Managing Compatible Vegetation for Targeted Species and Biodiversity

A Companion to the

Integrated Vegetation Management

Best Management Practice, 3rd Edition

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Utility Arborist Association
Environmental Stewardship Committee

Contents

Acknowledgments

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Cover photo: An electric transmission corridor maintained as native wet prairie to support native plant species and wild pollinators while maintaining safety and reliability of electric infrastructure. Photo courtesy of Cardno.

Many photos in this document are courtesy of the USFWS Conservation Library. Available online at https://nctc.fws.gov/resources/knowledge-resources/

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1. Introduction

What is the purpose of the companion guide?

Integrated Vegetation Management (IVM) is relied on to manage vegetation across a range of landscapes and objectives. This companion is oriented toward managers who use IVM methods and are interested in incorporating species and biodiversity objectives into their vegetation management (VM) programs. It should be used in conjunction with published industry standards and best practices guides such as *ANSI A300 (Part 7)-2018 Integrated Vegetation Management* and ISA's *Integrated Vegetation Management Best Management Practices (BMP), 3rd Edition*.

Many species have been lost over the past century. Continued loss of species results in endangered species listings, bio-simplification, and loss of ecological systems that sustain humans and wildlife. In some landscapes, such as wildlife management areas, species and diversity management may be a primary objective. Within other contexts, such as rights-of-way (ROW), species conservation or biodiversity may be an important management objective, albeit not the primary one. Increasingly, managing for compatible species and biodiversity can be a more comprehensive approach to reducing risks and costs, while ensuring safety and reliability.

This companion guide is a primer on how to incorporate IVM into the management of compatible vegetation for target species and biodiversity. It is broad in nature. Vegetation managers are encouraged to use this companion guide to inform and improve their vegetation management programs through the consideration of species conservation and biodiversity management.

What is "compatible vegetation" when it comes to species and biodiversity?

Compatibility implies that vegetation targeted for management is well suited for the site context and management objectives. The IVM BMP, 3rd edition, defines "compatible" as "plant forms that are consistent with the intended use of the site."

Compatibility will vary by the context within which vegetation is managed. Within a wildlife management setting, tall-growing trees and shrubs may be compatible for habitat needs for a particular species. However, those same trees and shrubs may be considered incompatible within the context of an electric utility corridor where such vegetation can conflict with other objectives, such as safety and reliability.

How do I approach using IVM for species and biodiversity?

Use of IVM for target species and biodiversity often focuses more on enhancing and restoring compatible flora and less on controlling incompatible vegetation. Within these contexts, managing for compatible vegetation for biodiversity involves a spectrum of approaches and tools that may vary depending on objectives. Table 1 on the next pages broadly characterizes the types of objectives commonly encountered when managing for compatible vegetation.

IVM for target species and biodiversity often focuses more on enhancing and restoring compatible flora and less on controlling incompatible vegetation.

Table 1: Spectrum of approaches to managing compatible vegetation for species and biodiversity

Focus	Protection	Enhancement	Integrity
Theme	"Do no harm"	"Leave it better than you found it"	"Be stewards of native ecosystems"
Common Objective	• Avoid and minimize impacts • Protect regulated species, plus other sensitive resources • Prevent spread of invasive species	• Mitigate impacts to native species habitats • Improve conditions for native species and biodiversity targets	• Sustain natural plant communities and native species • Manage for ecological integrity and climate resiliency by mimicking natural processes
BMP Application Strategies	• Inventory and map areas of compatible vegetation and wildlife to protect • Focus on BMPs that protect species and biodiversity from unnecessary disturbance such as natural regeneration (i.e., tool of rest) and avoidance • Consider treatment frequency that may be limited to the duration of planned work (avoidance) or time in between activities (regeneration; rest)	• Identify compatible vegetation targeted for improvement to achieve desired objective(s) for native species and biodiversity objectives • Focus on BMPs that are tailored to maintain or improve target conditions defined for compatible vegetation • Vary treatment frequency by objectives and sites identified	• Sustain an established compatible vegetation community by defining thresholds and selecting maintenance BMPs for sustained conditions • Focus on BMPs designed to mimic natural processes (e.g., fire, flooding, grazing regimes) and sustain an established cover type • Consider longer treatment frequency intervals (every 5–15 years), relying on compatible vegetation metrics to inform timing

Focus	Protection	Enhancement	Integrity
Example Site-specific Metrics	• Area protected from disturbance • Evidence of prevention protocols for invasive species • Evidence of avoidance measures in work planning	• Percent cover of flowering plants • Stems of milkweed or other host plants • Alignment of vegetation structure with target conditions for native species needs • Wildlife presence, absence, or population inventories	• Species composition relative to reference ecosystems or sites • Evidence of applying adaptive management or climate resilience frameworks into vegetation management planning • Ecosystem functional assessments • Participation in landscape conservation plans or partnerships
Example Program Metrics	• Documented environmental protection policies and procedures • Demonstrated compliance with environmental regulations (i.e., absence of noncompliance issues or violations) • Alignment with Levels 1 & 2 in the UAA Vegetation Management Program Maturity Model	• Documented enhancement approaches through environmental policies, tools, and reporting • Participation in species conservation plans or partnerships • Alignment with Levels 3 & 4 in the UAA Vegetation Management Program Maturity Model	• Defined integrity-oriented approaches documented through company environmental policies, tools, and reporting • Reporting inventory data to external resource databases (e.g., iNaturalist, state databases) • Alignment with federal, state, or tribal conservation goals for target communities • Alignment with Levels 3 & 4 in the UAA Vegetation Management Program Maturity Model

Where does an IVM program align within this spectrum of approaches to managing compatible vegetation for species and biodiversity?

The approaches outlined in Table 1 may apply either broadly across a program or more specifically at an individual site. In general, a program is aligned with one of these categories when the sum of its sites is managed according to a particular focus area. It is the responsibility of vegetation managers to define what a protection, enhancement, or integrity focus means for their program and how they measure its success.

Defining what the approach means for a program and how it is implemented is important to "telling the story" of how a program manages compatible vegetation for those purposes.

> ***It is the responsibility of vegetation managers to define what a protection, enhancement, or integrity focus means for their program and how they measure its success.***

Many vegetation managers may already be taking a protection-focused approach to their vegetation management activities by avoiding soil disturbance and routinely using prevention measures for invasive species. To the extent practical, vegetation managers are encouraged to consider programs that manage for the enhancement or integrity of compatible vegetation and the species and ecological functions that rely on such biodiversity.

As vegetation managers explore expanding their program into managing compatible vegetation for species and biodiversity, incorporation of this guidance may initially happen at a site-specific level. Vegetation planners may increasingly conduct work plans and demonstration projects that achieve an enhancement or integrity-focused approach to vegetation management. A program that continues to incorporate objectives and BMPs aligned with enhancement and integrity-focused management allows the organization to demonstrate an advanced understanding of IVM more easily and support for systemwide biodiversity. In turn, these improvements can help support corporate environmental stewardship goals and sustainability reporting.

How are objectives set for target species and biodiversity?

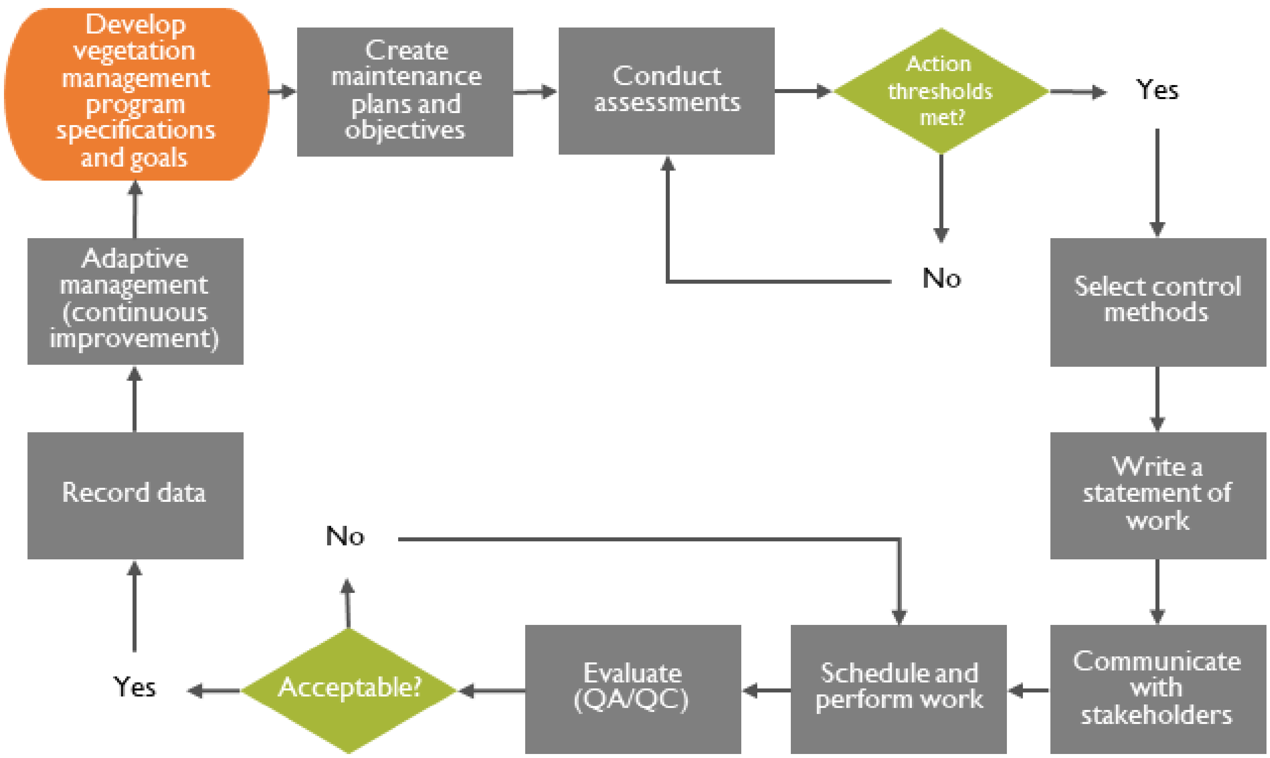
Many scientists and planners have already identified conservation priorities. Reaching out to resource agencies, universities, ecological consultants, and conservation organizations can help navigate these resources and identify management objectives applicable to managed lands and a vegetation management program. Such partnerships can help leverage knowledge, experience, resources, and funding.

> ***Partnerships can help leverage knowledge, experience, resources, and funding to address objectives for target species and biodiversity.***

2. The IVM Process: An Outcome-based Roadmap for Compatible Vegetation

Figure 1 is taken from the IVM BMP, 3rd edition (courtesy of the International Society of Arboriculture). The order of processes may vary or may occur concurrently. A list of partners and organizations that can assist vegetation managers with various steps of the IVM flowchart is available in Appendix A (Resources for Vegetation Managers).

Figure 1: IVM Process Flowchart for IVM BMP, 3rd Edition



Define how compatible vegetation fits within a vegetation management program's goals (i.e., focused on protection, enhancement, or integrity)

ROW managers are entrusted with managing vegetation for primary objectives like safety and reliability. Within this context, proactively managing for compatible vegetation is often a secondary objective and may be subject to constraints of the primary objectives.

As described earlier, managing for species and biodiversity can range in approach from protection to enhancement to restoring ecological integrity. Vegetation managers must decide which of these, or a combination thereof, are the goals for their vegetation management program.

Create maintenance plans, set objectives, and identify locations suitable for habitat management

The order of the IVM process flowchart steps is interchangeable in some instances. As an example, managers may define program objectives at a broad, high level and then identify specific locations best suited to achieve each objective after the fact. Alternatively, initial systemwide inventories may produce a list of primary and secondary management objectives based on the inventory process. Both process flows have merit.

Wild lupine is one example of a compatible species that benefits from IVM. Several butterfly species use lupine as a host plant. Photo from USFWS

Understanding how managing for species and biodiversity fits within the vegetation management context will help determine when, where, and how to manage for biodiversity. Examples may include:

- Cooperating with land managing agencies where ROWs intersect. Discussing habitat objectives and how vegetation management protects, enhances, or sustains integrity of the desired conditions.
- Targeting use of certain BMPs or vegetation management practices to support wildlife management goals such as rare species or game habitat.
- Promoting compatible vegetation to inhibit reintroduction of incompatible vegetation.
- Prioritizing a site for enhancement or restoration because neighboring lands share similar native biodiversity goals and partnerships/collaborations lead to positive synergies.
- Identifying high-value sites for target species, biodiversity needs, or other objectives that support compatible vegetation.
- Focusing management of compatible species in specific locations to address requirements associated with conservation agreements, such as habitat conservation plans (HCPs) or candidate conservation agreements with assurances (CCAAs).
- Supporting corporate sustainability and stewardship goals.

Determining where and how to manage compatible vegetation for species biodiversity requires consideration of related variables, such as those in Table 2.

Table 2: Considerations for identifying locations suitable for species and biodiversity

Where?	How?	Why?
• Where do the species or biodiversity targets for compatible vegetation management occur? • Is there cooperation from the easement landowner or neighboring property owners? • Are there high-value areas where protection of target species or biodiversity is important?	• What is the surrounding landscape context and how does this influence management? • What do the land and easement rights allow? • Are there specific regulatory drivers or requirements that influence how, what, or when management is conducted?	• How does managing for species and biodiversity support the organization's environmental stewardship goals and policies? • Does managing for species and biodiversity allow funding or cost-share opportunities not currently available?

Conduct assessments to establish baselines of current vegetation composition

Vegetation surveys for incompatibles that require attention are likely already established and regularly occurring. The addition of compatible vegetation surveys is necessary to refine objectives and prepare work plans. Compatible vegetation surveys may include, but are not limited to:

- Detection (presence/absence) or composition by general vegetation categories, such as estimating the ratio of compatible to incompatible vegetation, cool-season grasses to native forbs, invasive species cover, or native species cover.
- Inventories of specific species or groups of species, such as inventories of native species, estimates of percent cover, milkweed stem counts, or other target species abundance.
- Ecosystem functional assessments, which may include vegetation inventories, plus rapid assessments of ecosystem functions.

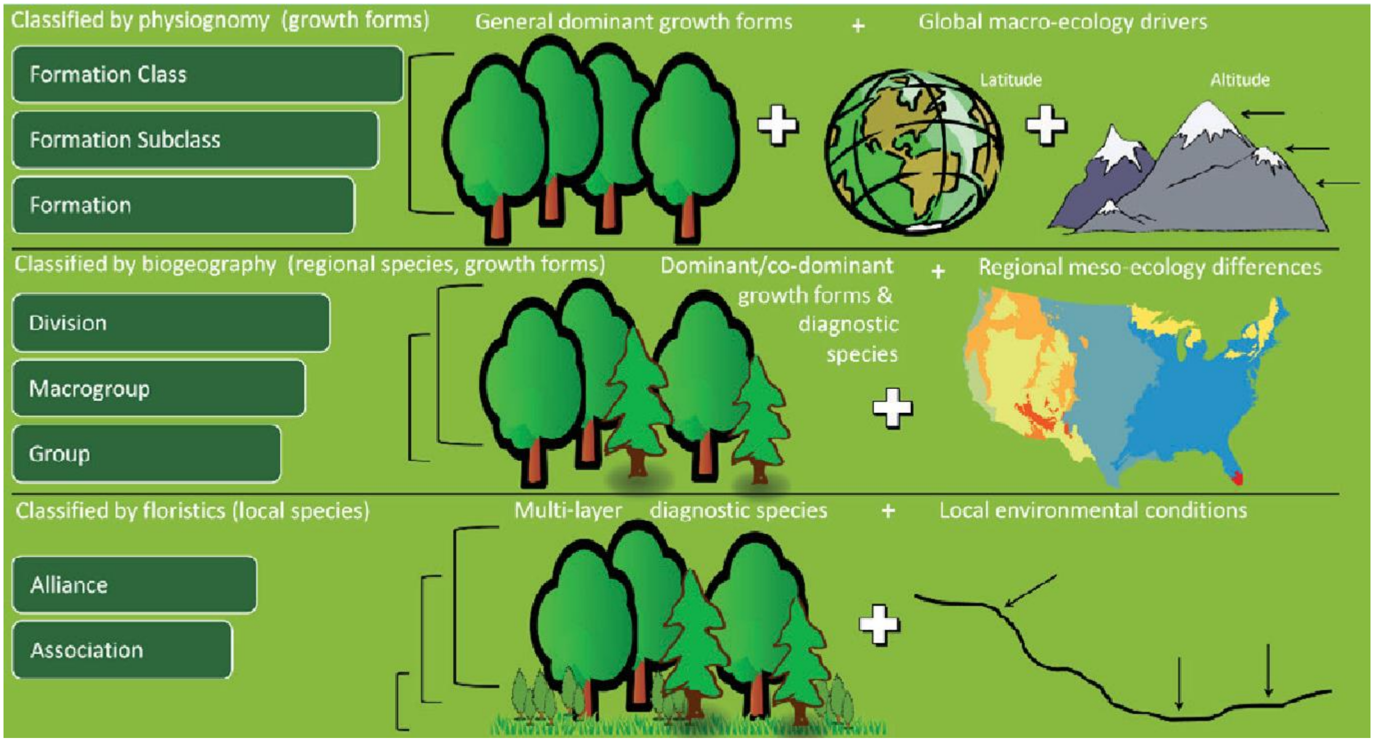
As objectives progress from protection to integrity focused, assessments may increase in complexity or technical requirements. An additional consideration, particularly if current assessments focus only on incompatible vegetation, is to select high-value areas to conduct additional assessments with an opportunity to expand scale in the future. A good example of a tiered approach to assessments is found in the pollinator scorecard developed by the Rights-of-Way as Habitat Working Group.

Assessment surveys should be conducted on two scales: a) surrounding landscape (e.g., adjacent to a ROW) and b) site specific. For the first scale, understanding the surrounding landscape is crucial for maximizing benefits and success of management objectives. This level of assessment can also assist in avoiding negative impacts and/or potential failures caused by neighboring land uses or land cover types. This process can reveal important partnerships to drive success at the site level for vegetation management programs. The second scale requires assessment at the site level and should identify locations to concentrate enhancement and integrity-focused objectives for compatible species and biodiversity.

The requirements and metrics associated with such surveys will be determined by the targets planned for compatible management. Once objectives are defined, assessments can be conducted on the land covers applicable to achieving those objectives. By using mapping of land cover types, a vegetation manager can identify locations to achieve the objectives and focus their assessment efforts accordingly.

Table 3 (next page) lists potentially suitable land cover types for species and biodiversity management and may help orient where compatible vegetation assessments could occur. While assessments may be driven by schedule or objectives, many species and biodiversity targets may be broadly associated with cover type.

It is important to note that cover types, natural communities, and their classifications may differ depending on geographic location. Other land cover type classification systems, such as the National Vegetation Classification Standard (NVCS) and the National Land Cover Dataset (NLCD), are also available for reference. The Multi-Resolution Land Characteristics Consortium of the USDA-NRCS provides additional information about land cover types. Using land cover types that are most beneficial to the location and context of the vegetation management program is vital to success. It is important to be aware that many sites occur at or near an intersection of two or more land cover types, thereby presenting multiple management opportunities (e.g., suburban–urban matrix).



Example of vegetation classification levels used within the U.S. National Vegetation Classification Standard. Image source: http://usnvc.org/data-standard/natural-vegetation-classification/

Table 3: Potentially suitable land cover types for species and biodiversity

Land Cover Type	Landscapes	Plant Communities	Examples on Rights-of-Way
Meadow and Prairie	Flat to rolling valleys and hills dependent on shallow groundwater or seasonal surface water	Grasses and herbaceous species, primarily of local origin (native)	Greenbelts, urban areas, roadsides, grazing lands, agriculture lands, wire zones, valley bottoms
Old Field	Flat valleys and hilltops with a history of cultivation and pastureland	Grasses, forbs, and scattered shrubs/trees	Abandoned croplands and pastures, vacant lots, hedgerows
Wetland	Flat or minimal slope with hydric conditions Areas where water can collect, such as depressions, valleys, or the basis of slopes	Wet-loving shrubs, lush herbaceous layer	Standing or shallow water table, soggy soil and seasonally or permanently inundated wetlands
Wildlife Corridor	Valley, riparian stream corridors, and near utility towers	Dense shrubs or tall grasses, forested valleys and riparian corridors that connect habitats	Spans that fragment continuous landscapes, valley crossings, strips of intact dense vegetation for cover (hedgerows, forest)
Shrub/Scrub	Sloped to flat drier soil sites	Low-growing shrubs or stunted clonal trees: closed canopy or dense patches with grassy openings	Forest to meadow transition, fragmented forest, border zones, riparian edges, young forest

Review (define) action thresholds for compatible vegetation

ANSI A300 Part 7 defines different thresholds for considering management actions. *Tolerance level* is the maximum allowable incompatible plant pressure (e.g., species, density, height, location, or condition) without unacceptable consequences. *Action threshold* is the level of incompatible plant pressure (e.g., species, density, height, location, or condition) where vegetation maintenance treatments should occur to prevent conditions reaching the tolerance levels.

Action thresholds for incompatible vegetation are typically triggered when an inspection detects a level of incompatible plant pressure that is too high. The maximum allowable thresholds are often set in accordance with drivers of economic loss, compliance with regulations, and damage levels as a result of incompatible vegetation. Similarly, managing for compatible vegetation may consider situations where too many threats exceed action thresholds for compatible plant species present (such as pressure from invasive species, levels of disturbance, or competing vegetation). For compatible vegetation, action thresholds may also be framed as minimum levels (i.e., too few or not enough). In this instance, action is taken when counts or coverage of beneficial vegetation dip below predefined levels. This is a different way of thinking about vegetation when considering compatible versus incompatible vegetation.

Compatible action thresholds should begin with detection thresholds—i.e., if a desirable species or habitat condition is absent, start with an assessment method that detects when it is present; then advance to coverage or count thresholds that mirror examples provided in the previous section (e.g., milkweed stems, sagebrush coverage). Action thresholds can be modified in successive rotation cycles to reflect progress toward species and biodiversity objectives. Triggering compatible vegetation action thresholds is likely to occur simultaneously with triggering incompatible vegetation action thresholds.

Examples of action thresholds for compatible vegetation may include:

- Protection focus
  - Non-native, invasive species cover exceeds a desired threshold set to protect compatible vegetation.
  - Area of disturbance exceeds the maximum desired amount.
  - Missing documentation of adherence to protection policies and procedures.
- Enhancement focus
  - Presence of a specific host plant (e.g., milkweed or lupine) does not sufficiently meet the minimum presence desired.
  - Percent cover of invasive species exceeds a desired threshold to support targeted wildlife.
  - Presence/absence of shrub thicket cover desired for American woodcock or wild turkey is below target density.
- Integrity focus
  - Herbaceous vegetation composition differs from that of a targeted reference (wetland) plant community nearby.
  - Key indicator or representative species declines.
  - Vegetation Index of Biotic Integrity (VIBI) used to evaluate wetland condition must achieve a minimum score of 55 (see Appendix C).

Setting action thresholds for compatible vegetation can be challenging. Metrics associated with fire reduction, species habitat requirements, existing management plans, and individual species conservation plans should be reviewed, or knowledgeable experts should be consulted. See Appendix C for example case studies.

Select and apply BMPs according to management objectives, land cover type, and action thresholds

The intent of this companion guide is not to provide a complete list of all possible management tools and techniques. However, the application of the BMPs described in this companion guide differ from many included in the IVM BMP, 3rd edition. Specifically, the BMPs outlined in Table 4 (next page) focus more on enhancing and restoring compatible flora and less on controlling incompatible vegetation.

Many BMPs have broad applicability to multiple early successional land cover types. Specific intensity, timing, frequency, and methods may vary depending on site specific objectives, current assessments, site conditions relative to targets, and other site-specific considerations. More specific technical assistance can be solicited from local and regional partners.

Some of the BMPs in Table 4 may already be part of the current vegetation management toolbox. Others may be new or outside of your typical management practices. Consider the organization's own vegetation management program abilities and constraints when identifying which tools are most appropriate to achieve your compatible vegetation objectives, current assessments, site conditions relative to targets, and other site-specific considerations.

Table 4: Best Management Practices for managing compatible vegetation for targeted species and biodiversity
Detailed information on BMPs listed in Table 4 below can be found in Appendix B.

IVM Methods	BMPs for Managing Compatible Vegetation for Targeted Species and Biodiversity
Biological Methods	• Natural regeneration • Plant allelopathy
Chemical Methods	• See IVM BMP, 3rd edition
Cultural Methods	• Amendments • Mulching • Planting • Prescribed grazing • Protection
Physical Methods	• Conservation mowing • Cutting • Disking • Water-level management • Deadwood management
Prescribed Fire	• See IVM BMP, 3rd edition

Develop and implement work plans

At this step, BMPs are implemented to achieve the desired targets for the selected treatments. Following the IVM flowchart, this includes:

- Write the statement of work—Determine which BMPs will be applied, when, their frequency, and accompanying specifications. For any new BMPs that crews and contractors are not familiar with, additional detailed descriptions, protocols, or training may be required.
- Communicate with stakeholders—Discuss the planned work with all relevant stakeholders. It is important to share the long-term vision of managing compatible vegetation to support species and biodiversity, especially since the results may take several years to realize.
- Schedule and perform work—Conduct the work in a manner consistent with the statement of work and stakeholder communications.
- Evaluate the work—Conduct a quality control review of the work completed and ensure that it addresses the specified action thresholds. If not, coordinate follow-up as appropriate. If successful, track and record the work conducted for future reference and associated record keeping.

Vegetation managers and crews may not have all the existing expertise necessary to implement compatible vegetation BMPs; therefore, additional training and building strong relationships with partners at local and regional conservation agencies and organizations may be helpful in achieving the desired objectives.

Monitor and record data

Baseline assessments provide a point of comparison for post-BMP implementation monitoring. Early in implementation, basic monitoring may at first include only detection (presence/absence). As implementation progresses toward enhancement and integrity objectives, surveys should evolve to include measures

of percentage composition, indices of biodiversity, and monitoring of floral and faunal species indicative of healthy and resilient ecosystems. Site-level metrics should link to program metric goals (see Table 1 for examples). Site-level metrics provide realistic, near-term targets and adaptive management feedback to accomplish program-level objectives through successive management cycles.

Post-BMP assessments provide feedback on where follow-up treatments are necessary as well as which BMPs were successful or need improvement, data to inform future management cycles, and additional information to support sustainability metric reporting at the corporate level. Habitat-quality monitoring and surveys also enable managers to tell the story of ecosystem enhancement and restoration on the lands they oversee.

Use adaptive management

On the basis of results from monitoring and comparing them to desired outcomes for compatible vegetation, adaptations can be made to the vegetation management program to achieve the desired results more efficiently. Consideration for adaptive management may also include continuous improvement and refinement of program goals or objectives associated with compatible vegetation management.

Appendix A: Resources for Vegetation Managers

This list is not intended to be comprehensive but rather is provided to give vegetation managers an idea of the types of organizations that can assist as they work through the steps in the IVM flowchart. Selection of partner organizations will depend on site-specific criteria and management objectives.

U.S. Federal Government Agencies

- US Fish and Wildlife Service
  - IPaC Information for Planning and Consultation
- US Environmental Protection Agency
  - Wetland Protection and Restoration
- USDA Natural Resources Conservation Service (NRCS)
  - Ecological Site Descriptions
- USDA Animal and Plant Health Inspection Services (APHIS) Wildlife Services

Tribal Government and Peoples

- Tribal Agencies
- Traditional Ecological Knowledge (TEK) holders

Canadian Resources

- Ontario Invasive Species Council
- Canadian Council on Invasive Species
- Invasive Species Center
- Transportation Association of Canada
- Ontario Vegetation Management Association
- Ontario Good Roads Association
- Ontario Public Works Association

State Level

- State Agencies
- State Lands
- Environmental Agencies
- State Natural Heritage Programs
- Local Soil and Water Conservation Districts

Nongovernmental, Not-for-Profit Organizations

- American Farmland Trust
- Ducks Unlimited
- Joint Ventures (examples Monarch Joint Venture and Appalachian Mountains Joint Venture)
- Land Trusts
- National Audubon Society
- National Wild Turkey Federation
- Pheasants Forever and Quail Forever
- Rocky Mountain Elk Foundation
- Ruffed Grouse Society and American Woodcock Society
- The Nature Conservancy
- The Xerces Society

Other

- Wildlife or Habitat Consultants
- Special Initiative Projects/Local Initiatives

Appendix B: Best Management Practices (BMPs) for Managing Compatible Vegetation

The BMPs listed below are categorized by the IVM methods from Table 4 and can be selected for any land cover type. The application of each BMP tool will be defined by seasonal timing, management interval, baseline vegetation conditions, and constraints to satisfying compliance and conservation objectives. BMPs may be applied selectively to elements within a site to protect, enhance, or achieve resilience and integrity within a particular land cover type. Rarely is a single BMP applied to an entire site because managing compatible vegetation requires a more nuanced and intentional approach.

For general references related to compatible vegetation, ecoregion management, and related pollinator value, see references listed below.

- **Trees Forever:** Compatible Trees and Shrubs for Pollinators
- **Pollinator Partnership:** Eco-regional planting guides for compatible plants that benefit local pollinator species
- **Federal Roadside Vegetation Protocols:** BMPs that benefit pollinators on ROWs
- **Federal Highway Administration:** Vegetation Management Handbook on the importance of managing with an ecoregional approach
- **NRCS:** Recommended conservation practices per state as they relate to soil, water, air, plants, and animals

BMPs for Biological Methods

Natural Regeneration: This "tool of rest" involves allowing natural growth processes to unfold and, other than monitoring activities, is best implemented without management disturbance. An entire site or patches of compatibles are left alone to regenerate without human interference. This tool is useful when a site is already dominated by a compatible land cover type or after a planned disturbance to allow effects to take shape. The tool of rest will play a role at some point in any IVM plan and could gain importance over time. Time periods may be long term, seasonal, or intermittent. The goal of IVM should be to promote sustainable, compatible plant communities that naturally perpetuate via the tool of rest.

Plant Allelopathy: Certain plant species possess allelopathic traits that inhibit the growth and survival of competing plant species within a certain radius of their growing space. Black walnut thriving along the edge of an early successional land cover type or certain species of goldenrod within a management area possess this unique ability (in addition to many native and non-native floral species). Utilizing more active BMPs to propagate or give an advantage to chosen compatible species with allelopathic traits can be effective in creating long-term natural bioresilience in a stable vegetative community. Notably, allelopathic plants often result in monotypic stands that may not achieve site or program objectives related to biodiversity; balance is warranted. Examples of plants having allelopathic effects can be found here.

BMPs for Chemical Methods

Chemical Management Practices

Also referred to as chemical control methods, these management practices are described in detail in the IVM BMP, 3rd edition. While using chemical methods, a vegetation manager should prevent pest plant buildup; scout for pollinator habitat (nest sites, flowers, etc.) and protect those areas; choose alternative active ingredients, formulations, or application methods to reduce damage to compatible vegetation; and adjust timing to avoid periods when pollinators (including bees) and other wildlife most likely are present.

Spraying invasive phragmites. Photo from USFWS.

- USDA guidance is available on integrated pest management planning around pollinators:
  - [Preventing or Mitigating Potential Negative Impacts of Pesticides [including herbicides) on Pollinators Using Integrated Pest Management and Other Conservation Practices]
- Other guidance is available on pesticide environmental stewardship:
  - [Pollinator Protection]

BMPs for Cultural Methods

Amendments

The addition of nutrients, microbes, or organic matter influences the makeup a plant community by balancing the soil characteristics necessary for their growth. The physical, chemical, and biological aspects of soil play an important role in which plant communities can be supported at a site. By conducting soil tests and understanding the requirements of compatible species, vegetation managers can choose amendments to incorporate into a site to support growth. This BMP is best suited to sites where there has been chronic disturbance, compaction, erosion, or major alteration from human activities. For example, an old field site may have become depleted in important nutrients and microbes needed to support diverse natural vegetation, or meadows may have been overgrazed and compacted. These sites may need inputs to allow other plant species to establish. Sites where construction has removed the topsoil and resulted in a hardpan will benefit from the addition of organic matter. For more information about soil amendments, see [The Definitive Guide to Soil Amendments].

Vegetation managers should consider the following:

- **Soil Tests:** Chemical and physical tests can be conducted by a soil testing laboratory to determine soil properties. These tests include bulk density, saturated hydraulic conductivity, organic matter content, pH, salts, and soil nutrients, as well as contaminants and herbicide residues. Samples are taken to a depth of one foot.
- **Soil pH:** The pH of the soil directly affects nutrient availability to plants, and different plants may require certain pH levels to thrive. Microorganisms and most plants prefer a pH in the neutral range, from 6 to 7.5. The amount of rainfall and the parent rock type determine overall regional soil pH, but many land use practices, such as intensive agriculture, prolonged herbicide use, and water diversion, can alter the pH at the local level. At certain sites, adjusting the pH may be a BMP to remediate soils and stimulate nutrient cycling. Extremes in pH affect the availability of plant nutrients

or the soil concentration of plant-toxic minerals, thereby impacting plant growth. In highly acidic soils, aluminum and manganese can become more available and therefore more toxic to the plant. Also, at low pH levels, calcium, phosphorus, and magnesium are less available to the plant. At pH values greater than 6.5, phosphorus and most of the micronutrients become less available. Changes in pH can be a slow process, often facilitated by the microorganisms present.

- **Organic Matter:** The carbon-based organic compounds derived from the remains and waste products of plants and animals in an environment provide the building blocks for the next cycle of life. Soils with high organic matter content promote deep plant root growth and high surface water infiltration and detention. Disturbed soils impacted by human activity, compaction, and development often have limited organic matter, shallow root growth, low infiltration rates, and high surface runoff and erosion. The addition of organic matter feeds microorganisms (increasing microbial activity) that make nutrients available for the establishment or promotion of stable compatible plant communities.
- **Cover Crops:** Typically, cover crops are annual grasses or legumes, which are grown to produce succulent biomass that is either cut and left or tilled into the soil. Cover crops provide a nitrogen boost to soils and help build organic matter. Sites where a cover crop may be beneficial include new construction areas (decreases weed pressure) with compacted or missing topsoil and agricultural areas with depleted soil.
- **Compost:** Compost is organic matter produced by controlled, accelerated decomposition. Microorganisms convert raw materials into stable organic matter. Sources of compost include manure (acidic), sewage sludge (alkaline), paper mill waste (alkaline), and green vegetative waste. The addition of compost can increase water retention, restore soil porosity, bind pollutants and reduce contaminant concentrations, reduce runoff, protect against erosion, and provide a nutrient boost to plants. This BMP is suitable where soils have a low infiltration rate, either due to soil compaction or topsoil removal, especially at sites with silt or clay soils. Compost is not recommended for sites with saturated or wet soils with high water tables (within two feet) or where slopes exceed 10%.
- **Nutrients:** The macronutrients nitrogen (N), phosphorus (P), and potassium (K); the secondary nutrients calcium (Ca), magnesium (Mg), and sulfur (S); and the micronutrients or trace elements zinc (Zn), manganese (Mn), copper (Cu), iron (Fe), and others come in dry, pelletized, or liquid form. Most secondary and micronutrient deficiencies are easily corrected by keeping the soil at the optimum pH value. Fertilizers are applied by large agricultural equipment (such as tractor-mounted sprayers or spreaders) or by hand application methods. Application rates and concentrations can be determined by a soil test to address site-specific deficiencies.
- **Organic Fertilizers:** Organic fertilizers, or soil conditioners, are minimally processed animal and plant wastes that feed the soil. Nutrients are released for use by plants by the activities (biodegradation) of soil microbes. Organic macronutrient sources include bones, blood, or feathers; alfalfa, cottonseed, or kelp; fish waste emulsions; or combination formulas. Ultimately, these fertilizers are slow to release, which benefits plants over time as soil builds up and microbial activity is promoted. There is little risk of overapplication burn or toxic buildup of salts. This BMP is best suited to sites with degraded soils from intensive land use.

- **Synthetic Fertilizers:** Synthetic fertilizers are produced through various chemical processes that refine and extract concentrated plant nutrients and then combine them with chemical fillers. This form of fertilizer promotes plant growth but can diminish soil health. Therefore, multiple applications are often needed to sustain nutrition over time, even while an immediate effect on plant growth can be seen. The drawback of synthetic fertilizers is that they can damage soil microbiology, which results in a loss of natural fertility over time, and they can leach into groundwater and runoff that can cause detrimental concentrations in the aquatic environment. Long-term application is not recommended for habitat objectives.
- **Beneficial Soil Microbes:** Soil microbes facilitate water and nutrient absorption in plants by acting as an extension of a plant's root system. Some native plants require specific symbiotic microbes to thrive. Mycorrhizal root dips and bacterial seed inoculants can aid in stimulating growth of new plantings. The roots of new starts (plugs) are dipped into a mycorrhizae powder before planting. Alternatively, seeds of legume plants can be coated with powdered rhizobium bacteria before sowing to support the formation of nitrogen-fixing nodules. To find more information about soil bacteria, see Soil Bacteria at usda.gov.
- **Mulching:** Mulching involves spreading a layer of material on the ground surface to protect plant roots from heat, retain moisture, anchor seeds, reduce competition, and/or control erosion. Materials can be organic, such as wood chips, straw, leaves, burlap and coir; or inorganic, such as plastic and nylon. Mulch also comes in different forms:
    - **Loose:** Materials are spread in layers.
    - **Mats:** Woven materials are anchored over an area.
    - **Baled or Bagged:** Materials are placed at key spots to control erosion; generally, downslope from loose soil or along waterways are common placements.
    - **Pulped:** Materials are used to help seeds stick to soil until germination (hydroseeding).

Seaside goldenrod at Monomoy NWR. Photo from USFWS.

Planting

Planting is the intentional introduction or spreading of compatible plants to increase the extent or density within a plant community. Optimal planting timing for success varies by species and seasonal site conditions. Preparations for planting may include other BMPs based on site conditions and habitat considerations. Determine what species of compatible plants are appropriate based on site-use compatibility, wildlife, and habitat type objectives. Flowering calendars can help decide what mix of flowering species will provide pollinator support year-round.

- For assistance finding native plants: Native plant finder
- Example flowering calendar
- Pollinator flowering calendars by region: Planting guides

Vegetation managers often must choose between higher planting rates with seeds or lower planting rates with plant starts or plugs. Site preparation, budget, species consideration, and other factors will inform the best decision. Consider the following:

- **Seeds:** Perennial plant seeds typically prefer to be sown in the fall, while many annuals can be sown in the spring. Site preparation usually determines the success of a seeding. There are multiple methods of seeding. Seeds can be collected and spread by hand onto prepared open ground or bare soil areas at a site. Hydroseeding involves mixing seeds with a pulped mulch and spraying them onto bare soil. A tractor-mounted seed drill is useful for seeding projects in large open areas. Flailing a site after compatible grasses and forbs have set seed is a method of spreading seeds already present at a site. For specific seeding details, consult with a local seed company. Local seed companies and seed experts can be found using this interactive seed map. The NRCS Plant Materials program has various resources for pollinator planting, including seed planting mix by region; see Plants for Pollinators.
- **Clones:** Clones are new plants that are propagated from pieces of a mature parent plant. Commonly, clones are propagated from branch or root cuttings. Different species have optimal seasons for taking cuttings. Dormant-season cuttings are typical for many woody species. Planting is often as simple as pushing cutting into the soil, and cuttings may be propagated from stock onsite or acquired from a nursery. Low-density propagation with cuttings can add biodiversity to a site, and high-density stocking rates can be useful to stabilize highly erodible slopes, such as along riparian corridors.
- **Plant Starts (or Plugs):** Seeds or clones raised in a nursery are called plant starts or plugs. Starts can be planted with minimal site preparation once they have developed sufficient roots to support their growth in the field. Perennial plant starts are best planted from fall to late winter, while annuals prefer the relative warmth of spring. Opportunities for planting throughout the season can arise with the availability of seasonal water or irrigation. For specific planting details, consult with a local nursery.
- **Layering:** Layering typically occurs when a branch touches the ground and forms adventitious roots. The resulting new plant is a clone of the parent plant. Intentional layering of woody shrubs at a site encourages their spread and patch density. Branch tips can be anchored to the soil using rocks, branches, large woody debris, or a heavy mulch such as wood chips. Optimal timing for layering is typically after fruiting. New branch roots develop the following season.

Prescribed Grazing

The managed rotation of semi-feral or domesticated livestock can be used to maintain, enhance, or control vegetation. A proper grazing prescription can promote structural and biological diversity. Prescriptions should be species specific and developed with an understanding of plant life cycles and grazing response of the selected vegetation. Care must be taken to minimize the possibility of overgrazing, erosion, and water contamination. The variables of herbivore selection, seasonal timing, and intensity must be considered to ensure site objectives are met. Contracting with commercial grazers can be helpful in determining suitable livestock and best timing for specific outcomes. Results should be monitored to inform future management decisions.

Grazing (other uses for wetlands). Photo from USFWS.

The American Sheep Industry Association sponsored a handbook on targeted grazing as a new ecological service. Additional guidance can be found from the American Solar Grazing Association and in USFWS's prescribed grazing management methods.

When planning grazing, consider:

- **Herbivore Selection:** The choice of graze animals depends on the target vegetation. Cattle graze grasses, sheep graze forbs, and goats selectively browse woody twigs and tender new shoots. Cattle can stimulate grass density by stimulating root and tiller growth. Sheep can enhance perennial forb cover by stimulating root spread. Goats can enhance the bushy nature of shrubs by browsing branch tips. Herding, penning, tethering, and pasturing are methods used to manage herbivore behavior.
- **Seasonal Timing:** The life cycle of the plants and palatability to the graze animals determine timing for grazing. To maintain or enhance compatible grasses and forbs, the optimal graze window is soon after the most rapid growth but before stem elongation (late spring). To control incompatibles or noxious weeds, the best graze window is at the early flowering stage before seed development. Structural diversity of vegetation can be enhanced by utilizing different herbivores at different times.
- **Intensity:** Grazing intensity is a factor of stocking rate, duration, and frequency (active and rest periods). In general, extensive grazing is preferred over intensive grazing for habitat preservation. Four to eight inches of vegetative growth should remain after each grazing interval and at the end of the growing season for wildlife cover. Compatibles can be enhanced using short grazing periods followed by long rest periods.

Protection

Protect new plantings while they establish. Temporary fencing can be installed around an area, or tree/shrub tubes can be used for individual plant starts, if needed. Mulching can be used to protect recent seedings. Limit or exclude herbivory, disking, burning, or mowing to protect young compatibles. Removal or reduction of obstacles to compatible vegetation can also be a form of protection. This may include selectively removing incompatible vegetation, weeding, and mulching to reduce competition for compatible vegetation growth. Timing of activities to protect sensitive life-cycle stages of compatible plants and local wildlife can also be a part of a protection BMP.

BMPs for Physical Methods

Conservation Mowing

Selectively mow areas within a site to avoid sensitive wildlife and pollinator life-cycle stages and/or to retain refuge areas for wildlife to escape nearby mowing activities. Timing and awareness during mowing application can preserve habitat niches, enhance compatible vegetation, and sustain meadow and old field land cover types. To help wildlife escape, perform active management by mowing from center to edges, use a flushing bar and lower mowing speeds.

Here is an example of species-specific conservation mowing strategies: Monarch butterfly

A variety of mowing BMPs can be considered:

- **Avoid Mowing:** Minimize or eliminate mowing during prime breeding/nesting and pollinator activities. Regional or local nesting and pollinator calendars are available for site-specific planning (examples of nesting and pollinator calendars). Avoid mowing in early morning, at dusk, or at night when pollinators are less active and unable to move away from the mower due to colder temperatures.
- **Limited or Rotational Mowing:** Limit mowing to once or twice per year. To preserve grasses and forbs, mow (or brush hog) only once in late fall to control woody species, if needed. Varying the season of mowing over time will promote diversity. Skipping an annual mow cycle may help promote seeding of biennials or retain structural characteristics of grasses and forbs for multiple years.
- **Strip or Patch Mowing:** Leave large undisturbed areas, or prairie strips, between mowed areas. This retains structural diversity of vegetation to preserve food cover and nesting site options. Rotate refuge strips from year to year. In addition, leave areas that may be good nesting or overwintering sites (leaf litter, dead stems, other ground cover) and ensure there are nest patch buffers of 30 feet around active bird nests.
- **Raised Mowing:** Raise the mower deck to 10 to 12 inches to minimize the risk to ground-nesting pollinators (like bees) and other wildlife and to preserve cover and vegetation height needed by wildlife during the winter.
- **Regenerative Mowing:** Time the mowing of rhizomatous-spreading compatible vegetation to encourage its spread. The best timing will vary by species, but in general, mowing after carbohydrates have translocated to root structures (fall–winter dormancy) retains the ability to resprout with vigor, whereas mowing during peak growth periods (late spring to mid-summer), before carbohydrates are sent to root structures, will weaken the ability of the compatible vegetation to resprout over time. In some regions, wildflower growth is promoted by a mid-summer mowing cycle; in others, mowing is best done right after spring bloom.

Cutting

Timing of cutting—using hand tools or mechanical tools—can stimulate compatible woody growth or discourage incompatible growth, reducing vigor over time. In general, cutting during peak growth will weaken plants because carbohydrates produced in the aerial growth have yet to be transported to the roots for future growth. Cutting during dormancy, when most activity is within the roots, retains the energy needed for the plant to resprout with vigor. Cutting can be used for various purposes, such as rejuvenating aging shrub stands, removing older stems to increase light and air circulation, promoting clonal expansion, reducing height or density, and increasing flower or fruit production. Most trees and shrubs have apical dominant growth, meaning that growth occurs at branch tips, where the growth hormone auxin is highest, to inhibit lateral bud growth. Apical dominance is lost with the removal of terminal buds, allowing lateral buds and dormant adventitious buds to take over growth.

A variety of cutting BMPs can be considered:

- **Thinning/Renewal:** Selectively remove older canes or branches from the base of the shrub or large branches of a tree. This can be useful for removing dead, dying, damaged, or diseased branches; thinning dense crowns for better air circulation and light; improving structure or removing rubbing stems; and promoting renewal.
- **Rejuvenation Cutting:** Cutting all stems to ground level during dormancy encourages vigorous regrowth. This is especially useful for old or overgrown shrubs. The removal of all aerial stems can also stimulate shoot growth from adventitious buds, increasing shrub patch spread, especially with clonal tree and shrub species.
- **Rule of Thirds:** As a variation of the BMP above, one-third of older branches are removed each year over the course of three years. This allows rejuvenation while keeping the overall structure intact. This rule can also be applied at the landscape level for shrub rejuvenation, where one-third of the shrub patch at a site is cut each year, resulting in a rotational cutting that retains a diversity of age classes for habitat benefits.
- **Pruning:** Selectively removing entire stems or branch tips. Cuts are made within a quarter inch of a main stem—close to the branch collar, where healing occurs. This reduces the potential for disease or insect infestation. Messy, jagged cuts made with dull tools leave plants less able to ward off infection. Most pruning for beneficial growth is done while the plant is dormant in winter to early spring. Fall pruning can stimulate late season growth, leaving insufficient time to harden off before a freeze. This has the potential to injure the plant. See the ANSI A300 Pruning Standards for more information.
- **Coppicing:** This woodland management technique is used to cut trees and shrubs in a way that encourages them to resprout from the roots, suckers, or stumps. Cuts are made close to the ground, within 6 to 12 inches. New shoots develop, fed by an established root system, and are capable of rapid growth. Coppiced trees take on a multi-stemmed growth structure. Coppicing encourages clonal expansion in many shrubs.
- **Pollarding:** Similar to coppicing, branches of trees and shrubs are cut eight to ten feet above ground level near the main stems. This cutting technique is commonly used in pasture systems to prevent livestock from browsing the succulent new shoots.

Disking

Disking is the method of disturbing the soil surface and existing vegetation with a disk to prevent an area from going through succession to a woody condition. It is a preferred management method to retain and improve wildlife habitat on open land. Disking intensity refers to the disk depth and/or number of passes.

Equipment used in moist-soil marsh management. Photo from USFWS.

Seasonal timing can influence the structure and composition of the soil. Disking is typically done from late fall to early spring to minimize risks to wildlife. In general, late-fall disking promotes hard-seeded forbs and legumes, while early-spring disking promotes annual grasses. Old fields with an agricultural history of spring disking may promote agricultural pest species.

Note: Any disking activity could potentially promote incompatible growth if there are dominant dormant seeds present, thick-matted rhizome species, etc. Soil conditions, and site-specific objectives should inform proper timing and frequency of disking. Additional information from NRCS may be found in [Light Disking to Enhance Early Successional Wildlife Habitat in Grasslands and Old Fields]

Consider the following disking BMPs:

- **Shallow Disking:** Disking is done at a three- to five-inch depth and accomplished in one or two passes. Generally, the greater the disking intensity, the less residual the perennial grasses and greater the annual plant composition. Shallow disking can be applied to enhance diversity and is appropriate within areas where (mono) grass-type cover has been established and undisturbed for at least two or three years. Shallow disking can be a useful tool for resetting meadow or field succession, stimulating grass and forb germination, preparing a site for planting, reducing undesirable weeds or woody species, and encouraging decomposition of accumulated ground debris. Disking will result in more germination of annuals from the soil in the first two years, with a diversity of perennials establishing by the third year. Disking is also used as a means of encouraging dormant seeds to germinate or to prepare a seedbed for planting. For the purpose of enhancement, rotations are not made regularly—just when needed.
- **Strip Disking:** Similar to strip mowing, strip disking leaves large undisturbed buffer areas surrounding disked areas. The buffer areas should be at least twice as large as the disked areas. This BMP retains an array of vegetation maturity to maintain the availability of food, cover, and nesting sites. The typical strip disking rotation is two to three years. For examples, the Indiana Division of Fish and Wildlife provides additional information on strip disking.
- **Erosion-Control Disking:** This practice involves following the contours of the land and limiting disked strips to 30 feet wide.

Water-level Manipulation

By alternating the water level throughout the season or rotationally flooding areas over time, different wet-loving vegetation can be encouraged and nutrients can be recycled to improve vigor. This BMP is best suited to existing wetlands or wet depression areas, in active or fallow fields, or in some meadow situations. Water-level management can be a very cost-effective BMP.

Water-control structure, Bear River NWR. Photo from USFWS.

Water-level manipulation can be passive or active. A natural wetland area relies on precipitation to alternate water levels during the year. Usually, water level is deepest in spring following snow melt, then recedes during summer to expose mud flats, and is inundated again from fall to winter with returning precipitation. Dry periods can vary in duration and intensity. For active management, an area with a dependable water source that can be gravity drained or diverted is necessary. Managed wetlands are created by building a berm or levee that impounds water. The levee should include a water-control structure, such as a stop-log setup, that allows better control than screw gates or flap gates. Supplemental pumps or wells may be needed in some situations.

Water-level manipulation relies on the natural regeneration of vegetation and seed banks. Compatible plant communities are encouraged through timing, rate, duration, and depth of water-level manipulation. It is not an exact science, and experimentation with these factors along with other BMPs at a site will guide understanding:

- **Wetland Types:** Various wetland types may be present at a site. Shallow wetlands typically have a maximum depth of 18 inches, with a dry period during the summer. Vegetation of shallow wetlands is mostly moist-soil plants such as annual grasses and forbs. Marsh and swamp wetlands have deeper water that remains for longer periods of time, often without a dramatic period of drying out. Marsh vegetation consists of emergent perennial plants, while swamps are characterized by woody species.
- **Rate of Water Drawdown:** In general, a slow drawdown rate of one inch per day is best to encourage moist-soil plants that feed waterfowl in a shallow wetland habitat. A slow drawdown retains more soil moisture near the surface. A fast drawdown can result in surface soils drying out, decreasing seed bank germination.
- **Seasonal Timing:** For shallow-water wetlands or field sites, slowly dewatering from spring to summer (after peak bird migration but before woody leafout) reveals mudflats where moist-soil plants grow throughout the summer. These plants are mostly annual grasses and forbs that produce an abundance of seeds and tubers that feed wildlife. Slowly rewatering after seedset during the fall provides winter foraging habitat with abundant food. Early to mid-season (June through mid-July) drawdown generally produces the greatest diversity of wetland plants and the greatest abundance of seeds. Late season (late July through August) drawdown often results in fewer species with less seed yield. Late drawdowns can reduce woody seed germination. Prolonged flooding during the growing season will kill many tree species. Dormant-season flooding protects trees.
- **Duration:** Water levels should be maintained during critical time periods, such as spring migrations for breeding and foraging, and during winter to provide foraging habitat for resident bird species. After drawdown, shallow wetland sites should remain dry for a minimum of 70 days from initial mudflat exposure to allow moist-soil plants to grow. Providing 120 days from beginning of drawdown to reflooding may maximize drawdown benefits.
- **Water Level:** Shallow wetland management should aim for a water depth of 18 inches or less during impoundment. Emergent and submerged aquatic vegetation of marshes can grow in depths up to 12 feet, with a minimum level of two to three feet needed. Prolonged deep flooding can be used to reverse succession to shrub/scrub and encourage emergent and submerged aquatic vegetation. Generally, increasing the water level leads to less dense vegetation and more open water, while decreasing the water level leads to an increase of vegetation and a decrease in open water. The successional end points of "choked with vegetation" to "open water" can be influenced by adjusting water levels.
- **Rotational Considerations:** Shallow wetland sites can be reinvigorated when vegetation becomes too dense or growth is stunted. By allowing the site to stay wet or increasing water levels, a marshlike condition can be encouraged. After one to two years, water drawdown can stimulate nutrient cycling, and management can again focus on moist-soil annuals. Occasional soil disturbance during the dry season (three- to four-year rotation) can knock back woody development and expose the annual seed bank. Shallow disking or prescribed fire have both been used successfully as companion BMPs. Deeper marsh wetlands with turbid water quality and poor vegetation growth can benefit from a reduction of water or a temporary dry-out period that consolidates sediments and stimulates seed germination. Nutrient cycling is enhanced by this when water levels are increased again.

Several Midwestern states provide guidance on shallow wetland habitats. Illinois DNR provides guidelines on shallow wetland habitat management. The Wetland Management for Waterfowl handbook published by USDA-NRCS is an in-depth handbook for wildlife considerations.

Deadwood Management

Handling of dead and dying trees is an important management decision. A dead standing tree, also called a snag, that does not present a safety hazard or access impediment may provide excellent cavity or foraging opportunities for a wide host of vertebrate and invertebrate wildlife taxa. Snags can be created intentionally by girdling a live tree. Dual cuts around the tree's circumference may be sufficient, but herbicides may also be required to effectively girdle and kill more resilient species. If trees do not meet a minimum diameter desirable for snag and eventual cavity creation, artificial cavities can be installed for the benefit of specific wildlife species; however, artificial cavities should be coupled with deterrent structures to discourage nest predation. Once a tree has fallen, the term "coarse woody debris" applies, and the tree can continue to provide wildlife habitat, contribute to nutrient cycling, and provide much-needed heterogeneity to the understory layer of a forest. Coarse woody debris may result from snags naturally falling, or more intentional actions can be taken to improve this key structural habitat component. Arranging brush cuttings or treetops into brush piles can be effective for creating thermal and escape cover for many wildlife species.

It is worth noting that dead or diseased trees present potentially dangerous hazards (e.g., fire risk) and may provide a potential vector to cause mortality in the rest of the stand.

BMPs for Prescribed Fire Methods

Prescribed Burning

Prescribed burn control methods are described in detail in the IVM BMP, 3rd edition. Effective communication with local fire departments and the general public is recommended. Usually, pre-approval and permitting is necessary for prescribed burns. On landscapes where prescribed fire is a common management tool (such as in southern pine ecosystems), coordination with partners to include ROWs in broader management activities could benefit everyone involved by burning larger compartments and utilizing linear features as safety checkpoints or firebreaks. When possible, burn outside the ground-bird nesting season and/or the bloom period for pollinator foraging species.

For more information on prescribed burns, see USFWS management guidance (Management Methods: Prescribed Burning) and NRCS information (Prescribed Burning).

Firefighter standing guard over fire. Photo from USFWS.

Appendix C: Case Study Examples

Case Study 1: Partnerships for an imperiled shrubland bird

ABC Utility is interested in managing their ROWs to provide habitat for disturbance-dependent wildlife species by proactively managing for compatible vegetation communities within a portion of their service area. Golden-winged warblers (GWW) (*Vermivora chrysoptera*) are a species of conservation concern and have been identified by the Young Forest Project as an umbrella species for disturbance-dependent, early successional wildlife species in the northeastern United States. In other words, if GWWs benefit from ABC Utility's IVM program, upward of 40 other shrubland and young forest songbirds and a host of other faunal taxa will too.

The GWW is a critically threatened songbird that has declined 66% in their Appalachian breeding range over the past 50 years. GWWs prefer patchy shrublands with diverse structure and rely on insects for food. Suitable sites must share at least one border with young forests and be above 950 feet elevation. GWWs are territorial and exhibit high nest-site fidelity; however, breeding pairs will relocate one to five miles away when forest succession advances beyond the desirable condition. The central hardwood region of Pennsylvania has been broadly designated as a GWW conservation focus area, and Audubon has recently delineated more Important Bird Areas within the region to spotlight specific GWW conservation areas.

To align ABC Utility conservation goals with existing efforts, managers partnered with the Pennsylvania Natural Resources Conservation Service (NRCS) Working Lands for Wildlife Program and the Golden-Winged Warbler Working Group. Coordinating ABC Utility's vegetation management objectives with partners' habitat conservation plans for GWW ensured the IVM program would be attentive to the life-cycle needs of the species, and the partners assisted ABC Utility in developing a scope of work to pursue their stewardship goals.

Golden-winged warbler. Photo from USFWS.

ABC Utility used multiple criteria to select sites for GWW-focused vegetation management within their service area. At a landscape level, ABC Utility selected service areas within the known breeding range of the Appalachian Mountains population, but they avoided utility ROWs where the breeding range of GWW and blue-winged warblers overlap (where the two species overlap, hybridization rates are high). At the site-level, stewardship objectives were prioritized if existing ROW cover was comprised of shrubland within forested landscapes. Sites bordering or proximate to other GWW habitat projects were also highlighted.

Vegetation surveys were developed and conducted one to two years in advance of management treatments with particular attention paid to percent cover (bare ground, grass, forbs, woody vegetation, and "bramble" species) and key floral components such as *Rubus* spp. and *Ribes* spp. Existing incompatible vegetation metrics helped determine timelines for which utility spans required more urgent attention to meet safety and compliance standards. To optimize heterogenous vegetation structure for GWW habitat, woody cover should comprise 30% to 70% intermixed with 30% to 60% grass and forb cover.

Optimizing structure heterogeneity provided quantitative action thresholds to initiate ABC Utility's active management cycles tailored to the conservation of GWW habitat. Woody cover height served as an action threshold to ensure compliance with safety and regulatory standards.

Vegetation managers selected BMPs to protect existing compatibles: a) Protection of key floral components for cover and food resources (e.g., *Ribes* spp. and *Rubus* spp.) during treatment activity, b) patch mowing and selective cutting during late summer to decrease woody density and regrowth, c) retaining evenly spaced saplings within the ROW for song perches, d) managing woody debris to re-purpose cut stems into protective cover and encourage brambles, and e) allowing natural regeneration to perpetuate grass and forb cover (e.g., by avoiding patch mowing of desirable annuals leading up to peak seed production).

The wire zone–border zone approach was adopted to feather forest edges and maintain open area to forest transitions. Beneficial woody species, such as viburnums, elderberry, dogwoods, brambles, and willows, were protected from control treatments up until the action threshold of 70 % woody cover was exceeded. If woody cover exceeded 50%, herbaceous openings were created by patch mowing incompatible species not listed above. Larger trees along the feathered edge were girdled to create snags so long as they would not pose a future hazard to the utility infrastructure. A scope of work was implemented to complete active treatments between August 16 and April 30 each year to avoid GWW breeding season.

Follow-up monitoring by conservation partners (two to four years post-treatment) revealed nesting GWWs within ABC Utility's ROWs. On spans where nests were not recorded, assessments were conducted to determine enhancement needs during future management cycles. Many of the unoccupied sites showed an adequate composition of shrub and herbaceous cover, but key forb species were underrepresented compared to utility spans where GWWs were nesting successfully. Incorporating insect surveys and linking them to their preferred host plants may further illuminate key floral components for GWW foraging needs. ABC Utility is considering whether prescribed fire or sowing seed could be utilized for rejuvenating forb diversity.

As ABC Utility's stewardship goals advance, feedback from regular monitoring will help shape adaptive management for successive IVM cycles. Broadening surveys to include other species benefiting from the GWW umbrella approach will also improve ABC Utility's documentation of biodiversity outcomes. IVM-driven shifts toward stable, low-growing beneficial shrub, forb, and grass cover promises a long-term return on investment, and ABC Utility is actively partnering with GWW conservation partners to share the stories of conservation success.

Case Study 2: Treatment for native seed regeneration on wetland mitigation site

A company would like to manage their recently constructed mitigation site to promote native plant species. Since construction, the emergent wetland has been dominated by invasive plant species, and no management practices have been implemented. Native plants are being choked out by hybrid cattail (*Typha* x *glauca*) and phragmites (*Phragmites australis*).

The manager chose to use the Vegetation Index of Biotic Integrity (VIBI) as the means of assessing the site's baseline biotic score. The method incorporates ten attributes of wetland vegetation that most closely correlate to human disturbance and levels of ecological condition. The scoring system is widely used as a performance measure for wetland mitigation projects. The Floristic Quality Assessment Index, a metric used in calculating a final VIBI score, assigns habitat sensitivity (coefficient of conservatism, or CofC) values to species within a geographic range and measures the presence and abundance of individual plants within a taxonomic group. More simply, tolerant species typically found in disturbed and/or early successional sites have low CofC scores, and more sensitive species generally present in undisturbed, "climax" communities have much higher CofC scores (more information can be found at [Ohio EPA Wetland Ecology]). The final score correlates to three categories of wetland in ascending order from lowest to highest quality (Category 1 through Category 3). Upon completion of the assessment, the manager discovered that the site has a VIBI score of 20 out of 100 (Category 1) and invasive vegetation cover of 40%.

After the baseline was determined, the vegetation manager developed management goals and objectives to enhance the quality of the wetland. The primary goal was set to achieve a minimum VIBI score of 45 (Category 2) and a maximum invasive cover of 10 percent. Achieving a minimum score of 45 would indicate a greater abundance and diversity of native vegetation present at the mitigation site. To assist in achieving this goal, the manager partnered with the local USDA-NRCS and Ducks Unlimited to obtain technical assistance material and guidance.

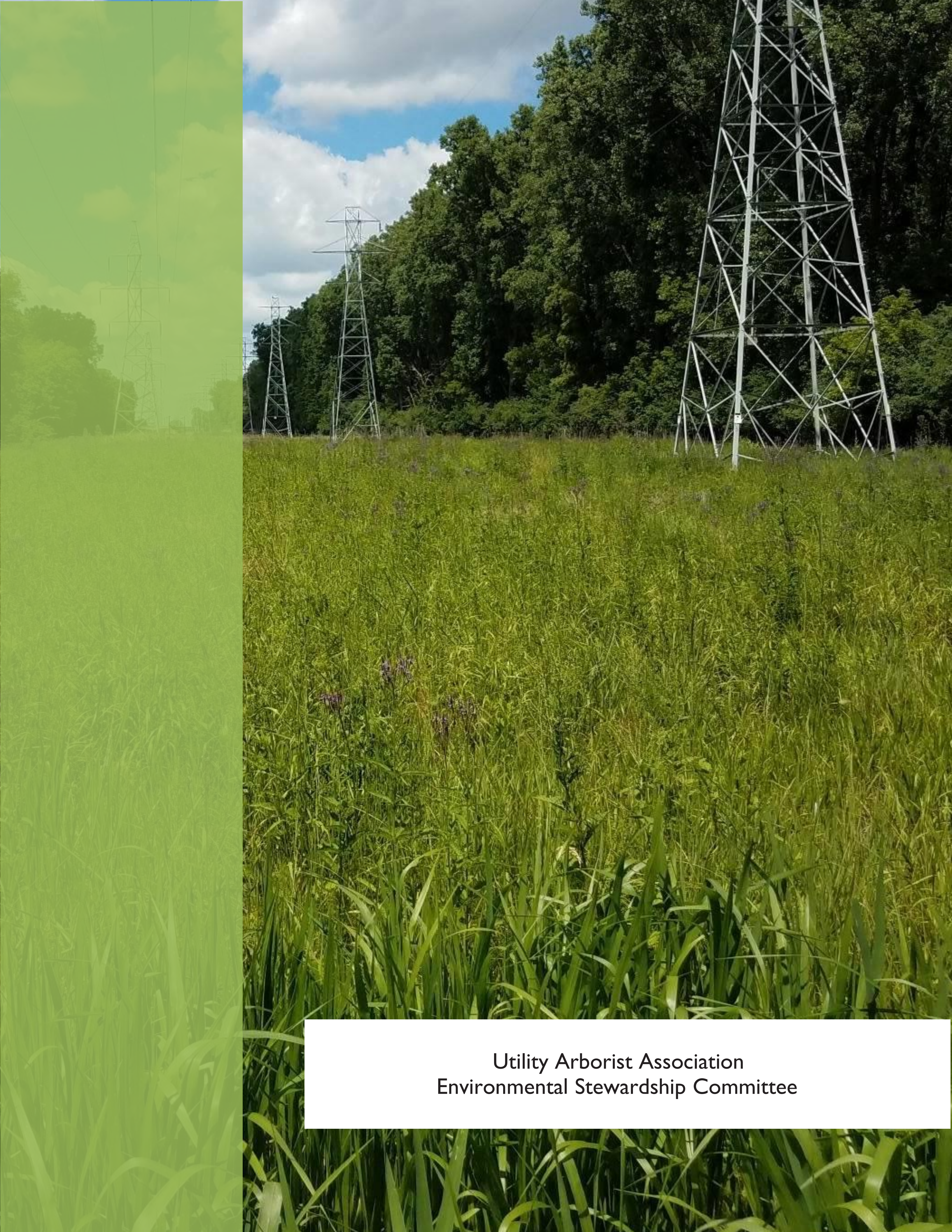
Ducks taking flight over a managed wetland. Photo from USFWS.

Using NRCS guidance, the manager implemented the following BMPs to support native vegetation growth: a) reducing water levels to discourage invasive growth around the shallow perimeter, b) applying foliar chemical treatment of glyphosate on all remaining visible invasive species, c) conducting a prescribed fire to burn off thick, dry vegetation (thatch), d) reflooding the site to introduce water levels at depths that would discourage invasive growth where previously observed, and e) planting starts (plugs) to allow some native vegetation to establish before invasive plants have the opportunity to return. (Note: these BMPs are listed in order of implementation.)

Reducing water levels (Step a) and conducting a prescribed burn (Step c) to reduce thick vegetation mats rejuvenated the previously seeded site and native seed bank. The applications of both BMPs provided an ideal environment for natural native regeneration and promotion of previously broadcasted seed. Using vigorous native plant starts (plugs) assisted in establishing a compatible vegetation advantage to prolong the time before invasive plants re-establish.

Chemical treatment and water-level manipulation were proposed to begin in the summer before invasive plants had the opportunity to produce seeds. The prescribed burn was conducted in the fall followed by reflooding the area in the early spring. By partnering with the local Soil and Water Conservation District, local phenotypes were secured to supply the compatible plant starts specific to the region for planting. Following the initial treatments, manually pulling and spot spraying invasive species continued annually.

Follow-up monitoring was conducted annually for five years. Year one was considered the first year in which the BMPs were implemented. The vegetation manager's VIBI assessments showed gradual increases in years one and two, and substantial score increases in years three through five. Although Category 2 wetland status was achieved, ongoing monitoring is extremely important to sustain native plant dominance on the site. Action thresholds were set to trigger the implementation of a BMP to maintain previously achieved management goals. As noted above, an example action threshold would be invasive encroachment of greater than 10%. Once action thresholds are triggered, the vegetation manager will utilize existing partnerships for guidance on additional appropriate BMPs.



Utility Arborist Association
Environmental Stewardship Committee