i> Tilling/Cultivation/Soil Removal Repeated cultivation and sod removal are intrusive techniques that require heavy equipment and large vehicles to remove large amounts of material. Cultivation and sod removal is considered appropriate only for very small backyard meadows in highly residential areas or where public sentiment is strongly against the use of herbicides. The cost for these techniques can exceed the value of the meadow due to the number of times that the technique must be used, associated erosion control materials, and permitting costs. <i>Note: Be sure to communicate with your County Conservation District if soil disturbance is part of your vegetation management plan as you might need to submit an Erosion & Sediment Control (E&S) Plan that could interfere with the building of your meadow. Seed drills are considered safe to use and generally do not require permits.</i>	NRCS Control Mechanisms PA E&S Plan Resources PA Pesticide Applicator Resources Xerces Organic Approaches Best Management Practices for Wildland Stewardship



Figure 31 - This half-acre meadow was repeatedly tilled and covered with straw due to the public's concern with the use of herbicide. The meadow eventually failed due to its extensive Japanese stilt grass seed bank, which quickly overran it

Solarization

Solarization is the practice of laying down plastic sheeting or tarps over the ground to suppress all perennial and annual vegetation. Solarization is a popular technique amongst hobbyists and homeowners but is quite expensive on a large scale. It costs about \$5000 per acre to install ground cloth, and it must remain in place for at least two years for adequate control. In some instances, ground cloth alone cannot fully suppress some pasture grasses and other weeds (they just go dormant) and the need for an herbicide follow-up treatment is often required. Solarization might not heat the soil to sufficiently high temperatures to damage seeds enough to prevent future germination. It is not uncommon for a recently solarized field to erupt in annual weeds, which require frequent mowings or chemical controls.



Figure 32 - Solarization of a meadow site can be performed and is occasionally successful, but takes a long time and can become quite expensive for large sites

	Sheet Mulch The sheet mulch technique employs a degradable form of soil covering, usually cardboard or kraft paper, with a layer of clean soil spread on top of the paper. Seeds are sown into the soil covering where they can germinate when irrigated sufficiently. If the paper layer is thin enough, the roots of newly germinated seeds might penetrate the paper and enter the soil profile where they can continue to grow normally. The paper must also be dense enough to prevent pre-existing vegetation from growing through the layer. This technique works best if some other technique is used to terminate or sufficiently damage the existing vegetation so that it cannot grow through the paper. This technique works well on a small scale but is generally considered inappropriate for building meadows due to its very high cost per square-foot.	
Control Timelines	Evaluate Control Timelines Different invasive species or unwanted plant species infestations respond differently to different control methods and might require retreatment. The number of retreatments is highly specific to the species themselves, the site's conditions, the available control techniques, and how long the invasives have been present at the site. While this guide cannot provide definitive guidance for every situation, read through the following commonly encountered scenarios, find the best match, and then incorporate the number of anticipate retreatments in your vegetation control plan. Clean Turf-to-Meadow Conversion For well-maintained turf and pasture areas with limited-to-no Stilt Grass (<i>Microstegium vimineum</i>), Carpgrass (<i>Arthraxon hispidus</i>), or Basketgrass (<i>Oplismenus undulatifolius</i>) infestations, you should be able to complete weed suppression in as little as 3 months, and almost always within a single season. Start chemical treatment in June/July and repeat as necessary to suppress all vegetation through November, at which point you should be safe to seed. Clean Pasture-to-Meadow Conversion For clean, well-maintained pastures and fields without notable populations of perennial and annual herbaceous weeds, expect weed control to take about 6-9 months to treat both the cool and warm-season grasses and other perennials. If you start weed control in April of a given year, you should be able to seed in November of the same year. Weedy Pasture-to-Meadow Conversion For weedy pastures and fields that have notable populations of Mugwort (<i>Artemisia vulgaris</i>), Thistle (<i>Cirsium ssp.</i>), Teasel (<i>Dipsacus ssp.</i>), Reed Canary Grass (<i>Phalaris arundinacea</i>), and other annual or perennial weeds and woodies, expect weed control to take a full 18-month duration or two growing seasons. If you start weed control in April of a given year,	Weeds & Herbicides Intro

you should be able to safely seed in the winter of the following year. Sowing a sacrificial annual ryegrass or oat covering in the spring of the second year can help to reduce erosion and limit the number of annual weeds.



Figure 33 - Extensive reed canary grass (RCG) infestations can take several years of aggressive controls before it is safe to seed a new meadow

Heavy Stilt Grass and Annual Invasives

For areas with intensive annual invasive pressure such as Stilt Grass, Carpgrass, or Basketgrass it is safer to assume that weed control will last at least two full growing seasons and sometimes even three years.

There are special site preparation techniques that might be required for areas with intensive annual invasives that can include a combination of herbicides, temporary conversion to turf, or employing a different seeding strategy. Consult with an experienced meadow builder before planning weed control for an area with a heavy annual invasive infestation.

Woody Invasives

Some perennial woody weeds, like Olive (*Elaeagnus umbellata*), Barberry (*Berberis ssp.*), Honeysuckle (*Lonicera ssp.*), and others often require multiple seasons for complete control. But unlike herbaceous weeds that are very difficult to control once the meadow is growing, you can normally continue to treat woody invasives one by one at any time. If you start control in the spring, you should be able to seed in the same fall.

Special Cases

Determine if you have a significant number of invasives that do not respond well to normal herbicides, solarization, tilling, or sheet mulching. These invasions often require highly specialized chemicals that can cause significant environmental damage if misused.

	Below is a partial list of invasives that might require special control techniques that you might not want to attempt yourself. ○ Japanese Knotweed (<i>Reynoutria japonica</i>), ○ Lesser Celandine (<i>Ficaria verna</i>), ○ Black Swallow-wort (<i>Vincetoxicum nigrum</i>), ○ Leafy Spurge (<i>Euphorbia esula</i>), ○ Incised Fumewort (<i>Corydalis Incisa</i>) Remember that you DO NOT want to plan any seeding event until your invasive and noxious weeds, including annuals, are around 98% controlled, or better. If you rush a meadow planting the quality of your meadow is likely to be substantially reduced and might have to be rebuilt.	
Control Tools	Choose Your Tools For each treatment line item on your control plan, note the specific technique or tool that you plan to use. Here are the most common techniques/tools used during vegetation management and when they are most employed: <i>Tractor and Large Boom</i> – For sites over 10 acres where the control plan is to apply a simple broad-spectrum herbicide, a traditional agricultural tractor with a boom sprayer setup is normally the most efficient option. Boom sprayers offer fine dosage controls and wide, even coverage. Use when you are trying to suppress or terminate 100% of all competing vegetation. Avoid using near areas with native vegetation or close to hedgerows to limit damage due to drifting spray. The typical case is an old hayfield or corn/soy field that you are converting to a meadow and there is little to no expectation of protecting any natives already present. <i>Utility Task Vehicle (UTV) and Small Boom</i> – For smaller spaces up to 10 acres where you want the efficiency of a boom but the flexibility of a smaller rig to weave in and out of native vegetation areas, wet spots, or other features that you want to avoid or protect. Small booms have lightweight arms and valves that allow you to turn off and flip up and arm to get into tight spaces, maneuver around trees, or navigate gaps in hedgerows. The typical case is a lawn-to-meadow conversion. <i>UTV and High-Pressure Wand</i> – This setup is most appropriate for spot spraying over a large meadow project. The UTV allows you to travel between infestation areas quickly and the high-pressure wand provides efficient coverage of your control target.	

The typical case is the rapid removal of non-native or invasive vegetation from a field that has at least 30% natives already present to prepare it for overseeding or reseeding.



Figure 34 - Low-volume, low-pressure setup for spot treating large meadows in remote locations

UTV and Low-Pressure Wand – This setup is for large-acreage, low-volume applications, usually when treating a specific invasive from the meadow, and is generally not used to prepare an overall meadow project.

A typical use case would be the post-implementation treatment of Mugwort or thistle from a new meadow.

Backpack – Backpacks are designed for small-acreage, low-volume applications, usually when treating a specific invasive from the meadow, and is generally not used to prepare an overall meadow project.

A typical use case would be the post-implementation treatment of Mugwort or Thistle from a new meadow.

	<i>Battery-Powered Tanks</i> – These small, handheld battery-powered sprayers are excellent for precise applications of herbicide to individual plants that are deemed a threat to a new meadow. An alternative to hand-pulling. Normally used to apply a specialty herbicide with limited action. <i>Hand-Pulling</i> – Yes, hand-pulling remains a viable technique to remove small, recent incursions of invasives into a meadow, especially when the use of herbicides could create openings for new invasions. Not suitable for preparing a new meadow.	
Consider Planting Strategy Impact	Upon review of the “Choose a Planting Strategy” section of this document, it is best to return here and ensure there are no conflicts with your planned vegetation management strategy and your planned planting strategy. Timing The largest consideration is generally the timing of the two events. For instance, if you are planning one last use of pre-emergent herbicide in Spring to quell annual invasives before planting, this could push your seeding time to Fall as otherwise you may risk harming the seeds you just planted. You also want to have a plan in place in case your vegetation management gets pushed back due to continued invasive pressure longer than expected. If this happens, depending on your strategy, you may have to wait a whole year longer for the right time to seed.	
Validate Plan	Review your Plan Look back over your plan and make sure that you haven’t overlooked important details and that you have backup plans for if anything needs to change. This step should be repeated every time there is any change to this or other plans. If this isn’t done, you run the risk of making an error like seeding earlier than you should, and this can lead to issues down the road.	
Select/Modify	Get Final Approval Once you and your team have reviewed and approved the plan, revisit with your stakeholders and review the plan with them. Be ready to justify any part of your plan with tangible evidence and/or reasoning. Take their feedback and adjust as needed. Don’t leave this section until you have a thorough plan that has been fully approved.	



Figure 35 - Steep slopes, soggy areas, groundhog holes, rocks, excessive organic matter, logs, trees, and fences are just some of the challenges facing a seed drill operator. Always thoroughly walk your meadow site before transporting and deploying your seeding equipment

PREPARING TO SPRAY				A
KEY QUESTIONS		OVERVIEW		
○ What kind of plants are being targeted? (forb, grass, woody) ○ What non-target species are present and what is the degree of mixing with invasives? ○ What is proximity to water? ○ How accessible is the site?		This section is for practitioners that have decided to implement a synthetic herbicide approach to suppressing weeds and invasives; organic practitioners should review literature on appropriate timing/technique for their practice. Rarely is a single application of a single herbicide effect. Most scenarios involve a collection of various herbicides tailored to different kinds of plants, applied together or separately, at various rates and times of year, and with multiple application methods. Thinking through the best approach is like preparing for battle. You must know your enemies, when they are weakest, and how they can best be subdued while not causing undue destruction to the surrounding community.		
CHECKLIST				
STEP	TITLE	SUMMARY DELIVERABLES	DATE	
1	Identify Nearby Native Species	Identify desirable vegetation and their location in the landscape related to non-desirable vegetation.		
2	Update Vegetation Management Calendar	Update your Vegetation Management Calendar with new and/or relevant information.		
3	Pesticide License	Obtain a pesticide applicators’ license. They are available to anyone, and you learn many valuable lessons. Or bring your license into compliance, if necessary.		
4	Choose Products & Read Labels	Select the product you will use for your first two (2) spray events. Read the product labels as they include important and valuable information about target species, optimal rates, and times.		
5	Choose Adjuvants & Read Labels	Select the additives or adjuvant products you will use (e.g., blue dye, so that sprayed areas are visible for a short time).		
6	Confirm Application Method & Equipment	Clean and test your spray equipment and/or other tools necessary for the application.		
7	Determine Application Rate	Decide on desired application rate for first two (2) applications.		
SUMMARY				
HOW TO KNOW WHEN YOU ARE FINISHED				
You are finished with this step once you have determined which herbicides and adjuvants you will be using, how many times and when you will be using them, at what rates, and using what application method. You will have tested your equipment and know that it can do the job when the time comes.				

PREPARING TO SPRAY		B
TITLE	DESCRIPTION	LINKS
Introduction	If you've chosen to complete vegetation management by carefully using herbicides, there are several tasks that will need to occur so that you are properly prepared when the time comes, and you'll want to give yourself a couple of months to do so. This is because there may be changes to your plan based on factors such as herbicide availability and cost, missed or underreported species, and licensing updates that need to be made. This also gives you ample time to understand the necessary safety gear. You'll want plenty of time to address any of these possible concerns and still be able to have everything ready for this extremely important task.	
Reassess Surrounding Native Species	Reassess Nativity of Surrounding Vegetation Even if you have already performed a thorough site evaluation and fully documented your native species, it is useful to return to the site in advance of herbicide application for this purpose. Look to see if there were native species you missed on your prior visits, especially if your site evaluation occurred during a time of year when many species were dormant or challenging to identify. Denote No-Spray Zones If there are significant populations of predominantly native species, use spray paint or other markers to demarcate these as areas to avoid herbicide application. If there are individuals of high ecological value mixed in to a largely invaded area, denote them with brightly colored flagging tape. Do the same for any bird nests or other clearly visible animal homes. If you are not the applicator, make sure the field lead knows to avoid these spots.	<u>Best Management Practices for Wildland Stewardship</u>



Figure 36 - Use highly visible devices to mark areas that should be protected during spraying or mowing activities

Observe Native Wildlife

Observe native wildlife species using the site, especially birds, insects, and amphibians. Note areas with high pollinator activity, nesting behavior, or frequent animal movement. If significant populations are present, find out at what point in the season they are most likely to be foraging or breeding. Find out when plants in your meadow are most likely to be flowering. Consider timing throughout a given day- many insects are most likely to be active during the period of day from mid-morning to early afternoon.

Employ Your Observations

Use your observations of native plants and wildlife to guide product selection, application method, and timing. For example, delay spraying until after flowering has finished, switch from broadcast to spot treatment in areas with high animal activity, or delay spraying until quieter periods of the day. Consider selective herbicides that you may be able to apply on invasive weeds while not affecting nearby native species, such as a graminicide for Japanese Stilt Grass in a field where it cohabitates with native forbs like Goldenrod.

Understand Potential Calendar Changes

After you've observed the project site again, if you have found that there are native or invasive species that you missed during your previous visits, you need to see how these new observations may affect the timing of your planned sprays.

Adjust Accordingly

As mentioned in the previous section, it may be that you need to add a timeline for a previously unnoticed invasive species. Depending on the species, this can considerably change the amount of time it will take to get successful suppression. This is why it is important to observe a project

**Update
Vegetation
Management
Calendar**

**PA
Controlled
Plant and
Noxious
Weed Lists**

[Invasive.org](https://www.invasive.org)

	site multiple times before planning vegetation management as it leads to a much lower likelihood and last-minute changes. On the other hand, it may be that you need to plan to work around when pollinator activity is especially high. And this can be as simple as planning to spray early in the morning or late in the afternoon when pollinators are less active. Whatever it may be, you need to note these changes in your calendar and if there are considerable changes to the timeframe for successful suppression, you should notify your stakeholders.	
Pesticide License	If your business does not have the necessary pesticide applicator license, follow the link to the right to understand and perform the proper procedures to obtain one. If your business has a pesticide license, make sure that it is not expired. Also, make sure that whoever is leading the herbicide application has an active pesticide applicator license as well. If they do not, follow the link to the right to understand how to obtain this. These licenses take time to obtain, possibly more than a couple of months, and therefore should be planned to do so far in advance of any herbicide application. If these licenses are not obtained by the time you are planning to spray, you will have to wait until this is the case. If you are found to be applying herbicide without the proper licenses, the individual and business can face disciplinary actions and fines.	<u>Business Pesticide Applicator License</u>
Choose your Products & Read Labels	Choosing your Products With the decisions of desired effect and length of activity figured out during the making of your vegetation management calendar, you now have to find the products that best match your needs. There are many that serve the same or a similar purpose, so read descriptions as well as labels carefully, looking for changes in products such as the number of active ingredients or the percentages of those ingredients in the product. There are also many generic brands of the name brand products, and these are just as effective and usually a little cheaper. It also helps, for example, if you want to find another company that makes a Glyphosate product to avoid giving money to Bayer Monsanto. To help narrow the types of herbicides you are looking for depending on your needs, consult the link to the right labeled “Herbicide Selection and Use.” This is a downloadable guide provided by Penn State Extension.	<u>Herbicide Selection and Use</u> <u>Reading a Pesticide Label</u>

Read the Label

Every herbicide comes with a “label.” The word label is an inappropriate term considering its length is more like a short novel. Unfortunately, it will probably be the driest and most tedious novel you ever read. That doesn’t mean you get to skip this part though. Every herbicide label contains vital information you will need to know before you even think of opening the container. Download the label online or use the hardcopy attached to every new container.

Elements of a Label

There are too many elements of the herbicide label to list here, but some of the most useful are:

- EPA registration number (you will probably have to write this down on a sign someday)
- Active ingredient (this is different from the brand name and describes the actual chemicals the herbicide contains)
- Acute toxicity (describes how toxic the product is to humans and animals)
- First Aid statement (describes what to do if someone is accidentally poisoned)
- Directions for mixing and applying (we will cover this in subsequent steps)
- When people/pets can re-enter the premises after spraying concludes
- How to store and dispose of the product

For a full guide to reading herbicide labels, consult the attached link.

DO NOT skip reading the herbicide label and,

DO NOT wait to read the herbicide label until spray day.

There is important information on the label that will inform planning and the acquisition of additional chemicals and materials.



Figure 37 - Herbicide labels provide signal words, legal dosage rates, and approved weeds

Confirm Application Method & Equipment	Do the Application Method & Equipment you chose still fit the project? Inevitably during the process of planning, things change. New obstacles arise. Certain equipment breaks, or is no longer available for rental, or opinions change and a client no longer wants to use herbicides. Before you can begin your chosen strategy, you must ensure that your previous choice still works, that it has the support of the land manager and that it is a viable strategy that will lead to suppression of the target weeds. If you need to change your strategy, revisit the previous section and choose the next best strategy that works for your project.	<u>Pesticide Application Equipment and Methods</u>
Determine Application Rate	Select the Appropriate Application Rate Consult the label again. Start by selecting an application rate within the labeled range for the chosen herbicide and method. Product labels typically provide a range (for example, 2.0-4.0 oz per acre). Where you fall within that range should be based on target species sensitivity, infestation density, plant growth stage, and whether the area has been treated previously. Lower rates are often appropriate for light infestations or early growth, while higher rates may be needed for dense or established populations. In some cases, rates can also be adjusted to reduce impacts to desirable species. For example, when treating Japanese stilt grass interspersed with native forbs near wetlands, choosing a lower rate (such as ~30 oz/acre for labeled products) may suppress stiltgrass while minimizing collateral damage. Calculating Multiple Products When tank mixing multiple herbicides, confirm on each label that mixing is allowed. Select rates for each product independently based on target species, For example, if applying 2 oz/acre of Product A and 4 oz/acre of Product B at 20 gal/acre, add both to the same 20-gallon batch. Calculate each product separately, then combine. Never assume that rates can be reduced simply because products are combined. Always confirm that your selected rate falls below the product's maximum annual application limit, which exists to protect surrounding ecosystems and water quality.	<u>Backpack Sprayer Calibration for Woodland Applications</u> <u>Boom Sprayer Calibration</u> <u>USFS Sprayer Calculations</u>

Calibrate Your Sprayer

Once a target rate is chosen, determine your spray volume (gallons per acre). This requires calibrating your equipment using water. For tank sprayers, spray volume depends on pressure and walking speed. For boom sprayers, it depends on nozzle output, boom width, and vehicle speed.

**APPENDIX K
CALIBRATIONS, CALCULATIONS, & CONVERSIONS**

SPRAYER CALIBRATIONS AND CALCULATIONS¹

TABLE K - 1. SPRAYER CALIBRATIONS AND CALCULATIONS

Calculation	Example	Formula
1. Determining the Gallon per Minute (GPM) required of nozzles to achieve a given Gallon per Acre (GPA)	Example 1 You want an output of 20 GPA. Your nozzles are 20 feet apart. Your field speed is 5 MPH. How much do you need to collect from each nozzle to achieve 20 GPA? $20 \text{ GPA} \times 5 \text{ MPH} \times 20 = \frac{2000}{5940}$ = 0.336 GPM per nozzle Example 1a - Convert Gallons per Minute (GPM) to Ounces per Minute (OPM) From Example 1 you have collected 0.336 GPM from each nozzle. $0.336 \times 128 = 43 \text{ OPM per nozzle}$ Example 1b - Convert OPM to GPM You have collected 43 OPM from each nozzle. $43 \text{ OPM} / 128 = 0.336$	Formula 1 $\text{GPM} = \frac{\text{GPA} \times \text{MPH} \times W}{5940}$ GPM = Gallons per minute from one nozzle GPA = Gallons per acre W = nozzle spacing (inches) or: = spray width (inches) if using a broadcast or: = row spacing (inches) divided by the number of nozzles per row. MPH = Field speed in Miles Per Hour 5940 = a constant Formula 1a $\text{OPM} = \text{GPM} \times 128$ Formula 1b $\text{GPM} = \text{OPM} / 128$

Figure 39 - Excerpt from a calibration calculator by the USFS

Example: If your label calls for 2 oz/acre and your calibrated sprayer applies 20 gallons per acre, you would add 2 oz of product to every 20 gallons of water. Accurate calibration ensures you deliver the preferred rate without over or underapplying.

Taking the time to calibrate and calculate rates properly is one of the most important steps in vegetation management- it improves control, protects non-target species, and prevents wasted product.

Reassess Proximity to Water

Reassess Proximity to Water

Before spraying, identify the nearest standing or flowing water and confirm current site conditions. If water is within your spray zone, pause and verify that your product is labeled for aquatic use- otherwise, do not apply. Many products require buffers of 50 feet or more, so always defer to label requirements.

Applying Herbicides in and Around Water

If working near a dry streambed, confirm there is no standing water present and check the short-term weather forecast. Avoid non-aquatic products if rain is expected. When water is nearby, adjust your plan by switching to aquatic-labeled products, tightening spray patterns, using wicks or spot treatments, or postponing work until conditions are suitable.



Figure 40 – An ArcheWild® project manager reinforcing the rules related to the use of herbicides near water.

CHOOSE A PLANTING STRATEGY			A
KEY QUESTIONS		OVERVIEW	
- Which species dominate your seed mix designs? Are these species commercially available? - What is the size of the project site? - What is the timeline for establishment? - What are the available planting methods? - What is the budget for planting? - What are the expected site conditions at the time of planting?		The planting strategy aims to determine the optimal planting methodology and timeline for the site and chosen species. Planting strategy considers the requirements and availability of the desired species as well as the optimal timeline for establishment. Although budgets are a factor, they are secondary to effective and efficient seed installation. After completing this section, you will have determined the timing of planting and the methodology for installation.	
CHECKLIST			
STEP	TITLE	SUMMARY DELIVERABLES	DATE
1	Financial Review	Review high-level budgets with decision-makers prior to making planting decisions to establish guard rails.	
2	Timeline for Establishment	Develop a project sequencing document that delivers the expected vision for the meadow on schedule. This informs future planting strategy decisions.	
3	Research Seed Requirements	‘Write’ down the germination requirements of every species on your list. Some species are best planted in fall, while others are best to sow in spring. Some are surface-sown, and some get drilled. Some benefit from pre-conditioning.	
4	Site Conditions	Identify site characteristics that would impede equipment access and/or efficacy on site.	
5	Understand Seeding Strategies	Research the relevant factors that determine seeding efficacy.	
6	Consider Vegetation Mgmt. Strategy	Review the project planting strategy sequence against the vegetation management strategy to identify potential conflict (i.e. you want to seed two months after applying pre-emergent).	
7	Choose Your Strategy	Determine the seeding strategy that delivers the seed at the appropriate depth during the appropriate season.	
SUMMARY			
HOW TO KNOW WHEN YOU ARE FINISHED			
You have developed a planting strategy that considers ecological and cultural timelines using equipment suitable to the type and scale of project. You should have a good understanding of when and how you will plant the meadow, and if pre-conditioning the seed could benefit outcomes.			

CHOOSE A PLANTING STRATEGY		B
TITLE	DESCRIPTION	LINKS
Financial Review	Before choosing a planting strategy, try to set a budget to work with before continuing. This is because the different methods outlined below all vary in price based on factors such as site size, site conditions, and rental costs, among others. Review your budget and have this number ready as you explore the different seeding methods and their associated costs.	
Timeline for Establishment	Timing a meadow seeding is not as simple as choosing Fall or Spring and planning the work around that. There are factors that impact timing as well as advantages and disadvantages to seeding at different times of year, and understanding these is crucial to ensure you time the seeding of your meadow correctly. The below sections discuss different factors that impact your choice of timing: Consider Cultural Factors It's important to remember as you're planning your approach to seeding that the establishment process takes time and will not always look beautiful, especially for the first couple of years. Make sure to remind your stakeholders of this as well as to understand if they have any concerns. There are approaches to seeding that can shorten this timeline. Below are several different scenarios that may require different approaches: <u>Remote Project Site</u> – for a project site that is far from many prying eyes, such as one on a large tract of private land, there may be little consideration for aesthetics. In this scenario, a simple seeding with a cereal cover crop with plans for mid-season mows (Rye or Oats) may suffice as the landowner knows that it will take time for the grasses and forbs to germinate and establish. <u>Suburban Project Site</u> – because there are prying eyes in a suburban setting, there may be more consideration that has to go into creating more aesthetic appeal in those first couple of years of establishment. After all, very few people like the look of seven-foot-tall cereal grains. In this case, using a showier cover crop such as a quickly germinating native forb (Black-eyed Susan, for example) can help to alleviate the stresses from stakeholders and passersby when the meadow is blooming yellow in the early Summer in its first couple of years. These do eventually fade out but will be replaced by the species that take longer to germinate and/or establish, such as Wild Bergamot (<i>Monarda fistulosa</i>) or New England Aster (<i>Symphyotrichum novae-angliae</i>).	Fall vs. Spring Seeding Establishment from Seed

	<u>Urban or Residential Site</u> – where there are perhaps even more prying eyes and therefore even higher standards for aesthetics, such as at an office building or town center, serious consideration may need to be given to shortening that timeline for establishment even more while also adding more color. While establishing the bulk of the planting cannot be pushed forward, there are alternative ways to get more color, more quickly. It is feasible to incorporate non-native annuals or even plugs to help speed this process along. These strategies are often not used because they are rather expensive, they are indeed upgrades. Still, they can be utilized for smaller sites, like the ones mentioned above. Non-native annuals do have to be seeded in the Spring as they don't survive Pennsylvania winters, however, they quickly germinate and provide lasting color throughout the first year of a meadow. Alternatively, plugs may also be used, usually as accents or focal points. These plugs are generally made up of some of the same species that were seeded in the meadow, but will guarantee some color from first-year blooms. Invasive Pressure As has been previously discussed, no seeding should happen if there is continued substantial invasive pressure in the project area. Even if this means holding seeding off for another season or two, this delay will be better than trying to manage this invasive pressure after the fact. Many meadows have failed or been abandoned because the project was rushed and seeded before there was thorough vegetation management. Herbicide Residual Effects Just as with invasive pressure, it's important to delay seeding if there are concerns of herbicide continuing to linger in the soil. This is only a concern with herbicides with long-term soil activity, such as pre-emergents, Clopyralid, and Imazapyr. Wintertime Temperatures Depending on the type of seed you are planting, there are important considerations to keep in mind. For some of our native plants, stratification, the process through which seeds are exposed to a freeze-thaw cycle, is one of these. This process naturally happens over the late Fall, Winter, and Early Spring. • Forbs (flowering plants) – many of our native forbs need to be exposed to this cycle to break dormancy and therefore to germinate. If you are planning to seed in Spring, it is suggested that you artificially stratify species that need to go through this process, so they are ready to germinate right when they hit the soil. Without going through this process before being seeded, these plants may	
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	not germinate until after the following winter and it is possible to lose a large amount of seed to rot and predation over that year - Grasses and Native Annuals – many of our grasses, sedges, and native annuals do not need to go through this cycle. This means the moment they hit the soil in Spring and temperatures begin to rise to their ideal, they will begin to germinate. If you are planning a fall seeding, you may lose some grass or annual seed to rot and predation. Remember, though, that most of these species drop seed in the Fall, so they can certainly survive the Winter before germinating - Non-native Annuals – for times when appearance is very important for a new meadow, some folks may elect to use more expensive non-native annuals over traditional cheap, but unaesthetic cover crops. These do not survive our winters, which is important, especially if you are planning a Fall seeding, as you will need to plan to return to the site to seed the non-native annuals in the Spring Three-Pass Method A scenario in which partial seeding may occur is if there is still a large amount of broadleaf weed pressure in the project site. - In this case, the first pass made is the seeding of the grasses that are to be included in the meadow, and this may occur in Spring or Fall. This allows these grasses to begin growing while also allowing the rest of that following growing season to manage broadleaf weeds using a broadleaf-specific herbicide. - The second pass, therefore, would be a follow-up seeding of all broadleaf plants in the meadow if you have finally obtained sufficient control of those broadleaf weeds and the grasses are well-established. - The third pass would be the addition of any plug species that could not be found commercially available or contain highly valuable local genetics. This may of course not be applicable to your project. And it is important to remember that splitting up seeding events will increase the overall budget of the project.	
Research Seed Requirements	Write Down Germination Codes Use the link to the right to find all the species on your list and write down their germination codes. Alternatively, you can often search for the specific species with the words “germination code” in a general browser search. This works for common species but should still be verified using this or another source. These germination codes tell the story of how these species grow naturally. Those with codes ending in “30,” “60,” “90,” etc. need exposure to a freeze-thaw cycle to break dormancy before they’ll germinate. This means	Germination Codes by Species Propagation Methods

	the ideal time to seed them is in the Fall or early Winter. If you are planning to seed in the Spring, it is suggested that you “pre-condition” seeds as needed so they are ready to germinate when they hit the soil. Otherwise, many can be lost over the subsequent year to predation, rot, or other factors. Use the link labeled “Propagation Methods” to the right for more information on conditioning seeds.	
Site Conditions	There are several main site conditions that play a major role in deciding on a seeding strategy. Topography Gentle slopes are of course always preferred on any type of project, but project locations will not always be on gentle slopes. It may even be the case that some areas of a project have gentle slopes while other areas are quite steep. Areas of steep terrain will limit your choices on seeding strategies: • No-till Drill Seeders – these are attached to a vehicle and are rather heavy, making them dangerous and potentially unmovable on steep terrain. • Broadcast and Drop Seeders – some of these are attached to vehicles, but smaller units can be walked behind or even hand-held. These smaller units can be viable; however, it will be a slow process to prepare the area, spread the seed, and lay down erosion control (straw, mulch, etc.) • Hydroseeding – if there is available access near the steep area, this strategy could be viable as the seed can be spread quite far from the vehicle holding the “slurry.” Still, this is not a cost-effective approach. Soil Moisture: Similarly, if the ground at the site stays quite moist, this could limit your seeding strategy choices as well: • Drill seeders and the vehicles that pull tow-behind drop and broadcast seeders could get stuck in the muck • Hand-broadcasting would be time-consuming as it would include exposing bare soil, spreading the seed, and then spreading erosion control material. Still, it may be the most viable and cost-effective option for seeding these moist areas. • Hydroseeding is possible, but again, it only becomes cost-effective at scale Proximity to Water Not only do you have to keep general soil moisture in mind when a project site is near water, but you also have to know whether the area is a threat for flooding as this can be a big risk when you’re planting expensive seed:	

- If possible, drill seeding is the preferred option near water as this will allow for the seed to be protected by soil and therefore less likely to wash away. Remember that this is not practical for small areas, though
- Broadcast, drop, and hydroseeding will more than likely require erosion control beyond straw or mulch as these will wash away with the seed. In these cases, a biodegradable product, like coconut coir, could help, but there is still a risk of seed being washed away. Not to mention, this is only feasible on a small scale as these products are not inexpensive.



Figure 41 - Streamside meadow installations often require using techniques to hold seed in place during flooding events, such as coir matting along streambanks

Access:

If there is nowhere on site to get a large machine like a tractor, UTV, or truck in, this will also play a role.

- Large drill seeders will also then be unable to access the site
- Smaller broadcast and drop seeders should fit, but tow-behind units will need something to pull them. Otherwise, you may be stuck broadcasting with a walk-behind unit or by hand
- If there is somewhere outside the area where a vehicle can park and is near enough that a hose could reach, hydroseeding may be a good option

Keep in mind that broadcasting and drop seeding are time-consuming and material-heavy activities and become especially so at scale. If your site is over a half-acre, it will behoove you to find a way to access it with a drill-seeder. If access to the site is limited, see if neighboring properties have access and see if you can procure an agreement to use that access point.

	You may even find at the end of this checklist that you will in fact need to incorporate more than one seeding strategy, and this is a normal occurrence. Every project site has its areas with differing terrain, soil moisture, or access, and you may have to choose the right strategy for several different areas.	
Understand Seeding Methods	When it comes to seeding meadows there are several strategies that are used the most often. Choosing your seeding strategy is half the challenge, though. There are countless models of seed drills, tractors, broadcast seeders, UTVs, trailers, etc., which can be used to seed a meadow.  <i>Figure 42 - Seed drills come in all shapes and sizes and are usually "tuned" for a specific type of project. Each has its own nuances, pros, and cons. Adapting your techniques to the capabilities of the drill is an essential skill</i> 1. No-till Drill Seeding This is a seeder that attaches to a vehicle and contains one or several seed boxes along with blades to open the ground, channels to direct the seed into the opening, and wheels to close the opening once seed has entered. When calibrated correctly, this allows for precision, leading to species being evenly spaced. Some other benefits of drill seeding include: ○ Little to no soil disturbance ○ Seeds get covered by a light layer of soil, the perfect conditions for germination and protection from predation ○ Can seed areas quickly, especially large areas	<u>Ernst Seeding Methods</u> <u>Xerces Meadow Guide w/ Seeding Methods</u> <u>NRCS Seeding Methods</u> <u>Hoffman Seeding Methods</u>

TRUAX BROADCAST SEEDER

The Trillion Broadcast Seeder is designed for shallow seed placement in a prepared seedbed. This seeder plants turf grasses, wildflowers or forbs, native grasses, introduced grasses, legumes, and cover crops.



Figure 43 - Specialized broadcast seeders simulate the natural falling and settling of seed and can help prevent planting too deeply

The best drill is the one best sized to your site. Think about your site, is it:

- Greater than 1 acre?
- Straight edged, and regularly shaped?
- Are weight restrictions for access unlimited?

If the answer to these questions is “YES” then opt for a large (6ft or greater) seed drill. Purpose built machines, like those produced by Truax are optimal.

There are some cons to using large seeders like this. Given the scarcity and high cost of this style, they are not frequently available to rent. On top of this, transporting equipment this size can be complicated and also quite costly. Some farmers may have this equipment and may be contracted to seed the site. Local conservation districts will be able to provide insight to their local network. Medium-to-large sized restoration contractors will have this equipment and the operators to run it. Still, unless your project is rather large, it may not be cost-effective to go this route.

If any of these questions are answered with a “NO” it is more appropriate to source a smaller width drill. These drills are not purpose built for these projects and are typically referred to as grain drills. Many conservation districts in Pennsylvania have these smaller drills for rent.

Their smaller sizes make it easier to transport these as well as the matching vehicle to pull them. They are also easier to operate, so running this setup on your own is therefore easier.

That being said, using these drills may require additional passes over the site, as all seed types may not be able to be combined because they won’t pass through the seeder at the same pace. This can lead to increased time to complete seeding but still allows for precise calibration and species distribution.

	It is possible to seed sites larger than 1 acre with a small drill, but the time costs can rapidly increase and is not recommended unless project limitations require it. 2. Broadcast Seeding This approach can be done by hand or with walk-behind devices but is most frequently completed using tow-behind models due to their larger capacity and therefore quicker coverage. This method is a good fit for small, less than 1-acre meadows. Some benefits of using broadcast seeders include: • Readily available for rental from various suppliers at reasonable prices, including local conservation districts • Easily transported due to low weight and small size • Even distribution of seed • Easily pulled behind by many different vehicles, including a UTV, truck, or tractors Aside from site size restrictions, there are other caveats to using broadcast seeders, such as: • Increasing soil contact using a harrow or other machine before seeding, which also increases the likelihood of erosion, • Performing multiple passes with different sized seeds, possibly even needing to spread fluffy seed by hand, • Using a cultipacker or other device to press seed into the soil, and • Spreading of straw or mulch to reduce erosion control All these extra steps can greatly increase the time and finances needed to complete seeding. It is possible to simply broadcast seed and then pack it down with a cultipacker or lawn roller, but this often does not lead to sufficient soil contact and can therefore lead to poor germination. Note on Straw Blowers: Straw blowers are used to mulch post seeding and are efficient for large areas. The model should be chosen based on the size of the meadow site (1, 5, 10, 100 acres, etc.), the locally available bale type (small bale, large square, round bale). Small blowers, suitable for sites less than 10 acres, may be rented from rental equipment stores. Local cattle/livestock farmers may have equipment suitable for larger meadow projects. Consult your local conservation district.	
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3. Hydroseeding

This method combines the seed you're using with water, mulch, fertilizer, and/or a tackifier (help the mixture stick to soil) and then this mixture is literally sprayed onto the desired area. While almost exclusively used in seeding lawns and areas along roadways it can be used for seeding meadows. Hydroseeding natives requires a two-step process – first spray your seed mix, then spray the covering.

Hydroseeding can provide:

- Good soil contact,
- Reduced predation, and
- Reduced erosion,

Still, hydroseeding comes with some major considerations:

- Requires access to large amounts of water (makes up 70%-85% of mixture)
- High winds blow the mixture around and may cause delays
- May require continued watering after installation
- Experience is needed to operate equipment, and hiring a company to do so can be expensive

While hydroseeding has the potential to be an efficient option, it can be very expensive and there is not enough information currently available to assess its viability in meadow building.

4. Drop Seeders

Drop seeders can be used if seed drills cannot be accessed.

Consult the local conservation district to see if they have equipment available to rent or if they know a local contractor. This method has similar benefits to broadcast seeding:

- Readily available for rental from various suppliers at reasonable prices, including local conservation districts
- Easily transported due to low weight and small size
- Even distribution of seed
- Easily pulled behind by many different vehicles, including a UTV, truck, or tractors

Like broadcast seeders, though, drop seeders also come with multiple extra steps:

- The site needs to be prepped with a harrow, which allows for more soil contact but also increases the possibility of erosion,
- Multiple passes will be required to evenly distribute species,
- A device like a cultipacker must be used to press seeds into soil, and
- Depending on topography there may need to be erosion control (straw, mulch, etc.) added on top

	All this to say that using a drop seeder comes with many step that can greatly increase the time to complete seeding and increase the cost of seeding considerably. This option should only be considered if there are issues with access for a drill seeder.	
Consider Vegetation Management Strategy	Caution Remember that before any planting can occur, you should see strong success from vegetation management efforts. If there are still issues with noxious weeds in the project area when you think you are ready to seed the meadow, you must PAUSE your seeding until the area is completely ready. This can be a tough decision, especially if it means waiting another whole year before seeding occurs, but it will lead to a more successful outcome in the end. Herbicide Residuals As mentioned earlier in this section, the types of herbicides used and how long their effects last are important considerations. Double-check the herbicides you used and their labels to make sure there is no chance of residual effects before you plant your seed. Failing to do so can lead to poor seed germination and or seedling survival and the possibility of needing to re-seed the meadow altogether.	
Choose your Strategy	Seeding Strategy: Review the outcomes of each of the steps above and see if any decisions have been overlooked or conflict with one another. Once you have thoroughly reviewed everything, outline the chosen strategy and be ready to explain your choice to your stakeholders.	

SOCIALIZE AND SET EXPECTATIONS				A
KEY QUESTIONS		OVERVIEW		
- Who is likely to notice or be affected by your work? (neighbors, park users, staff, volunteers, etc.) - Is there a risk of confusion, concern, or pushback if work proceeds without ample notification or explanation? - What aspects of the process will raise the most eyebrows? (herbicide, meadow height, access?) - Who is responsible for communicating, and when/how often should it occur?		Hopefully, by this point you have engaged with enough stakeholders that there are no major surprises with public perception and support for your meadow. You now have a concrete plan that you can share. Armed with an implementation plan, it is up to you to communicate it to everyone and let them know what comes next. This can be a delicate balance, especially if there are people from many backgrounds involved. The goal at this stage is to set clear expectations, reduce confusion, and proactively address common concerns.		
CHECKLIST				
STEP	TITLE	SUMMARY DELIVERABLES		DATE
1	Identifying New Stakeholders and Concerns	Create a list of all relevant stakeholders, including new stakeholders, and their expected reservations/concerns.		
2	Select Communication Method	Set up a meeting with stakeholders; send an email with an abridged version of the plan and ask for feedback.		
3	Communicate Desired Project Outcome	Remind stakeholders of the project goals (e.g., will serve as habitat for meadowlarks, will be kept at a maximum of 4’ tall)		
4	Communicate Vegetation Mgmt. Approach	Outline the planned vegetation management approach, discussing the technique, number of treatments, timing, and points of entry.		
5	Communicate the Planting Approach	Outline the planned planting approach, discussing the implementation strategy, particularly if it will occur over time.		
6	Communicate the Establishment Timeline	Outline the high-level timelines associated with prep, installation, and establishment. Let people know that it can be a long process to construct the meadow and collect feedback.		
7	Document Feedback & Confirm Readiness	If necessary, re-evaluate vegetation management, planting approach, and timeline based on feedback. Otherwise, proceed.		
SUMMARY				
HOW TO KNOW WHEN YOU ARE FINISHED				
If no communication is required with outside stakeholders, this step may be completed immediately, and no further action is necessary. If communication is required to proceed, you are finished once you have relayed the implementation plan, addressed concerns, and set expectations for anyone whose objections could delay, alter, or otherwise derail the project.				

SOCIALIZE AND SET EXPECTATIONS		B
TITLE	DESCRIPTION	LINKS
Identify Stakeholders and Concerns	Find Your Stakeholders Up to this point, if you have not identified and/or engaged with relevant stakeholders, this is the time to do so: before work commences. Stakeholders might be neighbors adjacent to the meadow, regular visitors to the site, researchers working in the area, or any organizations connected to broader land-use or management networks. Figure out who these people are and how to get in touch with them. Predict Their Likely Concerns Document each group and their likely concerns, such as herbicide use, changes to site aesthetics, or excitement about habitat restoration. Identify potential advocates within the community, as well as stakeholders whose support is especially important to project success. When conflicts arise, you will want to give added weight to the opinions of those most directly impacted or most critical to implementation. Understanding who will be affected and what their main concerns are will be important for determining what aspects of the project you proactively communicate, in what format, and how frequently.	Sharing knowledge to improve ecological restoration outcomes
Select Communication Method	Convene a Meeting If there are a few stakeholders who are important to the success of the project but who have not been involved in the planning stage up until this point, convene a meeting in which you discuss the details of the project with the group in a manner that encourages feedback and shows receptiveness toward incorporating that feedback. 	Principles and Guidelines for Ecological Restoration. Section 4.1.3.1 Engagement & Communication

	Or Send an Email If there is a large contingent of people who may be impacted by the project, but who have not expressed strong interest up until this point, you may instead address them through an amended version of the plan sent via email. An email may also be a useful way to engage someone who could otherwise disrupt planning in a group setting. For example, if one of the stakeholders is a neighbor who has a strong knowledge of the environment and local ecology but is also vehemently opposed to the use of herbicides, giving this person a public forum to debate the efficacy of your herbicide-based vegetation management approach could do more harm than good for achieving public support. Decide Your Non-Negotiables However, you decide to communicate, decide in advance what aspects of the project are non-negotiable before soliciting feedback from the group. For example, successful meadow establishment at your site may require multiple years of weed suppression before seeding can occur. Be prepared to defend that position and what your course of action will be if you receive pushback.	
Communicate Desired Project Outcome	Communicate Desired Project Outcome Perhaps most important is reaching consensus with stakeholders about the goals of the project and what is realistic. If that hasn't already been accomplished, now is the time. Make sure you are all in alignment about this question: "What does success look like?" Break this question down into a few categories such as ○ The meadow's primary ecological objectives (e.g., improved native plant species diversity) ○ How wildlife is using the meadow (e.g. habitat for threatened raptor species) ○ How people are using the meadow (e.g. observing it from a designated lookout) ○ How the meadow looks when it's established (e.g. pockets of wildflower color in a sea of grasses) ○ How the meadow contributes to local ecosystem services (e.g. reduces stormwater runoff) Refer to "Is This a Viable Meadow Opportunity?" for further elaboration on these topics. Being aligned on these larger goals can be an important factor in finding common ground on the nitty gritty. If establishing native habitat for meadowlarks is deeply important to a stakeholder and the project is clearly in service of that goal, you will likely face less opposition to your choice of vegetation control methods and expected timeline. On the other hand, if a stakeholder who is critical to the project's success likes having a native meadow in theory, but in practice would like it to look and behave more like a formal garden, those are two very different project	

	outcomes. Such a disagreement may require going back to the drawing board to find areas of alignment before the meadow can proceed. When To Talk About Outcomes If there is uncertainty about stakeholder expectations for the overall outcome, bring this conversation forward earlier rather than later. It is included here at the end because it can be a great way to end the discussion on a positive and harmonious note after likely disagreements about smaller details of the plan.	
Communicate Vegetation Management Approach	Communicate Need for Herbicide This is the area that is likely to elicit the strongest negative emotions surrounding the implementation of a meadow. There are many people who are broadly in favor of ecological restoration and want to see the creation of new meadows, but who are adamantly opposed to the inclusion of any non-organic herbicides. Come prepared to any conversation with an understanding of what risks are posed by the herbicide, why that herbicide is important to the creation of the meadow, and what safety precautions you will take to adequately minimize non-target effects on plants, wildlife, and human health and safety. Communicate Herbicide Specifics Also be prepared ahead of time with how much information you are comfortable revealing about specific herbicides you will be using. You will likely be required to post signage after the spray event detailing what kind of herbicide was used and when it will be safe to re-enter the premises, so there is little reason to conceal that information from the public early on. In fact, being upfront about exactly what you are using may earn you some goodwill. Explaining, for instance, that Glyphosate has very minimal soil persistence may alleviate some public fears about the toxicity of your approach. Vegetation management approaches that rely on organic herbicides or physical control methods are generally subject to far less public scrutiny.	<u>Why We Recommend Herbicide</u>
Communicate Planting Approach	Communicating Planting Approach This topic covers the three most important aspects of a planting strategy: planting method, timing, and species involved. None of these topics typically elicit much controversy among the public. Most people are passively interested to know whether you will use a no-till drill, hand seeding and raking, or some other application method. People are also generally ambivalent about the timing of seeding, though they may be surprised to learn that the best time for seeding is in late fall right before a snowfall. Explain why. Stakeholders, however, will generally be very curious to know what kind of species you intend to include. This can be a good opportunity to show off your knowledge of species selection. Explain how each species will fit into	

	the broader meadow plan and what kind of wildlife it will benefit. Prepare for Species Requests At times, people will request specific plant species that they are fond of and would like to see growing in the meadow that you have not already included. A common one is cardinal flower. If cardinal flower does not make sense ecologically, this may be a non-starter, and you can explain why it would not work. Alternatively, you may elect to use a small quantity of it in a specific area, such as a depression in the soil near a shady wooded edge where it has higher odds of success.	
Communicate Establishment Timeline	Communicate Establishment Timeline After vegetation management, the establishment timeline is the topic that induces the greatest public outcry. This is likely your final hurdle. Many people will assume that meadows complete their establishment within a three-year timeframe. In most situations, the timeline is closer to five-to-seven years. Communicate to stakeholders that not only will it take many years before the meadow becomes a self-sustaining ecosystem, but that the first two to three years of that timeline will likely be a period of deeply unappealing aesthetics. Provide Images of What to Expect Providing images and descriptions of what to expect in each year of meadow establishment will undoubtedly help you later on, for example when there is a sudden surge of fleabane overtaking your new meadow seedlings and when the project looks like a failure.  <i>Figure 44 Good example of a first-year meadow. The seed mix species are barely visible, but the rampant annual weeds often cause great alarm amongst the public and even your client. But relax! The good plants show up eventually.</i> Emphasize Positives Remember to emphasize at least one positive thing that people can expect to observe in each year of the meadow's trajectory and reiterate that seeing invasive species and/or a lack of native germination in the first couple of years is not necessarily cause for alarm. Set expectations low and let people be pleasantly surprised when they see butterfly milkweed flowering a year before you told them it would appear.	

Document Feedback & Confirm Readiness	Document Stakeholder Feedback You may not alter your plan, but if you are soliciting feedback, it is important to document it for future reference. You may find ways to incorporate it later or identify resources that help alleviate stakeholder concerns. Identify Small, Feasible Requests Some feedback will be relatively easy to implement and should be flagged for consideration during implementation. For example: • A neighboring landowner may want you to avoid boom spraying along the boundary of the meadow to minimize spray drift onto their property. • A neighbor may request that a slightly different seed mix, devoid of taller or more aggressive species, be used along the property edge. • A park visitor may request that herbicide application be restricted to certain days or times when the public is less likely to be present. Accumulating and addressing these small, achievable concerns can be a powerful way to build project support and avoid misunderstandings. Compile and Communicate Decisions Compile all input into a brief stakeholder summary, confirm which requests will be implemented, communicate those decisions back to stakeholders, and proceed only once expectations are clearly aligned. If you are not the one implementing the project, make sure this information is passed along to the person who is.	
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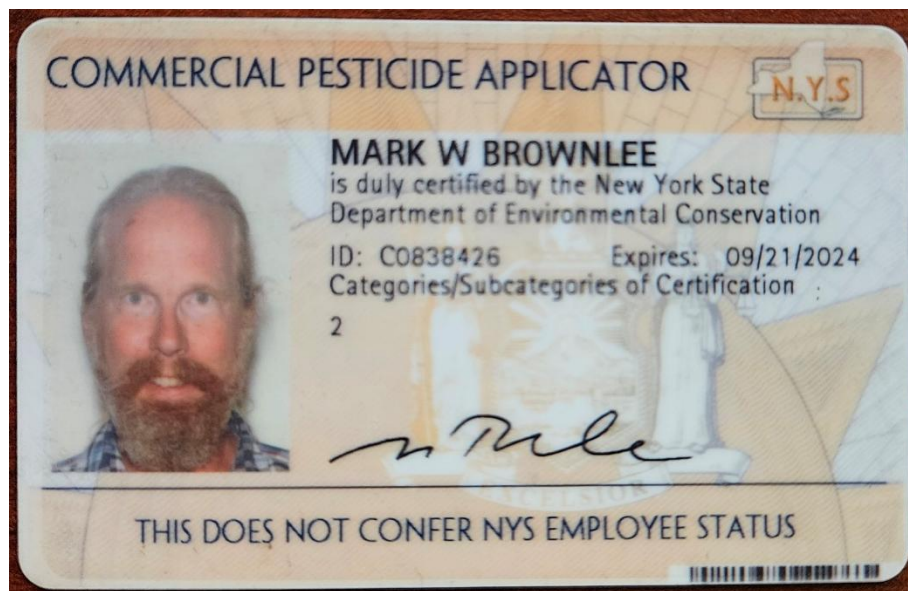
DECISION POINT #3

You have now made many of the most important decisions: species selection, how to plant, how to manage undesired vegetation, and so on. And now you have presented all this information to the relevant stakeholders with your reasoning. But what was their feedback? Did they give a resounding approval or did major questions on your choices arrive? Did any issues arise and were they resolved?

Your stakeholders don't have to love the plan, but they do need to agree to it. Remember that the end goal is near-complete control of undesired vegetation and a thriving ecosystem composed of the right plants for your site. If there is fear that the only available options will lead to a less-than-ideal product, serious consideration should be given as to whether the project should continue.

PERFORM VEGETATION MANAGEMENT				A
KEY QUESTIONS		OVERVIEW		
○ Do you own or do you have to set up rental of the equipment you will be using? ○ Is your equipment properly calibrated and ready to use? ○ Do you have all the necessary protective equipment for the strategy you're using? ○ Have you communicated your timeline with the necessary parties? ○ Have you completed all necessary documentation?		Finally, the start of the project is close at hand. But there are a few more important tasks that need completing before work can begin. This page will discuss the discrete steps to performing your vegetation management plan.		
CHECKLIST				
STEP	TITLE	SUMMARY DELIVERABLES	DATE	
1	Communicate the Timeline (Far in Advance)	Provide relevant stakeholders with notice at the beginning of the season and discuss relevant details. Post in a newspaper or on a community website.		
2	Check Necessary Paperwork	Ensure all documentation and paperwork is up to date (i.e. applicator's license, permits, etc.).		
3	Procure Materials	Procure necessary equipment and materials in advance of application (i.e. purchase products).		
4	Communicate the Timeline (Days in Advance)	Provide relevant stakeholders with notice at the beginning of the week, if not earlier, and discuss relevant details. Post signs a week in advance.		
5	Read Product Label and Instruction	Re-familiarize yourself with the product/equipment label, if relevant.		
6	Check Calibration	Test equipment and ensure proper calibration. Start with using water to test your equipment.		
7	Perform Strategy	Apply the vegetation management strategy.		
8	Document Everything	Take photos, complete herbicide logs, send updates to stakeholders.		
9	Check Efficacy	Return to the site 2-4 weeks after first treatment and evaluate efficacy.		
10	Plan your Next Treatment	Develop the plan for the next point of entry and communicate the plan, if necessary.		
SUMMARY				
HOW TO KNOW WHEN YOU ARE FINISHED				
You are finished with vegetation management once you have confirmed that you have reached the suppression goal (e.g. 90% vegetation suppression) that you've set for the project and all activities have been properly documented and communicated with all necessary parties. Remember that adequate time is needed to check efficacy of overall treatment. If there is any uncertainty, more time should be allowed to monitor efficacy. Projects with stilt grass, for example, should wait a year to check for efficacy.				

PERFORM VEGETATION MANAGEMENT		A
TITLE	DESCRIPTION	LINKS
Communicate Timeline (Far in Advance)	Give Stakeholders Notice of Planned Timeline Giving advanced notice to the client or stakeholders of your proposed timeline for vegetation management is always necessary. You do not want them to reach out to you asking when you'll be starting. Plan to give AT LEAST several weeks' notice and a timeframe if possible. This communication should include other relevant information also, such as where vehicles and equipment will be parked when not in use, where the project site will be accessed, estimated times when workers will be on site, and so on. An example of communication is below: • We are reaching out to inform you of our intention to begin herbicide application on the project site in three weeks, the week of 4/13/26. This work should take two days to complete. We will reach out again in two weeks to inform you of the exact date that we will begin. • As discussed in previous conversations, we will be using a tractor-mounted boom sprayer to treat all twenty acres within the project site, as marked on the provided map. We will also be using the same sprayer with a hose attachment to treat ten feet into the wood line along the Northern and Eastern borders of the site. The equipment will be parked at the South end of the project site, near the parking lot, until we are finished. We will be on the project site between the hours of 8am and 5pm only.	
Check Necessary Paperwork	Check Licenses/Permits As a reminder, examples of permits include a Pesticide Applicator's License if you plan to apply herbicide or an Erosion & Sediment (E&S) Control Permit if you plan to disturb a large amount of soil during this process. Without these permits in place and up to date, you can receive hefty fines and face project delays or even loss of the project. Resources for these documents are linked to the right.	PA E&S Plan resources PA Pesticide Applicator Resources PA Hypersensitivity Registry



Check Hypersensitivity Registry

If you are applying herbicide, it will also be crucial to check the “Hypersensitivity Registry,” which lists people that are to be notified in advance in the case that spraying will be occurring near their home. Each state has this list as well as their own definitions on who needs to be notified and when. You must check this list, ideally weeks in advance, to see if there is anyone near the site that is on it and if they need to be notified (usually based on proximity to the project site) and how far in advance they need to be notified (usually somewhere between 24 and 72 hours in advance).

Like licenses and permits, you can face hefty penalties for failing to properly notify someone on this list.

Procure Materials

Check Materials

In the weeks leading up to beginning of work, you should have long chosen or reserved all the materials needed for your chosen vegetation management strategy. Still, it is always a good idea to run back through your list and make sure that there are no additional materials needed, no materials are missing, have been damaged, or otherwise need to be replaced. Doing so several weeks or more in advance should allow you time to procure these items. As an example, if you are planning to spray with a boom sprayer attachment on a UTV your materials list may include:

- Herbicide (Triclopyr, Glyphosate) and quantities
- Adjuvants (marking dye, ionic surfactants) and quantities
- Boom sprayer
- Spare sprayer parts (nozzles, hoses, fittings)
- PPE (safety glasses, gloves, muck boots, ear plugs)
- Fuel for pump

	• Signage to denote spraying event • Herbicide log, if not filling out on a device • Backpack sprayer (for remaining herbicide in tank) Order Materials Be sure to give yourself ample time ahead of your planned vegetation management to ensure all materials are procured or delivered. This process includes having the space to store these materials either on site or at your shop.	
Communicate Timeline (Days in Advance)	After confirming that all materials and equipment have been arranged, vegetation management is finally close to commencing. Before that can happen, it is imperative to yet again communicate the plan and at this point offer an exact date and at least estimated time of the work. This is also when you need to notify anyone on the PA Hypersensitivity Registry that is within the designated proximity of your project. An example communication is below: • We are reaching out to confirm that we will begin vegetation management at the project site starting this coming Tuesday, 4/14/26. We will be treating the entire 20-acre space over two days. This timeline is subject to change based on weather conditions. If you have any questions before we begin, please let us know.	PA Hypersensitivity Registry
Check Calibration	As mentioned previously, precise calibration of equipment is essential. For machinery with moving parts, understanding proper operation and calibration will lessen the chances of errors or broken parts. This goes for herbicide application as well; however, herbicide equipment calibration is also important for ensuring the right amount of product is used. If the device is calibrated wrong, there could be too much or too little herbicide being used during vegetation management. Too little and it may be found that that round was ineffective. Too much and at the least an expensive product is being wasted; at the most it could expose the site and surrounding area to contamination. Machinery with Moving Parts Refresh yourself on how the machine is supposed to operate. This includes knowing how to operate the machine, how to properly activate and deactivate the attached implement (often at a particular RPM), and at what speed the implement should be used (also often a particular RPM). Before beginning, ensure the machine is operating properly and there are no obstructions to any moving parts. Herbicide Applicators Calibrating spraying equipment involves a multitude of steps and depends on the chosen method, as discussed in “Choosing an	Pesticide Sprayer Calibration Techniques Proper Sprayer Cleaning

	Herbicide.” Careful and accurate calibration is key, so verify that your application equipment is still correctly calibrated. Ensure Equipment is Clean At this time, it is also suggested that the equipment be cleaned of any debris and dirt as best as possible. A dirty machine can have seeds and other plant parts on it that can further spread invasive species. Ideally, cleaning will be completed using a pressure washer or other tool that can remove stuck on dirt and debris. With herbicide equipment you also want to check that any tanks are cleaned out from previous applications. Herbicide sprayers should be cleaned after every use, so this shouldn’t be a problem, but it is always worth checking. Depending on the previous herbicides used and the concentration, there could be residual effects if not properly cleaned. Not to mention, herbicide residues more quickly break down sprayer parts. A triple rinse, as described in the cleaning procedures to the right, should be sufficient in cleaning the sprayer.	
Perform Strategy	Refer to your Treatment Calendar As discussed in “Choose a Vegetation Management Strategy,” the exact timing of management will depend on the dominant species in the project area. For example, managing Stilt Grass with a post-emergent in March will yield poor results as the plant has not even germinated at this time, while this is the perfect time to manage Lesser Celandine. Verify that you have a plan to time treatments of different species based on your calendar and stick closely to this calendar. Observe Site Conditions Before work can begin there are several conditional factors to keep in mind and to check before and during the implementation of your chosen strategy. • Precipitation – always keep an eye on rain. If it’s been raining, it will be raining during the time you’ve chosen to treat, or it will be raining shortly thereafter, many strategies will not be effective and should be delayed. This is especially the case for herbicide applications but also includes strategies that require soil disturbance. - o Rain significantly lowers the efficacy of herbicide and can cause it to wash off altogether - o Wet soil can also cause machines to create ruts or bare patches, or to get stuck • Wind – this can cause herbicide drift, especially high wind. If you see winds higher than 10 mph, you may have to delay spraying. Wind can also make the spreading of mulch or straw more difficult.	<u>Spray Drift</u> <u>Proper Sprayer Cleaning</u>

- Extremes of temperature – a lot of herbicides are most effective only within a certain temperature range and lose efficacy quickly outside of this range. Make sure it's not too hot or too cold for the chosen herbicide to avoid these issues

Observe Equipment Function

By this time, you should have a strong understanding of how the device or machine you are using operates. Despite being well prepared, it's important to regularly observe how the equipment runs. Spotting problems early is always better, as is ensuring there have been no changes to calibration or system functions during transport. Observe how the device is working and keep an eye out for needed adjustments.

Functions to observe for boom sprayers:

- *System pressure* – is it correct? Is it stable?
- *Marking dye* – is it visible enough?
- *Nozzle spray* – are all nozzles spraying normally?
- *Sprayer height* – is the sprayer too close or too far from the ground?
- *Nozzle angle* – have any nozzles changed angles? (This can happen for long boom sprayers if the outer nozzles hit the ground on uneven terrain or objects along the outer edge of the spraying area)



Figure 45 - Technician setting up a truck-mounted boom sprayer

There are functions to keep an eye on no matter your management strategy, and inevitably there will be issues that arise and that need fixing.

Install Herbicide Signage

Signage must be installed immediately following any herbicide use and cannot be taken down until the timeframe denoted in your state's code has ended.



Figure 46 - All licensed herbicide applicators are required to post an area as being treated. It is good practice for everyone to post that an herbicide has been sprayed

Install needed Erosion Control

Installation of water erosion control methods must immediately follow the cessation of soil disturbance strategies.

Clean Equipment

Once the work is complete, it's important to again clean any equipment thoroughly, including triple rinsing any sprayer equipment. If this can be done somewhere on the project site that is not in the area that was just treated, this is ideal. It can be completed offsite but should be done as soon after completion as is possible to prolong the life of the sprayer.

Document Everything

No supervisor likes hearing that you didn't do an adequate job of documenting different phases of the project. This includes all parts, transporting the equipment, preparing the machine for use, performing the task, cleaning up, and so on. It's always better to have more documentation than not enough, even if that mostly consists of photos or videos.

Legal Documentation

It is especially crucial to document herbicide use. Like communicating herbicide use ahead of time, each state has different regulations on how to properly document its use. This generally includes denoting the project site, herbicide used, amount of total solution, and more information. The link to the right includes a downloadable record keeping manual.

Depending on partner organizations, there may be a requirement to send them proof of herbicide application. For instance, some

[Herbicide
Record Keeping
Manual
\(downloadable\)](#)

	organizations require copies of your herbicide logs while others have their own forms that you will need to fill out. Some organizations also require, or at least ask for, photos and/or videos. Communication with partner organizations should be prompt. Indeed, some even have specific timeframes of when paperwork should be submitted following the completion of a task. Recommended Additional Documentation Even if partner organizations or other stakeholders are not asking for photos or videos, it is always recommended to take plenty as these can be important down the road for verifying treatments, studying efficacy of methods used, as well as marketing purposes.	
Check Efficacy	Monitor Treatment Success Depending on the strategy, when signs of effectiveness will show may differ. Generally, after a soil disturbance event (tilling, sod removal, etc.) some plants may spring up quickly, but it may take a month or more to see how effective the work was. This depends on time of year as well as higher precipitation in Spring and Fall will cause quicker regrowth. The timeline for seeing effective control from herbicide use depends on the type of herbicide used. For post-emergent herbicides, it usually takes a matter of two to three weeks to see the effects. By this time, the difference between those plants that were affected and those plants that were not affected enough or were altogether unaffected will be clear. Those plants that were affected will be turning brown or will be completely brown after these few weeks. If you chose a viable strategy earlier, which may have included the use of multiple types of herbicides, these treatments should prove quite effective. Plan to revisit the site two weeks after the first round of soil disturbance or post-emergent herbicide application and again around a month after to check efficacy. For pre-emergent herbicides the timeline to see effective treatment will be longer as these are applied well in advance of annual weeds germinating. You'll want to plan for bi-weekly monitoring visits starting around a month after application to see how effective the treatment was. If the treatment was timed properly and the right amount of herbicide was used, you should see good results. If not, it will be obvious as you see a flush of germination. If solarizing, you'll want to wait until the end of the growing season to monitor results.	<u>Issues that Arise During Meadow Establishment</u>



Figure 47 - This riparian buffer meadow has been adequately prepared for seeding. The last treatment was five weeks prior to the photo being taken, documenting adequate suppression

Collect Data

For strategies that involve soil disturbance, especially tilling, expect to see a lot of regrowth due to disturbance of the seed bank and re-rooting of existing vegetation. It is advisable that these strategies be combined with another, such as herbicide application, to better suppress the current vegetation.

Again, for herbicide applications the success of the treatment should be clear as the treated plants should be brown or turning brown, or there should be little germination. If the vegetation is mostly green, refer to your data on how vegetation management was performed, more than likely there was an error somewhere in the process. Still, it is likely that you will see a flush of weeds, likely unrelated to your treatment, after this first treatment. This is normal as seeds in the soil take advantage of the space now available. This is why at least three applications are recommended, although the timing of these applications depends on the species.

Plan your Next Treatment

Follow-up Treatment Intensity

No matter how effective the first round of management was, and regardless of the strategy used, there will be vegetation that regrows after the first round. This is why it is recommended to plan for multiple rounds of management over multiple seasons, possibly years, to fully prepare a site for planting.

How intensive these follow-up rounds of treatment will be depends on the present noxious weeds and the efficacy of previous treatments. Some noxious weeds, like Stilt Grass or Thistle, are difficult to suppress and will most likely require multiple intensive rounds of treatment. For a

site dominated by turf made up of cool-season grass may only require several rounds of treatment that become less intense each time. For example, you may have to use a boom sprayer over the whole area for the first treatment, but then only over part of the area for the second and finally spot treatment with a hose for the third.

Follow-up Treatment Timing

This also depends on the present noxious weeds as some weeds can only be sprayed at certain times of year. Cool-season grass should be treated during the cool seasons, of course. And, continuing with Stilt Grass, post-emergent treatments will need to occur only during the warm season. Annuals like Stilt Grass will also most likely require multiple years of treatment before you can successfully suppress the seed bank.

Refer again to your treatment calendar and ensure that you are only planning vegetation management for the species at your site at times that will be the most effective.



Figure 48 - This meadow was seeded long before effective control was achieved. Weeds and undesirable weeds returned vigorously and ruined the meadow. The municipality did not have the budget to redo the meadow, and it remains an unsightly mess

Don't Sleep on Vegetation Management

Rushing this step to get to seeding is one of the top causes of meadow failure. It is imperative that you have strong suppression of any noxious weeds within your project area before moving on. If timelines for treatment get pushed back, or treatments are not as effective as planned, communicate with your stakeholders and discuss with them the importance of getting this step right, regardless of its impact on the project timeline. DO NOT move forward until invasive competition is minimal.

SECURE YOUR SEEDS AND PLANTING EQUIPMENT				A
KEY QUESTIONS		OVERVIEW		
○ Where are you sourcing your seed? ○ What types of seed are you using? ○ How are you seeding? Do you need a seed drill or a broadcast seeder? ○ What type of drill are you using? ○ Where is your drill? Are you subcontracting it? ○ Who is operating your drill? ○ Do you need a carrier? ○ Are you using a cover crop?		Once you have successfully suppressed your weeds, the next step is acquiring the seeds and securing the seeding equipment. Remember to honor your seed genetics policy established earlier in the process when purchasing seeds. There are many types of seeding equipment. Hunt around and find a Conservation District or contractor with the best equipment for the job.		
CHECKLIST				
STEP	TITLE	SUMMARY NOTES		DATE
1	Check Seed Availability	Contacted at least three (3) seed vendors to solicit quotes for seed. Inquire about genetics.		
2	Choose Seed Vendors	Consider price, availability, genetics, and weeds when making your decision about seed procurement. Native seeds are NOT generic products, and vendors are NOT inherently equivalent. Each vendor has different genetic strains, with different price points, different storage techniques, and percent weeds in their seeds. You want the most local genetics available and with minimal weeds. Saving money on seeds should NOT be a key consideration. Using different vendors is common practice.		
3	Choose Storage Strategy	Identify and decide on the optimal location and type of temporary seed storage.		
4	Order and Store Seed	Order seed as individual species rather than a seed mix. Purchase and then store the seed according to storage strategy.		
5	Secure Seeding Equipment	Reserve the equipment necessary to implement your planting strategy (ex. tractor and seed drill).		
6	Transport/Hauling	Safely pick up the rented seed drill from your provider and move it to your planting site or hire someone to move the equipment for you.		
SUMMARY AND SIGN-OFF				
HOW TO KNOW WHEN YOU ARE FINISHED				
You are finished with sourced your seed once you have figured out where seed will be stored, how it will be organized, and have placed the order.				
You are finished with securing your seed drill once you have a tractor and seeding equipment reserved and know how all equipment is getting to the site.				

SECURE YOUR SEEDS AND PLANTING EQUIPMENT

B

TITLE	DESCRIPTION	LINKS
Check Seed Availability	To verify your list as well as to receive quotes for these species, if desired, you will have to complete the following steps: Reference Known Seed Vendors (some local to PA are listed to the right) Most vendors have websites with either their available species listed and/or the ability to search for specific species. This can be a good starting point, but understand that the sites may not be completely up to date, may not display pricing, or the pricing may vary from what is displayed • Ideally, you'll reference the most local vendors first, especially if plant genetics are important to you, working your way further away as you go. Still, when deciding on vendors to contact, keep geography in mind and count out those you consider too far away. For example, a vendor in Minnesota might have the species you want, but those genetics may not be compatible with Pennsylvania conditions. • If you're using Evaluate™ to create your species list, some of these vendor databases are already worked into the software so you can quickly see if these species are available and from where. If they're not, you can easily change to another species that fits your site and continue the process. Contact Seed Vendors • To truly know what is available, though, you must call or email the vendors with your list ready for reference, which should include several alternative options. They can let you know if a species is currently available, the actual cost per pound, and sometimes even what weed seed might also be present and how much. They'll also give you a quote for the cost of each seed and shipping. • NOTE: If there is considerable weed seed or a particularly noxious weed mixed in with the desired seed, it may be necessary to look elsewhere for the species or ask about an alternate species. Utilizing one of the many seed vendors in the mid-Atlantic and northeast can expand the size and diversity of the planting. The "Directory" link to the right may be used to search for local, regional, and national sources. Vendors will be able to quickly verify species availability when prompted. Call or email them to discuss and get a quote for the seeds required. Provide an excel sheet with species botanical and common names and quantity to request a quote. Seeds may be sourced from as many vendors as necessary. Do not make substitutions on your species list unless no vendor can be found, or the genetics are undesirable. Some desirable species may not be available as seed from any vendor. If this occurs, search for commercial availability of the species as plugs, or a local population of the species which may be harvested, with permission, and grown into plugs for incorporation post-planting.	<u>Native Plant, Seed and Services Directory</u> <u>Pinelands Nursery</u> <u>Native Bee-ginnings</u> <u>Ernst Seed</u>

The varied ranges of species may or may not be reflected in the availability of a seed vendor. The highest quality of vendor maintains consistent and precise records of where material was harvested from when any seed farm crop is started. Recognize the importance of geography and **ecotype** in seed selection.

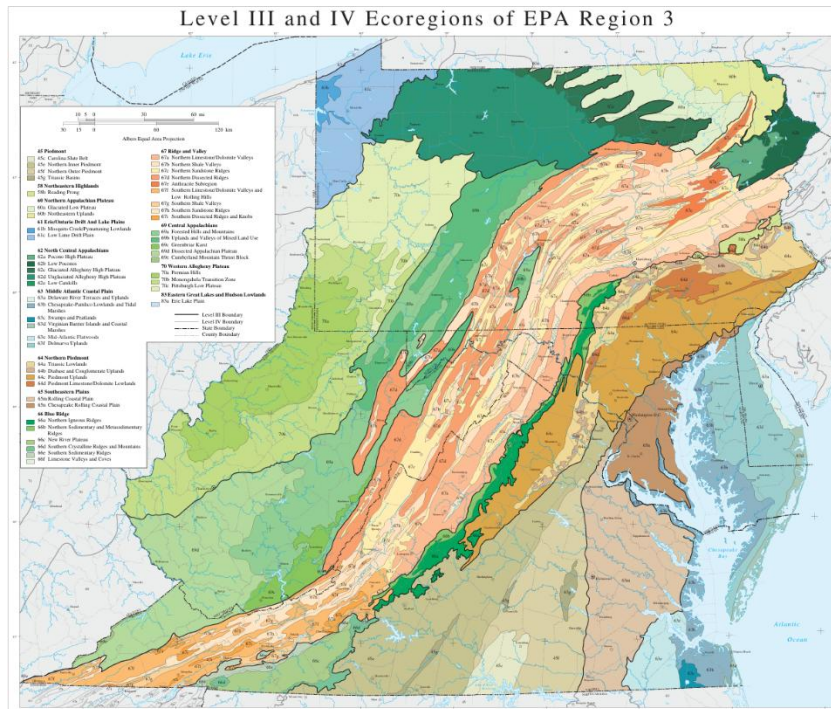


Figure 49 - EPA ecoregion map for Region 3. Seeds needn't originate from your state, just your ecoregion

Consider Ecological Factors

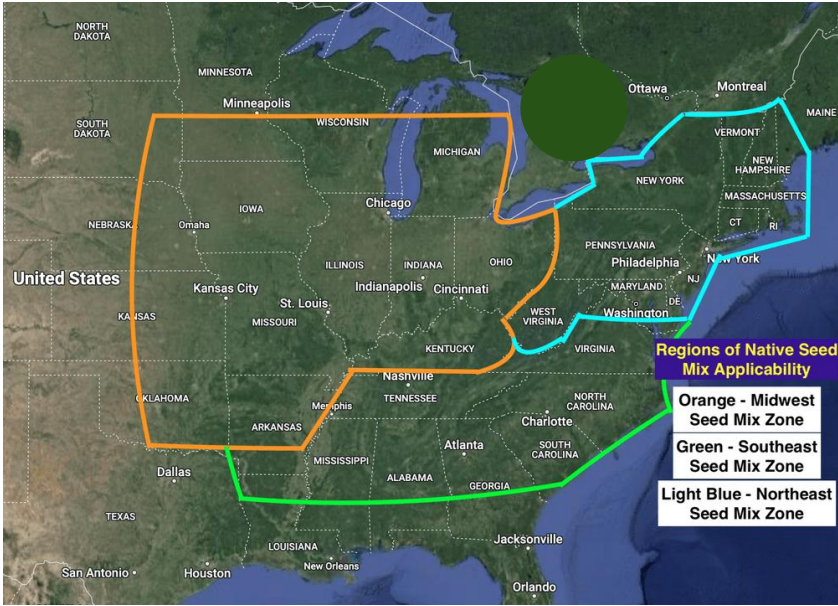
Genetic Considerations

EPA Ecoregions

Little bluestem seeds harvested from the mid-west may not be as resilient to a Rhode Island climate as seeds harvested from a crop from in-state. Species evolve in their own geographies and their ability to thrive is based on their ability to adapt. These differences can occur over remarkably short distances.

Always select the seed that is most local to you. Use the EPA Level IV ecoregion map to select ecotypes from the same ecoregion as your project. If none are available, use the EPA Level III ecoregion.

EPA Level II ecoregion may be considered if no Level III source is available. High variance species may be sourced from more disjunct areas while species with limited ecological variance may be considered for substitution (refer to Meadow Design) or expanded search for plug material than using distant ecotypes.

Choose Storage Strategy	If you are NOT Preconditioning Seed Seeds generally enter a dormant state upon maturation or dispersal from the parent plant. This state prevents seeds from germinating in adverse conditions such as reduced length of sunlight or extreme cold, conditions that would terminate a seedling. The proper combination of environmental conditions (e.g. sunlight, humidity, moisture, temperature, etc.) break seed dormancy and trigger germination. <i>Ideal storage increases the longevity of stored seeds by mitigating these dormancy breaking factors. It is also critical to secure the seeds from mold, rodents, and birds.</i> Review the guidance found in the appendix to ensure your seed storage solution is effective.	Seed Storage and Viability Germination Codes by Species Propagation Methods
Order & Store Seed	With the quotes verified and storage strategy chosen, submit your orders to the selected vendor/s. Submission via email with scientific names listed rather than common names can increase clarity for the vendor. Users of Evaluate software will have a ready-made PDF file of their designed seed mix.  <i>Figure 50 - Seed mixes marketed in this manner should be avoided entirely. There is no ecological relationship between meadows on Cape Cod and those in the Appalachian Mountains...it is much safer to consult with an ecologist on seed mix designs</i> Federal and state law requires the listing and quantification of noxious species within a seed mix on a label. Reputable vendors will be able to supply this information prior to purchase if prompted. Inclusion of one noxious species or another, like musk thistle, may be so detrimental that alternate sourcing should be done. If no substitution may be made, strategies should be developed to manage introduced weed seeds early on, review “Choose Vegetation Management Strategy”.	Native Plant Nursery and Seed Directory Seed Fillers and Carriers for Planting Native Warm-Season Grasses and Forbs Restricted Weed Seeds - PA Code Understanding the Seed Tag

	This only applies to noxious weeds and not all invasive plant species are legally identified as noxious, so be prepared for unexpected guests. You should have already selected an appropriate carrier and quantity in the “Seed Design” section. Carriers may be sourced from the larger native seed vendors, or they can be sourced locally from agriculture supply stores and grain mills. The same laws of listed noxious weeds and quantification apply here. If you’re planning to plug part or all your meadow, your plant order should be up to 2 years in advance for locally sourced seed, contract grown plugs. Other orders should be made as soon as you have decided on a species list and determined the need for plugs.	
Secure Seeding Equipment	<i>Purchase of any seeding implement should only be considered if meadow building is a core aspect of your mission.</i> <i>Purchasing or upgrading a tractor should be considered if it meets multiple organizational needs (increased equipment needs, etc.).</i> Appropriately sized equipment for most small to medium (0-25 acre) meadow building projects may be rented. Many local conservation district offices have seed drills available to rent. These are primarily grain-type drills, but some have multiple boxes suitable for multiple seed types. Consult your local conservation district for rental rates. Conservation district staff build relationships with local farmers and contractors. If they do not have the equipment available, they may have a local contact who can do the work or has the equipment. Ask if you need to, district staff are often happy to help.	PA Assoc. of Conservation Districts
Transport/Hauling	Review state and federal regulations for commercial driver’s license transport in the factsheet to the right. Each implement must be driven by another piece of machinery, either a truck, tractor, or UTV. The type of towing equipment is defined by that seeding implement Review your seeding implement manual for a description of requirements like: Ground Driven or PTO Driven. ○ Ground driven equipment is typically mounted on a 3-point hitch. There is a gear system that drives the mechanics when in contact with the ground. ○ PTO driven equipment must be mounted via a 3-point hitch. A PTO shaft drives the seed mechanism with power from the tractor.	PA Commercial Driver’s License Factsheet A Comprehensive Guide to Proper Towing Techniques and Equipment Cargo Securement Brochure Pre-Trip Towing Safety Checklist

	1-point or 3-point hitch mounting ○ 1-point mounting equipment may be mounted with a simple single point hitch typical for UTVs, trucks, and small utility tractors. ○ 3-point hitch mounts are typical on compact utility tractors or those of greater size Towing equipment must have equal or larger horsepower than the stated requirement on the implement Options for towing equipment include: UTV ○ Single point hitch ○ Low horsepower ○ Small & agile ○ High rental availability ○ Best for broadcast seeding small (1 acre or less) sites Truck ○ Single point hitch ○ High rental availability ○ Appropriate only for gravity driven broadcast seeding small sites (1 acre or less) Compact Utility Tractor ○ Single point and 3-point hitch ○ 25-50 horsepower ○ If PTO is available, it may be underpowered ○ Small & agile ○ High rental availability ○ Best for 0-5 acre sites with grain drill or broadcast seeding Utility Tractor ○ Single point and 3-point hitch ○ 50-250 horsepower ○ PTO is adequately powered for large implements ○ Adequate towing capacity ○ User comfort (enclosed cab, Bluetooth, GPS, etc.) ○ Less rental availability ○ Increased transport requirements ○ Best for 5-75 acre projects Row Crop Tractors ○ Single point and 3-point hitch ○ 100-450 horsepower ○ Adequate PTO capabilities ○ Adequate towing capacity ○ User comfort (enclosed cab, Bluetooth, GPS, etc.) ○ Low to no rental availability ○ Highest transport requirements ○ Best for 75 acre and larger projects	
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	If a CDL is required and the capability is not present on staff, local and national logistic firms may be able to assist with deployment of the seeding equipment to the site. Equipment rental stores may also be able to deliver to a site for a fee. If a CDL is not required, you can proceed with an appropriately sized towing set-up. Review the Comprehensive Guide webpage to the left for additional information on towing capacity, load ratings, and safety. Load your cargo and be sure it is appropriately secured. Even though you may not need a CDL, best practices should be followed. Inadequate loading or securing, may result in significant or death. If you are not comfortable with loading and securing heavy equipment, take a class or seek guidance and learning from knowledgeable individuals. Prior to departure, conduct a pre-trip safety checklist.	
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Figure 51 - Tractor and seeder properly loaded and secured on a flatbed.

PLANT YOUR MEADOW

A

KEY QUESTIONS

- Have you verified that the site is in a condition suitable for seeding?
- Do you have an experienced operator and/or enough support staff to complete the task?
- Have you communicated the timeline?
- Have you familiarized yourself with the necessary equipment/tools?
- What type of seeds are you sowing?

OVERVIEW

The individual characteristics of each site and seed mix will affect how seed will be planted

Equipment calibration ensures that the mix is applied by the specific machine, at the specific site, at the specific rate intended.

Uncalibrated planting may result in poor coverage, time inefficiency, and increased costs.

Be sure to understand the depth at which you should be seeding each species.

CHECKLIST

STEP	TITLE	SUMMARY NOTES	DATE
1	Verification Visit	Visit the site before seeding to re-confirm effective control has been achieved and that the soil conditions are suitable for seeding.	
2	Communicate Implementation	Communicate to stakeholders the plan for planting the meadow (ex. timeline, method).	
3	Site Review	Walk through the site to check for debris, ditches, swales, or other impediments. Remove or flag obstructions and areas to avoid.	
4	Equipment Review	Gather your planting team to review the plan and pertinent safety information. Check the equipment and review processes.	
5	Calibration	Perform calibration on the equipment, as necessary.	
6	Seed Mixing and Loading	Weigh (if needed), mix (if needed), and evenly distribute seed in the equipment. Mixing can be performed slightly ahead of time.	
7	Install Meadow	Use your equipment to install the meadow. Regularly check operations to ensure successful seeder operation, planting rates, seed distribution, and depth.	
8	Document	Capture key moments with images (with permission).	
9	Communicate	Communicate the effective planting of the seed.	

SUMMARY AND SIGN-OFF

HOW TO KNOW WHEN YOU ARE FINISHED

The seed has been mixed and successfully seeded into the predetermined ecological zones, and you have documented and subsequently communicated the effective completion of this step.

PLANT YOUR MEADOW		B
TITLE	DESCRIPTION	LINKS
Verification Visit	Check for Invasive Regrowth Before you spend the time and money moving all the necessary equipment to the site, you must verify again that the control methods from vegetation management were successful. If there is any evidence of regrowth of invasive or noxious weeds, you must make the decision as to whether it is safe to continue. DO NOT Continue until Invasives are Controlled If there are very small, isolated pockets of remaining invasives or noxious weeds, it may be decided to avoid these areas during seeding and control them later. If, however, there is evidence of considerable regrowth, it is highly recommended to delay seeding and to return to control these remaining weeds until they are fully suppressed.	
Communicate Implementation	Communicate your Plan Once you have confirmed that the site is ready for seeding, communicate your plans to your stakeholders. This should include the dates of when seeding will occur, how long it will take, the equipment being used, and the process involved in the chosen seeding method.	
Site Review	Walk the Site At this point, your seed and necessary equipment are on-site, and any site prep has been effectively completed. You are left with a weed free site and are ready to begin. Before hooking up the seeder, take a walk. Review the planting site with the operator looking for any debris, obstacles, steep grades, swales, and ditches that need to be avoided or considered. Remove what you can and use marking flags to mark other obstacles.	
Equipment Review	Examine the Equipment A journey on the flatbed trailer or long-term storage can reduce the operability of seeding equipment. It is best to verify working conditions prior to starting. Examine that the seed boxes on the implement are dry, any chutes are open, moving parts are well greased, any agitators/paddles are functional, and that any tires are inflated. If all aspects appear operational, then proceed to hook up the implement and begin calibration. If any damage or poor condition is present, assess if it can be repaired in the field (e.g. more grease is needed or seed boxes need to be dried) or if seeding must be delayed for repair (e.g. the welds on the implement hitch points are showing signs of failure). Hook up the Implement	

	If using a 1-point hitch, extend or retract the tongue so that the seeding implement is level with the ground and not excessively pressuring the hitch tongue. If using a 3-point hitch and an implement with a draw bar, raise or lower the hitch so that the draw bar is level with the ground. With the implement attached and in the activated position (if applicable), examine the tractor and implement for overall operability, condition, and signs of damage. If you need to review the manual, do so now, prior to starting.  <i>Figure 52 - Tractor with seeder attached via a draw bar connected to a 3-point hitch, which is the standard setup</i>	
Calibration	Calibrate Careful calibration is vital to ensure you are spreading seed at the required rate. There's no worse feeling than getting close to finishing the seeding of a site only to find you've run out of seed. Similarly, you don't want to find yourself with an abundance of seed left over either. The seed mix design will have an intended amount of seed mix to put out per acre, 5, 10, 25 lb./acre, etc. The calibration process is one of mixing proportions of the seed mix with carrier to so that the seeding implement is dropping the seed mix and the intended amount. Review the Advanced Calibration video to the left for a step-by-step process on how to calibrate a seed drill and to your implement's manual for model specific instructions. More experienced operators may be able to ballpark the calibration process off-site with only minor adjustments needed upon arrival. Carriers	<u>Advanced Calibration</u> <u>Calibration of Grain/Seed Drills</u> <u>Calibration of Broadcast Seeders</u>

	Carriers are an important part of seed mix design and calibration, they are used to bulk a final seed mix so that the expensive seed mix is dropped at a consistent, intended and designed rate. Inert carriers are non-viable additives, like cracked corn, kitty litter, rice hulls, etc., refer to the “Seed Mix Design” section for a discussion of active carriers. There are few differences between the performance of inert carriers and is often reliant on operator preferences with the seeding implement. It is beyond the scope of this document to discuss those varied preferences. If there is too little carrier, the expensive seed mix will run through the seeder and you will run out before you’ve finished planting the field. If there is too much, you will find yourself making multiple passes in the field to get the seed out.  <i>Figure 53 - Grains are accessible in most feed stores including Tractor Supply and can make effective carriers. Each grain has different features and performs differently so experiment to discover which is best for your seed mix</i> Supplemental Calibration Some seeding implements have other mechanisms that must be calibrated. Drill seeders must have their blades adjusted to the proper depth, too shallow or deep has been the death of many meadow projects. Review the manual for any such mechanisms and verify the depth of the blades is around 1/2 inch.	
Tractor Operation	Using the same speed as your calibration process, begin seeding. If the site is flat, debris-free, or a retired agriculture field: • Operate in the medium transmission range on your vehicle (if applicable) • Drive at 3 miles per hour If the site is uneven, steep, slippery, or has many obstacles: • Drive at 1.5 miles per hour • Operate in the lowest transmission range on your towing vehicle Always: • Operate in the medium or low transmission ranges, NEVER in the high range • Regularly check the seeding implement to ensure calibration consistency, blockages, and agitator operation • Smartly navigate contours and grades (i.e. do not drive straight up a steep grade, take the longer more gradual route and drive <i>down</i> the steep grade.) • Lift the seeding implement when navigating swales and ditches. Though the chassis or frame may appear strong, the mechanism of seeding implements is delicate. Bumps and jostling may alter the calibration state or break the mechanism • Continually scan for obstacles in front of the towing vehicle	

- Give obstacles a wide berth, there's no need to take risks for a few extra square feet of seed



Figure 54 - View from inside a tractor while seeding. Stop, get out, and check the operation of the seeder, and your seed drop rate, about every 30 minutes

Have a second person on site to **capture media of the planting**, conduct the regular checks for debris and calibration, and to mix and refill the seed box.

When driving on the open road to a seeding site, display an abundance of caution. Lift the seeding implement off the road and activate all lights and flashers. Be sure to disengage 4-wheel drive and drive under 20 miles per hour. Park in a safe place and lock any doors when leaving the implement and vehicle for any amount of time.

Seed Mixing and Loading

For larger projects where more than one seed box will need to be used to seed, a second person should be on-site to pre-mix the seed and refill the implement.

Mixing Seed:

From the seed mix design and the calibration process you know the amount of seed mix and carrier needed for an acre; you know the ratio of seed mix to carrier. Using a bucket, hanging scale, and a large mixing bin (or trash can), you can begin to weigh out each seed and carrier. *Do not just dump all the seed in and then all the carrier.* Create the final mixture by starting with a layer of carrier and then alternating measures of seed mix and carrier. Once a mixing bin is full, it can be transported to the seeding implement and loaded.

You can increase the speed of this process by marking the weight of seed mix and carrier on the inside of a measuring bucket.

Loading seed:

Larger seeding implements have multiple 'cells' which hold separate agitators or chutes. A seeding mix should be even distributed between each cell. Use a separate, smaller vessel to distribute an even measure into each cell when loading a seed mix.

Install Meadow	Continue to lay down seed until you have none left. If a second pass needs to be made over the site, with a different seed mix, run in the perpendicular direction if feasible. Any small amount of leftover seed should be used to bulk potential problem areas, areas near a particular invasive plant, poor soils, increased erosion areas, etc. to give the best chance of meadow success in that area. Tractor Operation Using the same speed as your calibration process, begin seeding. <u>If the site is flat, debris-free, or a retired agriculture field:</u> • Operate in the medium transmission range on your vehicle (if applicable) • Drive at 3 miles per hour <u>If the site is uneven, steep, slippery, or has many obstacles:</u> • Drive at 1.5 miles per hour • Operate in the lowest transmission range on your towing vehicle <u>Always:</u> • Operate in the medium or low transmission ranges, NEVER in the high range • Regularly check the seeding implement to ensure calibration consistency, blockages, and agitator operation • Smartly navigate contours and grades (i.e. do not drive straight up a steep grade, take the longer more gradual route and drive down the steep grade.) • Lift the seeding implement when navigating swales and ditches. Though the chassis or frame may appear strong, the mechanism of seeding implements is delicate. Bumps and jostling may alter the calibration state or break the mechanism • Continually scan for obstacles in front of the towing vehicle • Give obstacles a wide berth, there's no need to take risks for a few extra square feet of seed • Have a second person on site to capture media of the planting, conduct the regular checks for debris and calibration, and to mix and refill the seed box. When driving on the open road to a seeding site, display an abundance of caution. Lift the seeding implement off the road and activate all lights and flashers. Be sure to disengage 4-wheel drive and drive under 20 miles per hour. Park in a safe place and lock any doors when leaving the implement and vehicle for any amount of time.	
Document	As with every step, it is important to take photos and videos as well as to take note of any important information. This can include the species list, seeding rate of seed mix and carrier, the time it takes to seed, issues and solutions, and more. Document anything that might be relevant. This documentation will be important when reviewing the process with stakeholders as well as when seed starts to grow. Having this information will help you explain the process in depth and defend it from scrutiny.	

Communicate	During the process of seeding, communicate overall progress, any changes to timelines, and/or or any other issues that might arise. Upon completion, send any necessary documentation to stakeholders along photos of a job well-done.	
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Figure 55 Seeding in light snow can be advantageous because you can easily observe your seed drill tracks. This helps to prevent "skips" or "double-seeded" areas. Avoid seeding in heavy snow or snow more than 1" deep.

RE-EDUCATE YOUR STAKEHOLDERS			A
KEY QUESTIONS		OVERVIEW	
○ Have we sent a quarterly reminder to all stakeholders reinforcing the outcome that we collectively aspire to achieve (which takes seven years)? ○ What level of investment and specification was provided during the evaluation and planning process associated with timelines? ○ What elements of the growth stage predictably lead to negative feedback and how can we address those? ○ Was our planning, evaluation, site prep, and planting strategy implemented correctly, based on this guide?		This phase might sound redundant but remind your stakeholders that the journey is just beginning. Meadows are dynamic spaces that can shift and change from season-to-season, but they usually stabilize and mature into their near-terminal vegetation complex in about seven years. The meadow maturation process can be nerve-wracking for many people due to the unavoidable proliferation of annual winter weeds and slow meadow germination. Proactive, consistent, accurate, and confident communication and expectation management can mitigate these concerns and aid in the successful meadow maturation by avoiding counterproductive reactions to criticism.	
CHECKLIST			
STEP	TITLE	SUMMARY NOTES	DATE
1	Review Previous Protocols	Evaluate your process and scan for potential gaps during the design and install.	
2	Confirm Responsibilities	Review establishment responsibilities and protocols related to monitoring and supplemental weed control.	
3	Schedule & Deliver Annual Meeting	Re-engage with all stakeholders at least once per year to address both detailed observations and the bigger picture, and to reinforce expected outcomes and timelines.	
4	Identify & Engage New Stakeholders	Look for opportunities and always be prepared to engage and educate new stakeholders that could influence how the project is managed going forward. Have faith in the process and try to avoid getting derailed by someone wanting to take unplanned actions based on their interpretations.	
5	Develop some Media Assets	Create media assets that support the outcome and/or process you have described to stakeholders.	
SUMMARY AND SIGN-OFF			
HOW TO KNOW WHEN YOU ARE FINISHED			
You have reviewed the timeline and approach for establishment and responsibilities have been assigned for establishment. You have confidently communicated post-seeding expectations in a way that helps to resist in-the-moment decisions that might conflict with or change your planning. “Experts” like to intervene at this stage and can try to put your meadow on a different course than what you have planned. Follow the process; trust the process			

RE-EDUCATE YOUR STAKEHOLDERS		B
TITLE	DESCRIPTION	LINKS
Follow Meadow Protocols	This is a reminder that the seven-year rule only applies to meadow projects that followed the outline described in this document. Without following the protocols and best management practices described in the guide, you can't confidently communicate an outcome or timeline.	
Confirm Responsibilities	Who takes over from Here? Not always, but often, after seeding is completed and before establishment begins is a time when a contractor or conservancy that built the meadow will hand the project over to the landowner or another organization. Confirm again who it is that is supposed to be continuing with the project from here. Confirm Preparedness In the case that the project is being turned over to the landowner or another organization it is imperative that they understand not only what to do, but the importance of continuing to steward the meadow. Reiterate the importance of proper maintenance to protect their investment. Encourage partnership with entities who are equipped for maintenance over the establishment period if needed.	
Schedule & Deliver Annual Meeting	At least once per year, you should gather all stakeholders to take inventory and re-focus the group on the macro-level outcomes of the project. The meadow process should have been described to stakeholders previously during project socialization, but stakeholders should be reminded that the process takes a minimum of seven years to complete. This is a chance to discuss obstacles and challenges, but this conversation should aim to alleviate those concerns because they will be addressed prior to the end of year seven. This is also an opportunity to adjust strategies, if needed, to work towards the desired outcome all stakeholders approved of. As priorities and people shift and evolve, it's best practice to make sure your priorities are constantly being considered and evaluated.	Stakeholder Management Communication Strategy
Identify & Engage New Stakeholders	It's inevitable that, over a seven-year process, the people engaged in the project will change, or their priorities will change. Stay alert for new stakeholders, especially those with differing priorities, and leverage connections and media assets to include their priorities in the project strategy.	Stakeholder Management Communication Strategy
Develop Media Assets	Regularly capturing the meadow building process or project area with photos or videos allows the primary 'project manager' to control messaging and narrative. A seven-year project will have many, many life cycles and you need to be prepared to address every hurdle and accomplishment along the way. It's helpful to keep a project in front of mind to ensure it receives adequate investment and support. The media assets can help defend new or repeated requests. As the years go on, new priorities will emerge and you should be ready to support your project. Keeping media assets up to date also ensures you maintain a presence at the site which can support an adaptive management strategy.	

ESTABLISHMENT (YEARS 1-7)				A
KEY QUESTIONS		OVERVIEW		
○ How successful was germination? ○ Is reseeded necessary and if so what should change? ○ What weeds are appearing and how pervasive? ○ How frequently should you mow?		The first year after seeding is rough and the project will feel like a full-time job. Be prepared to handle criticisms. Client or public anxiety is your worst nightmare during the establishment period. Your job is to stick to the plan while regularly evaluating what worked and what didn't. Doing a thorough job in each of these areas the first couple of years will set you up for long-term success. Gradually, intervention frequency will decrease, and species will eventually germinate and naturally find their niches within the meadow. Your job is to steward it along. Establishment protocols should be tailored to each specific ecological zone in the meadow.		
CHECKLIST				
STEP	TITLE	SUMMARY NOTES		DATE
1	Photo Documentation	Photograph meadow regularly.		
2	Meadow Documentation	Periodically evaluate the project area for invasives and germination success. Monthly cadence in the first 1-2 years, quarterly or bi-annually in years 2-7.		
3	Consider Mowing	Consider the frequency and necessity of mowing to incorporate in the stewardship plan.		
4	Write the Meadow Stewardship Plan	Write out all anticipated steps to keep the meadow successful. This should be comprehensive. Monitoring will inform decisions about acting on the plan. Validate with a professional.		
5	Announce Stewardship Plan	This outreach effort should be explicit about responsibilities and outcomes for the stewardship plan. You don't intend to kill every weed, but rather steward the space to health.		
6	Implement Stewardship Plan	Act on the stewardship plan. Monitoring will inform the necessity for action.		
7	Review Germination Success	Identify species performing well, performing poorly, and other noticeable germination patterns.		
7	Collect Seed	Collect seed from valuable species to establish new meadows, share with the community, or grow into plugs.		
8	Decide Next Year's Management Approach	Use your periodic monitoring visits to make decisions about adjusting or modifying the stewardship plan on an annual basis.		
9	Maintain Communication	Regularly provide updates to stakeholders about the status of the meadow.		
10	Remain Vigilant	Continue this process until completion, defined below.		
SUMMARY AND SIGN-OFF				
HOW TO KNOW WHEN YOU ARE FINISHED				
Establishment is finished when the meadow can function with minimal human intervention. This means insignificant populations of invasive weeds that can be easily controlled and native herbaceous coverage that is self-seeding over >95% of the meadow area. Achieving this will likely take up to 7 years. Remember that everything should be documented.				

ESTABLISHMENT (YEARS 1-7)		B
TITLE	DESCRIPTION	LINKS
Meadow Documentation	Perform a Meadow Inspection Meadows are major capital investments in the health of our communities, and they consume an ongoing annual operating budget. Meadows protect water quality and provide critical habitat for insects, birds, and other animals. They are critical pieces of natural infrastructure, and they serve the community just like bridges and roads. But meadows can change rapidly from year-to-year and should be inspected regularly, just like bridges and roads. While meadows can get better with time, they can often get worse as well. Performing a regular inspection of your meadows benefits you for several reasons: 1. Meadows can become invaded with detrimental plants like Multiflora Rose, and annual reports can help document their expansion, or their effective treatment, 2. People can, and do, dump garbage in meadows, or drive through them on ATVs and snowmobiles, causing damage, 3. Meadows can evolve in a way that you didn't expect or in a way inconsistent with its intended use. Use the meadow documentation form included in the Appendix to perform your regular inspections of your meadow. Someday, you'll be glad that you did, especially when defending a budget request to perform stewardship, or to intervene, reset, or retire the meadow. Regular inspections create an opportunity for long-term learning and for sharing your meadow experience with others, especially at conferences or during internal training sessions. Your annual inspections can inform the design of future meadows in your community. Fixed photo stations and overhead drone footage can be valuable tools in documenting a meadow's evolution.	Successful Community Science Photopoint Program
Monitor Project	No matter how effective of control you obtained during vegetation management, it is inevitable that some invasive or noxious weeds persist. Regularly monitoring the new meadow, especially early in the growing season, will allow you to quickly identify these issues as well as monitor the height of the cover crop, if used, and germination success of the seeds. Early Inspection #1 – Inspect for Cool Season Weeds During your first meadow inspection, consult your site evaluation notes for mentions of cool-season weeds. Survey the meadow in March and early April for species such as Bromus species, Orchard Grass, first-year Thistles, and Plantain. Survey Strategy	Meandering Walk Survey Protocol

Use consistent, repeatable and easy to remember survey protocols to ensure they are done at regular intervals. Walk transects for a thorough and more empirical approach, but a meandering walk can be just as effective of a strategy to identify overall condition. However, during your survey, ensure you are keeping consistent and thorough notes.

Another helpful tactic is to assign photo points from different angles to repeatably compare from season to season and year to year.



Figure 56 - An herbicide specialist treats remnant reed canary grass patches in a previously seeded wet meadow

Early Detection #2 (following regrowth)

In late Spring if no mowing occurred, or about 2-4 weeks after the first mid-season mow (see next section for mowing considerations), return to perform an additional weed detection event. Now you will be looking for warm-season weeds. The main targets will be species such as Stilt Grass, Foxtail, Mugwort, second year Thistle, Bindweed, and woody invasives like Wineberry and Multiflora Rose. Document which species you find and their relative abundance.

Further Inspections

You may also add an additional inspection for warm-season weeds in late Summer and/or for cool-season weeds in mid-Fall.

Review Germination Success

This review can happen in concurrence with the planned inspections of the meadow as some species in the meadow will also be germinating at the same time as the weeds, depending on whether they are cool or warm-season.

Ask 6 Key Questions

At the end of the growing season take stock of each species you seeded and ask the following questions:

- Which species are doing well?
- Which species are not?
- For species that are doing well, what patterns can you discern in germination success? For example, are some species doing well in certain microhabitats but not others?
- Are some species that you would expect to see not appearing at all?
- How does the meadow generally look and does it align with your expected timeline?
- If germination did not meet expectations, what was the likely root cause?

Check Expected Germination Timelines

Consult the germination timelines for each species- you may not see Milkweeds (*Asclepias* spp.) or Wild Bergamot (*Monarda fistulosa*) until the third year, for example, and they may not flower until the fourth. If you are only in your first year of maintenance and those species are nowhere to be found, it is too early to conclude that they were ill-suited to this environment.

Biennials such as Black-eyed Susan (*Rudbeckia hirta*) should appear in year 1 as basal rosettes and grasses should appear in year 2. Their absence at these junctures could indicate poor species selection, smothering by invasives, or improper seeding.

If germination success is only poor in sections of the meadow, follow the below guidelines:

Find Dead Zones

Use your germination review to identify “dead zones” or areas of low diversity. If a patch of bare dirt is bigger than the size of a hula hoop it is a potential risk site for reinvasion.

Amend Seed Mix if Necessary

If reseeding is necessary, decide if your species mix should be amended. Base this on the findings in your germination review. If, for example, you are reseeding primarily wet areas, revise your mix to lean into species that are tolerant of moister soils.

Consider Plugs

Consider using plugs as an alternative to seed. Large sized plugs can give native plants a 2-year head start over weeds. Use them for stubborn areas where seeds have failed twice or for high-visibility “focal points.” Plugs can also be useful if you want to employ species that are too difficult/expensive to procure from seed.

If that’s not the case, however, and the majority of your site is seeing poor germination and invasive species encroachment, you may be at a point where you need to reset your meadow entirely.

Consider Mowing	Mowing is, by far, the most common stewardship activity. The role of mowing is two-fold – one, to cut back encroaching woody plants, both shrubs and trees, and two, to clean it up aesthetically if it is frequented by the public. Mowing is best performed with a flail mower or a 50+hp tractor and a brush hog attachment. These machines can easily cut through meadow detritus and cut down one and two-year old saplings and shrubs. You will want to sharpen your blades before mowing to make the process easier and cleaner. Mow at a height no lower than 6” or so. You want to avoid scalping the ground as that can damage or kill the crowns of some grasses and create bare soil spots that become a vector for weeds. A simple mowing should take care of your woodies for an entire year and give the public a nice clean appearance to ward off complaints. Using a mulching mower deck could help to break up detritus into finer particles for faster decomposition. Winter Mowing Mow large meadows in natural areas in sections and on a rotation. The prevailing best practice is to delineate your meadow into three or four sections and only mow one section each year. This maintains the ability of your mower to cut trees and shrubs while limiting the impact on overwintering insects and animals. Most insects, including moths and butterflies, overwinter either in the hollow leafy stems or in the tufts of grasses. Mowing on a three or four-year rotation allows insects to adequately complete their life cycles. Mid-Season Mowing During the first two growing seasons, plan for at least one mid-season mow, but up to three if needed. Mowing can help keep annual weeds from establishing and limit perennial weeds to a manageable height before targeting them with herbicide. Time your mow to occur once vegetation reaches a height of 12-18”, and mow to a height of 8”- high, enough to spare the basal leaves of native perennials but low enough to decapitate annual weeds. You may mow multiple times but should cease by mid-fall to allow plants to harden off for winter. [include image of summer mowing] CAUTION: Mowers and other contractor equipment are major sources of invasive weed infestations. Either use a dedicated mower for your meadows or thoroughly wash your mower deck and tractor before mowing your meadows. Do not allow landscape contractors to mow your meadow unless they sign a contract that compels them to power wash all equipment before they enter the meadow. If you do not have the equipment to mow your meadow, consider hiring the work out to a specialized meadow building organization. Dirty contractor equipment and rushed mowing operations are also a major vector for weeds, so the number of weeds you need to treat each year is a direct reflection on the quality of your mowing contractor. A good contractor that understands that they are performing maintenance in a natural area will commit to cleaning their equipment thoroughly before mowing. The operator	PGC Mowing Guidance
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	will avoid rough movements and turns that tear at the soil and damage the meadow plants. An irresponsible contractor simply rushes from jobsite to jobsite passing each property's weeds to the next and creating bare spots for new weeds. Your best alternative to a specialized contractor for meadow mowing will be a local farmer, who probably shares your interest in preventing the spread of weeds and invasive plants. Avoid using the same equipment used for roadside mowing in a meadow. Too many weed seeds can be inadvertently planted into the meadow.	
Write the Meadow Stewardship Plan	Write/Update the 3-year Stewardship Plan After your first meadow inspection, write your 3-year meadow stewardship plan based on your observations. This plan needn't be more than a paragraph or two that explains your plan and refers to the meadow inspection document. There are only three commonly recurring meadow stewardship activities that need performing annually – mowing, weed control, and supplementation. Your stewardship plan should describe what your plan is for the meadow for next year, and the following two years. Burning isn't a stewardship activity; it's a major intervention and performed only when there is a compelling science-backed case for burning.	Mid Atlantic Native Meadows, Maintenance
Announce Stewardship Plan	Discuss the Plan with Stakeholders Just as with vegetation management early on, the vegetation management at this stage is likely to include the use of herbicides, probably selective herbicides at that. And just as with earlier, you'll want to be prepared to defend the case for herbicide use. This can involve having plans to mostly manage plants manually and following up with minimal herbicide use. Go over all aspects of the stewardship plan; the present weeds, germinating species, gaps in the meadow, plans to control weeds (mowing, herbicide, etc.), frequency of inspections, levels of documentation, plans to fill in gaps, and so on.	
Implement Stewardship Plan	Even well-developed meadows can occasionally suffer from weed infestations, particularly after a cold wet winter or a long, dry and hot summer that created open spots in the meadow. If you find that invasives are in the meadow or encroaching from an edge, add invasive control to your stewardship plan. Use the same form and process as described in the Plan Your Vegetation Management Strategy section. Implement Mowing Regime Complete your mowing regime as outlined in the plan. Be prepared to change this regime as needed depending on the desired effect on present species.	See Vegetation Management Sheet Managing Woody Encroachment

	Consistent rain or drought can change the timing and frequency of mowing during the growing season. Rapid Response #1 - Control Strategy Following the creation of the stewardship plan, if early-season weeds are present at concerning levels, initiate control immediately. Spot spraying is typical, but mechanical methods are also possible, especially if the infestation is small. Avoid pulling weeds though, since this can create soil disturbance that just promotes the proliferation of more weeds by bringing their seeds to the surface. Instead, cut from the base. Rapid response is critical; issues cannot be left to deal with for a year or two after being identified. And remember that you want to effectively suppress these weeds, so use a method that will keep them from coming back. Cutting Mugwort at the base each year will only cause it to spread via rhizomes (underground runners), so its spread will continue. Rapid Response #2 Immediately treat detected invasives with herbicide or by cutting back to base following your second early detection visit (outlined in “Monitor Project” above). See the Vegetation Management and Preparing to Spray sections for guidance on choosing herbicide products, rates, and methods of application. Make sure you wait 2-4 weeks after mowing before conducting an herbicide application. This allows regrowth of the leaf surface, which is critical for applying foliar herbicides. You may repeat the sequence of mow>early detection>rapid response many times in the first year or two of the meadow. Update Stewardship Plan If there are invasive species identified after the first visit to the meadow, update the plan to include these and the required control methods for them.	
Review Germination Success	This review can happen in concurrence with the planned inspections of the meadow as some species in the meadow will also be germinating at the same time as the weeds, depending on whether they are cool or warm-season. Ask 6 Key Questions (intentionally repeated) At the end of the growing season take stock of each species you seeded and ask the following questions: • Which species are doing well? • Which species are not? • For species that are doing well, what patterns can you discern in germination success? For example, are some species doing well in certain microhabitats but not others? • Are some species that you would expect to see not appearing at all? • How does the meadow generally look? • If germination did not meet expectations, what was the likely cause?	Review Germination Success

	Check Expected Germination Timelines Consult the germination timelines for each species- you may not see Milkweeds <i>Asclepias</i> spp.) or Wild Bergamot (<i>Monarda fistulosa</i>) until the third year, for example, and they may not flower until the fourth. If you are only in your first year of maintenance and those species are nowhere to be found, it is too early to conclude that they were ill-suited to this environment. Biennials such as Black-eyed Susan (<i>Rudbeckia hirta</i>) should appear in year 1 as basal rosettes and grasses should appear in year 2. Their absence at these junctures could indicate poor species selection, smothering by invasives, or improper seeding. If germination success is only poor in sections of the meadow, follow the below guidelines: Find Dead Zones Use your germination review to identify “dead zones” or areas of low diversity. If a patch of bare dirt is bigger than the size of a hula hoop it is a potential risk site for reinvasion. Amend Seed Mix if Necessary If reseeding is necessary, decide if your species mix should be amended. Base this on the findings in your germination review. If, for example, you are reseeding primarily wet areas, revise your mix to lean into species that are tolerant of moister soils. Consider Plugs Consider using plugs as an alternative to seed. Large sized plugs can give native plants a 2-year head start over weeds. Use them for stubborn areas where seeds have failed twice or for high-visibility "focal points." Plugs can also be useful if you want to employ species that are too difficult/expensive to procure from seed.	
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If that's not the case, however, and the majority of your site is seeing poor germination and invasive species encroachment, you may be at a point where you need to reset your meadow entirely.



Figure 57 - Yes, meadows can be installed using tightly spaced plugs, as shown in this image. This technique is best for meadows under an eighth of an acre.

Decide if the Meadow Needs Resetting

Why would you want to reset a meadow? Good question!

Sometimes meadows don't turn out the way that anyone intended, and this can happen for a variety of reasons. Here are the top three reasons why meadows fail to establish properly and become candidates for a complete reset:

1. Inadequate Preparation – this is the most common reason why people decide to give up on a meadow and start over. Japanese Stilt Grass, basket grass, turf and pasture grasses, Mugwort, Thistle, Reed Canary Grass, Purple Loosestrife, and Phragmites are the principal culprits. If these weeds were present in the meadow area prior to building it and weren't completely cleaned, they could quickly overwhelm a new meadow. When this happens, your only reasonable recourse is to start over,
2. Poor Species Selection – The use of inappropriate species for a new meadow is probably the #1 reason why people can get frustrated or become disappointed with their meadows. Choosing species for a meadow is the purview of ecologists, not landscape designers. If a meadow was “designed” to host 80 beautiful and rare species then it was destined to fail from the very beginning. A meadow that results from poor species selection might not be a “bad” meadow, but it probably won't be the one that you wanted, especially if it is dominated by goldenrods. In this scenario, a limited reset and reseeding of the meadow could be warranted, and
3. Incorrect Seeding Technique – a much under-discussed source of meadow failure is the seeding technique. Choosing a seeding technique is a tri-lateral decision based on the equipment available,

	the type of seed, and the soil and hydrological conditions of the site. Choosing an inappropriate seeding technique can lead to only a few species germinating and growing, which can lead to a spotty meadow and significant weed incursions. The most common error is the use of a grain drill that buries warm season grasses and Asters too deeply into the soil. If the meadow was seeded improperly, you might or not need to reseed, but a reset is certainly in order. Check with a local meadow consultant on the techniques that might be able to recover the meadow, or if reseeding is inevitable. Resetting a meadow can be almost as expensive as it was to install the meadow in the first place. It is generally difficult to secure budget to reset a meadow, so you'll want to follow the instructions in this guide as closely as possible to avoid this scenario altogether. Be Honest and Document “Why?” a Reset is Required If you do decide to reset the meadow, first perform a thorough analysis as to “why” you have decided to reset the meadow. Is it for one or more of the reasons above, or something else. You'll want to perform a root cause analysis, or ask someone to perform it for you, so that you can avoid committing the same errors on your next attempt. In addition to documenting “why” a meadow project requires a reset, craft a new budget based on an updated vegetation management plan and a seed mix design. Hopefully, your second attempt incorporates your learnings into the new approach and design. Special Section on Burning – Decide if Burning is for You Interest in using burning as a meadow reset technique is at an all-time high. The most common case for burning is trying to sustain a warm season grass meadow in a place where a warm season grass meadow cannot sustain itself naturally. Burning is sometimes used to suppress large shrub infestations, but it is better to treat the shrubs before burning. While the role of burning is well understood for the maintenance of warm season grasslands in the Midwest, the effects of burning forb-dominated meadows on the east coast are under-studied. At best, burning can reduce thatch to improve access to the soil for treating weeds and seeding. At worst, burning can dramatically shift vegetation patterns in an undesirable direction. Yes, there are now many people qualified to plan and implement a burn, but precious few that can properly prescribe one and articulate its long-term effects.	
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	There are many considerations to account for when planning a burn. What time of year? Pre-mow or not? Treat invasives prior to burning, or after? How hot do we want the fire, or can it even get hot enough to have the desired effect? What to do if a burn is scheduled but cancelled due to weather conditions? How do we protect insects, birds, animals, and hard-to-replace species from the effects of burning?  <i>Figure 58 - This meadow is being repeatedly burned in a failing attempt to force this wet meadow area to support warm season grasses. Burning cannot compensate for poor species selection. Use Evaluate™ to avoid this common mistake.</i> Burning is not a cure-all – burning should be treated as a very specific tool to accomplish a very specific effect. If that specific effect cannot be articulated, then rethink the need for a burn. Burns are fun, but that’s no reason to reset a meadow.	
Collect Seed	Once native meadow plant populations have established, you may begin to collect seed. Seed can be used to help jumpstart a different meadow project or be used to fill in gaps within the meadow that are taking a long time to establish naturally. If these seeds are from locally sourced plant populations, they can also be collected to be contract grown into plugs by a native plant nursery.	Xerces Society, Collecting and Using Your Own Wildflower Seed



Figure 59 - Hand collected seeds from a successful meadow. These seeds will be used to start a new meadow.

At the end of each year, it's important to review the steps you took throughout that year and review as to whether they were effective.

Ask 4 Important Questions

Review how well your maintenance plan worked in the previous year. Answer the following questions:

1. Did you time your treatments correctly or did you miss a treatment window for an important weed?
2. If spraying herbicide, did your spray rates effectively control species or should they be altered?
3. Was the number of mowings during the previous year adequate to control annual weeds and preserve aesthetics? Should next year have more, less, or the same number of mowings?
4. Are you generally seeing a reduction in invasive species from the previous year?

Revise and document your management plan according to your answers.

Decide if the Meadow Needs Resetting

Why would you want to reset a meadow? Good question!

Sometimes meadows don't turn out the way that was intended, and this can happen for a variety of reasons. Here are the top three reasons why meadows fail to establish properly and become candidates for a complete reset:

4. Inadequate Preparation – this is the most common reason why people decide to give up on a meadow and start over. Japanese Stilt Grass, basket grass, turf and pasture grasses, Mugwort, Thistle, Reed Canary Grass, Purple Loosestrife, and Phragmites are the principal culprits. If these weeds were present in the meadow area prior to building it and weren't completely cleaned, they could quickly overwhelm a new

[PA Prescribed
Fire Council](#)

[Longwood
Gardens
Prescribed
Burn](#)

[Using
Prescribed
Fire to Manage
Native Grass
Forages in the
Mid-South](#)

**Decide Next
Year's
Management
Approach**

	meadow. When this happens, your only reasonable recourse is to start over, 5. <u>Poor Species Selection</u> – The use of inappropriate species for a new meadow is probably the #1 reason why people can get frustrated or become disappointed with their meadows. Choosing species for a meadow is the purview of ecologists, not landscape designers. If a meadow was “designed” to host 80 beautiful and rare species then it was destined to fail from the very beginning. A meadow that results from poor species selection might not be a “bad” meadow, but it probably won’t be the one that you wanted, especially if it is dominated by goldenrods. In this scenario, a limited reset and reseeding of the meadow could be warranted, and 6. <u>Incorrect Seeding Technique</u> – a much under-discussed source of meadow failure is the seeding technique. Choosing a seeding technique is a tri-lateral decision based on the equipment available, the type of seed, and the soil and hydrological conditions of the site. Choosing an inappropriate seeding technique can lead to only a few species germinating and growing, which can lead to a spotty meadow and significant weed incursions. The most common error is the use of a grain drill that buries warm season grasses and Asters too deeply into the soil. If the meadow was seeded improperly, you might or not need to reseed, but a reset is certainly in order. Check with a local meadow consultant on the techniques that might be able to recover the meadow, or if reseeding is inevitable. Resetting a meadow can be almost as expensive as it was to install the meadow in the first place. It is generally difficult to secure budget to reset a meadow, so you’ll want to follow the instructions in this guide as closely as possible to avoid this scenario altogether. Be Honest and Document “Why?” a Reset is Required If you do decide to reset the meadow, first perform a thorough analysis as to “why” you have decided to reset the meadow. Is it for one or more of the reasons above, or something else. You’ll want to perform a root cause analysis, or ask someone to perform it for you, so that you can avoid committing the same errors on your next attempt. In addition to documenting “why” a meadow project requires a reset, craft a new budget based on an updated vegetation management plan and a seed mix design. Hopefully, your second attempt incorporates your learnings into the new approach and design. Special Section on Burning – Decide if Burning is for You Interest in using burning as a meadow reset technique is at an all-time high. The most common case for burning is trying to sustain a warm season grass meadow in a place where a warm season grass meadow cannot sustain itself naturally. Burning is sometimes used to suppress large shrub infestations, but it is better to treat the shrubs before burning. While the role of burning is well understood for the maintenance of warm season grasslands in the Midwest, the effects of burning forb-dominated	
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	meadows on the east coast are under-studied. At best, burning can reduce thatch to improve access to the soil for treating weeds and seeding. At worst, burning can dramatically shift vegetation patterns in an undesirable direction. Yes, there are now many people qualified to plan and implement a burn, but precious few that can properly prescribe one and articulate its long-term effects. There are many considerations to account for when planning a burn. What time of year? Pre-mow or not? Treat invasives prior to burning, or after? How hot do we want the fire, or can it even get hot enough to have the desired effect? What to do if a burn is scheduled but cancelled due to weather conditions? How do we protect insects, birds, animals, and hard-to-replace species from the effects of burning? Burning is not a cure-all – burning should be treated as a very specific tool to accomplish a very specific effect. If that specific effect cannot be articulated, then rethink the need for a burn. Burns are fun, but that’s no reason to reset a meadow.	
Maintain Communication	At this point in the meadow-building process, communication often slows down. Still, you should communicate with relevant stakeholders ahead of major establishment tasks, especially mowing and vegetation management. Regularly sending along updates, even simply photos of the meadow, is always appreciated by folks. Remember that you’d rather be communicating with them often, and getting photos of blooms, pollinators, or other nice shots always brightens the day and reinforces your efforts.	
Remain Vigilant	Just as you want to be communicating often, you want to be visiting the meadow even more often. This increases the likelihood of noticing either successes or issues that you previously missed, paying off in the end as it allows you to better understand the site and to more quickly and readily respond to issues.	

MAINTENANCE (YEARS 8+)				A
KEY QUESTIONS		OVERVIEW		
○ What weeds are present and at what level? ○ What is your early detection protocol? ○ Are your goals still clear? ○ Will a burn be helpful? ○ How are desirable species responding? Are they still present? ○ Was your species selection right?		Once you’ve reached a point where there are minimal invasives present and native plants are re-seeding across roughly 95% of the meadow, your job does get easier, but it never stops. Remember, regular maintenance actions must be taken to preserve a meadow, except for extreme circumstances, such as a new invasive species incursion. Maintenance activities are the same as establishment activities, just performed less frequently and with less intensity, so you should be comfortable with these tasks. Remember that meadows are inherently unsustainable in most places so you will always have work to do to maintain your meadow in a meadow-like condition.		
CHECKLIST				
STEP	TITLE	SUMMARY NOTES		DATE
1	Meadow Documentation	Perform annual visit to evaluate meadow and photo-document the status of the system.		
2	Update Meadow Stewardship Plan	Find opportunities to re-engage with existing stakeholders and develop new stakeholders.		
3	Meadow Intervention	Teach others about the process that you used and the decisions that you made. Sharing the positive, or negative, results of any of your actions helps to build community knowledge and understanding about how to build meadows. Few meadow projects run perfectly. Learn from each one and share your learnings.		
4	Write Meadow Maintenance Plan	Write out all anticipated steps to keep the meadow successful. This should be comprehensive. Monitoring will inform decisions about acting on the plan. Validate with a professional.		
5	Meadow Intervention	Act on the maintenance plan. Monitoring will inform you of the necessity for action.		
SUMMARY AND SIGN-OFF				
HOW TO KNOW WHEN YOU ARE FINISHED				
You’re never finished with maintenance! Tasks every year should include succession interruption (mowing/grazing), surveying, and refined management actions.				

MAINTENANCE (YEARS 8+)		B
TITLE	DESCRIPTION	LINKS
Meadow Documentation	Perform an Annual Meadow Inspection Even once you've reached the stage of a well-established and fairly self-sufficient meadow, the work is never done. You may not need to complete multiple inspections per year anymore but should still complete at least one thorough meadow inspection every year. Again, it only takes a year or two for an invasive species to encroach on a meadow to the point that you've now got a real fight on your hands to get it back to where it had been. You can continue to use the meadow documentation form included in the Appendix to perform an annual inspection of your meadow. Remember, annual inspections create an opportunity for long-term learning and for sharing your meadow experience with others. These annual inspections can even inform the design of future meadows in your community. And keep up with photos and videos, not just for social media, but to continue to see changes over time and understand what those changes mean.	Meandering Walk Survey Protocol Successful Community Science Photopoint Program
Periodic Stakeholder Engagement	Once a meadow is well-established, communication should decrease even more, mostly revolving around periodic updates and the annual meeting/report. Still, it's important to keep up relationships with existing stakeholders and to keep an eye out for new stakeholders. A lot of time, sweat, and tears will have gone into the meadow by this point, so you'll want to maintain interest in continued stewardship of the meadow.	
Consider Educational Programs	A great way to not only maintain interest in a meadow, but to also further the mission of conservation is through interactive educational programs. Chances are there is a local EAC or conservation organization that would appreciate using the site for these purposes. If you've had a long history of assisting to maintain the meadow you may even be asked to discuss the project yourself at one of these events. These programs encourage other people and organizations to consider building a meadow themselves and helping them understand the level of work that goes into them right from the start will be a huge benefit for them.	Pennsylvania Association of Environmental Educators
Write Meadow Maintenance Plan	Update the 3-year Stewardship Plan After performing your annual meadow inspection, update your 3-year meadow stewardship plan with the same information as has been in previous plans: Specify your Mowing and Rotation Plan Mid-season mows have long-since stopped but winter mowing on a rotation is still vital to the continued health of your meadow. Announce your Weed Control Plan At this point also a smaller task, and yet still a vital one, especially with the continued introduction of new invasive species. Be thorough and ensure you know all of the plants you're looking at in your meadow.	Managing Woody Encroachment PGC Mowing Guidance

	Collect Seed Also, at this point you are hopefully able to collect a large amount of seed from several different species, and hopefully ones with local genetics.											
Meadow Intervention	Decide if you Need an Intervention Each year or so, during one of your annual inspections, you’ll want to step back and look at the meadow as a whole and ask yourself, “does the meadow look like it should, or is there something happening that has significantly changed its character?” Be sure to check your previous reports and review photos and drone footage because several things can happen over the course of a year that might be difficult to discern with a simple annual walk-through inspection, such as: 1. A stand of Cedar, Birch, Maples, or Dogwood have heavily encroached on one edge of the meadow, 2. The number of Olive, Honeysuckle, or Rose shrubs have greatly increased since last year, 3. A gulley has formed where there wasn’t one before and you are losing soil, 4. A region of particularly high plant diversity is being overtaken by a goldenrod, 5. A beautiful stand of grasses has become much smaller or has disappeared altogether, 6. A particularly beautiful plant, like Foxglove Beardtongue (<i>Penstemon digitalis</i>) or New York Ironweed (<i>Vernonia noveboracensis</i>), is expanding rapidly in one section of the meadow. 7. Walkers have worn a path through the meadow and stilt grass thatch is forming on either side 8. Etc... These types of stand-back observations, positive or negative, could give rise for making a specific intervention each year that could help to keep your meadow on track and healthy. Here’s a glimpse into how the above observations might inspire an intervention in a meadow <table><tr><th>OBSERVATION</th><th>POTENTIAL INTERVENTIONS</th></tr><tr><td>Trees or Shrubs Encroaching on an Edge.</td><td>Remove the encroaching vegetation and thin or remove some of the nearby sources of seed.</td></tr><tr><td>Invasive Shrubs are on the rise</td><td>Hire a meadow maintenance team to come in and treat the invasive shrubs instead of relying just on mowing.</td></tr><tr><td>A Gulley Formed</td><td>Install erosion control devices like silt socks to disperse concentrated flows. Regrade or install check dams.</td></tr><tr><td>Goldenrods Taking Over</td><td>Suggestive of a problem with the original seed mix design. Hire a team to assess the Goldenrod, suppress if necessary, and to reseed with a more resistant set of species in the affected areas. Sometimes a different mowing regime can be effective.</td></tr></table>	OBSERVATION	POTENTIAL INTERVENTIONS	Trees or Shrubs Encroaching on an Edge.	Remove the encroaching vegetation and thin or remove some of the nearby sources of seed.	Invasive Shrubs are on the rise	Hire a meadow maintenance team to come in and treat the invasive shrubs instead of relying just on mowing.	A Gulley Formed	Install erosion control devices like silt socks to disperse concentrated flows. Regrade or install check dams.	Goldenrods Taking Over	Suggestive of a problem with the original seed mix design. Hire a team to assess the Goldenrod, suppress if necessary, and to reseed with a more resistant set of species in the affected areas. Sometimes a different mowing regime can be effective.	Managing Woody Encroachment PGC Mowing Guidance
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	Grasses Have Waned	Usually, a sign of improper seed mix design, or a series of unusually wet seasons. Design a new seed mix for the affected areas and reseed.	
	Beautiful Flowers Expanding	Learn more about the conditions the species thrives in and look for more areas that are functioning similarly in the meadow. Add some additional seed of the species to improve aesthetics and function.	
	Worn Paths and Stilt Grass Problem	Intentionally close the trail with a sign, suppress the stilt grass, and reseed the trail with a seed mix that can tolerate compaction.	
	Etc...	There are too many potential observations and intervention options to list them all here. If you see something, say something, and contact your local meadow expert to take a look.	
	Share your observations and your recommended interventions with your manager, secure budget, and include in your 3-year stewardship plan.		

KEEPING A MEADOW, OR NOT...			A
KEY QUESTIONS		OVERVIEW	
- How does one keep a meadow as a meadow? - What does keeping a meadow as a meadow entail? - Can a meadow even be kept as a meadow? - Why doesn't my meadow look like it used to? - How do I get my meadow back to the point when it was full of flowers all year? - Why doesn't my meadow look like I thought it was going to look? - Weeds have taken over, especially Goldenrod; what do I do now? - How do I decide when to let the meadow go?		Meadows will become whatever they are meant to become; that's what nature does. Keeping a meadow as a meadow means that you will need to arrest natural processes, particularly the emergence of trees and shrubs. Keeping a meadow as a certain "type" of meadow is particularly challenging as doing so requires fighting against nature's processes, which can be expensive and usually fails. Ultimately, you might decide you don't need a meadow any longer and want to just let it go. Managing how the meadow evolves should follow a similarly rigorous process to the meadow-building process. Nearly all the steps are the same, except you might not need a seed drill.	
CHECKLIST			
STEP	TITLE	SUMMARY DELIVERABLE	DATE
1	Meadow Retirement	I have reviewed and documented my meadow, or had it reviewed and have the documentation in hand	
2	Transition to Shrubland?	I know what I will do to steward my meadow this year, and for the following two years.	
3	Transition to Forest?	I have decided whether my meadow needs more than simple maintenance, or not. I need to do this one big thing in Year XXXX to deal with a particularly large problem.	
SUMMARY AND SIGN-OFF			
HOW TO KNOW WHEN YOU ARE FINISHED			
You have made all your major decisions for the meadow, which you repeat annually. You know what your stewardship activities will always be for three years. You have consciously decided to intervene, reset, or retire the meadow each year, and socialized your decisions. You have secured extra budget and schedule for activities that require supplemental funding.			

KEEPING A MEADOW, OR NOT...

B

TITLE

DESCRIPTION

LINKS

Make a Conscious Decision Each Year to Retire, or Not to Retire, the Meadow
Should meadows be forever? Probably not, unless you already have a stable, naturally occurring meadow site. Meadows excel at building soils and acting as a nursery for shrubs, and then trees. Increasingly, the meadow is going to try “hard” to transition to the next stage of its development. No one can precisely predict when a meadow is ready to transition, but it should be obvious when it is.

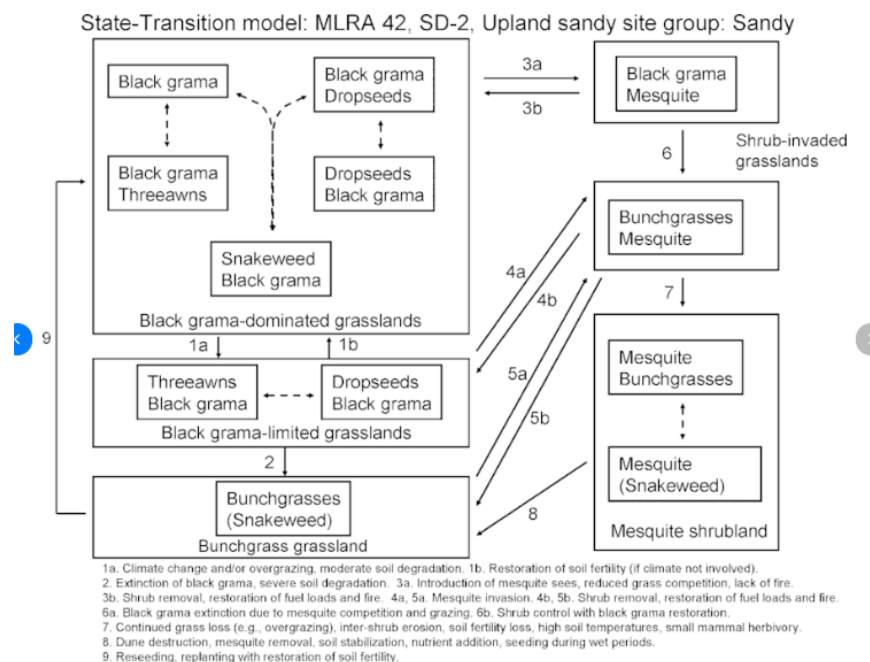
The Northeast has relatively few “built” meadows and even fewer have been studied intensively enough to draw any conclusions about when its time to let it develop naturally into a shrubland or forest. Until there is accepted guidance on the topic, keep it as a meadow until it becomes obvious that an annual mowing and a little bit of herbicide can no longer keep it functioning as a meadow.

There might come a time when a park or township is tired of maintaining their meadow, or the meadow no longer serves the purpose it once held. This is when you make the conscious decision to “retire” the meadow and allow it to progress to its next ecological state. NRCS might have a state-and-transition model built for your ecoregion and it would be good to consider another ecological state, the species that should be growing in it, and the transition model. An example model below:

Retiring a meadow doesn’t mean abandoning the meadow. It means intentionally helping it to transition to its new state, either a shrubland or a forest.

Meadow Retirement

NRCS-ESD



State and transition model taken from the Natural Resource Conservation Service's Ecological Site Description for a Sandy Upland site in Major Land Resource Area (MLRA) 42, Southern Desert (SD) region 2 viewable at http://esis.sc.egov.usda.gov/esis_report/fsReport.aspx?id=R042X B012NM&rptLevel=all.

Transition to Shrubland	Decide to Transition to Shrubland To establish a new shrubland for Turkeys, Woodcocks, and other birds, you will want to reintroduce the shrubs that are attuned to the ecological zones in your meadow to maintain its regional authenticity. Shrublands are relatively inexpensive and can be clustered for a more natural aesthetic that can expand outwards over time. Shrublands are more associated with moist to saturated soils, which are places where most trees struggle. If you are retiring a meadow in a moist or saturated area, first consider shifting to shrubs such as Cornus, Viburnum, Spiraea, Cephalanthus, Alnus, and Salix.  <i>Figure 60 - A properly designed and planted riparian buffer, using shrubs</i> If you are a user of Evaluate™, you can get shrub recommendations right from the software.	
Transition to Forest	Decide to Transition to Forest To move directly from a meadow to a forest involves planting trees, up to 500 per acre if unprotected or about 150 per acre if caged or tubed. There are many resources online, and several grant programs, that will help you to plant trees into your meadow to create a new forest-like area. You'll want to use the correct species, of course, for healthy long-term performance. Check out Evaluate™ for tree recommendations for your ecological zones.	

SUMMARY

Building a meadow is both an art and a science, but there's a reliable process that can yield positive results. This guidebook, and the accompanying [Practitioner's Toolkit](#), is here to help you move through that process with confidence and success.

While creating an authentic, resilient meadow takes thoughtful planning and patience, each step you take lays the foundation for an ecosystem that will reward you, your community, and the local fauna for years to come, or until you decide you want a resilient forest. Meadows don't appear overnight and don't occur randomly, but they can absolutely thrive under the right set of circumstances and conditions.

Our goal is to share the lessons practitioners have gained through years of hands-on experience so you can avoid common pitfalls and focus on what truly matters: choosing the right site, selecting species that belong there, preparing the landscape well, and stewarding the space as it grows. With each completed step, you move closer to a healthy, dynamic meadow full of life – a place where pollinators, birds, and people can all benefit.

So, follow the process described, take your time, communicate openly, and document your progress along the way. If you follow this guide with intention, you'll be rewarded with a thriving meadow that reflects not just ecological principles, but your own commitment to restoring and enriching the landscapes of Pennsylvania.

APPENDIX

ANNUAL NATIVE MEADOW INSPECTION FORM

For ecological restoration, adaptive management, and long-term meadow stewardship

SITE INFORMATION

Property / Project Name: _____
Location: _____
Inspector(s): _____
Date of Inspection: _____
Weather Conditions: _____

MEADOW OVERVIEW

Meadow Type: ☐ Seeded ☐ Plug-planted ☐ Hybrid
Year Established: _____
Total Meadow Area: _____ acres / sq ft
Management Zones (if applicable): _____

VEGETATION COMPOSITION, PERFORMANCE & GENOTYPE INTEGRITY

Native Species Survey (Compared to Original Seed Mix)

Original seed mix available? ☐ Yes ☐ No
Species expanding: _____
Species contracting: _____
Species no longer observed: _____
New species introduced by wildlife (e.g., birds): _____

Overall native species richness: _____ species observed
Notes: _____

Seed Mix Performance by Ecological Zone

Evaluate the performance of the seed mix for each ecological zone.

ECOLOGICAL ZONE	EXPECTATIONS MET	NOTES
	☐ Met ☐ Partially ☐ Not Met ☐ Failed	
	☐ Met ☐ Partially ☐ Not Met ☐ Failed	
	☐ Met ☐ Partially ☐ Not Met ☐ Failed	
	☐ Met ☐ Partially ☐ Not Met ☐ Failed	
	☐ Met ☐ Partially ☐ Not Met ☐ Failed	
	☐ Met ☐ Partially ☐ Not Met ☐ Failed	

Overall Performance Observations:

Genotype Integrity Check

Warm-season grasses present:

☐ Big bluestem ☐ Little bluestem ☐ Indiangrass ☐ Switchgrass

Signs of non-local genotypes (height, phenology mismatch, aggressive spread):

Genotype concerns requiring action:

INVASIVE SPECIES & ENCROACHMENT

Perform an annual inspection of invasive species. Write in the species observed as well as invasives observed during previous inspections.

Invasive Species Checklist

INVASIVE SPECIES	ABUNDANCE	NOTES
	☐ Absent ☐ Low ☐ Medium ☐ High	
	☐ Absent ☐ Low ☐ Medium ☐ High	
	☐ Absent ☐ Low ☐ Medium ☐ High	
	☐ Absent ☐ Low ☐ Medium ☐ High	
	☐ Absent ☐ Low ☐ Medium ☐ High	
	☐ Absent ☐ Low ☐ Medium ☐ High	

Edge Encroachment (Trees & Shrubs)

Encroachment present? ☐ Yes ☐ No

Species involved: _____

Encroachment severity: ☐ Low ☐ Moderate ☐ High

Distance encroached into meadow: _____ ft

Recommended action:

☐ Cut back ☐ Remove saplings ☐ Maintain edge buffer ☐ No action needed

HUMAN-CAUSED DISTURBANCE

Damage Assessment

Informal / social trails: ☐ Present ☐ Expanding ☐ Not present

Trampling: ☐ Localized ☐ Widespread ☐ None

Vehicle damage: ☐ Yes ☐ No

Dumping / debris: ☐ Yes ☐ No

Unauthorized mowing or cutting: ☐ Yes ☐ No

Notes:

Opportunities to Formalize Paths

Informal paths suitable for formalization:

Potential path alignments:

Recommended surfacing / edging:

MEADOW CONDITION & HABITAT FUNCTION

Flowering abundance: ☐ High ☐ Moderate ☐ Low

Pollinator activity: ☐ High ☐ Moderate ☐ Low

Bird use: ☐ Nesting ☐ Foraging ☐ Minimal

Bare ground exposure: ☐ <5% ☐ 5–20% ☐ >20%

Erosion: ☐ None ☐ Minor ☐ Moderate ☐ Severe

Hydrology issues:

MANAGEMENT REVIEW

Weed Control Actions Completed

Methods used: ☐ Hand removal ☐ Mowing ☐ Herbicide ☐ Solarization

Effectiveness: ☐ High ☐ Moderate ☐ Low

Follow-up needed:

Mowing / Cutting

Timing aligned with ecological goals: ☐ Yes ☐ No

Notes:

Overseeding / Planting Needs

Additional seeding recommended? ☐ Yes ☐ No

Priority species to add:

PHOTOGRAPHIC DOCUMENTATION

Photo points established? ☐ Yes ☐ No

Photos taken this year? ☐ Yes ☐ No

File folder location:

SUMMARY & RECOMMENDATIONS

Overall meadow condition: ☐ Excellent ☐ Good ☐ Fair ☐ Poor

Key successes this year:

Priority actions for next 12 months:

Additional notes:

Species to Avoid Using in Mid-Atlantic and Northeast Meadows

This list of species should be avoided when designing seed mixes. While it is perfectly “ok” to include these species to provide diversity, color, or botanical interest, you should know that they do not naturally occur in meadows in the Mid-Atlantic and the Northeast, except in very specialized conditions that you likely do not have. Expect each of these species to fade out of your meadow completely within a few years. Some are listed because they are not considered native to the region (e.g., *Echinacea purpurea*) or are too weedy to be safely used (e.g., *Panicum virgatum*). This is not a comprehensive list. Consult with a local ecologist if you need help choosing species native to your area.

<i>Agastache foeniculum</i>	<i>Euthamia caroliniana</i>
<i>Allium cernuum</i>	<i>Gaura biennis</i>
<i>Amorpha canescens</i>	<i>Glyceria canadensis</i>
<i>Amorpha fruticosa</i>	<i>Glyceria striata</i>
<i>Amorpha herbacea</i>	<i>Helenium autumnale</i>
<i>Aquilegia canadensis</i>	<i>Helianthus angustifolius</i>
<i>Asclepias speciosa</i>	<i>Helianthus maximiliani</i>
<i>Aster laevis</i>	<i>Hibiscus moscheutos</i>
<i>Aster lowricanus</i>	<i>Hordeum jubatum</i>
<i>Aster macrophyllus</i>	<i>Iris versicolor</i>
<i>Aster praealtus</i>	<i>Koeleria macrantha</i>
<i>Aster spectabilis</i>	<i>Leersia oryzoides</i>
<i>Astragalus canadensis</i>	<i>Liatris pycnostachya</i>
<i>Baptisia alba</i>	<i>Lupinus perennis</i>
<i>Baptisia albescens</i>	<i>Monarda media</i>
<i>Baptisia australis</i>	<i>Monarda punctata</i>
<i>Baptisia pendula</i>	<i>Panicum virgatum</i>
<i>Blephilia ciliata</i>	<i>Parthenium integrifolium</i>
<i>Bouteloua curtipendula</i>	<i>Penstemon canescens</i>
<i>Carex albolutescens</i>	<i>Phlox drummondii</i>
<i>Carex frankii</i>	<i>Pycnanthemum incanum</i>
<i>Carex lupulina</i>	<i>Ratibida columnaris</i>
<i>Carex shortiana</i>	<i>Ratibida columnifera</i>
<i>Carex stipata</i>	<i>Rudbeckia amplexicaulis</i>
<i>Chamaecrista fasciculata</i>	<i>Rudbeckia fulgida</i> var. <i>speciosa</i>
<i>Chamaecrista nictitans</i>	<i>Rudbeckia subtomentosa</i>
<i>Chasmanthium latifolium</i>	<i>Scutellaria incana</i>
<i>Cimicifuga racemosa</i>	<i>Silphium asteriscus</i>
<i>Coreopsis grandiflora</i>	<i>Silphium terebinthinaceum</i>
<i>Coreopsis lanceolata</i>	<i>Sisyrinchium angustifolium</i>
<i>Dalea candida</i>	<i>Solidago bicolor</i>
<i>Dalea purpurea</i>	<i>Solidago caesia</i>
<i>Desmanthus illinoensis</i>	<i>Solidago canadensis</i>
<i>Echinacea pallida</i>	<i>Solidago rigida</i>
<i>Echinacea purpurea</i>	<i>Sporobolus cryptandrus</i>
<i>Eupatorium coelestinum</i>	<i>Sporobolus heterolepis</i>
<i>Eupatorium purpureum</i>	

Seed Storage Guidance

Proper seed storage and conditioning are foundational activities for meadow buildings. This section highlights general guidance for storing and conditioning seed.

Do

- Store in a cool, dry and dark space with a temperature and humidity sum below 100 (i.e. 40 degrees and 30% humidity). A basement or refrigerator are good locations.
- Use thick plastic latching boxes to store seed bags, preventing spills and rodent damage
- Desiccant packs may be added to storage boxes to continue to reduce humidity
- Separate species into bags and label them
- Keep components of a mix together and store with the mix sheet
- Keep similar seed types in a mix together. Store small seeds with small seeds, fluffy with fluffy. This can improve efficiency when seeding time occurs.

Don't

- Let delivered seed sit outside overnight
- Store seed in bright, sunny, and warm spaces
- Store in spaces with high humidity
- Store seed exposed to natural elements
- Store seed loose in boxes (have two layers of protection against spills and elements)

Never

- Store seed unlabeled
- Store seed unprotected from rodents
- Store seeds near heat

If you ARE Preconditioning Seed

Remember that this will only be applicable if you are planning to seed outside of the ideal window of late Fall to early-Winter. If this is the case and you do plan to precondition seed, the timing of doing so will depend on each species.

Reference Germination Codes

You should have all these codes written down already from when going through “Choosing a Planting Strategy” as well as the necessary type of preconditioning each species will need.

Follow the guidance in the “Propagation Methods” link to the right to understand how to precondition each species and when this needs to occur.

Be Careful!

Seed conditioning is a science. Follow these important steps when doing so:

- Place seeds in a cool, dry place until it is time to put them in conditioning (follow instructions in previous section)
 - Try not to place them in conditioning too early
- Label all seed bags with the species name, date they entered conditioning, and/or date they need to exit conditioning
- Use a sterile medium (sand, vermiculite, etc.)
- DO NOT make the medium too damp
 - This will lead to mold and rot issues
- Regularly check the seeds during conditioning for signs of issues
 - Address any issues immediately
- DO NOT let seeds remain in conditioning beyond the listed time
 - Seeds can begin to germinate in the bag, leading to rot
- Promptly seed

Public Access Meadow Reference Sites



Peppermint Park

Two meadows in one, and a good example of different ecological zones in the same place. The drier upland areas feature purpletop grass while the moister foot slope features goldenrods and dewberry. A single annual mowing maintains both. In Upper Bucks County.

[40.531673, -75.310546](https://maps.app.goo.gl/St6X4n8keojFNxhH6)

<https://maps.app.goo.gl/St6X4n8keojFNxhH6>



Bowmans Hill Wildflower Preserve

A mosaic of meadow conditions in one easily accessible location. Visit the new 3-acre meadow that was designed, at great expense, to support more than 80 species. A good example of how species-site mismatches can yield unexpected results.

[40.330889, -74.938965](https://maps.app.goo.gl/C1KBhoKKRLxYK8td8)

<https://maps.app.goo.gl/C1KBhoKKRLxYK8td8>



Silver Lake Nature Center

The last remaining inner coastal plain meadow is located in Del Haas Woods at the Silver Lake Nature Center. Contractors and dog walkers introduced Japanese stilt grass into the meadow several years ago and threatens its viability.

1306 Bath Rd, Bristol, PA 19007

<https://maps.app.goo.gl/KcN5hLSFt5ChcAez6>

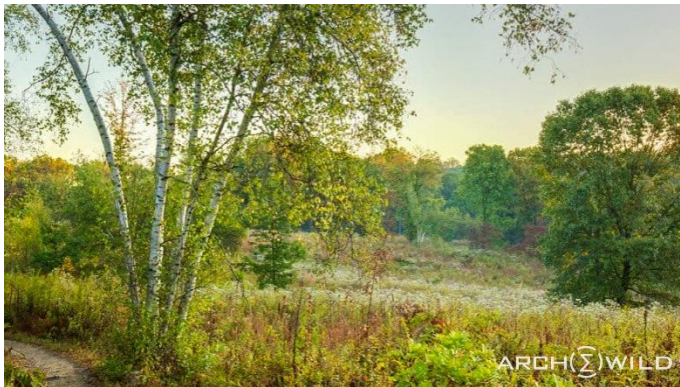


Owl's Nest Park

A nice example of a moist meadow system across from the parking area. Supports classic wet meadow species including sedges, rushes, and wetland flowering species. Suffering from a Japanese stilt grass infestation.

[40.362595, -75.149068](https://maps.app.goo.gl/PFq4YPP4vG2jUSsR7)

<https://maps.app.goo.gl/PFq4YPP4vG2jUSsR7>



Houston Meadow

A built meadow intended to perform as a warm-season grassland. See examples of a variety of warm season grasses and how certain areas are transitioning to a more stable plant community. Some rare species still exist.

[40.068810, -75.231959](https://maps.app.goo.gl/nCAjN6btPfuwLMJX7)

<https://maps.app.goo.gl/nCAjN6btPfuwLMJX7>



Mill Creek Preserve

Previously a corn-soybean farm and left to go wild. It is currently (2026) undergoing an enhancement process to remove invasives and to create space for the introduction of relevant-but-missing species. A mesic meadow with a wetland pocket.

[40.265233, -75.175202](https://maps.app.goo.gl/UbyEJPk3aMW9FgoQA)

<https://maps.app.goo.gl/UbyEJPk3aMW9FgoQA>

Why Genetics Matters

The Environmental Protection Agency (EPA)'s Ecoregion Map designates ecosystems that share similar environmental resources, including soil, climate, and existing vegetation. It is advantageous to install seeds or plants growing in the same ecoregion as your meadow. This should be a large factor in your decision/s when sourcing plant material for installation.



Figure 61 – Avoid this common scenario. An off-the-shelf showy wildflower seed mix was used for this meadow. Inappropriate midwestern genetics not only overwhelmed this site but looks ridiculous. Flowers have all but disappeared. Inappropriate genetics ruined this meadow.

“Outbreeding depression” is a term for describing the normally detrimental effects of mixing plant genetics from faraway places. Breeding butterfly milkweed between Arizona and Quebec-sourced plants might not be able to survive either location. Most meadow builders try not to move native plants around the country too much because of the potential for long-term negative results.

Plant “phenology,” refers to the timing emergence, bloom time, seed set, species sourced from a faraway place different schedule from its local then insects, birds, and other might not even be able to use the point that plant is simply decoration.



of spring etc. If a performs on a counterparts, pollinators plant at which

Figure 62 - Eragrostis spectabilis seed plot at Native Bee-Ginnings, featuring genetics specifically selected for projects in eastern Pennsylvania

ADDITIONAL REFERENCES