

Natural Resources Management Plan

2021–2024



ANL-21/48

NATURAL RESOURCES MANAGEMENT PLAN 2021–2023

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1. Purpose

Argonne National Laboratory is located on a 1,500-acre site comprising a developed campus within large tracts of undeveloped land (Figure 1). Approximately a third of the site consists of buildings, roads, parking lots, and support infrastructure.¹ The remainder is a complex of natural resources that includes woodlands, prairie and grasslands, wetlands, and open space. Some of these areas are reserved for future development, while others represent valuable ecosystems and potential protected habitat. Therefore, a series of natural resource management plans has been prepared for the management of the undeveloped campus within the context of mission need and overall site management requirements.^{2,3}



Figure 1. Aerial view of the Argonne site today. Photo credit: Argonne National Laboratory.

This edition of the *Natural Resources Management Plan* is an action course for the 2021–2024 phase of management. It builds on the progress made in the three previous years—habitat improvement throughout the site and a reduction of invasive species populations, successful use of new management techniques by contractors and grounds personnel, and continuous achievement of stated goals to improve the site’s ecosystems. Intensive mechanical control of invasive species will continue; however, other effective practices, such as controlled burning, will increase as more dynamic management becomes necessary after disturbances are reduced and habitats resume successional processes. Wildland fire risk, a phenomenon rising throughout the world, will also be addressed herein. (Note: In this report, the following words are used interchangeably: natural resources, habitats, natural areas, remnant, sites.)

2. Background

In 1947, the land that became Argonne National Laboratory was either in a natural state or used for agriculture, as the Chicago area* was just beginning the vast suburban development that occurred in the second half of the 20th century (Figure 2). Hence, habitats on the site were used for buffer space and screening as the communities that now surround it grew. In recent decades, the remaining natural areas (habitats) in urban regions have become more valuable as their representation has diminished, while their social and economic utility has increased. In 1972, some of the land that was part of Argonne at the time was declared government excess property, and it became the popular Waterfall Glen Forest Preserve that surrounds the current Argonne site.

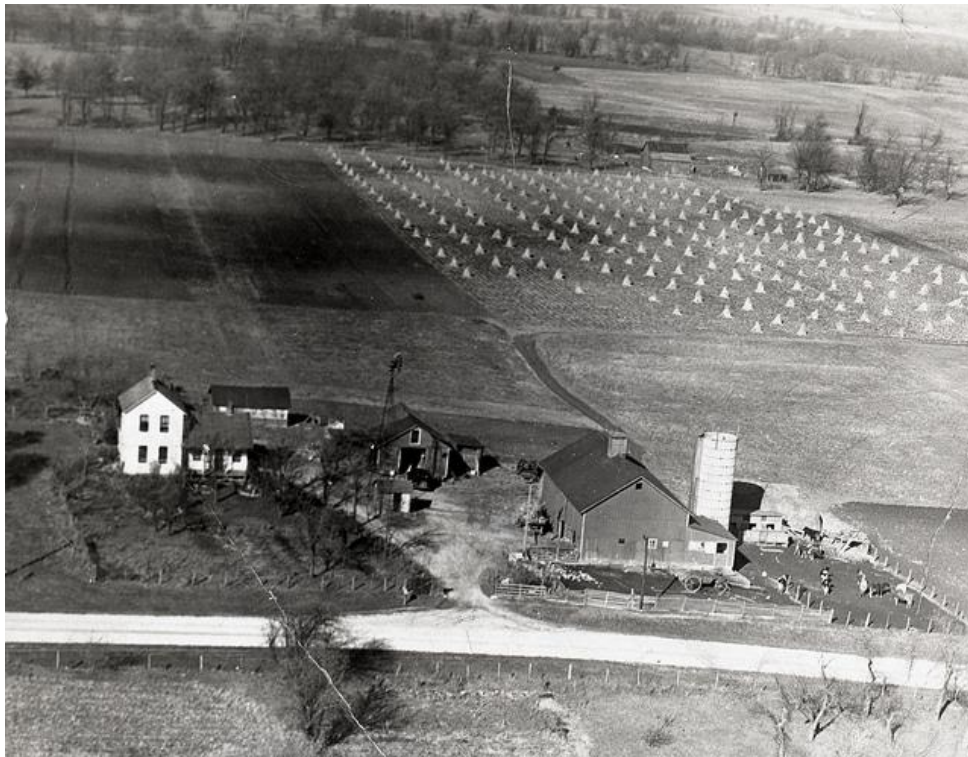


Figure 2. Aerial image of the Argonne site from 1939 showing farmland, woods, and open space.
Photo: Argonne National Laboratory

The U.S. Department of Energy (DOE) Order 430.1C Real Property Asset Management⁴ is the primary directive for Argonne’s natural resource management. This Order instructs the agency to ensure that applicable requirements related to and not limited to “natural resource preservation” are addressed.⁵ Hence, the management of Argonne, a Federal government facility, must meet all regulatory requirements in addition to its direct scientific mission. The DOE-Argonne Site Office monitors the laboratory’s compliance with this and other directives and statutes.

* Loosely defined as the city of Chicago, Cook County and the five “collar” counties: DuPage County, Kane County, Lake County, McHenry County, and Will County.

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An assessment of the site’s natural resources with other applicable Federal statutes and requirements that affect those resources reveals two general courses of action that are reflected in the goals of this management plan: The site’s natural resources are to be maintained and improved in quality, and threats to those resources are to be reduced and controlled. For all Federal agencies, two Executive Orders (EOs) also provide executive direction:

1. Executive Order 11990, “Protection of Wetlands,” directs agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands, and Title 10 of the Code of Federal Regulations, Parts 1021 and 1022, is DOE’s implementation of this executive order.
2. Executive Order 13751, “Safeguarding the Nation from the Impact of Invasive Species,” directs Federal agencies to control populations of invasive species and provide for the restoration of native species and habitats in affected ecosystems.

These two orders overlap in scope to cover all of the site’s natural resources. Further, these orders are culled from Acts by Congress providing specific direction for the management of natural resources (Figure 3). Most recently, the Fish and Wildlife Coordination Act now mandates the control of invasive species on Federal lands. Although not highlighted in previous editions of this plan, the Energy Independence and Security Act, 2007, Section 438, mandates action to control the impact that new buildings and developments may have on natural hydrology. This has promoted the utilization of improved water control features and native landscaping, which has been further advanced under EO 13814, which directs agencies to reduce potable and non-potable water consumption and comply with stormwater management requirements.

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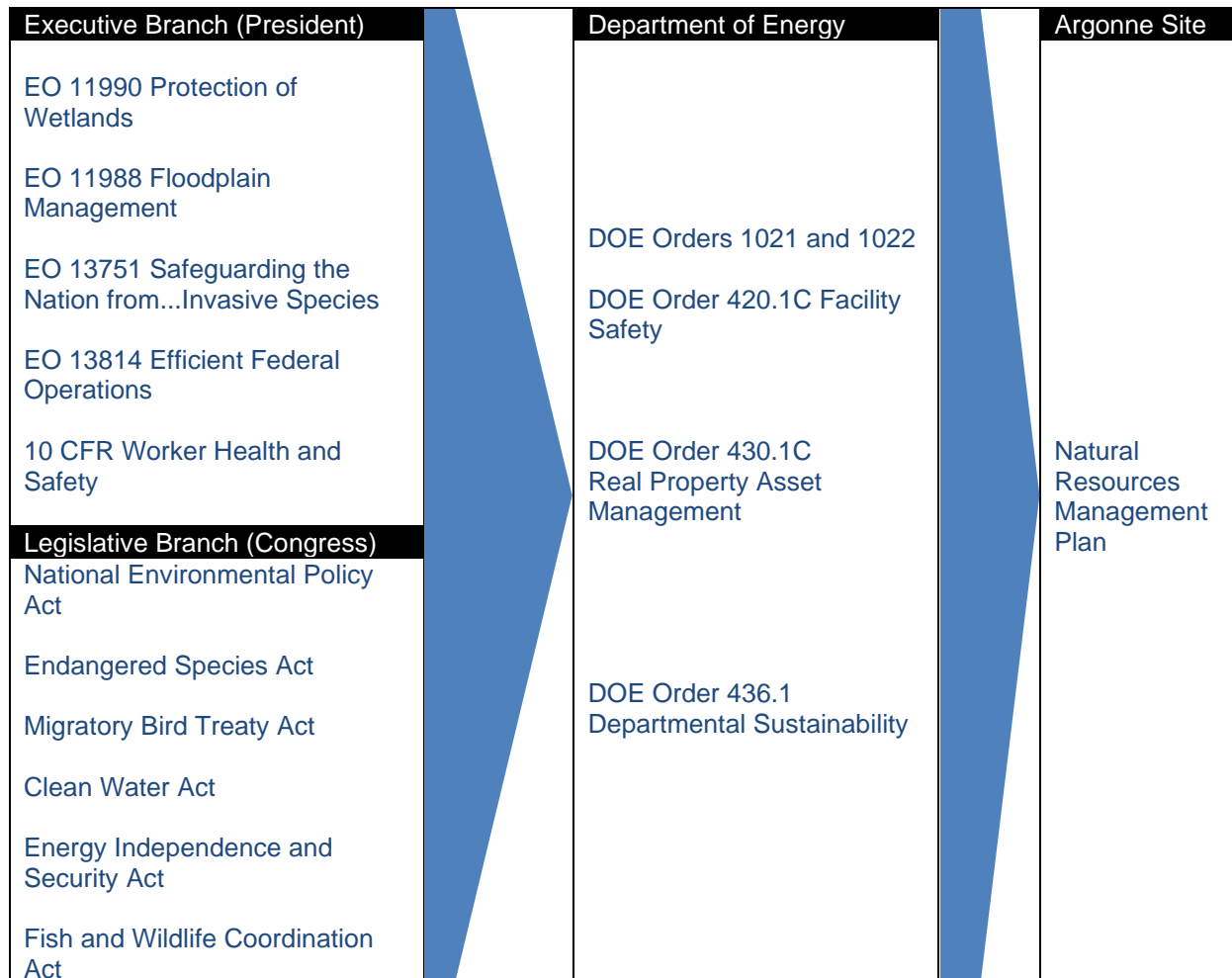


Figure 3. Relationships between Executive Orders, Congress, the U.S. Department of Energy, and the Argonne site.

The Endangered Species Act 1973 (ESA) requires Federal agencies to use their legal authority to aid in the conservation of listed threatened and endangered (T&E) species. Argonne’s natural resources include a threatened and endangered species: The Hine’s Emerald Dragonfly, shown in Figure 4, is a Federal and Illinois-recognized endangered species and is, as of 2016, documented at several locations on the Argonne site. Seven other Federal threatened and endangered species are in DuPage County: four plants, another insect, a snake, and one mammal species. At least two of those, the northern long-eared bat and the rusty-patch bumblebee, may visit and forage in the site in the summer months. Argonne complies with the Endangered Species Act by protecting and enhancing the habitats of known present T&E species and conducting continuous monitoring of the site in search of the other species known in DuPage County.

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Discovery of threatened and endangered species is documented in the laboratory's annual site survey report, and Argonne maintains an active dialogue with the U.S. Fish and Wildlife Service (USFWS) regarding the status of T&E species on the Argonne site. In addition to the ESA, other statutes have requirements related to natural resource management (Appendix C), such as the Clean Water Act, which regulates pollution, storm water discharges into waterways, and impacts to wetlands, and many of these statutes have implications for natural resource management.



Figure 4. The Hine's Emerald Dragonfly, a Federally endangered species documented at several locations on the Argonne site.
Photo: Paul Sparks/Shutterstock.com.

3. Land Use Areas

The Argonne Facilities and Infrastructure Strategic Investment Plan (FISIP) describes the overall management of the Argonne site to meet the scientific research mission of the laboratory and fulfill DOE requirements. From the beginning, all of the land at Argonne was allowed to be developed for our nation’s research needs; however, some of the land is intrinsically unsuitable for development, and other portions, often connected to unsuitable locations, support important natural resources. The FISIP classifies the site into primary development, environmental corridor, critical habitat buffer, and environmental monitoring areas (Figure 5). The primary development areas include existing programmatic mission areas, support services, housing/amenities, and areas identified as suitable for future development. The environmental corridor consists of sites that can accommodate future development for programmatic mission and support services but also currently have significant natural resources. The critical habitat buffer includes areas designated as open space and environmentally sensitive areas primarily within and adjacent to the 100-year floodplain.



Figure 5. Argonne campus plan with FISIP classifications.

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The critical habitat buffer and the environmental corridor host the majority of Argonne’s natural resources and comprise a number of different habitat types (Appendix A). Those resources are subdivided into ecosystem management units (EMUs) to facilitate management (Appendix B). Roads, buildings, and other constructed features often arbitrarily define ecosystem management units. EMUs typically include a predominant habitat type but may contain more than one plant community. The boundaries of each unit can be adjusted in annual revisions of this management plan, based on changes in plant community characteristics or changes in management approach.

The depth of this analysis has facilitated progress in natural resource management objectives thus far. Populations of many invasive species have been reduced, habitats have improved in quality and biodiversity, and the site’s wetlands have been removed from regulatory compliance obligations. Those achievements create a new advanced baseline for more progress; however, invasive species populations and other threats are resilient, and any progress can easily be lost with inconsistent focus or inaction (Figure 6).

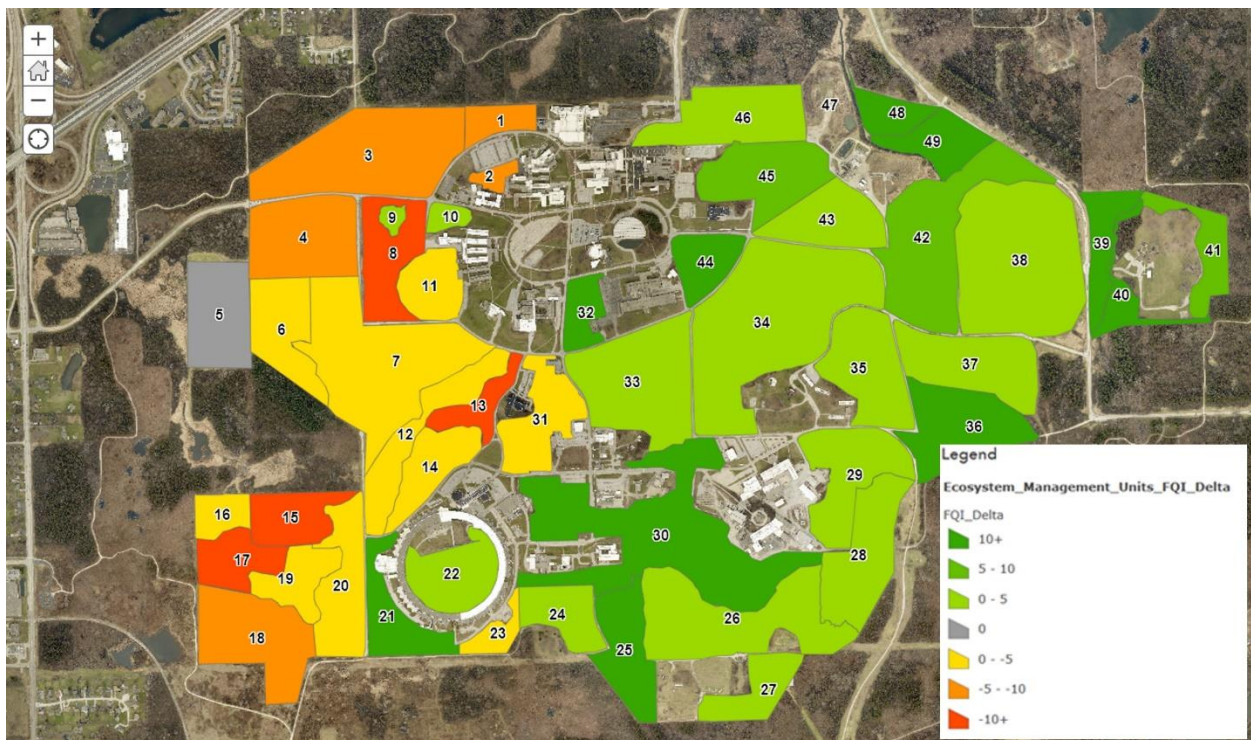


Figure 6. GIS map showing ecosystem management units, their respective numbers, and their improvement with management.

4. Natural Resources: Habitat Management Strategy

Argonne has generated a significant amount of information about the historic and current condition of the site's habitats through surveys, research, and regulatory analyses. Annual vegetation assessments provide information on extant conditions, especially the status of invasive species and recommendations for habitat improvement. Wetlands have regulatory obligations that have resulted in a significant body of studies and reports (see References). There are other reports on birds, reptiles, and the surrounding Waterfall Glen Forest Preserve. These examinations of the site's natural resources reveal that the site retains a range of components from its former ecology and support a management plan focusing on remnants of the pre-settlement plant community structure and species composition in the context of abiotic processes such as hydrology, soil types, weather, and climate.

Natural habitats on the Argonne site formed over a considerable period of time and have been influenced by a variety of factors, particularly recent man-made alterations and influences. Existing factors include soils, hydrology, landscape position, topography, slope and aspect, and the succession sequence of plant communities (See Appendix A, Plant Communities of the Argonne Site). Farming and grazing, site development and utilization, and inactive management of invasive species and other disturbances have altered extant habitats. The long-term goals of Argonne's natural resource management effort are to (a) reduce threats to habitat integrity, (b) promote habitat dynamics of biotic and abiotic interactions, and (c) realize the maximum potential of the site's natural resources—biodiversity, ecosystem services, and green infrastructure. These goals fulfill all of the regulatory obligations for managing the Argonne site.

Ecologists determine the quality of a habitat by its vegetation community. Vegetation is the primary support for all other organisms, and there is a direct relationship between the quality of a plant community and the welfare of all other life.

Floristic Quality Assessment (FQA) is a tool for analyzing the plant community quality of an area based on its plant species composition. The standard assessment tools used to measure habitat integrity and change are Mean C values and the Floristic Quality Index (FQI). The FQA method assigns coefficients of conservatism (C values) to all native species in a flora. C values range from 0 to 10: High C-values are assigned to species that can grow only in high-quality natural areas and cannot tolerate habitat degradation, while low C values are assigned to species with a wide tolerance for disturbance. C values of 0 are assigned to non-native and/or invasive species. The Mean C is a simple average (mean) of the C values for a given site. Native Mean C, as the name implies, is the average of C values of all native species present. Native Mean C is also an indication of native vegetative quality and resilience. Wetlands with Native Mean C values over 3.5 are considered high-quality aquatic resources.

The FQI provides an indication of native vegetative quality and biodiversity for an area: 1-19 indicates low vegetative quality, 20-35 indicates high vegetative quality, and above 35 indicates "natural area" quality. Wetlands with an FQI of 20 or higher are considered high-quality aquatic resources.

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These two interrelated values depict the quality of the vegetation and its integrity in response to disturbances. Hence, successive assessments reveal how the vegetation quality responds to management actions. Vegetation in the Midwest region typically responds to a management action within three years; therefore, the site was divided into three management sections, and this assessment was conducted on one of those three divisions every year, in rotation, typically after a management action two or more years earlier. Usually, the FQI value will show an incremental increase over time in response to appropriate management actions. Ecosystem management units have current and historic FQI and Mean C values calculated from at least six years of consistent assessments. In-depth methodology and findings of this assessment are discussed annually and reported in the Argonne National Laboratory Ecology Survey.⁶

This plan extends the management cycle to a four-year rotation in which are now four management zones instead of three, each corresponding to a management phase. This adaptation reflects the discovery that each action would benefit from a follow-up the following season. Now any one unit will be in one of the following phases:

- Year One: Action
- Year Two: Follow-Up
- Year Three: Fallow
- Year Four Monitoring and Assessment

In the Chicago area, sites of 10 or more acres that have both high FQI and optimum Mean C values are very rare due to the region's vast urban and agriculture development, representing less than 0.5% of the region's land cover. The average FQI of sites in the Chicago area is 40 or less. Argonne has several sites with an FQI over 50. The optimum Mean C value is 5, and a "good" range is between 4 and 6. Some Argonne sites have a Mean C of 4.0, but none are higher than 5. (Values less than 5 indicate vegetation disturbance and a higher number of non-native species.) Several other Argonne locations approach optimum values and should in time become high-quality natural areas with continued management. In order to realize the long-term goal of maximizing values provided by the site's natural resources—biodiversity, ecosystem services, and green infrastructure— all FQI and Mean C values of individual EMUs should be optimized with management, especially where those EMUs still possess elements of their historic ecology. See *Floristic Quality Assessment, Revised*, by Wilhelm and Masters,⁷ for an extensive discussion of the methodology of floristic assessments.

Argonne applies an integrated approach to managing the site's natural areas, determining priority by evaluating the condition of site resources against available funds, labor, and equipment. Hence, habitats with the highest quality ratings will receive management priority before lower-quality areas, so as to avoid backsliding to degraded quality. Where prioritization is required among communities with similar FQIs, those EMUs occurring within the critical habitat buffer will receive the highest priority, followed by those in the environmental corridor and then those in the developed areas (Figure 5).

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Efforts in secondary low-quality and developed areas generally are intended more to address invasive species or other concerns rather than to improve habitat; however, there may be exceptions where important natural resources can be preserved in the context of potential development. This approach is inherent in the goals and objectives stated below.

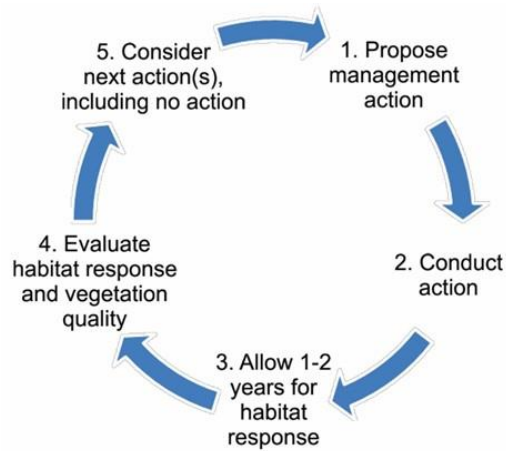


Figure 7. Lessons learned process.

After prioritization, treatments are selected that will improve habitat quality and reduce or control threats, mainly populations of invasive species (Figure 7). These treatments may include native species augmentation, various methods of invasive species control that include prescribed fire, physical or chemical treatments, restoration of hydrology where appropriate, and deer management. Treatments are then assessed to determine both effectiveness and the need for additional effort. Disturbed habitats typically require a continuous program of effort. Appendix E contains a more detailed Invasive Species Management Plan describing various control techniques employed by the laboratory.



Figure 8. *Phragmites australis* (common reed), an invasive plant species found on the Argonne site.
Photo: Casey J. Sullivan, Argonne National Laboratory

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The management of wetlands receives particular attention from the Argonne Site Office. A permit is required for construction, dredging or filling, hydrology alteration, or other activities in or near wetlands that may alter their condition as wetlands. These permits are issued by DOE and, where applicable by statute, by the U.S. Army Corps of Engineers. Much of the wetland effort managed under this plan is similar to work conducted in other habitats on the Argonne site and is intended to control invasive species populations and improve vegetation quality.⁸ Wetlands also benefit from improvements to upland areas, especially when upland habitat improvements restore hydrology processes so that the water table contributes to the influx of standing water to wetlands, and the depth of the water table influences plant distribution and diversity (Figure 9).

Overall, wetland size is relatively small —about 50 acres—in relation to the size of the Argonne site (1,500 acres); however, the habitat type is complex and has the potential to be among the most diverse on the property. Two wetlands are host to reproduction of the Hine’s Emerald Dragonfly, and others provide suitable habitat for its reproduction and other behavior. Wetlands are home to other threatened and endangered species known in DuPage County.



Figure 9. A wetland on the Argonne site.
Photo: Argonne National Laboratory

5. Roles and Responsibilities

The Argonne Site Office has overall responsibility for land management at Argonne National Laboratory. The laboratory's Infrastructure Services (IS) Division is responsible for planning and implementing natural management that complies with all appropriate directives and laws. IS's Sustainability & Environmental Program group conducts the necessary planning, budgeting, and coordination with input from the IS Natural Resources Manager and subject matter experts from the laboratory's Environmental Sciences (EVS) Division. The Natural Resources Manager supervises the implementation of all site work. IS Grounds personnel and/or contractors perform land management and habitat restoration work (Figure 10). Finally, the Natural Resources Manager determines annual site work project priorities with their costs against an annual budget allocation. The budget is determined during fiscal year budget development based on the plan objectives and habitat conditions.



Figure 10. Argonne Infrastructure Services grounds staff member operating a skid steer forestry device.
Photo: Argonne National Laboratory

6. Goals and Objectives

The goals of Argonne’s Land Management and Habitat restoration program present a broad vision of desired conditions on the Argonne site and direct the implementation of the Natural Resources Management Plan. Objectives more specifically describe management initiatives or strategies designed to achieve each goal. The goals and objectives are based on the management principles discussed in Section 4 and Appendix A. These goals and objectives are independent of each other, and the list enumerates all goals and objectives that at any point in time might be pursued. There are many, and it is not expected that activities to meet all goals and objectives would be taking place at the same time. **Error! Reference source not found.** shows the time of the year in which these goals and objectives are met.



Figure 11. *Trillium flexipes* (drooping trillium or nodding wakerobin).
Photo: Casey J. Sullivan, Argonne National Laboratory

GOAL 1. Maintain high-quality remnant plant communities on the Argonne site (Figure 11).

Objective 1.1. Monitor natural areas to determine existing conditions, response to management actions, and resource threats.

Project 1.1.1. Survey one-third of the Argonne site natural areas each year including both uplands and wetlands, update species lists for each land management tract, identify the presence of T&E species, and document conditions, plant community, invasive species concerns and other threats.

Project 1.1.2. Develop, maintain, or revise management plans for individual EMUs. Modify management plans based on previous annual survey results.

Project 1.1.3. Determine the status of threatened and endangered species at Argonne by consulting with the USFWS.

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Objective 1.2. Focus management actions on previously managed sites, wetlands, and T&E species habitat.

Project 1.2.1. Direct restoration activities to previously treated areas, based on three-year cyclic management plan schedules, using least disturbing management tools, most notably controlled burning.

Project 1.2.2. Transfer and incorporate management of non-compliance wetlands into this Natural Resources Management Plan framework from previous division management. The laboratory's Infrastructure Services Natural Resources Manager will coordinate program history and data from the appropriate personnel, including appropriate transfer of budget authority.

Project 1.2.3. Employ habitat restoration techniques with protocols to avoid harm to threatened and endangered species.

Sub-Project 1.2.3.1. Conduct improvement effort in Hine's Emerald Dragonfly habitat following Argonne's Inter-Service Hine's Emerald Dragonfly Technical Guidance from USFWS. See Appendix B, EMUs 03 and 26.

Sub-Project 1.2.3.2. Conduct habitat improvement efforts with situational awareness of potential T&E species presence. See ASO-CX-344 Habitat Maintenance Activities.

Project 1.2.4. Preserve site-wide oak tree health.

Sub-Project 1.2.4.1. Inspect and record oak trees displaying signs of premature decline.

Sub-Project 1.2.4.2. Treat oak trees in decline with plant health care treatments.

Sub-Project 1.2.4.3. Plant oak trees in the landscape of developed areas to maintain oak presence with at least one oak tree planted for each oak tree death.

Sub-Project 1.2.4.4. Install mulch beds around oak trees and groups of oak trees.

Sub-Project 1.2.4.5. Plant mulch bed with selected ground cover of compatible species: native species found in local oak savannah ecosystems.

Objective 1.3. Expand restoration activities into selected remnant plant communities from high-quality areas to those that are lower quality.

Project 1.3.1. Develop a restoration plan for selected management unit(s) and initiate activities.

Sub-Project 1.3.1.1. Remove 30 to 50 acres of invasive shrub infestation (e.g., buckthorn, honeysuckle, etc.) in wooded ecosystem management units annually with mechanical clearing.

Sub-Project 1.3.1.2. Control cool-season grasses in prairie management areas to eliminate competition with native plants.

GOAL 2. Conduct Invasive Species Control/Integrated Pest Management Plan (Appendix E) for identified populations throughout the site (Figure 12).



Figure 12. *Rhamnus cathartica* (common buckthorn), an invasive shrub species found on the Argonne site.
Photo: Casey J. Sullivan, Argonne National Laboratory

Objective 2.1. Identify and control new and/or existing invasive plant species.

Project 2.1.1. Identify invasive herbaceous species with localized populations based on results of annual site surveys.

Project 2.1.2. Implement invasive tree/shrub/vine control actions following the Invasive Species Control Plan.

Objective 2.2. Combine natural resource planning and objectives with those of the Federal Wildland Fire Management Policy, DOE-STD-1066-2016 Fire Protection, and NFPA 1143 Standard for Wildland Fire Management in areas where a site-specific wildland fire management plan is established and integrated with the natural resources management plan (Figure 13).

Project 2.2.1 Work with site stakeholders annually to identify high-risk wildland fire locations and fuels throughout the Argonne facility.

Sub-Project 2.2.2 Create fire protection measures to reduce the potential of natural fuel loads in areas identified as high risk where efforts complement ecosystem and invasive species management.

Sub-Project 2.2.3 Work with internal and external stakeholders on supportive actions and agreements to advance the fire protection standard through agreements, training, planning, and communication.

Objective 2.3 Detect, identify, and control potentially harmful insect populations.



Figure 13. Northern Illinois habitat following prescribed burning.
Photo: ESB Basic/Shutterstock.com

GOAL 3. Re-establish natural plant communities in the critical habitat buffer or environmental corridor.

Objective 3.1. Identify/select appropriate locations to re-establish native plant communities.

Project 3.1.1. Identify areas currently lacking native plant communities and develop appropriate management strategy. Priority will be based on (1) potential spread or host of invasive species, followed by (2) connectivity and defragmentation of adjacent habitats, and (3) visual enhancement.

Objective 3.2. Convert non-native plant communities to native plant communities.

Project 3.2.1. Increase prairie acreage by three acres annually. Focus this where a watershed will benefit from stormwater infiltration improvement from prairie vegetation.

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GOAL 4. Incorporate native species into landscaped areas of the site where they will meet a specified Federal requirement (Figure 14).



Figure 14. Argonne’s Advanced Protein Crystallization Facility landscaped with native flora.
Photo: Casey J. Sullivan, Argonne National Laboratory

Objective 4.1. Identify locations for sustainable landscaping in capital construction projects consistent with guidance found in EO 13693.

Project 4.1.1. Prepare and distribute Site Landscape Plant List (SLPL) for landscaping of capital construction projects. Landscape design can include non-native plants; however, native plant species must be utilized to blend designs into the natural landscape. Selection of non-native species will exclude all invasive species and those species that can hybridize with other local species. The SLPL can change according to project-specific requirements. See Appendix D for SLPL.

Objective 4.2. Provide guidance to Infrastructure Services and the Project Management Office landscape design contractors, grounds managers, and other project management staff to ensure a smooth transition between project concept development and final plan and to ensure that longevity and sustainability requirements are matched to long-term maintenance capability.

Objective 4.3 Provide design guidance to contractor and internal staff (grounds personnel) in identification of species used in sustainable landscaping and maintenance objectives.

Project 4.3.1. Respond to grounds personnel needs for Goal 4 guidance as represented in the Facilities Design Guide 2018.

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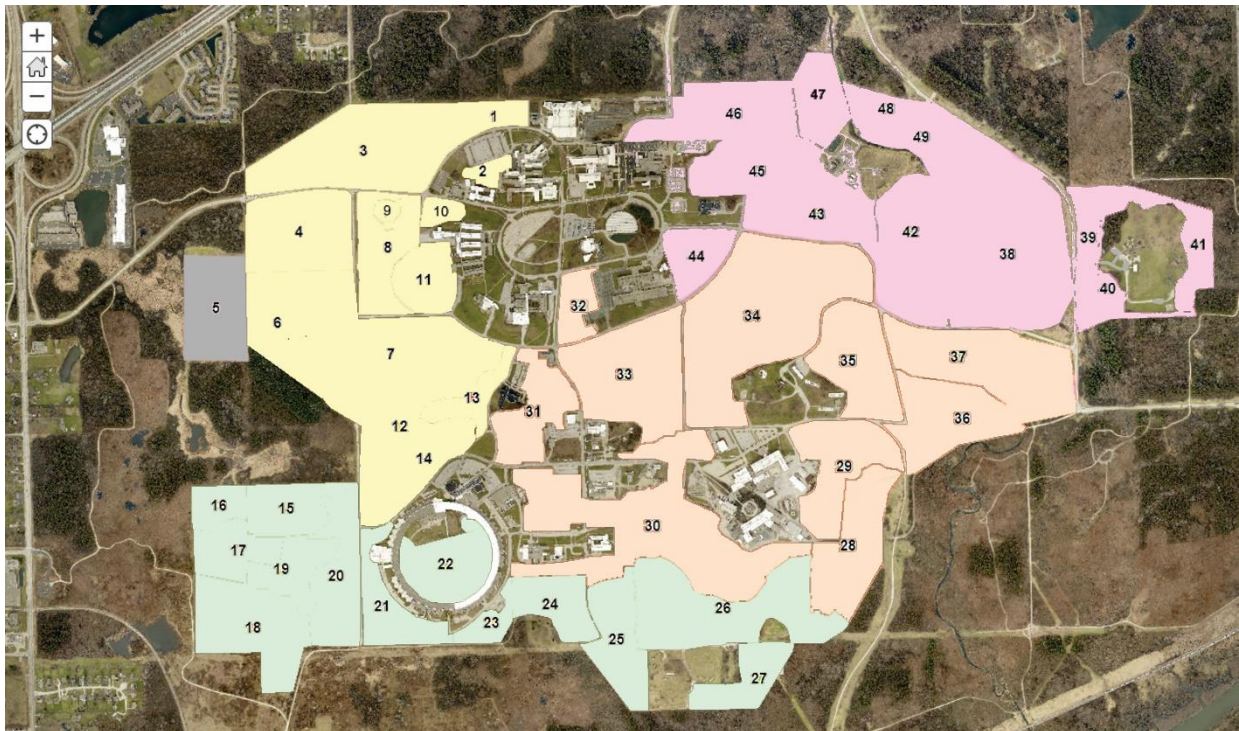
Table 1. Fiscal timeframe for achievement of goals and objectives and completion of projects

Goals, Objectives, and Projects	Abbreviated Descriptions	Fiscal Quarter			
		1	2	3	4
GOAL 1	Maintain existing remnant plant communities on the Argonne site				
Objective 1.1	Monitor natural areas				
Project 1.1.1	Survey one-third of the Argonne site natural areas				
Project 1.1.2	Develop, maintain, or revise management plans				
Project 1.1.3	Determine the status of T&E species and consult USFWS				
Objective 1.2	Focus management actions on managed sites, wetlands, T&E habitat				
Project 1.2.1	Conduct restoration activities on areas previously treated with fire				
Project 1.2.2	Incorporate non-compliance wetlands into Land Management/Habitat Restoration (LMHR) program				
Project 1.2.3	Conduct habitat restoration, avoiding harm to T&E species				
Sub-Project 1.2.3.1	Conduct improvement effort in Hine’s Emerald Dragonfly habitat				
Sub-Project 1.2.3.2	Conduct habitat improvement with awareness of T&E species				
Project 1.2.4	Preserve site-wide oak tree health				
Sub-Project 1.2.4.1	Inspect and record oak trees displaying signs of premature decline				
Sub-Project 1.2.4.2	Treat oak trees in decline with plant health care treatments				
Sub-Project 1.2.4.3	Plant oak trees in the developed areas to maintain oak presence				
Sub-Project 1.2.4.4	Install mulch beds around oak trees and groups of oak trees				
Sub-Project 1.2.4.5	Plant mulch beds with selected native species found in oak woods				
Objective 1.3	Expand restoration activities into selected remnant habitats				
Project 1.3.1	Develop and engage restoration plans for management units				
Sub-Project 1.3.1.1	Remove 30-50 acres of invasive shrubs in ecosystem mgmt units				
Sub-Project 1.3.1.2	Control cool-season grasses in prairie management areas				
GOAL 2	Conduct invasive species control/integrated pest management				
Objective 2.1	Identify and control new and/or existing invasive plant species				
Project 2.1.1	Identify herbaceous invasive species with localized populations				
Project 2.1.2	Implement invasive tree/shrub/vine control actions				
Objective 2.2	Meet fire protection policy in natural resource management				
Project 2.2.1	Identify high risk locations and fuels based on previous management				
Project 2.2.2	Create protection measures for high risk locations				
Project 2.2.3	Work with stakeholders to advance fire protection plan				
Objective 2.3	Identify and control harmful insect populations.				
GOAL 3	Re-establish natural plant communities				
Objective 3.1	Identify locations in which to re-establish native plant communities				
Project 3.1.1	Identify areas and strategy for new native plant communities				
Objective 3.2	Convert non-native plant communities to native				
Project 3.2.1	Increase prairie acreage by three acres annually				
GOAL 4	Incorporate native species into landscaped areas of the site				
Objective 4.1	Identify locations for sustainable landscaping in capital projects				
Project 4.1.1	Prepare and distribute Site Landscape Plant List				
Objective 4.2	Provide landscape design guidance to IS Infrastructure				
Objective 4.3	Provide landscape guidance to contractors and Grounds personnel				
Project 4.3.1	Respond to guidance needs with Facilities Design Guide 2018				

7. Implementation and Monitoring

This Natural Resources Management Plan divides the lab into four approximately equal sections for purposes of focusing annual management resources and implementing an adaptive management procedure. Site work is performed for two successive years by contractors or Argonne grounds personnel, at the direction of the laboratory's Natural Resources Manager, based on unique needs, past actions, and any of the goals and objectives above. After three years, actions performed are evaluated using floristic assessments of the predominant vegetation and changes that have occurred. A Site Ecology Report is then prepared with observations and recommendations for the next management cycle. Site Ecology Reports include recommendations that are implemented in subsequent years for revising or updating the management plans found in the next section. In this manner, a cycle is established so that in any given year at least a quarter of the site receives management action, a second quarter receives follow-up from the previous year, a third quarter is allowed to respond to the previous two year's actions in a fallow condition, and a fourth quarter is being assessed for actions performed years previously. This process rotates to one of four areas every year (Figure 15).

Figure 15. Four-year management planning units.



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8. Plan Management and Direction

An overall assessment of the site’s EMUs from 2018 to 2020⁸ shows continuous improvement in habitat quality (see Table 2). Units with longer management histories—EMUs 21 through 46, the central and eastern units—show gradual and steady improvement. Units 26, 34, and 37 have remarkably high numbers. The western units are not as consistent, as management actions are more recent. This is expected to change over time, as several units in the central and eastern portions have FQI values above 40. Some quality increases are attributable to other factors. For instance, the FQI for Unit 21 rose by 25.6 points (statistically impossible) due to more attentive surveys of a unit that was not considered of high ecologic value in 2016. Many of these sites will receive more management in an effort to maintain or increase their values.

Table 2. Comparison of FQI and Mean C to values three years earlier over the duration of this plan (2018–2020).

EMU	FQI		Δ	Mean C		EMU	FQI		Δ	Mean C		EMU	FQI		Δ	Mean C	
	2015†	2018		2015†	2018		2016†	2019		2016†	2019		2017†	2020		2017†	2020
1	34.6	25.7	▼	3.3	2.8	21	7.6*	36.4	▲	1.7	3.3	34	67.2	68.0	▲	4.3	4.0
2	24.5	19.0	▼	2.5	2.4	22	11.5*	15.0	▲	2.4	2.5	37	53.5	51.2	▼	3.6	3.5
3	42.3	36.9	▼	3.7	3.2	23	40.6	39.9	▼	4.1	3.7	38	41.9	41.1	▼	3.3	3.1
4	29.5	20.1	▼	2.8	2.3	24	47.1	48.4	▲	3.6	3.6	39	19.2	30.7	▲	2.9	3.1
5	N/A					25	25.5*	25.9	▲	2.14	3.1	40	27.5	38.1	▲	3.2	3.6
6	35.8	31.3	▼	3.3	3.1	26	53.3	57.0	▲	4.1	4.0	41	27.5	22.8	▼	2.1	2.7
7	48.0	44.0	▼	3.4	3.2	27	31.8*	34.2	▲	3.3	3.0	42	13.4	48.6	▲	3.2	3.3
8	31.5	21.2	▼	2.9	2.4	28	22.2	24.6	▼	2.6	2.4	43	41.2	31.2	▼	3.0	2.9
9	23.6	24.3	▲	3.3	2.9	29	39.1	41.5	▲	3.1	3.1	44	29.5	45.5	▲	3.9	3.5
10	26.3	26.8	▲	3.1	3.1	30	18.4	37.2	▲	2.5	3.0	45	39.2	48.7	▲	3.7	3.6
11	37.0	35.6	▼	3.5	3.6	31	42.5	41.6	▼	3.4	3.2	46	51.4	49.1	▼	3.7	3.5
12	42.3	41.6	▲	3.5	3.5	32	11.8	24.1	▲	2.4	2.6	47	51.3	30.1	▼	2.7	2.7
13	33.0	21.9	▼	3.0	2.9	33	37.3	42.3	▲	3.2	3.2	48	22.3	33.2	▲	2.6	2.8
14	35.8	33.9	▼	3.3	3.7	35	43.5	41.7	▼	3.6	3.5	49	21.0	33.3	▲	3.3	2.9
15	30.6	19.5	▼	3.4	2.7	36	4.0*	14.6	▲	1.1	1.7						
16	44.1	42.0	▼	3.6	3.5												
17	24.9	14.1	▼	3.0	3.0												
18	45.3	38.8	▼	3.7	3.8												
19	42.7	42.0	▲	3.5	3.7												
20	51.2	50.8	▲	3.5	3.6												

† In 2017 the coefficient of conservatism for many of the plant species found in the Chicago Region changed with the publication of *Flora of the Chicago Region*, Wilhelm and Reicha, 2017. All previously reported unit numbers now had to be reconciled to perform a proper comparative analysis.

Δ This column indicates the direction of the Floristic Quality Index: ▼ indicates a decrease and ▲ an increase in the FQI.

N/A—Unit 5 is a landfill which has not been surveyed as it is not expected to have high vegetation quality or any management action.

* Values marked with an asterisk are from 2013 surveys, because in 2016 these units had become too dense to survey, no management action took place to improve the unit, or the unit was determined not to have an improved conservation value. A management action may have taken place after 2016.

All of these values reflect the presence of non-native species, which causes the FQI and Mean C to drop. For instance, without the influence of any non-native species Unit 20 would have had an FQI of 43.4 and a Mean C of 3.6 in 2018, and Unit 26 an FQI of 54.3 and Mean C of 3.9 in 2019.

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The Mean C value is particularly impacted: Several units would reach values of 4 and above if non-native species were excluded.

Past management efforts have resulted in increases in both native species and non-native species. This is because past habitat management efforts were a form of disturbance relying on methods like mechanical clearing, which quickly alters plant competition, increases light regimes, and creates opportunities for both native and non-native species. The region's plant communities are adapted to fire as a least damaging and most stabilizing disturbance factor and increases in non-native species are not associated with this kind of disturbance. Stability will be a function of both time and consistency of management, and the focus of the next four years will be to increase fire-based management over mechanical clearing. This is specified in Project 1.2.1.

Overall the site's plant communities are improving. The floristic quality index and mean C difference between 2017 and 2020 for the whole site are evidence of the positive change.



Figure 16. *Hibiscus palustris* (rose mallow)
Photo: Casey J. Sullivan, Argonne National Laboratory

9. References

Note: Argonne publications referenced below will be available through the laboratory’s Natural Resources Program website at www.anl.gov/sustainability/natural-resources-program.

- 1 Argonne National Laboratory, *Facility and Infrastructure Strategic Investment Plan* (Lemont, IL: Argonne National Laboratory, 2016).
- 2 Argonne National Laboratory, *Natural Resources Management Plan 2015–2017* (Lemont, IL: Argonne National Laboratory, 2015).
- 3 Argonne National Laboratory, *Natural Resources Management Plan 2012–2014*, (Lemont, IL: Argonne National Laboratory, 2012).
- 4 *Department of Energy Order 430.1C, Real Property Asset Management*, Section 4 Requirements. (DOE, updated 2019). Available at <https://www.directives.doe.gov/news/0430.1C-new>.
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- 6 Argonne National Laboratory, *Argonne Ecology Survey Reports, 2018-2020* ANL/IS 20/1, ANL/IS 20/2, ANL/IS 20/3 (Lemont, IL: Argonne National Laboratory, 2020).
- 7 G. Wilhelm and L. Masters, *Floristic Quality Assessment, Revised* (Lisle, IL: Morton Arboretum, 1995). Available at <https://conservationresearchinstitute.org/files/chicagoareafqa.pdf>
- 8 Argonne National Laboratory *Wetland Management Implementation Plan*, ANL/EQO/Wetlands-2007/1 (Lemont, IL: Argonne National Laboratory, 2007).

Appendix A: Plant Communities of the Argonne Site

The 1,500-acre Argonne site includes approximately 1,000 undeveloped acres, many of which support native plant communities. Prior to European settlement of the region, the types of plant communities present on what is now the Argonne site were primarily open savanna/prairie and savanna, with smaller areas of dark woodland and forest,⁹ on silt loam and silty clay loam soils.¹⁰ All of these communities included at least some trees, primarily oaks (*Quercus spp*). Prior to Federal acquisition of the land in 1946, most of the Argonne site was in agricultural use, both for crop production and livestock grazing. Fire suppression began with settlement, around 1840. During this time, the remnant natural areas were likely used for grazing as well as sources of timber.

Many natural areas were lost as trees were cut and fields were plowed. Populations of white-tailed deer (*Odocoileus virginianus*) increased considerably following the establishment of Argonne, with subsequent effects on plant communities by selective herbivory. Argonne construction activities and other land disturbances began in the late 1940s and have generally been concentrated in several areas scattered throughout the site. As a result of past land uses, natural areas on the site are considerably heterogeneous, fragmented, and disturbed, although there are still a number of relatively large areas that are only slightly disturbed.

Plant communities of the Argonne site were surveyed and mapped in 1998 and have been surveyed consistently since 2011. The community maps have been entered into the Argonne Geographic Information System (GIS) and the dominant species of each plant community recorded in a database integrated with the GIS. The initial survey was repeated in 2003, including the diameters at breast height (dbh) of selected trees, and the GIS files were updated. Comprehensive species lists for many of the plant communities have been developed to include all known species in each community. For these communities, a Floristic Quality Index has been calculated using the protocol described in Swink and Wilhelm (1994).^{11,12} This index allows for the identification of high-quality remnant natural areas and provides a measure of the overall quality or degradation of Argonne plant communities. All of the plant communities on the Argonne site have been degraded to varying extents by such factors as fire suppression, former grazing of livestock, hydrologic alterations, establishment of invasive species, herbivory by deer, and construction. However, a number of high-quality natural communities still occur on the site. Plant communities, which are classified based on the Chicago Wilderness community classification system, are described below.

Woodlands on the Argonne site include a wide range of habitat types, successional stages, and floristic quality. These remnant natural communities are the most common on the site. Canopy cover of mature native trees ranges from approximately 50% to nearly 100%, with dominant species consisting of white oak (*Quercus alba*), black oak (*Q. velutina*), bur oak (*Q. macrocarpa*), and red oak (*Q. rubra*). A large number of these trees exceed 80 cm dbh and 150 years in age. The larger trees (over 100 cm dbh) likely predate European settlement of the area. A variety of secondary species, such as shagbark hickory (*Carya ovata*) and black cherry

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(*Prunus serotina*), also commonly occur in these woodlands. Several woodlands support highly conservative species (species that are found most often in high-quality, undisturbed native habitats) such as large-flowered trillium (*Trillium grandiflorum*) and wood sandwort (*Arenaria lateriflora*). Because of the presence of many younger fire-intolerant native trees, such as black cherry, the canopies of these woodlands are closed (100%). Non-native invasive species, such as common buckthorn (*Rhamnus cathartica*), a small- to medium-sized tree, and shrub honeysuckle (*Lonicera spp.*), have become established in all of the woodlands on the Argonne site, in many cases forming a dense thicket with few native herbaceous species. Soil erosion sometimes occurs beneath these thickets. Other invasive species often present are oriental bittersweet (*Celastrus orbiculatus*) and garlic mustard (*Alliaria petiolata*). Reproduction and recruitment of the canopy oak species seldom occur in woodland communities of the site in these circumstances. The woodland communities on the Argonne site can be further differentiated as dry-mesic silt loam woodland, mesic silt loam woodland, and wet-mesic silt loam woodland. Some woodland communities contain vernal pools or basin marsh communities.

Savanna communities are also common on the Argonne site. The dominant trees of these remnant natural communities are generally bur oak, white oak, black oak, or some combination of these species. The canopy of mature trees averages 10% to 50%, with many pre-settlement trees present. These savanna communities tend to have trees with greater average diameters than the woodlands on site, but support fewer highly conservative species. However, the large number of younger trees, especially Hill's oak trees (*Quercus ellipsoidalis*), now creates a nearly closed canopy. As in the woodland communities, invasive species have become established in all of the savanna communities on the Argonne site. Soil erosion occurs in some areas where invasive species have formed dense thickets. Much of Argonne's 200 Area includes remnant savanna communities in which the understory has been replaced with turf grasses. Reproduction and recruitment of the canopy oak species are generally absent from the savanna communities. At times, infestations of gypsy moths have resulted in the temporary defoliation of canopy and understory trees in some savannas on the Argonne site. The savanna communities on the Argonne site include dry-mesic silt loam savanna, mesic silt loam savanna, and wet-mesic silt loam savanna. Some savanna communities contain vernal pools or basin marsh communities.

Stands of jack pine (*Pinus banksiana*), white pine (*Pinus strobus*), and red pine (*Pinus resinosa*) were planted in the 1950s to provide an acceptable plant cover on previously cultivated fields that had become weedy following abandonment. Although these pine species are native to the Chicago area, they are not known to be part of DuPage County natural communities and do not constitute a native plant community. Other plantations of hardwoods were also planted in the same period. Patches of black walnut (*Juglans nigra*), sweet gum (*Liquidambar styraciflua*), and ash (*Fraxinus sp.*), among others, remain and have demonstrated succession or have become slightly degraded. These sites can be regarded as mid-period successional communities and managed toward oak/hickory woodland or savannah; however, most have an understory of unassociated woody species, particularly of invasive buckthorn and honeysuckle.

A number of areas are classified as **unassociated vegetation**. These areas support a variety of weedy native and non-native trees, such as box elder (*Acer negundo*), green ash (*Fraxinus*

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pennsylvanica subintegerrima), black cherry, common buckthorn, and black locust (*Robinia pseudoacacia*). These communities have generally become established on former agricultural fields and do not progressively develop into a successive community where dominant species (often long-lived trees) support highly diverse and regular assemblages of plant species. Agricultural field soils are highly disturbed and only remotely resemble the parent soil. That soil was formed and matured by the influence of successive plant communities over time; hence, opportunist weedy species (mostly non-native and some invasive) are more capable of invading and perpetuating populations in disturbed field soils over the same period of time in which successional plant communities would naturally occur. Management can direct successional processes toward establishing native prairie or woodland with restoration best-management practices.

Dominant **grassland** communities on the site generally have an invasive shrub component and are classified as unassociated grasses and forbs. These communities have become established on former agricultural fields. Most of the grasslands are primarily composed of non-native, cool-season grasses, such as orchard grass (*Dactylis glomerata*), tall fescue (*Festuca elatior*), and Hungarian brome (*Bromus inermis*), with occasional native forbs, such as wild bergamot (*Monarda fistulosa*). These communities also include the woody invasive species common buckthorn and honeysuckle, as well as herbaceous non-native invasive species such as crown vetch (*Coronilla varia*), field thistle (*Cirsium arvense*), and cut-leaved teasel (*Dipsacus laciniatus*). In many areas, these latter species are the dominant species, with few other species present.

There are a few areas that could be considered prairie communities on the Argonne site, but these lack a complex of highly conservative species. The native species present tend to be forbs, such as Deam's rosinweed (*Silphium integrifolium deamii*), prairie dock (*Silphium terebinthinaceum*), wild bergamot, and yellow coneflower (*Ratibida pinnata*). However, Indian grass (*Sorghastrum nutans*) and big bluestem (*Andropogon gerardii*) occur in several areas. Non-native species are common in these communities, and several, such as crown vetch, are invasive. The largest prairie community on the Argonne site, located in the southwestern portion of the site, is approximately 10 acres in size. However, most or all of this community may have been planted since the establishment of Argonne. The prairie communities on the Argonne site include dry-mesic silt loam prairie, mesic silt loam prairie, wet-mesic silt loam prairie, and wet silt loam prairie.

Wetlands are the most-regulated habitat both at Argonne and in the U.S. and have physiographic connections to all other habitats. Particular focus is directed to wetlands and adjacent uplands to meet or preserve natural assets that meet or may serve regulatory requirements.

Wetlands on the Argonne site range from basin marsh and wet prairie to vernal pools. These wetlands represent a variety of types, including (1) floodplain or riparian wetlands, (2) forested wetlands, and (3) marshes dominated by cattails, grasses, sedges, and rushes. Several high-quality, relatively undisturbed wetlands support unusual plant species or high species diversity. Some of the wetlands are of relatively recent origin and have been formed as a result of human

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activities. Many of these have degraded plant communities, with relatively weedy species and low species diversity, and are dominated by cattail (*Typha spp.*), common reed (*Phragmites australis*), or reed canary grass (*Phalaris arundinacea*). Purple loosestrife (*Lythrum salicaria*) is also common in several wetlands. Disturbance, pollution, alteration of natural hydrologic regimes, and increased sedimentation generally favor the colonization and continued spread of these invasive species.

Argonne completed a site-wide wetland delineation in 1993. All wetlands present on site were identified and mapped following the 1987 *Army Corps of Engineers Wetlands Delineation Manual*. The delineation map shows the extent of all wetlands present at Argonne. Thirty-five individual wetland areas were identified; their total area is approximately 50 acres (20 ha). A compensatory site, Wetland R, was created for wetland losses caused by the building of the Advanced Photon Source. In 2011, the Army Corps of Engineers stated that this mitigation wetland was successfully established and requested that continuous monitoring be conducted. Argonne has also restored and improved several acres of high-quality wetland in the 400 Area (Wetland 302) by disabling a drainage tile network installed when the land was a farm.

References

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 - 10 U.S. Department of Agriculture Soil Conservation Service in cooperation with Illinois Agricultural Experiment Station, *Soil Survey of DuPage and Part of Cook Counties, Illinois* (USDA, 1979). Available at https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/illinois/dupage_cookIL1979/dupage.pdf.
 - 11 F. Swink and G. Wilhelm, *Plants of the Chicago Region* (Indianapolis, IN: Indiana Academy of Science, 1994).
 - 12 G. Wilhelm and L. Rericha, *Flora of the Chicago Region* (Indianapolis, IN: Indiana Academy of Science, 2017).

Appendix B: Ecosystem Management Units

Argonne’s natural resources are divided into ecosystem management units (EMUs), often defined by roads, buildings, or other constructed features to facilitate management. EMUs typically include a predominant habitat type, but may contain more than one plant community. The boundaries of each unit can be adjusted in annual revisions of this management plan, based on changes in plant community characteristics or changes in management approach. Figure B-1 shows Argonne EMUs.

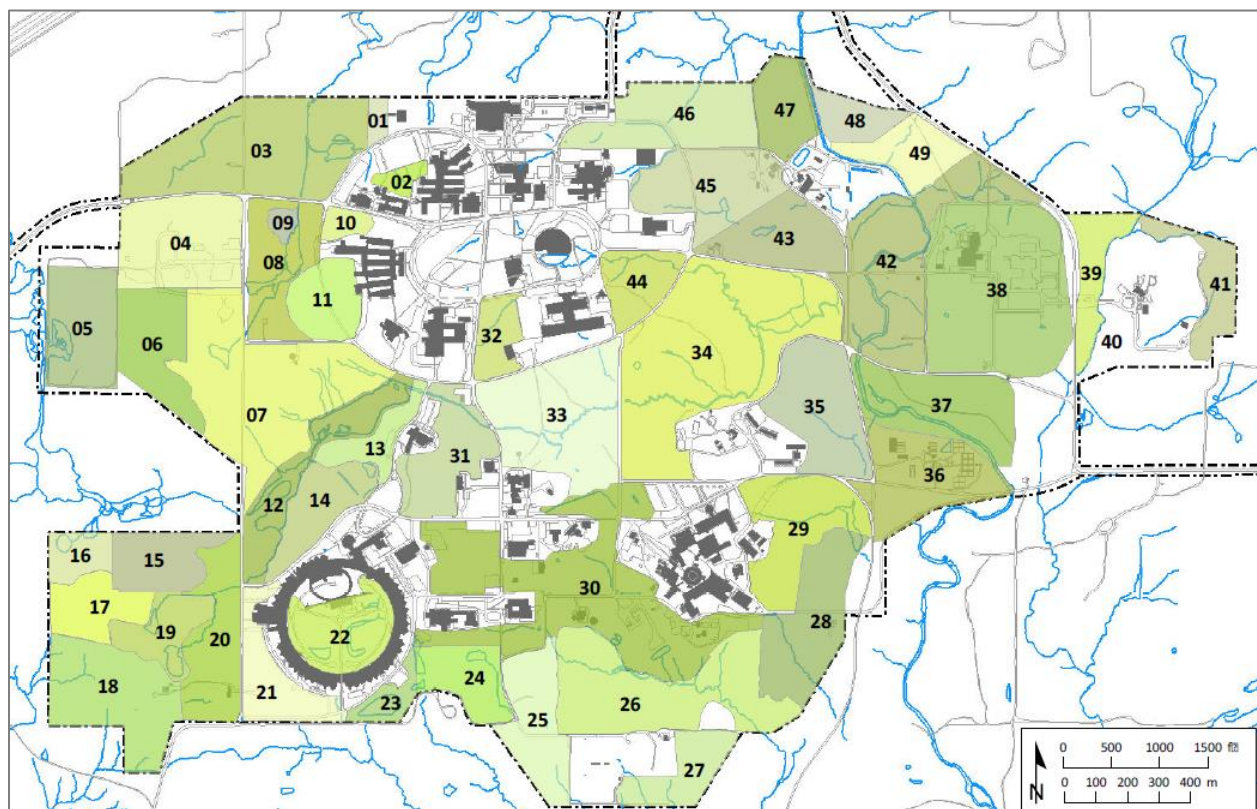


Figure B-1. Argonne EMUs

EMU 01: Includes mesic savanna, in two small individual stands. Construction of the chilled water facility has eliminated approximately half of the western stand. The dominant tree species of the canopy in both stands are bur oak (*Quercus macrocarpa*) and white oak. This unit includes black walnut trees planted by Argonne in 1954. The west boundary of this unit is formed by a hedgerow of large Osage orange (*Maclura pomifera*) trees. The savanna communities contain several species with a C of 8: downy green sedge (*Carex swannii*), narrow-leaved oval sedge (*Carex tenera*), flowering dogwood (*Cornus florida*), flat-stemmed spike rush (*Eleocharis compressa*), and spinulose shield fern (*Dryopteris spinulosa*). Redbud (*Cercis canadensis*), present in this unit, has a C of 10. Common stiff sedge (*Carex tetanica*; C=9), occurs in the western stand in the area of the chilled water facility. A basin marsh is located between the two oak stands. This wetland is a naturally occurring wetland that is drained by a culvert under the

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Argonne boundary fence. Although this wetland is dominated by narrow-leaved cattail (*Typha angustifolia*), it supports a high diversity of native plant species. The floristic quality of this unit is moderate.

EMU 02: Primarily mesic savanna. The dominant tree species of the canopy are bur oak and white oak. Two small wetland areas, supported by building drainage, are dominated by narrow-leaved cattail. An area of unassociated grasses and forbs in the western portion of this unit is composed almost entirely of non-native species. The savanna was regularly mowed until 2005. A population of buckthorn became established and was cut once, in 2015. The floristic quality of this unit is low to moderate.

EMU 03: This unit primarily consists of pine plantations, including red pine, white pine, and jack pine. Some areas that were planted with jack pine and have been in decline in recent years are now considered unassociated woody growth, with black cherry composing most of the tree canopy. Conservative species observed in this unit include mockernut hickory (*Carya tomentosa*; C=10); rattlesnake master (*Eryngium yuccifolium*) and marsh blue grass (*Poa palustris*), both C=9; and lady fern (*Athyrium filix-femina*), downy green sedge, spinulose shield fern, sensitive fern (*Onoclea sensibilis*), and chinquapin oak (*Quercus muhlenbergii*), all C=8. A large wetland, primarily a basin marsh, is located within this unit and is dominated by narrow-leaved cattail and non-natives reed canary grass and common reed. Larvae of the Hine's Emerald Dragonfly, a Federally and state-listed endangered species, were discovered in this wetland. The northern portion of this wetland includes a segment of Wards Creek, a tributary of Sawmill Creek; however, much of the channel in this wetland was excavated during development of the Argonne site to convey surface water from the 800 and 200 Areas. This wetland is drained by a culvert under the Argonne boundary fence. The floristic quality of this unit is low to moderate. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years and needs to continue.

EMU 04: Comprises the Argonne 800 Area, which previously contained numerous temporary buildings and storage areas. Conservative species observed in this unit include red pine (C=10), sweet grass (*Hierochloa odorata*; C=9), and narrow-leaved oval sedge (C=8). The entire unit has been significantly disturbed and supports a mosaic of upland and wetland plant communities. Wetland development is associated with compacted soils, excavations, and altered drainage patterns. Although the dominant species in these communities are non-native, a variety of disturbance-tolerant native species are present. The floristic quality of this unit is low to moderate.

EMU 05: Includes the Argonne landfill area. The landfill cover was completed in 1993 and supports a herbaceous community of mostly non-native grasses. A basin marsh is located along the western boundary fence line and is contiguous with a large marsh in Waterfall Glen Forest Preserve. Dominant species in the marsh are common reed, narrow-leaved cattail, and non-natives reed canary grass and common reed. A small remnant of a jack pine plantation is located in the southwest corner of this unit and includes deciduous woody species, primarily non-natives. The floristic quality of this unit is low.

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EMU 06: Primarily white pine and jack pine plantations. Much of the area that had been planted with jack pine is now becoming dominated by deciduous woody species, primarily non-natives. Sweetgum, planted by Argonne in 1954, occurs in the northern section of this unit. Conservative species observed in this unit include lady fern, downy green sedge, narrow-leaved oval sedge, spinulose shield fern, and sensitive fern (all C= 8). A basin marsh is located within this unit and supports a wide variety of mostly native species. The northern portion of the wetland includes a drainage ditch, conveying water to a culvert under Kearney Road. The northernmost portion of this unit consists of an area of unassociated grasses and forbs composed almost entirely of non-native species. The floristic quality of this unit is low to moderate.

EMU 07: Primarily unassociated woody growth. The dominant tree species vary throughout the unit and include non-native species and box elder, green ash, and eastern cottonwood (*Populus deltoides*). Green ash was planted by Argonne in this location in 1954. Conservative species observed in this unit include great bladderwort (*Utricularia vulgaris*; C=9) as well as narrow-leaved oval sedge, pale purple coneflower (*Echinacea pallida*), false pennyroyal (*Isanthus brachiatus*), sensitive fern, and white water crowfoot (*Ranunculus longirostris*), all C= 8. Portions of this unit were disturbed in the past by facility construction and demolition. Small degraded remnants of mesic prairie occur in this unit, primarily along Kearney Road and near the intersection of Watertower and Outer Circle Roads. Numerous small wetlands occur within this unit, primarily supporting native sedges (*Carex spp.*) and bulrush (*Scirpus spp.*). In recent years, a significant wet prairie community has developed west of Kearney Road, likely the result of drain tile failure. A basin marsh with a variety of native sedges and forbs is located in the western section of the unit. A wetland in the eastern portion of the unit is supported by drainage from nearby water towers and dominated by narrow-leaved cattail and common cattail (*Typha latifolia*). The floristic quality of this unit is low to moderate. Some removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years, allowing for greater access and evaluation.

EMU 08: Primarily unassociated grasses and forbs, composed almost entirely of non-native species, with non-native shrubs predominating over much of the area. Marsh blue grass (C=9) occurs in this unit. Areas of this unit were disturbed in the past by facility construction and demolition. This unit includes a basin marsh. A portion of this wetland is naturally occurring; however, much of it was excavated to convey surface water from the 800 Area during the development of the Argonne site. Dominant species include narrow-leaved cattail, sandbar willow (*Salix interior*), and common reed. The floristic quality of this unit is low to moderate.

EMU 09: Dry-mesic savanna. The dominant tree species of the canopy is black oak. Green ash and black walnut planted by Argonne in 1954 occur in this unit. A variety of native herbaceous species is present under the oak canopy, but sparse in coverage. A drainage ditch along the eastern margin of the unit conveys surface water north from the 800 Area and supports a wetland community of shrubs and herbaceous species. The floristic quality of this unit is low to moderate. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years.

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EMU 10: Dry-mesic savanna. The dominant tree species of the canopy are black oak and bur oak. This savanna is isolated, being surrounded by mowed lawns. A wide variety of native shrubs and herbaceous species is present. The floristic quality of this unit is moderate.

EMU 11: Mesic savanna in two stands separated by Outer Circle Road. The dominant tree species of the canopy are bur oak and white oak. This unit includes black walnut trees planted by Argonne in 1954. The savanna community contains two species with a C of 8: narrow-leaved oval sedge and large-flowered trillium. A variety of native shrubs and herbaceous species is present, with species diversity particularly high in the eastern section of the unit. The floristic quality of this unit is high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years.

EMU 12: Two streamside marsh wetlands connected by a narrow channel. These wetlands are associated with the floodplain of the lower branch of Freund Brook. Agricultural drainage tiles were removed from the southern wetland in 2001 to increase the wetland area. Conservative species observed in this unit include rattlesnake master (C=9), marsh blue grass (C=9), grass-leaved arrowhead (*Sagittaria graminea*; C=9), bottlebrush sedge (*Carex lurida*; C=8), stiff bedstraw (*Galium tinctorium*; C=8), and arum-leaved arrowhead (*Sagittaria cuneata*; C=8). The northern wetland includes extensive stands of common reed, while the southern wetland includes large areas of narrow-leaved cattail. A beaver dam at the northern end of this unit has raised water levels considerably in recent years. The floristic quality of this unit is moderate.

EMU 13: Primarily unassociated woody growth, composed of woody native and non-native species. Canopy species are primarily eastern cottonwood and non-native black locust. Areas of this unit were disturbed in the past by facility construction. This unit includes sycamore (*Platanus occidentalis*) trees planted by Argonne in 1954. Conservative species observed in this unit include sycamore (C=9), wood sandwort (C=8), and narrow-leaved oval sedge (C=8). A small wetland community in the northern part of the unit has expanded in recent years due to the presence of a beaver dam in unit 12 and is dominated by narrow-leaved cattail. The floristic quality of this unit is low to moderate.

EMU 14: Mesic savanna. The dominant tree species of the canopy are bur oak and white oak. The savanna community contains one species with a C of 8: spinulose shield fern. A canal, excavated during the early development of the Argonne site, is located in the northeast part of the unit and contains a gabion dam to hold surface water runoff from nearby parking lots. The canal is a remnant of a larger wetland, which was mostly filled in during construction of the Advanced Photon Source (APS). A small wetland has developed in the northeast corner of the unit as a result of altered surface drainage patterns during APS construction. The floristic quality of this unit is moderate to high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years.

EMU 15: Primarily a jack pine plantation. Much of the area that was planted with jack pine and has been in decline in recent years is now becoming dominated by deciduous woody species,

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primarily non-natives. Conservative species observed in this unit include lady fern, spinulose shield fern, floating manna grass (*Glyceria septentrionalis*), and sensitive fern (all C=8), as well as false aster (*Boltonia latisquama recognita*; C=9). The west and south boundaries of this unit are formed by hedgerows of large Osage orange trees. The floristic quality of this unit is low to moderate.

EMU 16: Primarily mesic savanna. The dominant tree species of the canopy are bur oak and white oak, with black oak and red oak also present. The savanna community contains several species with a C of 8: spinulose shield fern, narrow-leaved oval sedge, downy green sedge, and lady fern. This unit includes a basin marsh and a streamside marsh associated with the floodplain of the South Branch of Freund Brook. The basin marsh is dominated by common bur-reed (*Sparganium eurycarpum*), while the streamside marsh is dominated by common reed. Grass-leaved arrowhead (C=9) and floating manna grass (C=8) occur in the basin marsh. The floristic quality of this unit is moderate, trending to high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years.

EMU 17: Primarily unassociated woody growth composed of woody native and non-native species. Canopy species in this low-lying area are primarily box elder and green ash. An extensive network of drain tiles was discovered in this unit, discharging to the west in Waterfall Glen. Downy green sedge and spinulose shield fern (both C=8), and woodland blue grass (*Poa sylvestris*; C=10) occur in this unit. The floristic quality of this unit is low to moderate.

EMU 18: Primarily mesic prairie dominated by big bluestem and Indian grass. It is likely that much of this prairie was planted by Argonne. Narrow-leaved oval sedge, downy green sedge, prairie blazing star (*Liatris pycnostachya*), sideoats grama (*Bouteloua curtipendula*), bottle gentian (*Gentiana andrewsii*), pale purple coneflower, flat-stemmed spike rush, and wild quinine (*Parthenium integrifolium*), all with a C of 8; rattlesnake master, white prairie clover (*Petalostemum candidum*), sweet black-eyed Susan (*Rudbeckia subtomentosa*), and purple prairie clover (*Petalostemum purpureum*), all with a C of 9; and prairie brome (*Bromus kalmii*), prairie dropseed (*Sporobolus heterolepis*), and bent grass (*Agrostis alba palustris*), all with a C of 10, occur in this unit. Several small wetland areas occur in this unit and are dominated by sedges. The floristic quality of this unit is high. Efforts to control woody species encroachment has progressed in recent years.

EMU 19: Mesic savanna. The dominant tree species of the canopy are bur oak and white oak. Several shagbark hickory trees are also present in the canopy. The savanna community contains several species with a C of 8: lady fern, narrow-leaved oval sedge, downy green sedge, and spinulose shield fern. This unit includes two basin marshes, one characterized by blue flag iris (*Iris virginica shrevei*), and the other by common bur-reed. These wetlands contain floating manna grass and stiff bedstraw (both C=8), and false aster and grass-leaved arrowhead (both C=9). The floristic quality of this unit is moderate to high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years.

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EMU 20: Primarily unassociated woody growth composed of woody native and non-native species. Canopy species in this unit are primarily box elder; however, a large stand of the non-native black locust also occurs in this unit. A woodland vernal pool and a basin marsh, as well as a small streamside marsh, occur in this unit. Conservative species observed in this unit include bent grass (C=10); smooth blue aster (*Aster laevis*), tall swamp marigold (*Bidens coronata*), false aster, and marsh blue grass (all C=9); and lady fern, swamp oval sedge (*Carex muskingumensis*), narrow-leaved oval sedge (*Lathyrus palustris*), sensitive fern, showy black-eyed Susan (*Rudbeckia speciosa sullivantii*), and spinulose shield fern (all C=8). The floristic quality of this unit is moderate, trending to high. Removal of the non-native encroachment of buckthorn and honeysuckle has progressed in recent years, promoting the native vegetation, and the unit is far more open than in previous years. A parking lot across from the Building 440 was installed in 2014.

EMU 21: Primarily unassociated grasses and forbs, composed almost entirely of non-native species. Areas of this unit were disturbed during construction of the APS, and most of the unit was eliminated by the construction of the Advanced Protein Crystallization Facility. The floristic quality of this unit is low.

EMU 22: Primarily consists of unassociated grasses and forbs, with an increasing presence of non-native shrubs. This unit, located within the Advanced Photon Source (APS) ring, was graded for stormwater management during construction of the APS, directing surface flows to the south of the ring. Mesic prairie species were planted within this unit in 2004. The floristic quality of this unit is low.

EMU 23: Primarily native community reconstruction and includes Wetland R and surrounding prairie. The wetland was constructed in 1991 as mitigation under a U.S. Army Corps of Engineers permit, using topsoil salvaged from a wetland destroyed during APS construction. Reconstructed plant communities present in this unit include permanent pond, basin marsh, wet prairie, wet-mesic prairie, and mesic prairie. The unit contains floating manna grass, white water crowfoot, wild quinine, dodder (*Cuscuta polygonorum*), and sideoats grama (all C=8); grass-leaved arrowhead, rattlesnake master, smooth blue aster, and false aster (all C=9); and prairie dropseed (C=10). The eastern section of this unit includes a drainage swale characterized by common reed and narrow-leaved cattail. The floristic quality of this unit is high.

EMU 24: Primarily mesic savanna. The dominant tree species of the canopy is white oak. Sensitive fern (*Onoclea sensibilis*), purple milkweed (*Asclepias purpurascens*), narrow-leaved oval sedge, marsh St. John's wort (*Hypericum virginicum fraseri*), and wild quinine (all C=8); plus beaked agrimony (*Agrimonia rostellata*) and low bindweed (*Convolvulus spithameus*), both with a C of 10, occur in the savanna. A woodland vernal pool is located in this unit and has a canopy composed mostly of eastern cottonwood, with silver maple (*Acer saccharinum*) and the non-native catalpa (*Catalpa speciosa*) becoming dominant in the sub-canopy. The floristic quality of this unit is moderate to high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years, promoting the native plant community.

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EMU 25: Primarily plantations of white pine and jack pine. Areas of unassociated woody growth and unassociated grasses and forbs also cover large areas of this unit. The floristic quality of this unit is low to moderate.

EMU 26: Primarily mesic and dry-mesic savanna. The dominant tree species of the canopy are white oak and bur oak, with several large red oak and black oak present. A small area of jack pine is located in the western part of this unit. Several small wetlands supporting wet prairie or woodland vernal pool communities occur in the savanna. A streamside marsh is located in this unit, which is characterized by narrow-leaved cattail. Larvae of the Hine’s Emerald Dragonfly, a Federally and state-listed endangered species, were discovered in this wetland. Sensitive fern, purple milkweed, Short’s aster (*Aster shortii*), and lady fern (all C=8); poke milkweed (*Asclepias exaltata*) and few-fruited gray sedge (*Carex oligocarpa*), both with a C of 9; and low bindweed, beaked agrimony, and bent grass (all C=10), occur in the savanna. The floristic quality of this unit is high. Removal of the non-native understory of buckthorn and honeysuckle has occurred in recent years, allowing for greater access and examination. This unit contains a significant diversity of land forms and is greatly influenced by a landfill, an underground utility corridor, and an overhead powerline cut through the middle of the woodland.

EMU 27: Primarily mesic and dry-mesic savanna. The dominant tree species of the canopy are white oak, red oak, and black oak. The westernmost part of this unit shows evidence of disturbance and includes areas of unassociated woody growth. A small woodland vernal pool is located in the northeastern corner of this unit. The floristic quality of this unit is low to moderate.

EMU 28: Primarily jack pine plantations. Areas of unassociated woody growth composed almost entirely of non-native species (characterized by box elder and unassociated grasses and forbs) also cover large areas of this unit. A basin marsh, which receives drainage from the 300 Area, is located in this unit and is characterized by narrow-leaved cattail. Spinulose shield fern (C=8), rough clustered sedge (*Carex cephaloidea*; C=9), and beaked agrimony (C=10) occur in this unit. The floristic quality of this unit is low.

EMU 29: Primarily mesic and dry-mesic savanna. The dominant tree species of the canopy are white oak, black oak, and bur oak. A large stand of non-native black locust occurs in the southern section of this unit. Areas of unassociated grasses and forbs, composed primarily of non-native species, occur in the northern section of this unit. Narrow-leaved oval sedge, false pennyroyal, and showy black-eyed Susan (all C=8), and prairie dropseed and beaked agrimony (both C=10, occur in this unit. The floristic quality of this unit is low to moderate.

EMU 30: Primarily unassociated grasses and forbs, almost entirely non-native species. Portions of this unit were planted with jack pine, but few individuals remain. Some areas in the southeast part of this unit were disturbed when ravines were filled in during construction of the 300 Area. False pennyroyal, prairie sunflower (*Helianthus rigidus*), and prairie blazing star (all C=8), false aster (C=9), and prairie dropseed (C=10) occur in this unit. The floristic quality of this unit is low.

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EMU 31: Primarily mesic savanna. The dominant tree species of the canopy are white oak and bur oak, with several large red oak present. A woodland vernal pool is located in this unit and has a canopy composed mostly of eastern cottonwood. The south branch of Freund Brook forms the north boundary of this unit. Sycamore (C= 9) and beaked agrimony (C=10) occur in this unit. The floristic quality of this unit is moderate to high.

EMU 32: Primarily mesic savanna. The dominant tree species of the canopy are white oak and bur oak. This unit was mowed regularly until 2005, and very few native species remain in the understory. Areas of unassociated grasses and forbs are located in the eastern part of this unit. A streamside marsh, characterized by narrow-leaved cattail, conveys surface water from the 200 Area to the north branch of Freund Brook. Several acres in the eastern part of this unit were cleared and graded for a construction project. The floristic quality of this unit is low. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years.

EMU 33: A mosaic of white pine, jack pine, and red pine plantations, mesic savanna, and tulip poplar planted in 1954. The dominant tree species of the savanna canopy are white oak and bur oak. Areas of unassociated grasses and forbs occur in this unit, primarily around the perimeter, as well as unassociated woody growth. A basin marsh, characterized by narrow-leaved cattail, is located in the northeast corner. The south branch of Freund Brook flows west to east through the unit. Spinulose shield fern (C= 8), sweet black-eyed Susan (C= 9), and beaked agrimony (C=10) occur in this unit. The floristic quality of this unit is low to moderate.

EMU 34: Primarily mesic woodland and savanna. The dominant tree species of the canopy are white oak and bur oak, along with red oak in the woodland area. The western areas of this unit include black walnut planted by Argonne in 1954. This unit contains several species with a C of 8: large-flowered trillium, lady fern, sensitive fern, narrow-leaved oval sedge, and wood sandwort, as well as beaked agrimony and red mulberry (*Morus rubra*), both with a C of 10. Several small wetlands supporting wet prairie communities are located within the savanna. Three wetlands formed by stone dams constructed on Freund Brook are located in this unit. The dam failed at the middle wetland in 1996, reducing this wetland to the stream channel. The other two wetlands include streamside marshes. The lower wetland also includes a naturalized pond. These wetlands are characterized primarily by reed canary grass and common reed. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years, allowing native plant populations to flourish. This unit is large with a heterogeneous topography, and there is evidence that the unit was not subject to grazing or other agriculture. Hence, the floristic quality of this unit is high. This unit has the highest floristic quality on the Argonne site.

EMU 35: Primarily mesic woodland and savanna. The dominant tree species of the canopy are white oak and bur oak. This unit contains two species with a C of 8—large-flowered trillium and false mermaid (*Floerkea proserpinoides*)—as well as beaked agrimony (C=10). The floristic quality of this unit is moderate to high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years and needs to continue.

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EMU 36: Primarily unassociated grasses and forbs, composed mostly of non-native species. Portions of this unit were planted with jack pine, but few individuals remain. The floristic quality of this unit is low.

EMU 37: Primarily mesic savanna. The dominant tree species of the canopy are white oak and bur oak. This unit contains large-flowered trillium and narrow-leaved oval sedge (both C=8), and stout blue-eyed grass (*Sisyrinchium angustifolium*; C=10). Sawmill Creek, a perennial stream, flows through this unit, with streamside marsh communities occurring intermittently along its banks. Small isolated marshes occur within the floodplain. The floristic quality of this unit is high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years.

EMU 38: Areas of unassociated grasses and forbs as well as areas of native community reconstruction. This unit was significantly disturbed during the early development of the Argonne site. Most of this unit has been planted with prairie species and much of the area contains a combination of native and non-native species. The oldest plantings, in the southeast portion of the unit, support a mesic prairie community dominated by big bluestem and Indian grass. Prairie milkweed (*Asclepias sullivantii*), white wild indigo (*Baptisia leucantha*), sideoats grama, pale purple coneflower, and wild quinine (all C=8), rattlesnake master and sweet black-eyed Susan (both C= 9), and prairie dropseed (C=10) occur in the prairie. The floristic quality of this unit is low to moderate.

EMU 39: Areas of unassociated grasses and forbs and areas of unassociated woody growth, both composed mostly of non-native species. Non-native shrubs are increasing throughout the unit, and many young black oak trees have become established. A small stream and associated floodplain run through this unit. The floristic quality of this unit is low.

EMU 40: Primarily unassociated woody growth. The dominant species along a small intermittent stream are sandbar willow and eastern cottonwood. Also present are remnants of jack pine plantations that include a large component of non-native shrubs. The floristic quality of this unit is low.

EMU 41: Primarily mesic savanna. The dominant tree species of the canopy are white oak and bur oak. The savanna extends into Waterfall Glen Forest Preserve. The floristic quality of this unit is low to moderate.

EMU 42: A mosaic of mesic savanna, unassociated grasses and forbs, unassociated woody growth, and streamside marsh, as well as areas of native community reconstruction. The dominant species of the savanna canopy are white oak and bur oak; the dominant marsh species is reed canary grass. False pennyroyal and sideoats grama (both C=8) as well as swamp rose mallow (*Hibiscus palustris*; C=9) occur in this unit. The floodplain of Sawmill Creek, a perennial stream, constitutes much of this unit and includes two wetlands, both streamside marshes. The floristic quality of this unit is moderate.

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EMU 43: Planted with jack pine in 1955, but now considered unassociated woody growth, with black cherry and box elder composing most of the tree canopy. A basin marsh is located in this unit. Reed canary grass is the dominant species. The floristic quality of this unit is low to moderate.

EMU 44: This unit includes mesic savanna, unassociated woody growth, and unassociated grasses and forbs. The dominant canopy species of the savanna are bur oak and white oak. A few individual jack pines, black walnuts, and green ashes planted in 1954 remain in this unit. The north branch of Freund Brook flows through the savanna. The narrow floodplain supports a community of willows (*Salix spp.*) and eastern cottonwood. Beaked agrimony (C=10) occurs in this unit. The floristic quality of this unit is low to moderate.

EMU 45: Primarily mesic savanna. The dominant tree species of the canopy are white oak and bur oak. A streamside marsh dominated by narrow-leaved cattail is located in the northwest corner of this unit; a woodland vernal pool is located in the eastern section. Sensitive fern, bristly cattail sedge (*Carex frankii*), and narrow-leaved oval sedge (all C=8), marsh blue grass (C=9), and beaked agrimony (C=10) occur in this unit. The floristic quality of this unit is moderate to high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years and needs to continue.

EMU 46: Primarily mesic savanna. The dominant tree species of the canopy are white oak and bur oak. The western section includes an area of unassociated woody growth. Sweetgums, planted by Argonne in 1954, occur in the eastern section of this unit. A zone of unassociated grasses and forbs is located north of Outer Circle Road. A wetland, located in a drainage ditch along Outer Circle Road, continues north through the savanna and conveys surface water from the 200 Area to an unnamed tributary of Sawmill Creek. Lady fern, narrow-leaved oval sedge, spinulose shield fern, and sensitive fern (all C=8); poke milkweed and marsh blue grass (both C=9); and prairie sundrops (*Oenothera pilosella*) and beaked agrimony (both C=10), occur in this unit. The floristic quality of this unit is moderate to high. Removal of the non-native understory of buckthorn and honeysuckle has progressed in recent years.

EMU 47: Primarily areas of unassociated woody growth, basin marsh, and native community reconstruction. Formerly Lime Sludge Pond, this unit is a remnant of the Sawmill Creek floodplain that was diked off and used for the storage of lime sludge, a byproduct of Argonne's steam generation process. Following removal of the lime sludge in 2000, the area was planted with native species to create mesic, wet-mesic, and wet prairie communities. The central area of this unit is used for the disposal of soils excavated from construction projects around the site. Basin marsh and a naturalized pond occur in the southern part of this unit. A narrow band of mesic savanna occurs along the former bank of Sawmill Creek. The channelized creek forms the eastern boundary of this unit. Water star grass (*Heteranthera dubia*) and false pennyroyal (both C=8), and at one time false aster and Pursh's tufted bulrush (*Schoenoplectus [=Scirpus] purshianus*), both with a C of 9, were present. The floristic quality of this unit is low to moderate. This unit has received deposits of construction soils in recent years, significantly altering the terrain suitable for many of the mentioned and formerly observed species.

EMU 48: Primarily a red pine plantation. Areas of unassociated grasses and forbs, composed mostly of non-native species, also cover portions of this unit. The channelized segment of Sawmill Creek forms the western boundary of this unit. The floristic quality of this unit is low. A very recent clearing of non-native understory has occurred in this unit.

EMU 49: This unit primarily consists of mesic savanna. The dominant species of the canopy are white oak and bur oak. Areas of unassociated woody growth and unassociated grasses and forbs also occur in this unit. Sawmill Creek forms the western boundary of this unit. The floristic quality of this unit is low. A very recent clearing of non-native understory has occurred in this unit.

Appendix C: Legislative and Regulatory Requirements for Natural Resource Management on Federal Lands

Note: This section has been adapted from the *Oak Ridge National Laboratory Wildlife Management Plan* and adjusted for relevance to Argonne National Laboratory.

DOE is committed to land management and conservation and works to be a good steward of its land and the natural resources on it. A number of regulatory requirements direct DOE's land use and natural resource management, including:

- Federal laws, executive orders, and presidential memoranda
- DOE directives (e.g., orders, guidance)
- Illinois state laws and regulations

Federal Laws

A number of Federal laws require or encourage Federal agencies to actively manage natural resources, including wildlife, on their lands. Regulations that have the force of law implement many of these Federal laws, and the DOE complies with them. (Summaries of some of these laws and their implementing regulations are available on the DOE website at <https://www.energy.gov/em/long-term-stewardship-related-information>.) The following laws are listed in chronological order of their initial passage by Congress. Many of them have been amended at least once; the discussions below reflect the most recent versions of each law, including all amendments.

Migratory Bird Treaty Act (1918)

The Migratory Bird Treaty Act (MBTA) (Title 16, United States Code [USC], Sects. 703–712) of 1918 implements treaties—signed by the United States and Canada, Japan, Mexico, and the former Soviet Union—for the protection of shared migratory bird resources. The act protects migratory birds by governing the taking, killing, possession, transportation, and importation of such birds; their eggs, parts, and nests; and any product, manufactured or not, from such items.

The USFWS has developed a list of migratory birds that are protected under the act. The list can be found in Title 50, Code of Federal Regulations (CFR), Part 10.13, or at the website, www.gpo.gov/fdsys/pkg/FR-2010-03-01/pdf/2010-3294.pdf. (The latter list provides updated scientific and common names that conform to the most recent taxonomy, with cross references to the names in the CFR list.) The USFWS has also published a list of 125 bird species (Title 70, Federal Register [FR], Part 12710, March 15, 2005, available at <http://migratorybirds.usfws.gov>) that are not native to the United States and therefore are not protected under the MBTA.

Fish and Wildlife Coordination Act (1934)

The Fish and Wildlife Coordination Act (FWCA) (16 USC 661–667e) of 1934 recognizes the vital contribution of wildlife resources, both animals and plants, to the nation. The act requires Federal agencies to consult with the USFWS and appropriate state wildlife agencies when they plan to conduct any activity involving the impoundment, diversion, deepening, control, or modification of a body of water. It requires that equal consideration and coordination be given to conservation of fish and wildlife and to other water resource values during project planning involving water bodies larger than 10 acres (4 ha) in size. Federal agencies must assess the impacts of their planned activities on wildlife resources and modify project plans by justifiable means and measures to prevent loss or damage to those resources. Reports and recommendations prepared by these agencies are to document project effects on wildlife and identify measures that can be adopted to prevent loss or damage to wildlife resources. The most recent update of this act was prompted by the John D. Dingell, Jr. Conservation, Management, and Recreation Act (see below) in 2019 regarding Federal agencies’ response to invasive species. Until the Dingle Act, Federal invasive species policy was established by executive order, and is now managed “through the Fish and Wildlife Coordination Act...[by]the head or a representative of any other Federal agency the duties of whom require planning relating to, and the treatment of, invasive species for the purpose of protecting water and wildlife on land and coasts and in oceans and water.” Presumably, the result of the President’s executive orders effectively include the Department of Energy as one of the other agencies.

Bald Eagle Protection Act (1940)

The Bald Eagle Protection Act (16 USC 668–668d) of 1940 protects bald and golden eagles by prohibiting, except under certain specified conditions, the taking or possession of and commerce in such birds. (Although the short title of the act mentions only bald eagles, its provisions also apply to golden eagles.) The act imposes criminal and civil penalties on anyone who, unless exempted, takes, possesses, sells, purchases, barter, offers to sell, purchase, or barter, transports, exports, or imports at any time or in any manner a bald or golden eagle, alive or dead, or any part, nest, or egg of those eagles. “Take” means to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb. “Transport” means to convey or carry by any means or to deliver or receive for conveyance. The bald eagle has been listed as both endangered and threatened under the Endangered Species Act. The species was delisted in 2007; however, the protections of this Act remain in place.

Sikes Act (1960)

The Sikes Act (16 USC 670a–670o) of 1960 calls for cooperation with state fish and game agencies in planning and managing wildlife habitat on Federal lands. This act specifically mentions lands controlled by DOE in Part 670h. It states that the “Secretary of the Interior shall develop, with the prior written approval of the Atomic Energy Commission (AEC) [now the Department of Energy], a comprehensive plan for conservation and rehabilitation programs to be implemented on public land under the jurisdiction of the Chairman” of the AEC (now the Secretary of the DOE). “Each such plan shall be developed after the Secretary of the Interior

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makes, with the prior written approval of the Chairman ... and in consultation with the state agencies, necessary studies and surveys of the land concerned to determine where conservation and rehabilitation programs are most needed.” The act further states that “each comprehensive plan developed ... shall be consistent with any overall land-use and management plans for the lands involved.” Programs are to include, but not be limited to, specific habitat improvement projects and related activities that provide adequate protection for species of fish, wildlife, and plants considered threatened or endangered.

National Environmental Policy Act (1969)

The National Environmental Policy Act (NEPA) (42 USC 4321–4347) of 1969 declares that it is a national policy to encourage productive and enjoyable harmony between people and the environment, and to promote efforts to better understand and prevent damage to ecological systems and natural resources that are important to the nation. In the act, Congress stated that it is the continuing responsibility of the Federal government to use all practicable means to create and maintain conditions under which people and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations. NEPA requires all Federal agencies to consider the effects of their actions on the environment, employ an interdisciplinary process in decision making, and develop the means to ensure that unquantified environmental values are given appropriate consideration along with the economic and technical aspects of the actions. Thus, when DOE proposes an action, it must develop a NEPA document (e.g., categorical exclusion, environmental assessment, environmental impact statement) to consider the potential impacts. Hence, the activity conducted under this NRMP has site-specific categorical exclusions (ASO-CX-344 Habitat Maintenance Activities), and the plan itself is reviewed every three years. Compliance with several other wildlife and conservation acts (e.g., ESA, FWCA) is integrated into Argonne’s NEPA process.

Endangered Species Act (1973)

The purpose of the ESA (16 USC 1531–1544) of 1973 is to preserve plants and animal species facing extinction. It mandates the conservation of proposed and listed T&E species and the designated critical habitats supporting them. The act prohibits the harm, harassment, trade, or capture of endangered species and provides for the protection of both threatened species and those species that may become endangered. The USFWS maintains lists of designated T&E species in the Code of Federal Regulations Title 50 Part 17 (50 CFR 17), Endangered and Threatened Wildlife and Plants, and updates them as needed.

Section 7 of the ESA requires all Federal agencies to ensure that any action they authorize, fund, or carry out does not jeopardize the continued existence of a T&E species or result in the destruction or adverse modification of designated critical habitats that are important in conserving those species. The USFWS and National Marine Fisheries Service (NMFS) have established informal and formal consultation procedures in 50 CFR 402, Consultation by Federal Agencies, that implement this section of the act. If DOE proposes an action and if no previous NEPA documentation exists for the area involved for any alternative under consideration, a biological survey and evaluation might be required to determine whether any T&E species are or

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could be present. Initial consultation with the USFWS can take from 30 to 45 days. However, field surveys, if required, could extend over one year or more to identify seasonal issues. If a listed T&E species might be affected by the action, a detailed biological assessment of potential impacts can be prepared independently or concurrently with the NEPA document and included as an appendix to that document.

A biological opinion issued by USFWS at the conclusion of consultation can include a statement authorizing the taking of a T&E species that might occur incidentally to an otherwise legal activity. Section 7(a) of the act requires Federal agencies to use their authority to further the purposes of the act by carrying out programs to conserve listed T&E species. Section 9 lists actions that are prohibited under the act, including damaging or destroying endangered plants on Federal lands or taking a listed species.

Clean Water Act (1977)

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into U.S. waters and regulating quality standards for surface waters. Under the CWA, the U.S. Environmental Protection Agency (EPA) has implemented pollution control programs such as setting wastewater standards for industry and set water quality standards for all contaminants in surface waters. It also ensures that drinking water is safe and restores and maintains oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitats for fish, plants, and wildlife.

The CWA made it unlawful to discharge any pollutant from a point source into navigable waters without a permit. EPA's National Pollutant Discharge Elimination System (NPDES) permit program controls discharges. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.

Fish and Wildlife Conservation Act

The FWCA (16 USC 2901–2912) of 1980 is commonly known as the “Nongame Act.” The purpose of the act is to provide financial and technical assistance to states for the development, revision, and implementation of conservation plans and programs for nongame fish and wildlife. It encourages Federal agencies, such as DOE, to use their statutory and administrative authority to protect and promote the conservation of nongame fish and wildlife and their habitats. The USFWS shares responsibility for administering the FWCA with the NMFS in the Department of Commerce (NMFS is responsible only for marine species). Public Law 106-224 repealed Sections 2801-2813 on June 20, 2000.

Comprehensive Environmental Response, Compensation, and Liability Act

The purpose of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 USC 9601 et seq.)—also referred to as “Superfund”—is to clean up sites

contaminated by hazardous substance releases and ensure that the public is compensated for natural resource injuries caused by such releases. The act designates the President of the United States as the trustee on behalf of the public for Federally protected or managed natural resources. This responsibility has been delegated to Federal agencies, including DOE. (See discussion of Executive Order 12580, below.) The act defines “natural resources” as “land, fish, wildlife, biota, air, water, groundwater, drinking supplies, and other such resources.”

As a natural resource trustee for land it manages, the DOE has a broad responsibility for the natural resources under its jurisdiction. After notification or discovery of a natural resource injury, loss, or threat, DOE will take appropriate actions. These actions can include conducting a preliminary survey of areas affected by a discharge or release to determine whether natural resources are or might be impacted; cooperating with the on-scene coordinator/regional project manager in coordinating assessments, investigations, and planning; and carrying out a plan for restoration, rehabilitation, replacement, or acquisition of equivalent natural resources. DOE, as a natural-resource trustee, can assess damages “... for injury to, destruction of, or loss of natural resources ...” following a release of hazardous substances. Assessments are made on the basis of “residual” injury that was not or could not be addressed by the selected remedy.

Plant Protection Act (2000)

The Plant Protection Act regulates the control of plant pathogens and noxious weed introductions and populations. The Act is administered by the U.S. Department of Agriculture (USDA) and enforced by the USDA’s Animal and Plant Health Inspection Service. This broad legislation addresses the destructive impact that a wide array of organisms can have when introduced into an area. Further executive guidance for this Act is found in Executive Order 13751, Safeguarding the Nation from the Impact of Invasive Species, released in December of 2016.

Energy Independence and Security Act (2007)

The objective of the Energy Independence and Security Act (EISA) is to move the U.S. toward greater energy independence and security; increase the production of clean renewable fuels and the efficiency of products, buildings, and vehicles; promote research on and deploy greenhouse gas capture and storage options; improve the energy performance of the Federal government; increase U.S. energy security; develop renewable fuel production; and improve vehicle fuel economy. Section 438 of the Act addresses stormwater management for new buildings and impermeable surfaces. Areas of these features that are more than 5,000 square feet now must maintain or restore pre-development hydrology such that the new construction does not increase the amount of surface water entering into waterways. A guidance manual describes features and tools to address this rule, such as permeable pavement and bioswale enhancements.

John D. Dingell, Jr. Conservation, Management, and Recreation Act (2019)

The Dingell Act was the largest conservation bill in over a decade as of 2019. Many areas of national conservation interest were addressed, including additional conservation land, protections from land development and resource extraction, wildlife conservation, and recreation. The

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impact of this bill will benefit conservation interests for decades to come. Language that explicitly addresses the impact and control of invasive species by amending the Fish and Wildlife Coordination Act has a direct effect on Argonne and this plan. For the first time, control of invasive species on Federal land by land-holding agencies when those lands host invasive species is mandated by statute.

Other Laws and Regulations

DOE and its operating contractors are also subject to laws and regulations pertaining to radiation (e.g., Atomic Energy Act) and contaminants regulated under other laws (e.g., Resource Conservation and Recovery Act, Contaminated Substances Control Act) that are present on its lands as a result of past and continuing activities. Although this plan is not intended to deal with such issues, reference will be made where relevant to instances relating to natural resources.

Executive Orders, Policies, and Presidential Memoranda

Executive orders and presidential memoranda also provide direction to DOE in managing its lands. The following summaries cover those that pertain directly or indirectly to wildlife management. A guidance document, *Integrating Natural Resource Damage Assessment and Environmental Restoration Activities at DOE Facilities*, is available to help DOE program and field organizations understand and meet their natural resource trustee responsibilities.

Executive Order 11990: Protection of Wetlands

EO 11990, signed May 24, 1977 (published May 25, 1977, at 42 FR 269614), establishes wetland protection as the official policy of all Federal agencies. The order directs each agency to provide leadership “to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.” The executive order applies to Federally undertaken, financed, or assisted construction and improvements in or with significant impacts on wetlands. Agencies are to avoid adverse impacts on wetlands wherever there is a practicable alternative. Work conducted or funded by a Federal agency should not call for new construction in wetlands unless the head of the agency finds that there is both no practicable alternative to such construction and the proposed action includes all practicable measures to minimize damage to wetlands. In making this finding, the head of the agency can take into account economic, environmental, and other pertinent factors. Agencies are also required to provide for early public review of any plans or proposals for new construction in wetlands.

Under this executive order, DOE must preserve and enhance the natural and beneficial values of wetlands when (1) acquiring, managing, and disposing of its lands and facilities, (2) undertaking, financing, or assisting construction and improvements, and (3) conducting any activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

In carrying out the activities described above, DOE must consider a proposal’s effect on the survival and quality of the wetlands. The value of wetlands to be considered includes

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maintenance of natural systems, including conservation and long-term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, scientific uses, and fish, wildlife, timber, food, and fiber resources. DOE’s regulations implementing this executive order are found in 10 CFR 1022, Compliance with Floodplain and Wetland Environmental Review Requirements.

Executive Order 13112: Invasive Species and EO 13751 Safeguarding the Nation from the Impacts of Invasive Species

EO 13112, signed February 3, 1999 (published February 8, 1999, at 64 FR 6183), directs all Federal agencies to address invasive species concerns and refrain from actions likely to increase invasive species problems. The purpose of this executive order is to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts such species cause. Argonne’s Invasive Species Management Plan (Appendix E) implements this EO and interacts with this wildlife management plan to protect Argonne’s wildlife from the impacts of invasive species. This EO was amended on December 5, 2016, by EO 13751, Safeguarding the Nation from the Impacts of Invasive Species, to modernize and more clearly define Federal action. EO 13751 did not supersede the earlier order.

Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds

This executive order, signed January 10, 2001 (published January 17, 2001, at 66 FR 3853), requires Federal agencies—within existing budgets, missions, and responsibilities—to avoid or minimize the negative impact of their actions on migratory birds (see Migratory Bird Treaty Act summary earlier in this Appendix). Agencies must actively protect birds and their surroundings by, for example, restoring and enhancing habitat, preventing or abating pollution affecting birds, and incorporating migratory bird conservation into agency planning processes. A 2013 memorandum of understanding (MOU) commits DOE to cooperating with the USFWS to “substantially contribute to the conservation and management of migratory birds and their habitats.” It affirms DOE’s commitment to “[take] its environmental stewardship role seriously and [take] a proactive management stance toward the natural environment.”

The MOU details the individual and collective obligations of the DOE and the USFWS, as follows:

- Protect, restore, enhance, and manage habitats of migratory birds
- Promote collaborative inventorying, monitoring, management studies, research, and information exchange related to the conservation of migratory birds and management of their habitats
- Integrate migratory bird conservation principles, measures, and practices into agency activities
- Protect, restore, enhance, and manage habitats of migratory birds

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- Incorporate migratory bird habitat and population management objectives and recommendations into planning processes, including DOE site planning documents
- Recognize and promote the ecological, economic, and recreational values of migratory birds into outreach and educational materials and activities.

10 CFR 851, Worker Health and Safety Program

Federal agencies establish their own policies and regulations, published in the CFR. In 10 CFR 851, DOE establishes safe work conditions for contractors and their employees and requires contractors to develop structured safety approaches to work and facilities. Areas of concern include fire safety as well as such issues as construction safety and industrial hygiene. DOE Order 420.1C specifically addresses wildland fire safety requirements.

U.S. Department of Energy Orders

Order 430.1C Real Property

DOE Order 430.1C is intended to establish a data-driven, risk-informed, performance-based approach to the life-cycle management of real property assets that aligns the real property portfolio with DOE mission needs: to acquire, manage, positively account for, and dispose of real property assets in a safe, secure, cost-effective, and sustainable manner and to ensure that the real property portfolio is appropriately sized, aligned, and in the proper condition to support efficient mission execution. This Order, its history and predecessors, and its connection to all other related Federal statutes and mandates, show the Department's commitment to effective management of the nation's resources.

DOE O 420.1C, (Chg 3) Facility Safety

Facility Requirements, Chapter II, Section 3 Requirements, Part g. (page 30) Wildland Fire, of Order 430.1C states that facilities must prepare an integrated site-wide wildland fire management plan consistent with the Federal Wildland Fire Management Policy and in accordance with the relevant portions of NFPA 1143, Standard for Wildland Fire Management, and DOE-STD-1066 Federal Wildland Fire Management Policy.

Appendix D: Site Landscape Plant List

The Site Landscape Plant List below incorporates plant species native to DuPage County, Illinois, that are found at Waterfall Glen Forest Preserve and the Argonne site. These species are appropriate for capital improvement projects, decorative landscapes, and landscape screening, and are available from commercial nurseries. This selection is intended to identify native plant species that provide horticulture value, meet sustainable landscape specifications, and fulfill the intention of blending designs into the greater landscape. Landscape designs for projects may include non-native species not listed here if the non-native selection does not have invasive qualities or the potential to corrupt the integrity of native genotypes through hybridization. Final review and approval of a project planting design and species list must be obtained from the Argonne Natural Resources Manager for all projects.

Key * needs full sun ** tolerates partial shade/full sun *** tolerates full shade w tolerates wet soil

Grasses

<i>Andropogon gerardii</i> /big bluestem**	<i>Glyceria striata</i> /fowl manna grass**w
<i>Andropogon scoparius</i> /little bluestem**	<i>Hystrix patula</i> /bottlebrush grass**
<i>Bouteloua curtipendula</i> /sideoats grama*	<i>Juncus tenuis</i> /path rush*
<i>Cinna arundinacea</i> /common wood reed**	<i>Panicum virgatum</i> /switchgrass*
<i>Elymus canadensis</i> /Canada wild rye**	<i>Sorghastrum nutans</i> /Indian grass*
<i>Elymus virginicus</i> /Virginia wild rye**	<i>Spartina pectinata</i> /prairie cord grass*w
<i>Eragrostis spectabilis</i> /purple lovegrass*	<i>Sporobolus heterolepis</i> /prairie dropseed

Forbs

<i>Allium cernuum</i> /nodding wild onion**	<i>Eupatorium purpureum</i> /purple Joe Pye weed**
<i>Anemone cylindrica</i> /thimbleweed**	<i>Geranium maculatum</i> /wild geranium***
<i>Aquilegia canadensis</i> /wild columbine***	<i>Geum triflorum</i> /prairie smoke*
<i>Arisaema triphyllum</i> /jack-in-the-pulpit***	<i>Heliopsis helianthoides</i> /false sunflower**
<i>Asarum canadense</i> /wild ginger***	<i>Heuchera richardsonii</i> /alumroot**
<i>Asclepias incarnata</i> /swamp milkweed*w	<i>Hierochloa odorata</i> /sweet grass**w
<i>Asclepias tuberosa</i> /butterfly weed**	<i>Hydrophyllum virginica</i> /Virginia waterleaf***
<i>Athyrium filix-femina var. michauxii</i> /lady fern***	<i>Iris virginica var. shrevei</i> /blue flag iris**w
<i>Campanula americana</i> /tall bellflower**	<i>Lespedeza capitata</i> /round-head bush clover*
<i>Clematis virginiana</i> /virgin's bower***	<i>Liatris aspera</i> /rough blazing star*
<i>Coreopsis lanceolata</i> /sand coreopsis*	<i>Liatris pycnostachya</i> /prairie blazing star*
<i>Desmodium canadense</i> /showy tick trefoil**	<i>Lilium michiganense</i> /Michigan lily*
<i>Dicentra cucullaria</i> /Dutchman's breeches***	<i>Lobelia cardinalis</i> /cardinal flower**w
<i>Dodecatheon meadia</i> /shooting star**	<i>Lobelia siphilitica</i> /great blue lobelia**w
<i>Echinacea pallida</i> /pale purple coneflower*	<i>Lobelia spicata</i> /pale spiked lobelia*
<i>Echinacea purpurea</i> /purple coneflower**	<i>Monarda fistulosa</i> /wild bergamot**
<i>Eryngium yuccifolium</i> /rattlesnake master*	<i>Parthenium integrifolium</i> /wild quinine*
<i>Eupatorium maculatum</i> /spotted Joe Pye weed*w	<i>Penstemon digitalis</i> /foxglove beardtongue**
<i>Petalostemum candidum</i> /white prairie clover	<i>Solidago juncea</i> /early goldenrod*
<i>Petalostemum purpureum</i> /purple prairie clover*	<i>Solidago nemoralis</i> /grey goldenrod*

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Phlox divaricata/blue phlox***
Phlox pilosa var. *fulgida*/prairie phlox*
Physostegia virginiana var. *arenaria*/prairie obedient plant*
Physostegia virginiana var. *speciosa*/showy obedient plant**w
Podophyllum peltatum/May apple***
Polemonium reptans/Jacob's ladder**
Polygonatum canaliculatum/Solomon's seal***

Potentilla arguta/prairie cinquefoil*
Ratibida pinnata/yellow coneflower*
Rudbeckia hirta/black-eyed Susan**
Sanguinaria canadensis/blood root***
Silphium integrifolium deamii/rosinweed*
Silphium laciniatum/compass plant*
Smilacina racemosa/false Solomon's seal**

Shrubs:

Amorpha canescens/leadplant*
Baptisia leucantha/white wild indigo**
Ceanothus americanus/New Jersey tea**
Cornus obliqua/blue-fruited dogwood**w
Cornus sericea/stolonifera/red-osier dogwood**w
Corylus americana/American hazelnut*
Euonymus atropurpureus/wahoo***
Hamamelis virginiana/witch hazel***
Lindera benzoin/spicebush***w

Trees:

Carya cordiformis/bitternut hickory**
Carya ovata/shagbark hickory*
Cercis canadensis/redbud**
Crataegus coccinea/scarlet hawthorn**
Crataegus crus-galli/cockspur hawthorn**
Crataegus mollis/downy hawthorn**
Gymnocladus dioica/Kentucky coffee tree**
Malus ioensis/Iowa crab**

Solidago riddellii/Riddell's goldenrod*w
Solidago rigida/stiff goldenrod*
Solidago ulmifolia/elm-leaved goldenrod***

Symphotrichum ericoides/heath aster*

Symphotrichum laevis/smooth blue aster**
Symphotrichum lateriflorus/side-flowering aster***
Symphotrichum novae-angliae/New England aster**w

Symphotrichum oolentangiense/sky blue aster**
Symphotrichum shortii/Short's aster**
Tradescantia ohiensis/spiderwort*
Trillium grandiflorum/great white trillium***
Trillium recurvatum/red trillium***
Vernonia fasciculata/ironweed*w
Veronicastrum virginicum/culver's root**
Zizia aurea/golden alexanders**

Physocarpus opulifolius/ninebark**w
Rosa blanda/early wild rose*
Rosa carolina/pasture rose*
Rosa setigera/Illinois rose**
Sambucus canadensis/elderberry**w
Viburnum acerifolium/maple-leaved arrowwood**
Viburnum lentago/nannyberry*
Viburnum prunifolium/black haw**
Viburnum rafinesquianum/downy arrowwood**

Quercus alba/white oak*
Quercus bicolor/swamp white oak**
Quercus imbricaria/shingle oak**
Quercus macrocarpa/bur oak*
Quercus muhlenbergii/chinquapin oak
Quercus rubra/red oak**
Quercus velutina/black oak**

Appendix E: Argonne National Laboratory Invasive Species Management

Managing invasive species is inherent in this NRMP, as many invasive species degrade native natural systems. This section covers Argonne’s invasive species control measures in more depth than in the NRMP itself, as described in EOs 13112 and 13715. In 2008, the National Invasive Species Council (NISC) prepared the National Invasive Species Council Management Plan 2008–2012 for Federal facilities. This comprehensive work was adapted to the Argonne site, given other prevailing orders and directives, as of 2014. That plan and additional information from the NISC provide greater detail on these recommendations.

Argonne’s habitat management and invasive species control efforts have been evaluated under NEPA, and categorical exclusions (CXs) have been created that allow these control efforts with limitations (ASO-CX-344 Habitat Maintenance Activities and ASO-CX-345 Routine Grounds and Maintenance Activity). Because invasive species management must rely on local knowledge of the site and regions, the state of Illinois has developed management strategies through the Illinois Nature Preserves Commission (INPC). INPC’s *Vegetation Management Manual* has been integrated into Argonne’s invasive species management plan.

Argonne and the National Invasive Species Management Plan

The NISC Management Plan created a strategic framework in which Federal agencies can address the national problem of invasive species’ impacts on natural and human systems, as directed by EO 13715. The framework is adaptable to the local level for Federal facilities. Following are excerpts and adapted language of that document and others previously mentioned, as well as relevant language for more recent EOs on climate change and facility management.

Long-range strategic planning is necessary to address complex invasive species issues. The Argonne NRMP, modelled on the national plan, establishes five long-term and continuous strategic goals to focus Argonne National Laboratory’s efforts for invasive species control:

1. Prevention (P)
2. Early detection and rapid response (EDRR)
3. Control and management (CM)
4. Restoration (R)
5. Organizational collaboration (OC)

The ongoing strategic goals serve as guideposts for managing invasive species as noted below.

Prevention

Prevent introduction and establishment of invasive species to reduce their impact on the environment, economy and health. Addresses Goal 4 of the Natural Resources Management Plan.

Prevention is the first line of defense against invasive species and can also be the most cost-effective approach, because once a species becomes widespread, controlling it may require significant and sustained expenditures. Therefore, public investment in prevention tools, resources, and infrastructure is essential to protecting human health, agriculture, and natural resources. Long-term success in prevention will reduce the rate of introduction, the rate of establishment and the damage from additional invasive species. Measuring success requires accurate baseline data and monitoring systems to measure long-term trends. This will substantially contribute to the accomplishment of strategic goals and objectives.

Prevention is accomplished through examination and restriction of horticultural introductions with invasive histories and hybridization potential, field checking for new invasive or non-native species, communication with partners (state and local) through advisories on new invasive species, and targeted field control effort.

Early Detection and Rapid Response

Carry out Invasive Species Control/Integrated Pest Management Plan for identified populations throughout the site by developing and enhancing the capacity to identify, report and effectively respond to newly discovered/localized invasive species. Addresses Goal 2 of the Natural Resources Management Plan.

There are three components of EDRR: early detection (ED), rapid assessment (RA), and rapid response (RR).

Early detection (ED) is the first step: Invasive species populations must be found, specimens authoritatively identified, and the boundaries of the infestations determined. These essential efforts require resources, planning, and coordination.

Rapid assessment (RA) encompasses the actions necessary to determine the appropriate response, including the current and potential range of the invasive species' infestations. The RA process identifies the invasive species interdiction options, the timing and overall strategy for actions, and effective ways to provide reliable information to the public. Advance planning that anticipates species invasions and takes into account trans-jurisdictional issues greatly expedites efforts.

Rapid response (RR) is a systematic effort to eradicate or contain invasive species while infestations are still localized. RR may address new species introduced into a site or expanding infestations of previously established species. Speed is key to RR: It is critical to quickly mobilize intensive resources to control an infestation before it becomes widely established.

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Invasions can rapidly overwhelm local resources. The ability to share resources across jurisdictional boundaries, form strategic partnerships, and have ready access to plans, funds, and technical resources are essential for effective RR.

At Argonne, early detection is accomplished through annual field surveys of specific sections of the lab, with field ecologists recording species found within ecosystem management units. In addition, the entire lab is reviewed by the Natural Resources Manager. Rapid assessment starts with identification of the species and its known behavior in the region. We have the benefit of comprehensive flora lists for the Chicago region and a comprehensive invasive species identification network. Rapid response is conducted with contractors or an internal Grounds crew in order to quickly and effectively control new invasive species.

Control and Management

Carry out Invasive Species Control/Integrated Pest Management Plan for identified populations throughout the site by containing the spread and reducing the population of established invasive species to minimize their harmful impacts. Implements Goal 2 of the Natural Resources Management Plan.

A variety of control and management tools is used to assess, remove, and contain invasive species populations and guide management decisions. These tools are applied within coordinated and integrated invasive species management strategies that are adjusted as needed, though lack of financial and human resources often limits the capacity to control and manage invasive species. An integrated pest management approach, based on the best available scientific information, updated target population monitoring information, and the effectiveness of control methods, informs the selection and implementation of a range of complementary and environmentally sound technologies and methods to achieve the desired objective(s). These methods are described in detail in the NISC Management Plan.

Invasive species can span geographic and jurisdictional boundaries. Their control and management requires inter-jurisdictional communication and regionally coordinated action. Information on the distribution, abundance, rates of spread, and impact of invasive species is critical to their control. Eradication of widespread invasive species may not be feasible. Widespread invasive species are subject to control and management efforts that slow the rate of range expansion and lessen the impact of invasive populations.

There are several invasive species, such as buckthorn and honeysuckle, that have completed the full extent of invasion throughout the Argonne facility. The approach to these late-stage and complete infestations is to control and manage their population through attrition and restoring habitats after their removal. This fulfills Goal 2 of the Natural Resources Management Plan. There are many control approaches in this effort, but all must be long-term, continuous efforts in order to maintain a reduction in these invasive species populations.

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Restoration

Restore native species and habitat conditions and rehabilitate high-value ecosystems and key ecological processes that have been impacted by invasive species to meet desired future conditions. Implements Goals 1-3 of the Natural Resources Management Plan.

Restoration treatments to help guard against future re-infestations and further harm are an integral part of control and management efforts. Section 2(a) (2) of EO 13112 charges Federal agencies to “provide for restoration of native species and habitat conditions in ecosystems that have been invaded,” and Section 4 (d) of EO 13112 calls on NISC to provide guidance, in coordination with the Council on Environmental Quality (CEQ), “including the procurement, use and maintenance of native species as they affect invasive species.” New restoration guidance will be shared widely with Federal, tribal, state, and private landowners and water managers.

This plan recognizes the relationship between invasive species population control and habitat restoration. The control of one or several invasive species provides an opportunity for the settlement of new occupant species. Ideally, new species will match existing or historical native vegetation and habitat conditions. If desirable vegetation is not established, non-native invasive species are likely to re-invade. Habitat restoration is a dynamic endeavor, with many variables required for success. It is never a one-step process and will require several actions based on continuous action inputs and assessments. Such efforts are described in detail in the Land Management/Habitat Restoration (LMHR) program .

Organizational Collaboration

The Chicago area is host to a number of invasive species populations, and that number continues to grow. Federal facilities throughout the Chicago area also host a number of invasive species populations, so there are opportunities for area facility managers to collaborate with neighbors and other agencies. Although any one organization’s resources may be limited, research, information and data sharing, international cooperation, education and outreach, best practices, and inter-agency agreements are all ways to collaborate and maximize existing resources for prevention, early detection and rapid response, control and management, and restoration. Where Federal facilities border large areas under state, local, or non-government jurisdiction, invasive species may be impossible to manage in the absence of joint action.

Argonne’s invasive species effort coincides with the management of the surrounding Waterfall Glen Forest Preserve by the Forest Preserve District of DuPage County (FPDDC). Neither Argonne or the FPDDC can be successful without the success of the other, as nothing would keep invasive species from migrating from the less successful site to the more successful. Argonne works with the FPCDC on controlled burning, invasive species location information, and other cooperative efforts.

Control Options for Invasive Species at Argonne

Table E-1 below shows the methods used to control the various invasive species on the Argonne site and their effectiveness. Definitions of the terms and rankings used in the table follow.

Invasive Species

The term “invasive species” is often thought of as applying only to plants. Many other living organisms can be regarded as invasive, such as mammals, insects, fungi, microorganisms, aquatic organisms, and many more—the list is extensive. The invaders affect not only habitats but growth and regeneration processes, food chains, and any number of natural system processes that have established homeostasis. At any point in time a species introduced into a system can either exploit that system or be unable to survive in it. All of our invasive species have been able to exploit system functions. Some systems become stressed and are then defenseless against invasive species that exploit those systems. Habitats are functioning systems, and our most common invasive species are often plants that can exploit system resources in the absence of controls or are responding to system stresses, as in the case of habitat disturbance. In all cases, invasive species damage system processes and reduce system efficiency. In habitats, that means loss of biodiversity.

Significance

Argonne hosts both habitats and populations of invasive species typical of the Chicago area. The Illinois Nature Preserves Commission provides a list of known invasive species in the state, which we have adopted here as many occur in the Chicago area or are already on the Argonne site. Population significance at Argonne (see Table E-1) is classified as one of the following: not present, not significant, population stable, significant and expanding, or throughout the site.

- Species that are “not present” but known in the area should be sought on site for early detection and subsequent rapid response.
- Species that are “not significant” may be present but have reached a limitation in population expansion or have been controlled.
- “Stable populations” also have reached limitations, but may have a potential to expand. Species in this category may have a plus (+) or minus (–) qualifier indicating a likely expansion or reduction in population.
- “Significant and expanding” populations are invasive species that have not completely invaded all possible habitats but are expanding in that direction.
- Some species have reached the full extent of advance (i.e., are stabilized) and are found throughout the Argonne site in suitable habitats.

Control Rank

Most invasive species can be controlled through one or several options. There may be a most effective option that is best among a group of other variably effective options, and some options may be effective only under certain conditions. For instance, mechanical control is variably effective on autumn olive, but the stumps must be treated with an herbicide solution for the most effective control option. Mechanical control is typically integrated into a control option for

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autumn olive because, although herbicide is most effective, the herbicide application's effectiveness is diminished without mechanical effort. The six control options are ranked by three categories: most effective, conditionally effective, or ineffective.

Controls

The controls for most invasive species are well described in the literature. Table E-1 identifies the effectiveness of potential controls for selected invasive plant species found on the Argonne site.

- *Chemical control* is the use of a tested and approved substance for the control of a problem species. Controls are generally classified according to the group of organisms that they control and have the suffix “icide” attached to the classification word. For instance, an herbicide is effective at controlling plants and a fungicide is effective at controlling species of fungi. Rodenticide, insecticide, and miticides are all chemical controls for groups of species. Of all the controls, chemical applications have the greatest chance of adverse impacts to the environment. Integrated pest management, inherent in this plan, guides practitioners to use the most effective control possible that has the lowest impact on the environment.
- *Mechanical control* is the alteration of the physical structure of an organism. An example is the removal of the large parts, limbs, and branches of an autumn olive shrub and either grinding the stump or applying an herbicide to the remaining parts to control the specimen.
- *Biologic control* is the use of a living predator or pathogen to control a problem species. In most cases, the control comes from the same origin as the invasive species to be controlled and does not occur in the new range. Purple loosestrife, for example, can be controlled by use of a beetle species that consumes parts of the plants, limiting the plant's expansion.
- *Herbivory* is the use of an animal herd to control an invasive species. In most instances, it is only somewhat effective; its most effective use is situations in which the invasive species' range is naturally controlled by herbivory.
- *Prescribed fire* (controlled burning) is the burning of natural fuels to control invasive plant species that are not adapted to fire. The tool is very effective on species that invade habitats that have a history of fire in their development. Most habitats in the Chicago area experienced fire often enough over the millennia that their species composition has developed resilience to fire. Therefore, prescribed fire can be effective for invasive species control without harm to habitats.

Invasive species become costly problems in the absence of identification, assessment, and action, as demonstrated by the significant and increasing number and population of invasive species. The control alternative of taking no action has thus demonstrated its impact. The NEPA charges all Federal agencies to consider “no action” as an alternative to determine whether taking an action has a greater (unintended) adverse impact on the environment than no action. Overall, “no action” will usually result in an ever-more-costly impact on the environment. However, each

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control option must be evaluated at the individual project level—location, characteristics, and invasive species present—to determine the best control option.

Table E-1. Control of Invasive Plant Species at the Argonne Site

Control Matrix	Argonne Site Significance					Control Options							
	Species	Not Present	Not Significant	Population Stable (+/-)	Significant and Expanding	Throughout	Ranking: 1–Most Effective, 2– Conditionally Effective, 3– Not Effective						Notes
							Chemical	Mechanical	Biologic	Fire	Herbivory	No Action	
ALKALI GRASS				x									
ALSIKE CLOVER				x									
AMUR CORK TREE		x											
AMUR HONEYSUCKLE				x									
AMUR MAPLE		x											
ANNUAL BLUE GRASS		x											
APPLE		x											
ASPARAGUS		x											
AUSTRIAN PINE		x											
AUTUMN OLIVE		x				1	2	3	2	2	3		
BEGINNER'S PONDWEED		x											
BIRD'S FOOT TREFOIL				x									
BITTER DOCK		x											
BITTERSWEET NIGHTSHADE			x										
BLACK BINDWEED			x										
BLACK LOCUST				x		1	1	3	2	3	3		
BLACK MEDICK			x										
BLACK MUSTARD			x										
BLACK SWALLOWWORT		x											
BLADDER CAMPION		x											
BORDER PRIVET		x											
BOUNCING BET		x											
BRADFORD CALLERY PEAR				x		1	2	3	2	2			
BRISTLY FOXTAIL		x											
BROOM-CORN MILLET		x											
BROWN KNAPWEED		x											
BULL THISTLE			x										
BURNING BUSH				x									
BUTTER-AND-EGGS		x											
BUTTERWEED		x											
CANADA BLUEGRASS				x									
CARPET WEED		x											
CATNIP			x										
CHICORY					x								
CHINESE CUP GRASS		x											
COCKLEBUR			x										
COMMON BUCKTHORN			x		x	1	2	3	1*	2	3	*Effective on seedlings	
COMMON BURDOCK			x										

NATURAL RESOURCES MANAGEMENT PLAN, 2021–2024

Control Matrix		Argonne Site Significance					Control Options									
Species		Not Present	Not Significant	Population Stable (+/-)	Significant and Expanding	Throughout	Ranking: 1–Most Effective, 2– Conditionally Effective, 3– Not Effective									
							Chemical	Mechanical	Biologic	Fire	Herbivory	No Action	Notes			
COMMON CHICKWEED				x												
COMMON COMFREY			x													
COMMON DANDELION						x										
COMMON DAY FLOWER			x													
COMMON FLAX			x													
COMMON FLY HONEYSUCKLE					x											
COMMON GOAT'S BEARD			x													
COMMON GROUNDSEL			x													
COMMON KNOTWEED				x												
COMMON MALLOW			x													
COMMON MULLEIN				x												
COMMON ORACH				x												
COMMON PLANTAIN				x												
COMMON PRIVET					x											
COMMON SOW THISTLE				x	x											
COMMON ST. JOHN'S WORT				x												
CORALBERRY					x											
CORN			x													
CORN SPEEDWELL			x													
CRACK WILLOW			x													
CREEPING CHARLIE				x												
CREEPING SMARTWEED				x												
CROWN VETCH					x		1	2	3	2*	2	3				*Useful to burn off duff
CURLY DOCK				x												
CUT-LEAVED TEASEL					x		2	1	3	3	3	3				Two species in area
DAFFODIL			x													
DAHURIAN BUCKTHORN			x													
DAME'S ROCKET				x +			1	1*	2	1	2	3				*For basal rosettes
DEPTFORD PINK			x													
DOG FENNEL			x													
DOG ROSE			x													
DOWNY BROME					x											
DUTCH MICE			x													
EARLY SPIREA			x													
ENGLISH PLANTAIN						x										
EUROPEAN Highbush CRANBERRY				x												
EUROPEAN SPINDLE TREE			x													
EUROPEAN WATER MILFOIL			x													
EXPRESSWAY ASTER					x											
FALSE REDTOP			x													
FIELD BINDWEED				x												
FIELD CRESS				x												

NATURAL RESOURCES MANAGEMENT PLAN, 2021–2024

Control Matrix	Argonne Site Significance					Control Options							
	Species	Not Present	Not Significant	Population Stable (+/-)	Significant and Expanding	Throughout	Ranking: 1–Most Effective, 2– Conditionally Effective, 3– Not Effective						Notes
							Chemical	Mechanical	Biologic	Fire	Herbivory	No Action	
FIELD HAWKWEED			x										
FIELD SORREL		x											
FIELD THISTLE				x									
FLOWER-OF-AN-HOUR		x											
FRINGE TREE			x			1	1		2	2	3		
GARDEN SUNFLOWER		x											
GARLIC MUSTARD				x		2	1*	3	1	3	3	*For basal rosettes	
GIANT FOXTAIL			x										
GIANT GREEN FOXTAIL		x											
GLOSSY BUCKTHORN				x									
GREAT BURDOCK			x										
GREEN FOXTAIL			x										
HAIRY CRAB GRASS		x											
HAIRY WILLOW HERB		x											
HARDY CATALPA				x									
HELLEBORINE ORCHID		x											
HORSE NETTLE			x										
HUNGARIAN BROME					x								
INDIAN STRAWBERRY		x											
ITALIAN RYE GRASS		x											
JAPANESE BARBERRY				x									
JAPANESE CHESS				x									
JAPANESE CRAB			x	x									
JAPANESE HEDGE PARSLEY		x											
JAPANESE HONEYSUCKLE				x		2	2	3	3	2	3		
KENTUCKY BLUEGRASS			x			1	3		3	3	3		
LADY'S THUMB			x										
LAMB'S QUARTERS			x										
LESSER SALT SPURRY		x											
LILY-OF-THE-VALLEY				x									
LITTLE-LEAVED LINDEN		x											
LIVE-FOREVER		x											
MAXIMILIAN SUNFLOWER		x											
MEADOW FOXTAIL			x										
MONEYWORT			x +			1	3	3	2	3	3		
MOTHERWORT			x										
MOUSE-EAR CHICKWEED			x										
MUGWORT				x									
MULBERRY			x			1	2	3	2	2	3		
MULTIFLORA ROSE			x +			1	2	3	2*	3	3	*Effective on seedlings	
MUSK THISTLE		x				1	2	2	2	3	3		
NORWAY MAPLE			x										
OATS		x											

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Control Matrix	Argonne Site Significance					Control Options							
	Species	Not Present	Not Significant	Population Stable (+/-)	Significant and Expanding	Throughout	Ranking: 1–Most Effective, 2– Conditionally Effective, 3– Not Effective						Notes
							Chemical	Mechanical	Biologic	Fire	Herbivory	No Action	
ORANGE DAYLILY			x										
ORCHARD GRASS			x		x	1	3	3	3	3	3		
ORIENTAL BITTERSWEET				x		1	2	3	2*	3	3	*Effective on seedlings	
ORNAMENTAL PEAR				x									
OSAGE ORANGE			x			1	1	3	2	2	3		
OX-EYE DAISY					x								
PENNY CRESS			x										
PERENNIAL RYE GRASS		x											
PINEAPPLE WEED		x											
PRICKLY LETTUCE			x										
PURPLE LOOSESTRIFE				x									
PURSLANE		x											
QUACK GRASS			x										
QUEEN ANNE'S LACE					x								
RED CLOVER			x										
REDTOP			x										
REED CANARY GRASS				x									
ROUGH BLUE GRASS		x											
ROUGH DROPSEED		x											
SALT SPURREY		x											
SALT-MEADOW GRASS			x										
SEA BLITE		x											
SEASIDE GOLDENROD				x									
SHEEP FESCUE		x											
SHOWY CENTAURY		x											
SHOWY FLY HONEYSUCKLE		x											
SIBERIAN CRAB		x											
SIBERIAN ELM				x									
SIDEWALK KNOTWEED		x											
SMALL SNAPDRAGON		x											
SMOOTH ARROWWOOD				x									
SMOOTH CRAB GRASS			x										
SORGHUM		x											
SPEARMINT		x											
SPINY SOW THISTLE			x										
SQUIRREL-TAIL GRASS					x								
STORE-FRONT SOW THISTLE		x											
SWEET GUM				x									
SWEET WORMWOOD		x											
SWEETBRIER		x											
TALL BUTTERCUP		x											
TALL FESCUE			x +			1	2	2	3	2	3		
TALL YELLOW IRIS		x											

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Control Matrix	Argonne Site Significance					Control Options							
Species	Not Present	Not Significant	Population Stable (+/-)	Significant and Expanding	Throughout	Ranking: 1–Most Effective, 2– Conditionally Effective, 3– Not Effective							
						Chemical	Mechanical	Biologic	Fire	Herbivory	No Action	Notes	
THYME-LEAVED SANDWORT		x											
THYME-LEAVED SPEEDWELL		x											
TIMOTHY			x										
TOOTHED SPURGE		x											
TREE OF HEAVEN				x									
TRUMPET CREEPER		x											
TUMBLEWEED		x											
TURNIP		x											
TURQUOISE BERRY		x											
UPRIGHT CINQUEFOIL			x										
VELVETLEAF			x										
WASHINGTON HAWTHORN		x											
WATER CHICKWEED		x											
WAYFARING TREE		x											
WHEAT		x											
WHITE CAMPION		x											
WHITE CLOVER			x										
WHITE MULBERRY			x	x									
WHITE MUSTARD		x											
WHITE POPLAR		x											
WHITE SWEET CLOVER			x	x									
WHITE WILLOW		x											
WILD FOUR O'CLOCK		x											
WILD PARSNIP				x									
WILLOW LETTUCE			x										
WISTERIA		x											
WOOD BLUE GRASS		x											
YARROW			x										
YELLOW FOXTAIL			x										
YELLOW ROCKET			x										
YELLOW SWEET CLOVER			x	x									
YERBA DE TAJO		x											

Adaptive Management and Integrated Pest Management

Learning from the results of processes enables us to refine those processes to increase their effectiveness and efficiency and guard against accidents and catastrophe. Applying this adaptive management (Figure E-1) approach to invasive species problems can be very effective. We have a substantial amount of information about invasive species and effective control techniques (as shown in Table E-1); however, with every new invasive species and increasing costs, new and improved methods are vital to an improved control operation.

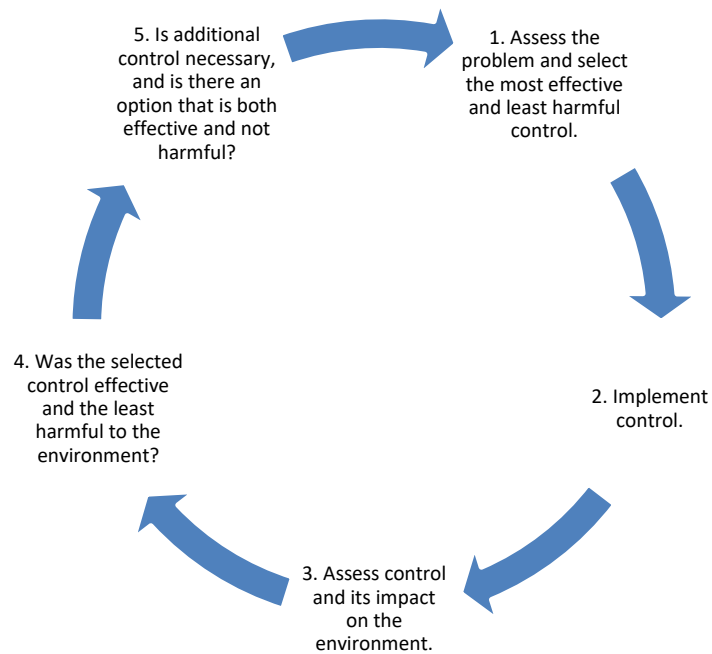


Figure E-1. Invasive Species Adaptive Management



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