Final Restoration Design/Restoration Action Plan for Kirvin Memorial Park, Pittsfield MA

Williams Street, Pittsfield Massachusetts

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Prepared for General Electric Company
Pittsfield, Massachusetts

AECOM

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I. Pollinator Habitat Information

ABBREVIATIONS

ARAR	Applicable or relevant and appropriate requirement
BFE	Base Flood Elevation
BMP	Best management practice
CD	Consent Decree
CGP	EPA NPDES Construction General Permit
CWM	Coarse woody material
DEM	Digital Elevation Model
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	FEMA Flood Insurance Rate Map
FIS	FEMA Flood Insurance Study
GE	General Electric Company
GPS	Global Positioning System
IPaC	Information, Planning, and Consultation System (of the USFWS)
LiDAR	Light Detection and Ranging
MassDEP	Massachusetts Department of Environmental Protection
Mass GIS	Massachusetts Geographic Information Service
MEPA	Massachusetts Environmental Policy Act
MESA	Massachusetts Endangered Species Act
MHC	Massachusetts Historical Commission
MIPAG	Massachusetts Invasive Plant Advisory Group
MNHESP	Massachusetts Natural Heritage and Endangered Species Program
NAVD 1988	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
ROR	Rest of River
SOW	Statement of Work for Removal Actions Outside the River
USACE	U.S. Army Corps of Engineers
USDA NRCS	U.S. Department of Agriculture Natural Resource Conservation Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1.0 Introduction and Overview

1.1 Introduction and Background

On behalf of the General Electric Company (GE), AECOM has prepared this Final Restoration Design/Restoration Action Plan (Restoration Plan) for the implementation of natural resource restoration/enhancement activities in the Housatonic River watershed in accordance with Paragraph 118.e of the Consent Decree (CD) for the GE-Pittsfield/Housatonic River Site and Section 5 of Technical Attachment I of the Statement of Work for Removal Actions Outside the River (SOW), which is Appendix E to the CD. Those provisions of the CD and SOW require GE to install and monitor a total of approximately 12 acres of forested/wetland habitat, consisting of approximately 9.75 acres of floodplain forest habitat and 2.25 acres of freshwater palustrine wetlands, within a non-contaminated riparian area within the Housatonic River watershed outside of the CD Site.[1] Section 5 of Technical Attachment I of the SOW sets forth a number of specific Performance Standards and other requirements for the creation of these habitats at the selected off-site restoration area. It states further that, after selection of the off-site restoration area, technical details regarding existing conditions in that area and specific design parameters and habitat restoration/enhancement techniques will be provided in a Restoration Design/Restoration Action Plan.

Based upon a June 2019 site selection assessment prepared by the Massachusetts Department of Environmental Protection (MassDEP) on behalf of the Housatonic River natural resource trustees (Trustees) (MassDEP 2019) and preliminary reviews and discussions among the Trustees, the City of Pittsfield (the City), and GE, a portion of Kirvin Memorial Park in Pittsfield was selected as the site for these restoration/enhancement activities. The Trustees met with the Pittsfield Conservation Commission on January 16, 2019, and the Commission indicated that it is open to the possibility of hosting the restoration project on this site. Representatives from the City, the Trustees, and GE met at the site on April 20, 2021 to conduct a preliminary site review. Subsequently, GE directed AECOM to conduct additional site evaluations and prepare a preliminary conceptual restoration/ enhancement plan to facilitate further discussions among the Trustees, GE, and the City. That preliminary conceptual restoration plan was submitted to the Trustees in August of 2021 (AECOM 2021). Based on direction from the Trustees, work plans were developed between March and July of 2022 to define additional baseline investigations needed to evaluate and support the preparation of further iterations of the restoration plan. With the approval from the Trustees of those pre-design investigations, more detailed field investigations occurred from spring through fall of 2022, and additional research was conducted in support of the restoration planning. On November 1, 2022, GE

[1] The CD and SOW also gave GE the option of creating a portion of this habitat at Former Oxbow Areas A and C. GE previously elected not to utilize that option.

and AECOM gave a presentation to the Trustees summarizing the investigations conducted up to that point, the results obtained, and an update on the development of the restoration plan with discussion of specific restoration components, including removal of buckthorn and other invasive woody plants in the floodplain, grading to promote the creation and enhancement of wetlands, and revegetation of subject areas.

Based on positive feedback from the Trustees, GE submitted an updated Conceptual Restoration Plan on January 31, 2023 (AECOM 2023). On February 21, 2023, GE and AECOM gave another presentation to the Trustees and the City of Pittsfield to summarize the updated Conceptual Restoration Plan. The Trustees provided comments on the updated Plan on June 26, 2023. These comments included a question regarding the need for obtaining permits for the project. Following discussions and communications among GE, the U.S. Environmental Protection Agency (EPA), and the Trustees, it was agreed that, in accordance with Paragraph 9.a of the CD, permits would not be necessary,[2] but that GE would be required to comply with the substantive provisions of applicable or relevant and appropriate requirements (ARARs) for the project. On March 18, 2024, GE submitted to the Trustees a table of federal and state ARARs for the project, including a description of the actions to be taken to achieve the substantive provisions of those ARARs. In a May 10, 2024 email, the Trustees indicated concurrence with that ARARs table, subject to a number of conditions. Those conditions included the following:

- GE should develop a written outreach plan to make the community aware of the project, to address public input on project design, and to provide notice to the abutters of affected properties. In this regard, the Trustees requested that the outreach plan follow protocols required under the Massachusetts Environmental Policy Act (MEPA) – namely, the MEPA Public Involvement Protocol for Environmental Justice Populations, effective January 1, 2022.
- To comply with the Massachusetts Endangered Species Act (MESA), GE should conduct additional monitoring for potential state-listed rare species at the project site, including not only the species listed in the Restoration Plan, but other potential state-listed rare species that may be in the vicinity of the project site.
- The Trustees noted that they will need to review and approve the Restoration Design Plan and all best management practices (BMPs) to control stormwater, erosion, and sedimentation and, if any

[2] Paragraph 9.a of the CD provides that "no permit shall be required for any portion of the Work conducted entirely on-site." Further, it clarifies that "[a]ny measures performed pursuant to Paragraphs 118 and 123 . . . shall be considered on-site for purposes of this provision." The "Work" (as defined on Paragraph 4 of the CD) includes all activities that GE is required to perform under the CD. This includes the installation of forested/wetland habitat at an Off-Site Restoration Area (now Kirvin Park), which is required by Paragraph 118.e of the CD. Thus, under Paragraph 9.a of the CD, that activity is part of the "Work" and is to be considered "on-site," and therefore no permit is required.

cultural resources are detected, any BMPs related to avoiding and/or limiting impact on those resources. The Trustees also requested that the City of Pittsfield (including the Pittsfield Conservation Commission) have the opportunity to review and approve the final Restoration Design Plan.

- Finally, the Trustees noted that the U.S. Fish and Wildlife Service (USFWS) will conduct additional outreach to tribal entities in the vicinity to ensure that they are aware of the project and to see whether they wish to be involved.

On May 21, 2024, GE provided the Trustees with a matrix summarizing the approach that GE proposed to take in response to the Trustees' comments on the January 2023 Restoration Plan. On June 17, 2024, the Trustees responded via email indicating acceptance of most of the responses, but also adding two additional comments/questions:

- The Trustees requested that GE's consultant (AECOM) be available to assist at any public meetings (which the Trustees would host).
- The Trustees requested that GE provide additional information regarding the planting of trees in the restoration area (including a map and information on density), and they recommended that GE discuss with the City of Pittsfield whether there are additional locations at Kirvin Park, or elsewhere, where trees could be planted.

In response to the Trustees' recommendation, GE discussed with the City the potential for planting in additional areas at Kirvin Park. Specifically, although the City had previously expressed the desire to maintain the open, recreational area north of Sacket Brook as an open area, GE inquired again whether the City would be agreeable to the planting of trees in a portion of that area east of the existing athletic fields. The City indicated that it would be agreeable to that, so long as the tree species are suitable for the type of soil there, which includes a wet meadow. In addition, at the Trustees' request, GE conducted a preliminary evaluation of the potential for creating an additional nesting area at the site for wood turtles (a state-listed rare species).

A Revised Conceptual Restoration Plan was then developed to address the Trustees' comments and suggestions on the prior draft plan, including their communications of June 26, 2023, May 10, 2024, and June 17, 2024, as well as the City's agreement to plant trees in an area north of Sackett Brook (AECOM 2024). In addition, as directed in the Trustees' May 10, 2024 email, that Revised Plan included a Community Outreach Plan. The Revised Conceptual Restoration Plan was submitted to the Trustees (and the City) on September 13, 2024, and a presentation was made to the Trustees and the City on November 12, 2024 to summarize the Plan. That presentation included a showing that there would be increased flood storage volume at the site (on a foot-by-foot incremental elevation basis) after implementation of the restoration plan. On December 10, 2024, the Trustees conditionally approved the Revised Conceptual Restoration Plan. Five conditions were specified in that approval:

- The Trustees directed GE to calculate the amount of soil to be removed and added to the site (cut/fill balance) as part of the restoration work and to describe the process for testing any soils that will be re-used or disposed of off-site as part of the restoration project.
- GE was directed to provide ample time for the Trustees and the City to review and comment on all remaining phases of design and associated reports.
- GE was directed to participate in a public meeting to discuss the project with the public prior to finalizing design plans and to assist the Trustees and City in responding to any comments.
- GE was directed to work with the City to determine whether a "no-rise" analysis under regulations of the Federal Emergency Management Agency (FEMA) (showing that the project would not result in any increase in flood elevation) is needed for the restoration project.
- The Trustees noted that GE, in coordination with Trustees and the City, would determine the preferred construction access and staging areas in advance of the public meeting.

GE responded to this conditional approval with additional analyses culminating in a submission to the Trustees (and City) on April 1, 2025 proposing certain plan updates. These updates included: (1) the elimination of any southern access to the site, such that only access from the north (off of Williams Street) will occur, following the existing cart path to the northern side of Sackett Brook; (2) construction of a temporary timber mat crossing of Sackett Brook; (3) use of the south staging area for re-grading of excavated soil material from the wetland creation area; and (4) the creation of a pollinator meadow habitat in the south staging area as a further habitat enhancement measure on the site.

On May 1, 2025, GE conducted a site review with the Trustees and the City to review the plan updates described in the April 1, 2025 submittal. During that site review, GE confirmed with the City that, given GE's prior showing that there would be increased flood storage on the site after implementation of the restoration plan, there is no need for a formal "no-rise" analysis. On May 7, 2025 GE provided a summary of the May 1 site review. On May 12, 2025, the Trustees noted their intent to provide for a 30-day public comment period during the review of the final restoration plan.

Community outreach on the proposed restoration plan progressed in May and June of 2025. A public meeting was scheduled for June 11, 2025 and abutters were notified of this meeting by mail on May 30, 2025. The Trustees established a website on June 2, 2025 to announce the meeting as well as to provide project background information.[3] The public meeting took place on June 11, 2025 and included a detailed slide presentation on the proposed restoration plan followed by a question and answer period. The Trustees posted the meeting presentation on their website along with a recording of the public meeting.

In the meantime, on March 11, 2025, GE reviewed the restoration plan with the Massachusetts Natural Heritage and Endangered Species Program (MNHESP) of the Massachusetts Division of Fisheries and Wildlife to discuss the inclusion of a wood turtle nesting area at the site. On March 13, 2025, MNHESP responded that it saw value in that concept and did not see any significant concerns with the proposal for creation of wood turtle nesting habitat. MNHESP noted that more than one nesting area would be preferred, and that timing of machine-based construction work on the site should be restricted to the November to March period to avoid impacts to the wood turtle. While GE agreed to consider that time-of year restriction, it responded on March 18, 2025, requesting consideration of a wood turtle construction-phase management plan that may allow for work on the site outside of the November to March time period. Further review and discussion of these issues are ongoing, as discussed further in this plan.

Based on the collective input from the Trustees, the City, MNHESP, and the public from the events described above, this Final Restoration Design/Restoration Action Plan (Final Restoration Plan) has been prepared.[4] It includes in **Appendix A** an updated ARARs table (reflecting developments since the Revised Conceptual Restoration Plan) and in **Appendix B** an updated Community Outreach Plan.

1.2 Overview

Kirvin Park is located south of Williams Street in the southeastern corner of Pittsfield, Massachusetts. The park itself encompasses 226 acres, roughly one-fourth of which is open field parkland in the northern part, with the remainder consisting mostly of forested habitat extending south into the lower parts of Washington Mountain. A residential neighborhood borders the park to the southeast. The proposed restoration area is situated primarily south and east of two perennial stream systems, Sackett Brook and Ashley Brook, which flow east to west and south to north across the site, respectively (**Figure 1-1**). Specifically, the primary portion of Kirvin Park selected for the restoration/enhancement activities consists of an area south of Sackett Brook and east of Ashley Brook (referred to as the restoration area), as shown on **Figure 1-2**. In addition, following discussion with the City, a separate area north of Sackett Brook and east of the existing athletic fields will be

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[3] https://www.mass.gov/info-details/kirvin-park-floodplain-and-wetland-restoration.

[4] For completeness, this Final Restoration Plan incorporates large portions of the Revised Conceptual Restoration Plan that have not changed since its submission and were approved by the Trustees via its December 10, 2024 conditional approval.

used for the planting of certain additional trees (referred to as the supplemental tree planting area), and an area at the southern end of the restoration area will be incorporated into the habitat enhancement measures as a pollinator habitat, as also shown on **Figure 1-2**.

As a result of the presence of Sackett and Ashley Brooks, a large area of Kirvin Park is situated in a riparian/floodplain setting. Despite this suitable setting, much of the floodplain riparian zone south of Sackett Brook is heavily dominated by invasive plant species, which collectively impair the overall habitat diversity and ecological functions of this site (see **Appendix C** for site photographs). In particular, large portions of the site are dominated by the invasive shrub/small tree common buckthorn (*Rhamnus cathartica*), forming in many areas a dense monoculture which has been expanding on the site over the past several decades. In addition to buckthorn, there are several other primary invasive species that warrant control efforts at the site, notably Morrow's honeysuckle (*Lonicera morrowii*), Asian bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*), garlic mustard (*Allaria petiolata*), and bishop's goutweed (*Aegopodium podagraria)*. These species substantially impact the ecological integrity and functions of the floodplain community at the Kirvin Park site.[5] Accordingly, a primary objective of the proposed restoration/enhancement program is to convert the existing invasive vegetative cover to a plant community dominated by a diverse assemblage of native (or indigenous) floodplain/wetland/riparian zone plant species. Coincident with this primary objective of habitat enhancement through plant species diversification, wetland resource enhancement will be further accomplished by expanding the area of wetland at the restoration area, and a two-acre pollinator meadow habitat will be created at the southern end of the restoration area.

To accomplish the invasive species control objectives, extensive background research has been conducted on the most abundant invasive species at the site to understand their life histories and develop management strategies with the highest potential for success in ecological restoration; this is particularly focused on the dominant invasive species at the site, common buckthorn (see **Appendix D**). In addition, based on comments from the Trustees in 2022, additional site investigations were conducted incorporating agreed-upon survey methodologies during the 2022 field season to provide a more detailed assessment of baseline conditions at the proposed Kirvin Park wetland and floodplain restoration area. Additional data to support the restoration plan were also collected in 2023 and into 2025 (e.g., groundwater data, rare species habitat monitoring). This Final Restoration Plan details results of these 2022-2025 field investigations and provides an updated floodplain and wetland creation/restoration plan with proposed topography, planting schedule, and invasive species control

[5] The supplemental tree planting area north of Sackett Brook does not contain a similar proliferation of invasive plant species. It consists primarily of an open meadow habitat.

and monitoring programs. In addition, it provides details on the purpose of and methods for establishing the pollinator meadow habitat.

1.3 Format and Scope of Restoration Plan

This Final Restoration Plan is formatted to first provide detailed descriptions of the background and field investigations conducted in support of developing the restoration plan.[6] Section 2 presents the methods and results of these investigations, resulting in descriptions of the site's land use history, geology, soils, topography, surface waters and floodplain, wetlands, plant communities, invasive species, rare species, and cultural resources. This information has formed the foundation to determining the approach and ultimately the details for site restoration. Section 3 provides the overall objectives of the restoration plan, based on the Performance Standards established in Section 5 of Technical Attachment I to the SOW (referenced above). Sections 4 and 5 then present the details of the restoration of the floodplain and wetland components of the project, respectively; and Section 6 provides details regarding the creation of pollinator meadow habitat. Construction-phase management and post-construction monitoring and maintenance are described in Section 7, with the latter based on the Performance Standards in Section 8 of SOW Attachment I. Section 8 outlines the next steps for selecting a construction contractor and progressing toward construction of this restoration project. In addition, the actions to be taken to meet the substantive provisions of the ARARs for this project are specified in the updated ARARs table in **Appendix A**.

[6] As noted above, much of the information in this Final Restoration Plan was previously presented in the approved Revised Conceptual Restoration Plan, but is repeated for completeness.

2.0 Site Investigations and Ecological Characterization

A variety of investigations have been conducted over the past several years to develop both background information and current ecological data on the Kirvin Park site. This includes the preliminary investigations conducted by MassDEP on behalf of the Trustees (MassDEP 2019). Those investigations included the compilation of a wide variety of assessment factors derived from both background data collection and site reviews, and also included discussions with the City. During the 2021 growing season, AECOM conducted site investigations which included a preliminary wetland delineation and vegetative inventories in preparation of the initial conceptual restoration plan in August of 2021 (AECOM 2021). Background information reviewed and incorporated into the understanding of the site and used in developing the current conceptual plan has included reviews of historical aerial photographs (since 1960) and U.S. Geological Survey (USGS) topographic mapping (since the 1880s), and reviews of MassGIS mapping and data on a wide variety of natural resource conditions.

To contribute to the ecological characterization of the site for developing a restoration plan, a total of seven site visits to the Kirvin Park proposed wetland and floodplain restoration area were conducted during the 2022 field season. Surveys began in late April and early May 2022 with four site visits to delineate wetland boundaries, map soil conditions, and install monitoring wells, followed by two site visits in August to conduct plant inventories and map natural plant communities, with a final inspection in December 2022 to collect additional field data needed for the restoration area design. These field surveys included the following components:

- A detailed delineation of wetlands and watercourses in accordance with the US Army Corps of Engineers' (USACE) 1987 Corps of Engineers Wetland Delineation Manual (USACE Environmental Laboratory 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions (USACE 2012);
- Inspection of soil profiles along 200-foot long transects perpendicular to the topographic gradient to demarcate limits of soil series mapping units as described by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS);
- Plant inventory and cover type mapping through both qualitative and quantitative means using most recently available (2021) aerial photographs from MassGIS, ground-truthing with a Global Positioning System (GPS), and inspection of randomly placed vegetation monitoring plots established throughout the site; and
- Installation of three shallow groundwater monitoring wells within the limits of the proposed wetland restoration area to collect data on groundwater levels throughout the growing season using pressure transducer dataloggers installed in each well.

Additional site visits occurred during 2023-2025 for various data collection purposes. Several site visits occurred in 2023 to review and confirm site conditions, such as to observe the status of beaver activity and the regrowth of wetland vegetation following drawdown after beaver dam breaching (described in Section 2.7), and to download groundwater monitoring data. Similar visits occurred several times in 2024, including a visit on May 30, 2024 to download water-level data from the transducers in the monitoring wells, and on several other dates to conduct surveys for state-listed species (particularly wood turtle activity). In November 2024, a site review was conducted with a local contractor to consider site access options. Site visits continued into 2025, again to download groundwater monitoring data as well as to document conditions along Sackett Brook for purposes of considering temporary crossing options and to obtain information for establishing the pollinator habitat at the southern end of the restoration area. A site review was conducted on May 1, 2025 with the City and the Trustees to review all components of the plan in preparation for finalizing the plan.

Detailed information on the methods implemented for the various field investigations is provided in the following sections, as taken from the approved work plans referenced in Section 1. In addition to these investigations, extensive research has been conducted on the ecology/biology and management of the primary invasive species documented to occur on the site to develop a sound basis for designing and implementing site restoration incorporating the control and management of these invasive species.

2.1 Setting and Land Use History

An understanding of land use history and the overall setting of the site is important in recognizing why and how current conditions have developed, as well as considering how this background may factor into restoration planning. Kirvin Park lies along the eastern edge of the Housatonic River Valley, bordered on the east and south by the mountain range that includes October Mountain, Washington Mountain, Warner Hill and Tully Mountain (the latter of which are traversed by the Appalachian Trail). Both Ashley Brook and Sackett Brook flow westerly from these highlands onto the glacial outwash plain of the Housatonic River Valley. Kirvin Park extends south from Williams Street across this plain, encompassing the confluence of these brooks and the associated floodplain area.

A review of historical aerial photography indicates that from at least the 1920s into the 1970s the Kirvin Park area was in active agricultural use, with access from a large farm operation on the southern side of Williams Street via a farm road extending south across both Sackett and Ashley Brooks (see **Appendix E** for aerial photographs and USGS topographic maps from past dates). By 1985, the agricultural uses appeared to be ending, the farm road (and culverted crossings of the brooks) was discontinued, and recreational fields were being developed north of Sackett Brook. By the mid-1990s, the floodplain area south of Sackett Brook and east of Ashley Brook was succeeding from open fields to scattered brush. The colonizing shrubs and small trees had rapidly expanded by 2005 to cover much of the floodplain area and the adjacent upland; several open corridors and patches among the woodland remained evident up through the more recent (2020) aerial photographs, although the woodland became denser and woody plants grew taller. In comparing these historical conditions to existing vegetative patterns, it appears likely that the common buckthorn had started to colonize the open fields during the mid-1990s and expanded rapidly over the following two decades, possibly along with the honeysuckle shrubs. The open patches and corridors which have remained evident in the woodland matrix over these two decades appear to be dominated by herbaceous meadows containing goldenrod (*Solidago spp*.), which have been able to exclude the buckthorn expansion. The buckthorn forest which has developed over the floodplain area is among the densest and most mature stand of buckthorn observed in the Housatonic River Valley. While buckthorn is a common invasive shrub/small tree in the floodplain of the Housatonic River itself, it has not been observed to form such dense, mature, mono-typic stands as that which appears in Kirvin Park.

Another significant factor affecting conditions in the site's floodplain and wetlands is that of beaver activity. Understanding the past nature and extent of this activity is important in assessing the potential that it may have in affecting restoration plans. Beaver activity is first apparent at the site on 2014 aerial photographs, where an expanded area of flooding is noted in the eastern part of the wetland along the south side of Sackett Brook. The limits and apparent depth of the beaver impoundment continued to expand into 2019, at which point the athletic fields north of Sackett Brook were shown to be flooded. The beaver dam was constructed across Sackett Brook and extended to the southwest across the wetland to merge with the fill remaining from the old cart path. In September of 2019, the City breached the beaver dam to drain the flooding from the playing fields, and this also substantially lowered the water level in the wetlands. However, more than three successive years of flooding in the wetland had induced significant changes in the wetland plant community, and portions of the wetland continue to adjust to the effects of the changing water regime.

In summary, despite the suitable location of this portion of Kirvin Park to provide ecological functions, the area is heavily dominated by invasive plant species which impair this potential. Thick and dense stands of common buckthorn make up a majority of the canopy in this area of Kirvin Park, likely as a result of the post-agricultural succession that the site has experienced. Additional invasive species throughout the understory include Morrow's honeysuckle, garlic mustard, bishop's goutweed, Asian bittersweet, multiflora rose, purple loosestrife *(Lythrum salicaria),* and common reed *(Phragmites australis)*. A total of 15 species of invasive plants have been recorded within this portion of Kirvin Park. Mixed within these dominant invasive plant assemblages are scattered open areas largely dominated by goldenrod. There are also occasional larger native tree species interspersed across the site, including cottonwood, silver maple, American elm, black cherry, red maple, and box elder. As noted previously, the wetland in the eastern side of this area has been heavily influenced by recent beaver impoundment. Other than several species of willow, much of the woody plant growth in the wetland has been killed by the beaver flooding, and the herbaceous plant community has also been affected by the flooding and the more recent drawdown. These changes to the wetland herbaceous community over the past two years appear to be primarily positive in terms of native plant species composition (and even resulted in some mortality of mature buckthorn plants).

2.2 Site Topography and Survey Validation

The area being designated for ecological restoration encompasses roughly 15 acres south of Sackett Brook and east of Ashley Brook, with an additional two acres north of Sackett Brook. Surface topography across this area is generally very level, consistent with floodplains in glacio-fluvial settings. Site elevation data have been obtained from several sources, including USGS topographic mapping, the National Oceanic and Atmospheric Administration's (NOAA's) Digital Elevation Model (DEM) based on Light Detection and Ranging (LiDAR) remote sensing, the FEMA Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM), and site-specific surveys by registered land surveyors. A site contour map was developed using NOAA's DEM by converting the LiDAR data into one-foot contour intervals using spatial analyst. The surface elevations of the restoration area range from a low of approximately 1015 ft (NAVD 1988) near the confluence of Sackett and Ashley Brooks to a high of approximately 1030 ft near the southern limits of the restoration area; most of the restoration area is between elevations 1018-1025 ft. In April of 2022, a site survey was conducted by Hill Engineering, Inc. to verify the accuracy of the LiDAR data and to specifically survey the elevation and location of three groundwater monitoring wells installed at that time. The results of that survey are provided in **Table 1**. The site survey data confirmed the accuracy of the LiDAR surface topographic data for restoration design purposes. In the case of each of the three monitoring wells, surveyed elevations were within a few inches of the elevations indicated by the LiDAR data; given the microrelief apparent on the floodplain surface, these elevation differentials are not consequential to the restoration design. In addition, a survey was conducted along Sackett Brook in June 2025 to provide information on topography and trees to use in considering options for the temporary crossing of the brook during the construction/restoration work.

As discussed in Section 1.2, in addition to the primary 13-acre floodplain/wetland restoration area south of Sackett Brook and east of Ashley Brook, a supplemental tree planting area was added to the project in the Revised Conceptual Restoration Plan. This area is situated along the northern side of Sackett Brook east of the active recreational (soccer) field. It consists of an open meadow, with wet meadow conditions apparent in the southern portion closest to the brook, transitioning to upland meadow moving north. The area appears to be mowed periodically but infrequently. This area ranges in grade from 1020 feet along Sackett Brook to approximately 1025 feet in the northern portion of the area. In addition, following submission of the Revised Conceptual Restoration Plan, a two-acre pollinator meadow habitat has been added to the project at the southern end of floodplain/wetlands restoration area (in the south staging area). This area currently consists of an open field with scattered shrubs and trees, including invasive species.

2.3 Surface Water, Floodplain, and Hydrology

Sackett Brook is a perennial stream that flows from the east to west across the northern part of the site. Ashley Brook is a perennial stream that flows into Sackett Brook from the south. The confluence of the two streams is in the northwestern section of the site. Both streams are mapped as Coldwater Fisheries Resources. Sackett Brook is a direct tributary of the Housatonic River.

Both Sackett Brook and Ashley Brook are relatively high-quality upper perennial headwater streams which are fed by a largely wooded mountainside watershed and therefore overtop their banks during spring runoff periods to flood this adjacent woodland and wetland.

The site is within mapped FEMA-designated A & AE flood zones. The AE flood zone is an area inundated by 100-year flooding, for which Baseline Flood Elevations (BFE) have been determined based on the Kirvin Memorial Park FIRM (see **Figure 2**). The AE flood zone is associated with Sackett Brook. The A flood zone is an area inundated by 100-year flooding, for which no BFEs have been determined. The A flood zone is associated with Ashley Brook.

As a result of the sloping floodplain (from upstream to downstream due to the gradient across the site) and the confluence of the Ashley Brook floodplain (with no BFE determined), some interpolation is required in plotting flood limits on the site plan. In general, based on the FEMA FIS, the 100-year floodplain of Sackett Brook extends to elevation 1023 ft (NAVD 1988), and the Ashely Brook 100-year A flood zone extends off of Ashley Brook to converge with the Sackett Brook flood zone in the central portion of the site. Of equal interest in terms of floodplain restoration considerations are the more frequent flood events. The Sackett Brook 10-year flood level is indicated on the FEMA FIS to be 1021.5 ft (NAVD 1988). Using a logarithmic regression off these elevations approximates the two-year floodplain at 1019 ft and the one-year floodplain at 1018.5 ft. Consideration of these more frequent flood events is especially useful in planning the lower wetland creation/enhancement portions of the floodplain.

2.4 Geology and Soils

Documentation of bedrock and surficial geologic conditions at the Kirvin Park Site was based upon information available from MassGIS (2022), supported by previous studies such as that described in the Woodlot 2002 Ecological Characterization (Woodlot 2002). Soil conditions were evaluated using the information provided by the USDA NRCS Web Soil Survey (https://websoilsurvey.nrcs.usda.gov). Soil conditions were also evaluated in the field at 28 survey locations distributed among the mapped cover types on the site (**Figure 3**). At each of these locations, a soil profile description was documented from a test pit, using either a shovel or auger, which allowed for a detailed assessment of the soils in the top 2-3 feet.

The Kirvin Park Site is situated within the Housatonic River Drainage Basin and the Grenville Shelf Sequence. The dominant lithogeochemical character of the near-surface bedrock in this sequence is composed of carbonate rocks and other metasedimentary rocks deposited in a carbonate shelf sequence overlying the Grenville basement, which extends from western Connecticut, to Massachusetts and Vermont (MassGIS 2022). Based on the USGS 1:24,000 Surficial Geology (MassGIS 2022), the entire Kirvin Park Site is mapped as having a thin till layer overlain by the succeeding coarse textured glacial stratified deposits.

Soils that form in these glaciofluvial deposited materials are typically very deep and variable in drainage class. According to the NRCS mapping, soils series on the Kirvin Park Site include the well-drained Copake, moderately well drained Hero, and poorly drained Limerick soil series described as follows:

Copake Soil Series

The Copake series consists of well-drained, fine sandy loam soils formed in loamy mantled stratified drift and glacial outwash comprised of sandy and gravelly glaciofluvial materials derived mainly from schist, limestone, gneiss, and dolomite. The soils are moderately deep to stratified sand and gravel and are very deep to bedrock. They are nearly level to very steep soils on outwash plains, terraces, kames, eskers, and moraines. Permeability is moderate or moderately rapid in the surface layer and subsoil, and rapid or very rapid in the substratum.

Hero Soils Series

The Hero series consists of very deep, moderately well drained, gravelly loam soils formed in loamy over stratified sandy and gravelly glacial outwash derived mainly from limestone, shale, schist, sandstone and dolomite. They are nearly level and gently sloping soils on glaciofluvial landforms, and are typically in slight depressions and broad drainageways. Permeability is moderate or moderately rapid in the surface layer and subsoil, and rapid or very rapid in the substratum.

Limerick Soil Series

The Limerick series consists of very deep, poorly drained, silt loam soils on flood plains. These soils formed in recent alluvial deposits that are dominantly silt and very fine sand. They are on the flood plains of major rivers and their larger tributaries. In some places, they are on the flood plains of small streams. They may be on broad flat areas or in shallow depressions. Although not specified in the

USDA NRCS Official Soil Series Description, permeability is stated to be moderate in the USDA NRCS Limerick Soil Fact Sheet for Addison County, VT (USDA NRCS 2015). Saturated hydraulic conductivity is moderately high or high. Most areas are flooded for periods of several days each year, usually in late winter or early spring.

Appendix F provides additional information on site soils from NRCS.

2.5 Groundwater

Three shallow groundwater monitoring wells were installed on May 6, 2022 within upland areas adjacent to the delineated wetland boundary designated in the preliminary restoration concept plan as potential wetland creation areas. Wells consisted of two-inch diameter slotted PVC pipe with solid riser section to reach above-ground elevations. Monitoring wells MW-1, MW-2, and MW-3 were installed by hand with a three-inch bucket auger to 6.9, 7.3, and 6.5 feet below the ground surface, respectively, and backfilled with a coarse sand to fill space between the PVC pipe and the edge of the pilot hole.

One pressure transducer datalogger (Solinst® 3001 Levelogger) was installed in each of the three wells to collect quasi-continuous data on water levels (specifically, at 12-hour intervals). Monitoring within each of the three wells has been ongoing since May 6, 2022, with the most recent site visit occurring on May 30, 2024 to download water-level data from the transducers. In addition, one Solinst® 3001 Barologger 5) was installed in MW2 to provide accurate compensation for impacts of atmospheric pressure on water level measurements taken with the pressure transducers. Manual readings with an electronic water level probe were taken at times of deployment and each time the pressure transducers were extracted for data-download, to field verify groundwater elevations calculated using transducer data.

Using elevation data for each monitoring well surveyed by Hill Engineering (**Table 1**), groundwater depths were converted to elevations in the NAVD 1988 Datum, as shown on **Figures 4a-4c**. Among the three well locations, groundwater elevations within the proposed wetland creation area fluctuated roughly four feet on average (range of 3.8-4.3 feet) between elevations 1014 feet and 1019 feet. On average, the groundwater tables ranged from approximately 0.65 to 4.6 feet below the ground surface (**Table 2**). The lowest water levels observed in all wells occurred in August and September of 2022 (an abnormally dry period), when water levels were approximately 4.3 feet below the ground surface on average. Precipitation and temperature data at the Pittsfield Lakewood Station from May 2022 to May 2025 (www.wunderground.com) are shown on **Figure 4d**. As indicated there, precipitation in Pittsfield from May through August 2022 was consistently below normal, with only 9.88 inches of precipitation falling during these four months, 6.49 inches below the normal precipitation of 16.37 inches (Pittsfield MA: Local Climatological Data (weather.gov)). Western

Massachusetts was in a declared drought from June through August; June and July were in a "Level 1—Mild Drought," while August was in a "Level 2—Significant Drought" (Drought Status | Mass.gov). Accordingly, groundwater levels during this period would also be expected to be significantly below the normal condition. In June 2023, water levels once again dropped following several weeks of little rain and were approximately 3.6 feet below the ground surface on average. Groundwater levels were closest to the ground surface during April and May of each year, averaging approximately 2.8 feet below the ground surface. Groundwater elevations indicate an east to west slope in the water table, with an average water table elevation of 1019.3 feet at MW-3, 1018.1 feet at MW-2, and 1015.5 feet at MW-1.

Of the 2223 groundwater elevation data points that have been collected at MW-1 in 2022 through 2025, only 10 observations were within one foot of the ground surface, and only two of these occurred during the growing season (during April and May). A total of 102 observations were recorded within two feet of the ground surface, 35 of which occurred during the growing season (April through July). Based on inspection of the hydrograph at MW-1 (Figure 4a), the water table at this location appears to be very flashy, rapidly responding to rain/flooding events with numerous spikes in the water table of 2.5-3 feet or more, which begin shortly after onset of precipitation and decrease to a baseline elevation shortly thereafter. Since MW-1 is situated closest to Sackett Brook, such a rapid response to rain events is expected. Of the 2211 data points collected at MW-2 over this period, 100 observations are within one foot of the ground surface, 43 of which were recorded during the growing season (April through July). A total of 562 observations are within two feet of the ground surface, with 252 occurring during the growing season (April through July). Based on inspection of the MW-2 hydrograph (**Figure 4b**), the water table at this location appears to respond with a slightly longer lag-time from a rain event in most cases and recedes a little more slowly following peak discharge when compared to MW-1. In addition, changes in the water table elevation from baseline to peak following a storm event are generally 1-2.5 feet.

The water table at MW-3 is deeper than at the other two wells, with no observations within one foot of the ground surface and only 62 out of 2223 observations within two feet (25 of which occurred in April and July). The MW-3 hydrograph (**Figure 4c)** is very similar to that of MW-2.

Overall, the installation and monitoring of the groundwater wells, including the soil profile information recorded during the installation process, have provided an understanding of the shallow groundwater conditions and subsurface stratigraphy for the site. When considered along with the flood data for the site generated by FEMA, this has contributed critical information for the restoration design, particularly for the wetland creation/enhancement component. The subsurface and flooding information underscores the floodplain setting of this site, with even the bordering wetlands dependent largely on seasonal overbank flooding and surface water input. The groundwater table in such settings is typically controlled by the water stage in the adjacent streams, such that the water table is likely to recede below the major part of the root zone fairly early in the growing season. Wetland creation in this setting should be consistent with this floodplain hydrology. **Table 2** presents a summary of the groundwater elevation data collected from the monitoring wells from 2022-2025. **Figures 4a-4d** provide graphs of the groundwater elevations, as well as local temperature and precipitation data, through this same period of time. The groundwater monitoring data at the site support the proposed wetland grading plan and indicate suitable conditions for the proposed wetland creation/restoration area.

2.6 Wetland Delineation

2.6.1 Wetland Delineation Methods

During a preliminary assessment of the site in April 2021, the approximate upper boundary of wetland areas to the north and northeast of the proposed restoration area was determined in the field. This approximate boundary was determined by following a topographic break, observing changes in plant communities, and conducting periodic inspections of soil conditions for the purpose of locating areas potentially suitable for wetland restoration. As described below, a more detailed/formal delineation was performed in April 2022, and the resulting wetland boundaries are shown on the current updated site plan.

Delineation of wetlands and watercourses was performed in accordance with the *1987 Corps of Engineers Wetland Delineation Manual* (USACE Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regions* (USACE 2012). Upper limits of the jurisdictional wetlands in the area were demarcated in the field using sequentially labeled pink flagging and field located by AECOM using a GPS capable of sub-foot accuracy. **Appendix G** provides the USACE Wetland Determination Data Forms in support of the wetland delineation.

AECOM identified plant species using appropriate botanical reference material for the region. The indicator status of each species was identified using *The National Wetland Plant List* (USACE 2020). Plant species with indicator status of obligate (OBL), facultative wetland (FACW), and facultative (FAC) (i.e., hydrophytic vegetation species) were determined prevalent following dominance criteria outlined in the USACE *Supplement*.

In addition to vegetation, the presence of hydric soils was used to delineate the wetland boundaries. To categorize soils in the field, a hand auger and/or tile spade shovel was used and soils were generally inspected to a depth of 18-24 inches. The information collected for each soil profile included soil horizons, depth, texture, color, and the presence or absence of redoximorphic features (mottles and other features). Colors of the soil matrix and mottles were identified using Munsell Soil Color Charts. All hydric soil determinations were based on criteria established in *Field Indicators for Identifying Hydric Soils in New England* (NEIWPCC, 2018) and guidance in the USACE *Supplement*. Note that the wetland determination at this site generally falls under the "problem area" provisions of the Corps' manual due to the floodplain setting and past agricultural conditions at the site.

2.6.2 Wetland Community Description

Wetland conditions on the site vary considerably based upon the hydrologic conditions. As with most floodplain wetland settings, hydrology is dependent first upon the surface water flooding regime that develops from overbank flooding. In the case of the wetlands at Kirvin Park, this setting has also been affected historically by various factors, including construction of the farm road across Sackett Brook and its floodplain, channelizing and straightening of Sackett Brook (sometime between 1960 and 1972), and beaver activity. The wetland conditions of the site reflect the effects of these activities, with wetter conditions east of the old farm road corridor due to surface water impoundment from the farm road fill and beaver damming. Wetlands in that eastern part of the site consist mostly of marsh and shrub swamp with species adapted to wetter conditions. West of the old farm road, the wetland conditions have developed into a drier shrub swamp, with much higher prevalence of woody invasive plants (primarily buckthorn and honeysuckle). Consequently, the logical location for wetland creation/enhancement/restoration on the site is within this western portion of the site's wetland.

2.7 Beaver Activity

The western wetland portion of the Park proposed for floodplain/wetland restoration and enhancement is a low-lying, relatively flat riparian/floodplain that is largely a post-agricultural woodland. As noted previously, the eastern end of this area consists of wetland which has been subjected to extensive beaver flooding by damming of Sackett Brook (with the beaver dam breached by the City in 2019 to reduce flooding of the recreational fields). Based on discussions with the City's Conservation Commission agent, a "water flow blockage" permit to trap beavers and breach the dam located in Sackett Brook was issued by the local Health Department in 2017 and in 2019 to alleviate flooding on baseball fields located adjacent to the northern side of Sackett Brook in Kirvin Park. According to the agent, smaller dams would be acceptable provided that the playing fields are not inundated, but the intent is to continue managing the beaver activity in Sackett Brook as necessary. This type of management would likely limit future effects of flooding in areas south of Sackett Brook as well (including the restoration area).

The historical location of the beaver dam has been just upstream of the proposed restoration/enhancement area (see **Figure 2 and Figure 3**). In constructing their impoundment, the beavers incorporated the historical fill from the old farm road into the beaver dam. Despite the City's removal of the main part of the dam across Sackett Brook, drainage from the southeast subwatershed area remains impounded along the eastern side of the old farm road fill. The proposed grading plan for the wetland creation/enhancement will remove a portion of this historical roadway fill, allowing surface water to disperse westerly across the floodplain. Future beaver activity does have the potential to continue to affect the water flow paths and surface water stage within the floodplain, with or without implementation of the proposed restoration plan. Such beaver impacts may be positive or negative in terms of habitat changes.

Aside from the potential for hydrologic impacts imposed by beaver activity, there is also a potential for impacts to woody plantings by beaver herbivory in the restoration/enhancement area, as well as the supplemental tree planting area, and throughout the adjacent floodplain. All woody trees and shrubs planted on the site will require wire-mesh cages (or similar measures) to protect them from beaver herbivory as well as that from white-tailed deer.

2.8 Vegetative Cover Types and Plant Community Composition

2.8.1 Methods

Plant inventory and cover type mapping within the main 13-acre wetland and floodplain restoration/enhancement area were accomplished through both qualitative and quantitative means. The qualitative approach included mapping of general habitat cover types (e.g., forest, scrub-shrub and open field) through interpretation of the most recently available (2021) aerial photographs from MassGIS and ground-truthing with a GPS, as needed. The quantitative method involved sampling of vegetation plots that were distributed within each cover type to be representative of general conditions and allow for cover type classification. Plot locations were located by GPS in the field. Data collected during the qualitative and quantitative assessments were then used to create a plant community cover type map by digitizing on 2021 aerial photographs in ArcGIS. This mapping is described in Section 2.8.2.

Percent cover of trees, woody shrubs, and vines was estimated within five-by-five meter quadrats (25 m^2) with a nested one-by-one meter (1 m^2) quadrat for estimating herbaceous plant cover (graminoids and forbs). A Daubenmire mid-point cover class scheme (based on Barbour et al. 1999), modified to include a <1% category, was used to estimate percent cover of each species. Plot data were used to characterize the vegetative communities.

For each habitat type sampled quantitatively, four descriptive metrics were reported: (1) species richness; (2) relative dominance (D_R); (3) relative frequency (F_R); and (4) an Importance Values (IV_{ave}) identifying those plant species that are essentially most important (i.e., most dominant and occur most frequently within the given community). These community metrics were further described by Barbour et al. (1999).

2.8.2 Results and Description of Vegetative Communities

During each of the seven site visits conducted in 2022 (as well as during those inspections conducted in 2021), a running plant list was maintained for the main 13-acre wetland and floodplain restoration/enhancement area. That list is presented in **Table 3**. In addition, on August 9 and August 23, 2022, the vegetation plots were established and sampled, locations were surveyed by GPS, and representative photographs were taken. Those photographs are provided in **Appendix C**. Using data collected in the vegetation plots along with the cover type data obtained through interpretation of the most recently available aerial photographs and other GPS surveyed features (e.g., points along habitat edges, locations of large diameter trees), a plant community cover type map was created. Due to the extensive cover of invasive plant species observed throughout the restoration/enhancement area, cover types were not classified into natural community groups. Instead, the area was mapped into four broad cover type categories that identified native or invasive plant species dominance. These mapped habitat cover types are presented with associated total area in **Table 4** and habitat cover type mapping is illustrated in **Figure 5.**

Within the limits of the main wetland and floodplain restoration area, a total of 88 plant species were identified, including 11 tree species, 16 woody shrub species, four woody vine species, and 57 herb species (**Table 3**). Those species listed as invasive are shaded in gray in **Table 3**. Specifically, a total of 11 observed species are listed as invasive by the Massachusetts Invasive Plants Advisory Group (MIPAG) (https://www.massnrc.org/mipag/linvasive.htm), including five herbaceous plant species, five woody shrub species, and one woody vine. In addition, one woody shrub species and three herbaceous plant species are listed in Appendix K of the New England District Compensatory Mitigation Guidance (USACE NED 2020) as an "Invasive or Other Unacceptable Plant Species." No state-listed or federally listed rare plant species were identified.

A total of 42 plant species were observed within the vegetation plots. The number of species observed per plot ranged from three to 15 species with an average of 7.8 ±0.7 SE species per plot. Relative dominance was calculated for all species observed in the vegetation plots. The relative dominance of all species observed in the vegetation plots is shown in **Table 5**. As shown, the most dominant species occurring within the limits of the restoration/enhancement area is Canada goldenrod (*Solidago canadensis*). The top 10 most dominant plants include four herbaceous species, two shrubs, three trees, and one bryophyte. Also included in the top 10 most dominant plants are two invasive plant species, common buckthorn and garlic mustard (see **Table 5**).

Importance Values (IV_{ave}) calculated for the main restoration/enhancement area include only species that were observed in three or more plots. These metrics are presented in **Table 6**. The most frequently occurring plant and that with the highest relative dominance and greatest importance value was common buckthorn, an invasive species. Also included in the top five species are garlic mustard and Morrow's honeysuckle, both of which are also invasive species. A total of seven plant species observed in the plots are listed as invasive and occurred in 17 out of the 19 vegetation plots. The most frequently occurring invasive species were common buckthorn, garlic mustard, and Morrow's honeysuckle, which were observed in 14, 14, and 11 out of the 19 plots, respectively.

The two native species included in the top five most important species include a species of bryophyte (moss) and Canada goldenrod. The moss was observed in nine out of the 19 plots, and typically exhibited high estimated cover (range of 10.5-98% cover, with a mean of 58.3% ±10.8 SE). Although Canada goldenrod was observed in only five out of the 19 plots, the estimated cover was very high where it did occur (range of 85.5-98% cover, with a mean of 95.5% ±2.5 SE).

The main floodplain and wetland restoration/enhancement project area is approximately 13.1 acres (not including the supplementary planting area or the pollinator meadow area, each of which is roughly two acres in size). As noted above, the mapped cover types in the main project area and the acreage covered by each are shown in **Table 4**. As shown, a large proportion of this area (nearly 70%) is mapped as "Herb/Shrub Cover, Invasive Plants Dominant." This area is dominated by a dense stand of common buckthorn trees with an understory of Morrow's honeysuckle and garlic mustard, and occasional clearweed (*Pilea pumila*), white avens (*Geum canadense*), and moss cover (a bryophyte). Approximately 20% of the area consists of openings in the buckthorn canopy mapped as "Herb and Shrub cover Native Plants Dominant." Dominant plants include goldenrods, cleavers (G*allium aparine*), sensitive fern (*Onoclea sensibilis*), and river grape (*Vitis riparia*), with lesser amounts of garlic mustard, and common buckthorn. Finally, approximately 9% of the area is mapped as "Forested Cover, Native Trees Dominant," which includes areas dominated by eastern cottonwood, boxelder maple, American elm, and black cherry.

The vegetation in the two-acre supplemental tree planting area has been more generally reviewed, finding that it consists of typical meadow plant species with a few scattered shrubs. Similarly, the south staging area where the pollinator habitat will be established has also been more generally reviewed, finding that it consists of scattered invasive shrubs and small trees with various forbs and grasses in the intervening old field areas.

2.9 Invasive Species

2.9.1 Overview of Issue

An invasive species is defined by the National Invasive Species Council as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." (Executive Order 13112; http://www.invasivespecies.gov/). For the purposes of this Final Restoration Plan, this definition includes the plant species listed by recognized organizations – notably, the USACE New England District and/or the MIPAG – as "invasive" or "likely invasive." Documentation of the presence and abundance of such plant species on the Kirvin Park site has been incorporated into the plant community inventory and mapping process for the main project area, as described above in Section 2.8; and the presence of such species in the supplementary planting area and the area planned for a pollinator meadow has also been considered more qualitatively.

In MassDEP's 2019 report on Kirvin Park, the dominance of invasive plant species in the Kirvin Park floodplain was recognized and cited as both a constraint and an opportunity to achieve and maintain habitat enhancement objectives (MassDEP 2019). The report noted the presence of at least four invasive plant species on the site – common buckthorn, garlic mustard, bishop's goutweed, and Asian bittersweet – noting that "the non-native invasive plants will likely create challenges for the success of the project." In addition to these species, Morrow's honeysuckle is prevalent in the floodplain, often in the understory of the buckthorn woodland (as noted in the previous section), and multi-flora rose is common in various locations through the floodplain. The dominance of these invasive species impairs the ecological functions and biodiversity of the floodplain. For example, the presence of these species limits the capacity of the site to develop plant communities consistent with mature forested floodplain conditions in the region. The Massachusetts Audubon Society has concluded that "invasive plants are one of the greatest threats to the nature of Massachusetts" (Mass Audubon 2023). Overall ecosystem impacts from the increasing pervasiveness of invasive species such as buckthorn are now known to extend beyond effects on native plants and associated habitat impacts and to further create adverse impacts on leaf litter, soil biota (microbial and macroinvertebrate biota), soil chemistry processes, soil erosion, and water quality (see, e.g., Knight et al. 2007). The MassDEP (2019) report added: "It is anticipated that the project must include significant implementation of pre-installation invasive species controls as well as long-term monitoring and maintenance to achieve and maintain habitat objectives." GE's July 2022 work plan for this project recognized that "removal and control of buckthorn at the site is a critical component of the restoration process, and therefore preliminary assessments of buckthorn community dynamics have been initiated and will require further assessment as the restoration plan is advanced." **Appendix D** provides a technical assessment of buckthorn ecology and community dynamics for use as part of the Kirvin Park floodplain/wetland restoration; it draws upon an extensive data base and experience from other efforts in the north-central to northeastern United States to develop management and control procedures for this species.

2.9.2 Findings and Assessment of Restoration Implications

Based upon the findings of the recent field investigations, the six invasive plant species cited above (common buckthorn, Morrow's honeysuckle, garlic mustard, Asian bittersweet, multi-flora rose, and bishop's goutweed) are the most prevalent in the main 13-acre restoration/enhancement area and warrant the most consideration in the restoration and enhancement planning process. Based upon the quantitative and qualitative inventory of the plant community in the floodplain, and considering their life form and function, the two most impactful invasive species in this area are common buckthorn and Morrow's honeysuckle. Buckthorn was recorded in 74% of all vegetative plots, with a mean relative dominance of 26.3%, while honeysuckle was recorded in 58% of all plots, with a mean relative dominance of 5.6%. Garlic mustard, bishop's goutweed, multi-flora rose, and Asian bittersweet, while also prevalent and significant in this area, are considered secondary in the restoration and management program given the overall dominance of honeysuckle and buckthorn (in particular) in this portion of the site. Invasive plant species were not observed within the supplementary planting area north of Sackett Brook. However, the south staging area planned for a pollinator habitat currently contains many invasive shrubs and trees, including common buckthorn, multi-flora rose, bittersweet, and Morrow's honeysuckle.

As noted above, **Appendix D** includes a detailed technical assessment of common buckthorn's life history, invasive characteristics, and summarizes the extensive research which has been conducted on buckthorn control across the northern United States over the past 30 years. This section of the text provides a brief summary of that information. It then provides brief reviews of the other primary invasive species at Kirvin Park – Morrow's honeysuckle, garlic mustard, Asian bittersweet, bishop's goutweed, and multi-flora rose.

Common Buckthorn (*Rhamnus cathartica*)

While buckthorn was apparently introduced to the United States in Massachusetts in late 1800s, it's occurrence as an invasive species affecting habitat quality has been noted more prominently in the upper Midwestern states, leading to extensive research and control efforts in those states versus the Northeast. However, the information and experience gained from the upper Midwest are directly applicable to the Northeast given the ecological similarities between these regions. In New England, buckthorn is found most often on disturbed, open, moist sites and successfully invades abundant habitats including "abandoned fields and pastures, open woods, early successional forests, edges, planted forests, floodplain and riparian forests, wet meadows, ravines, open disturbed areas, roadsides, fencerows, vacant lots, and yards or gardens" (IPANE 2007). Buckthorn outcompetes native understory species for light, nutrients, and moisture, potentially forming monotypic stands that suppress plant and animal diversity. Old field areas of this region most often show buckthorn abundance and preference on sites that had a history of plowing compared to former pastures or continuously forested woodlots (McDonald et al. 2008). As buckthorn continues to persist and establish, further invading a forested area to become increasingly dominant, it creates shadier areas throughout the growing season than forested areas not invaded by buckthorn, thus progressively shading out the native seedlings and saplings of herbaceous, shrub, and tree layers and outcompeting most plants that try to grow beneath it. These conditions are exemplified at Kirvin Park, where the dense growth of 20-year old buckthorn thicket/woodland is among the more extreme example of this species' dominance observed in the region, and has severely diverted the floodplain forest successional development from achieving its natural potential.

As described in **Appendix D** in detail, there are a number of buckthorn traits that promote invasiveness, as summarized below:

- **Habitat/site type tolerance:** As a facultative species, buckthorn is adapted to grow in both wetlands and uplands with equal prevalence. While it generally appears less common in very wet or very dry sites, the seasonal flooding and moisture of floodplain areas appear very favorable to buckthorn growth. The prior use of many of these areas for agricultural activity, which often included wind row breaks that may have purposefully planted buckthorn, provided prime settings for buckthorn expansion under the post-agricultural fallow conditions.
- **Shade tolerance and leaf phenology**: Buckthorn has a wide tolerance range to light and shade giving it an advantage to invade a wide range of environments. Although buckthorn grows in open habitats in full or partial sunlight, its tolerance of deep shade is the trait for its success in invading and thriving in forest habitats. Buckthorn benefits from a high shade tolerance, and that trait in combination with its leaf phenology allows it to successfully invade a broad range of available light habitats of North American temperate forests. Further, its phenology creates an extended growing season that gives buckthorn an advantage in the ecosystems that it invades. The leaves of buckthorn emerge early in the spring and reach senesce late in the fall, comprising as much as an average of 58 days longer leaf season than that of many native species. This extended growing season enhances the ability of buckthorn to outcompete native plants by shading out the seeds of native plants as they try to germinate and grow under the already present shade of the buckthorn leaves, as well as to compete with buckthorn seedlings for nutrients and water.
- **Rapid growth rate:** Buckthorn has a rapid rate of growth due to its beneficial leaf phenology providing an extended growing season and its high photosynthetic rate generated from a high leaf chlorophyll content. The leaf phenology and high photosynthetic rate of buckthorn, in

combination with its prolific ability to reproduce sexually to produce abundant seedlings and/or to vigorously regenerate vegetatively to produce numerous shoots (as discussed below), enables it to quickly reach large size and abundance to dominate a site. Even if growth rates between buckthorn and co-habitating shrubs are comparable, the extended seasonal growth provided by the leaf phenology of buckthorn allows it to produce more biomass annually.

- **Prolific fruit/seed production/dispersal and vegetative reproduction**: Buckthorn reproduces sexually by producing seeds where the population of males and females varies locally. However, buckthorn also sprouts vigorously and expands by vegetative propagation. Buckthorn seeds may remain viable in the soil for at least two years and possibly up to six years. Fruit (drupe) and seed production of buckthorn is prolific, as is its potential for seed dispersal. Gravity and birds are the primary methods by which buckthorn seeds are dispersed, followed by animals and water. Unripe fleshy fruits are protected from seed predators by containing the chemical anthraquinone emodin, which causes severe diarrhea. Birds and small mammals are unable to detoxify emodin efficiently, especially when it is present in high concentrations in unripe fruit. The laxative effect in smaller birds can be strong enough to result in death. When the fruit ripens, the emodin subsides and functions mildly to encourage swift passage of the seed before seed viability diminishes and seeds are dispersed by regurgitation and defecation. Floodwater and surface stream flow also function to disperse buckthorn seeds.
- **Ecosystem changes to improve buckthorn success:** A trait common to many invasive plants is the potential to modify the environment to benefit that species to the detriment of native plants. Studies have indicated that buckthorn may impact the ecosystem in this manner through changes in soil nitrogen, elimination of the leaf litter layer, possible facilitation of non-native earthworm invasions, potential effects on native plants through allelopathy (i.e., the chemical inhibition of one plant by another) or competition, and effects on animals that may or may not be able to use it for food or habitat. Plants may release allelopathic chemicals that can inhibit germination, growth, and survival of nearby plants and deter herbivores. Buckthorn has been found to have one of these secondary compounds in particular, anthraquinone emodin, which has been theorized to potentially promote its invasive success by causing allelopathic effects on nearby plants, discouraging insects and herbivores from eating its leaves, bark, and fruit, and causing digestion effects in birds and mammals that consume its fruit.

Despite the potential allelopathic effects of buckthorn, such effects do not preclude use of the Kirvin Park site as the off-site restoration area. Evidence for buckthorn allelopathy has been difficult to establish and is not discussed in various publications discussing restoration after buckthorn removal.[7] In any case, buckthorn's ability to outcompete and eliminate native species is broader than just due to potential allelopathy, extending to multiple edaphic (i.e., soil-related) and biotic variables (e.g., soil structure/chemistry and biota, leaf litter composition, light availability, etc.). These variables will be addressed in the implementation of this restoration/enhancement project through the incorporation of specific construction sequencing (see Sections 4 and 5) and revegetation planning (such as planting of buckthorn resistant/competitive native species), as well as ongoing monitoring and assessment for further buckthorn seedling and sprout removal to inhibit potential adverse impacts on the restoration process.

Morrow's Honeysuckle (*Lonicera morrowii*)

Morrow's honeysuckle is a deciduous shrub that was imported from Japan and South Korea in the 1800s for use as an ornamental plant, as wildlife food and cover, and in soil erosion control. After wide planting through the 20th century, its progressive destructive impact on native species in natural areas and parks and gardens prompted its recognition as a highly invasive species. It is shade-tolerant but prefers full sun, in which it produces more flowers and fruit; and it grows on moist to dry, gravelly, or sandy soils. It invades and thrives in woodlands, mature and disturbed forests, forest edges, floodplains, pastures, old fields, roadsides, and other disturbed areas through the help of rapid seed dispersal by birds and mammals. It also spreads vegetatively by root suckering and layering, promoting its ability to form dense thickets or monocultures by outcompeting native trees, shrubs, and herbaceous plants, thereby displacing them. It can alter a habitat's microclimate by creating dense shade, depleting soil moisture and nutrients, and possibly releasing alleopathic chemicals that inhibit growth of other plant species. The branching structure of Morrow's honeysuckle promotes nest predation of birds. Its fruit provides some nutrition for birds and mice in winter, but is insufficient for the overall nutrition needed to sustain birds, particularly migrating birds, which is naturally provided by the nutrition rich fruit of native species. Its prevention and control are the same as for buckthorn by pulling (seedlings), cutting larger stems, and applying herbicides containing glyphosate or triclopyr to foliage or cut stems (Minnesota DNR 2023; invasive.org 2023).

[7] For example, recent state and conservation agency literature promoting buckthorn removal, and management and control plans for land managers do not mention allelopathic remediation for encouraging growth and plantings of native species (Mass Audubon 2023; Minnesota DNR 2022; Wisconsin DNR 2023; USDA Forest Service/Northeastern Area State and Private Forestry 2022; Friends of the Mississippi 2019 and 2022). Wragg et al. (2020), Schuster et al. (2022, 2024), and Greet et al. (2019) focused on the importance of revegetation of native species in buckthorn removal sites as management and control of buckthorn and report significant success with growth of native seeds, sedges, shrubs, and trees, with no indication or finding of allelopathy affecting revegetated plant growth or their studies. Larkin et al. (2014) studied restoration effects of managed woodland sites after buckthorn removal and found restoration to be successful with native species diversity and growth with no allelopathic indications.

Garlic Mustard (*Alliaria petiolata*)

Garlic mustard is an invasive biennial herb likely introduced to North America from Europe and western Asia for medicinal and herbal uses and erosion control. It was first recorded in 1868 in Long Island, NY. It is shade-tolerant and thrives in forest understories, but also grows in open sun. It grows best on moist, well-drained soils, and is found in upland and floodplain forests, in savannas, and along trails, roadsides, and disturbed areas. It reproduces only from seeds, seed production is very high, and seeds remain viable in the seedbank for many years. Garlic mustard outcompetes native species for sunlight, moisture, nutrients, and space to form dense populations by emerging and growing earlier than native species in the spring and by releasing chemicals from its roots (causing allelopathy). which impact mycorrhizal communities critical to native species subsistence. Control and prevention of garlic mustard are the same as for buckthorn by pulling (seedlings) and applying herbicides containing glyphosate or triclopyr to foliage. The primary goals are to prevent second-year plants from producing seed, to prevent new seeds from arriving from nearby populations, and to deplete the seed bank (Michigan DNR 2018).

Asian Bittersweet (*Celastrus orbiculatus*)

Asian bittersweet is an invasive deciduous, woody, twining vine native to China, Japan, and Korea, which was introduced into the United States around 1860 as an ornamental plant. Although hybridization with native American bittersweet has been observed in the laboratory, it is unclear how commonly it may occur naturally. It is most productive in full sun, but easily germinates in shade and its seedlings are extremely shade-tolerant. It is found in grasslands, open woods, woodland edges, closed-canopy forest, roadsides, and fence rows, although it is also a problem on beaches and dunes in some states. Its growth by climbing any available support significantly threatens plant communities. It grows rapidly and shades out the vegetation supporting it, while encircling and girdling trees and shrubs, cutting off water and nutrients. Having a deep, extensive root system, it grows to 30 meters (98.5 feet) in length and 18 centimeters (seven inches) in diameter. It reproduces by seed and vegetatively by spreading underground roots that form new stems, as well as sprouting from the root crown and small root fragments, thereby forming abundant clones from one or few seedlings. Flowers are produced by male plants (for pollen) and female plants by two years of age, and prolific fruit is produced by mature female plants with highest fruit production in full sun. Fruits are eaten and dispersed by birds and mammals, and the seeds have been observed to remain in the gut of birds for extended time (14-42 days), promoting long-distance dispersal of the species. Humans also contribute significantly to its dispersal through planting and through the use of its fruiting (clustered scarlet berries with yellow-orange outer covering) in fall decoration, facilitating its spread. Asian bittersweet vines and leaves may become a massive weight burdening and weakening trees, causing them to become vulnerable to wind and ice storms. Trees attached by these vines may also be pulled down when one tree falls or is cut down. The destructive impacts of invasive Asian bittersweet on trees and shrubs requires its prevention and control with the help of mechanical and chemical methods in meeting these goals, as with the prevention and control of buckthorn (Michigan DNR 2012).

Bishop's Goutweed (*Aegopodium podagraria*)

Bishop's goutweed was introduced to North America from Europe and northern Asia by European settlers as an ornamental groundcover and was established in the United States by 1863. Its use has been as a low maintenance ground cover. It is an invasive, aggressive, creeping herbaceous perennial that forms dense, impenetrable patches that inhibit germination and/or establishment of native tree, shrub, and herbaceous seedlings, thereby displacing native species and greatly reducing species diversity. It prefers full sun, but is highly shade-tolerant and easily invades forests and dominates understories. It does very well in light to moderate shade and will flower least in dense shade. Seedlings grow best on disturbed, sunny sites, but leaves will die under intense heat or drought conditions. It is found in abandoned fields, pastures, gardens, forests, forest edges, riverbanks, streambanks, meadows, and disturbed areas. Bishop's goutweed tolerates a wide range of soil quality and pH. It changes soil chemistry and alters decomposition and nutrient cycling as well as other ecological processes in forests and woodlands, such as raising the humidity and increasing shade near the forest floor by forming an early spring canopy that continuously overtops most herbaceous native species and severely reduces seedling recruitment of shade tolerant conifer species, endangering boreal forests. It reproduces primarily vegetatively by fast-growing rhizomes, and spreads quickly as even a small rhizome fragment can resprout. It produces seeds that require cold stratification to germinate; therefore, seeds germinate the following year after initial dispersal. Its seedbank is short-lived. It can grow to be 15-40 inches tall. Bishop's goutweed is quickly dispersed as populations grow, increase, and spread rapidly through the rhizome system. Humans also are significant in its long-range dispersal through its use as a popular garden plant and sold as an ornamental groundcover. It also spreads through waterways. The destructive impact of bishop's goutweed on native plant species emphasizes the need for its control. The most effective control for an herbaceous, prolific rhizome forming and sprouting plant like bishop's goutweed is use systemic herbicides, such as glyphosate, because they are translocated to the roots. Manual treatments are not recommended for bishop's goutweed (VT Invasives 2023; Maine DACPF 2019).

Multi-Flora Rose (*Rosa multiflora*)

Multiflora rose is a perennial, deciduous invasive shrub introduced to the United States in 1866 from east Asia as rootstock for its aesthetic ornamental roses, a living fence, erosion control, and wildlife food and cover. It is found in abandoned fields, hedgerows, forest edges, and roadsides, and has a preference for full sun to moderate shade environments, but can also endure the shade of mature forests. It flourishes on sites having general poor growth conditions involving light, moisture, salinity, or pH, but does not tolerate extreme cold below -28^0 F. Multiflora rose spreads by seed, root sprouting and layering, a process where a stem, or cane, arcs as it grows coming in contact with the soil and produces roots to become a functionally independent plant. Canes have stout, recurved thorns. The fruit, or hips, persist on branches through winter providing a continuous food source as they are commonly found among the next year's flowers. Birds and mammals facilitate seed dispersal and seeds can remain viable in the soil for up to 20 years. After an initial slow growth period the first 1-2 years, the shrub reproduces aggressively by seeds and sprouts, and expands through layering to form dense thickets 6-10 feet tall, establishing monocultures that deteriorate natural environments and inhibit plant and wildlife diversity. Native invertebrates rarely consume its leaves creating a change in the chemical composition of the decomposing leaf litter that enhances the shrub's growth and dominance of the site, particularly in riparian areas. Treatment for control of multiflora rose includes the cut stem with immediate herbicide application method as with buckthorn. (https://extension.psu.edu/multiflora-rose).

2.10 Rare Species

An objective of the restoration plan, in the context of improving and enhancing floodplain and wetland habitat conditions, is to support the habitat requirements of both federally listed and state-listed threatened, endangered, or special concern species which are known to occur or could potentially occur in the vicinity of the Park. These federal and state-listed species are referred to collectively as rare species. The relevant information relating to rare species at the Kirvin Park restoration/enhancement area is provided in **Appendix H**

2.10.1 Criteria and Methods

The occurrence of any federally listed threatened or endangered species or their habitat on the Kirvin Park Site has been identified based on the USFWS on-line Information, Planning, and Consultation System (IPaC) (USFWS 2025). The occurrence of state-listed threatened, endangered, or special concern species and their Priority Habitats is based on established records available from, and communications with, MNHESP. As shown on **Figure 1**, the Priority Habitat of state-listed rare species (and Estimated Habitat of rare wetlands species) has been designated by MNHESP to run along both Sackett and Ashley Brooks and extend across much of the proposed restoration area. Accordingly, in September 2022, GE prepared and submitted on behalf of the City of Pittsfield (with its review and consent) a formal request for state-listed species information to MNHESP.[8] In addition, in July 2025, the IPaC process was conducted for the restoration area.

2.10.2 Findings

The results of the above-described consultations are documented in **Appendix H1.** As indicated there, the July 2025 IPaC consultation did not result in the identification of any species that is currently federally listed. However, two species which are proposed for federal listing, the tricolored bat (*Perimyotis subflavus*) and the monarch butterfly (*Danaus plexippus*), were included in the 2025 IPaC listing.[9]

As also documented in **Appendix H1**, MNHESP provided a response to GE's inquiry on the City's behalf on October 18, 2022, stating that the project site, or a portion thereof, is located within Priority Habitat 1465 (PH 1465) and Estimated Habitat (EH 1027) for two state-listed rare species – the dion skipper (*Euphyes dion),* a threatened species of moth; and the wood turtle (*Glyptemys insculpta*), a special concern species of reptile. In a subsequent letter to AECOM, dated October 21, 2022 (which did not reference the October 18, 2022 response), MNHESP identified those same two species plus two others – the bridle shiner (*Notropis bifrenatus*), which is a fish species, and the ocellated darner (*Boyeria grafiana*), which is a dragonfly species (identified by MNHESP as a butterfly) – "in the vicinity of the site." MNHESP subsequently provided clarification on the two responses cited above in the form of an email dated January 27, 2023. That email response clarified that the October 21, 2022 letter responded to the request "for species management/conservation purposes, and are not intended for use in MESA Project Review" (see Appendix H). Accordingly, for a typical MESA project review, only the dion skipper and wood turtle would be subject to MNHESP consideration.[10] However, for completeness, GE has also considered the other two species in this Final Restoration Plan.[11] On

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[8] As discussed further below, a request was recently made to MNHESP as to whether an updated request for state-listed species records is needed. A response from MNHESP has not yet been received.

[9] As noted in the September 2024 Revised Conceptual Restoration Plan, an earlier IPaC consultation, conducted on January 17, 2023, indicated that the Kirvin Park area potentially provided habitat for one federally listed species, the northern long-eared bat (*Myotis septentrionalis*), as well as the monarch butterfly (which was then a candidate species for listing). The July 2025 IPaC consultation did not include the northern long-eared bat on the species list for Kirvin Park.

[10] It should be noted that, although not identified by MNHESP as potentially present in the Kirvin Park area, the tricolored bat identified through IPaC is also a state-listed species. That species is discussed in Section 2.10.3.

[11] In their May 10, 2024 email, the Trustees noted that, in addition to the species identified by MNHESP, other species may be in the overall vicinity of Kirvin Park, as listed in the Pittsfield BioMap 2 report; and they requested that GE conduct monitoring for those species as well. However, the BioMap lists species that may be present in the overall vicinity, not those that may be present specifically in the Kirvin Park area. Further, BioMap2 (a 2011 document) has been superseded by the 2022 on-line BioMap (biomap hub arcgis.com). As discussed in **Appendix H1**, that current

July 7, 2025, a request was made to MNHESP as to whether its October 2022 rare species response remains applicable for this project or whether an updated request for state-listed species records is needed. A response from MNHESP has not yet been received. GE will advise the Trustees when that response is received.

Thus, in this Final Restoration Plan, based on the consultations and communications described above, the following rare species have been considered:

- Tricolored bat (Perimyotis subflavus);
- Monarch butterfly (Danaus plexippus);
- Dion skipper (Euphyes dion);
- Wood turtle (Glyptemys insculpta);
- Ocellated darner (Boyeria grafiana); and
- Bridle shiner (Notropis bifrenatus).

2.10.3 Implications for Restoration

Brief descriptions of the six species listed above are included in **Appendix H2**, along with an assessment of whether proposed restoration activities at Kirvin Park would be expected to adversely affect such species, and where warranted, measures to be taken to protect the species. As discussed there, the specific area proposed for restoration/enhancement does not contain preferred habitat for the dion skipper, ocellated darner, or the monarch butterfly and, if anything, the proposed activities will improve the habitat for those species after construction. The bridle shiner prefers clear streams with moderate coverage of submerged aquatic vegetation; such vegetative growth is not present in either Sackett Brook or Ashley Brook in proximity to Kirvin Park, and the high flashy flows in these brooks are likely constraints for this relatively weak swimmer.

For the wood turtle, as discussed in Section 1.1, MNHESP indicated in discussions in March 2025 that construction using machines should be limited to the non-active (hibernating) season for wood turtles (from November through March). At the present time, consistent with that recommendation, the schedule for on-site construction work is set to occur between November 1, 2025 and April 1, 2026.

BioMap for the Kirvin Park area (included in the appendix) indicates the presence of only one rare species habitat within this area; and does not list the species (which seems likely to be the wood turtle). In any case, the normal and required process to determine the need for monitoring of state-listed species at a project site is the formal request to MNHESP, as has been followed here. For these reasons, GE concluded in the Revised Conceptual Restoration Plan that is not necessary or warranted to consider or monitor for the additional species listed in the Pittsfield BioMap 2 that were not identified by MNHESP. That conclusion was approved by the Trustees via their December 10, 2024 conditional approval letter.

However, given the potential that such work would occur between April 1 and October 31, GE has developed a wood turtle management plan, which is presented in **Appendix A3**, for the protection of wood turtles in the event that on-site construction work is conducted during the wood turtles' active period. As also indicated in Section 1.1, GE responded to MNHESP in March 2025 requesting consideration of whether that management plan is sufficient to protect wood turtles during potential construction outside of the non-active time period. In addition, as requested by the Trustees and based on discussions with MNHESP, GE has included the creation of two wood turtle nesting habitat areas in this Final Restoration Plan, as discussed further in **Appendix A4**. Discussions with MNHESP regarding wood turtles will continue leading up to and through construction.

Finally, with respect to the tricolored bat, it is noted that, although a common approach to addressing potential effects on such bats is to implement time-of-year restrictions on tree cutting, the restoration plan for Kirvin Park does not propose to cut any mature native trees which might provide habitat for tricolored bats, and the thickets that will be removed do not provide desirable habitat for that bat.

2.11 Cultural Resources Assessment

Background research and a visual reconnaissance inspection were conducted to evaluate the potential for the site to contain historical or archaeological resources (jointly referred to as cultural resources). This research included review of the Massachusetts Historical Commission's (MHC's) report files and on-line databases as well as examination of historical aerial photographs and historic maps. In addition, AECOM sought input from the Stockbridge-Munsee Band of Mohicans, the Wampanoag Tribe of Gay Head (Aquinnah), the Schaghticoke Tribal Nation, and the Schaghticoke Indian Tribe regarding the locations of traditional Native American cultural properties in the vicinity of the site. Environmental data on soil types, topography, and drainage were also evaluated.

2.11.1 Background Research

This section describes the background research conducted to assess the potential for the site to contain cultural resources.

Previous Studies and Recorded Archaeological Sites

Although no archaeological sites or historic structures have been previously documented within Kirvin Park, the area west of the park along Sackett Brook to the confluence of the Housatonic River has one of the highest densities of previously recorded archaeological sites in the region. The general area known as Canoe Meadows, where Sackett Brook meets the Housatonic River, has reports of finds of native American artifacts and burials documented as early as the late 18th century. The exact locations of these sites are unknown because they were recorded based on secondary reports of artifact finds and historic maps rather than from systematic archaeological surveys.

In 1988, the Boston University Office of Public Archaeology conducted a reconnaissance survey for six miles of corridor in Pittsfield for the Tennessee Gas Pipeline NOREX project (Jones and Seasholes 1988). This corridor crosses Sackett Brook near the East New Lennox Road crossing. A subsequent survey of the pipeline corridor in 1990 identified a pre-contact site (MHC no. 19BK185) approximately 4,000 feet west of Kirvin Park near Court Hill, north of Sackett Brook.

Historic Maps and Aerial Photography

An 1858 map known as the Walling map depicts houses along Williams Street, but the land along Sackett Brook in the current project area is shown to be vacant. The residence of one T. Parker is mapped to the east of the current project, next to the border with Dalton. On the 1876 Beers map, the situation is much the same, but with the Parker house now owned by T. F. Clark. An 1888 USGS topographic map documents that a road had been constructed south from Williams Street across Sackett Brook and continuing uphill along Ashley Brook to Ashley Reservoir. That same configuration is depicted on the 1944 and 1959 USGS maps, with no other structures or manmade features besides the road located within the current project area. Aerial photographs document that the residential subdivision located just to the southeast of Kirvin Park off Mountain Drive was developed between 1960 and 1972.

Environmental Setting and Archaeological Site Potential

As discussed previously, the area being considered for ecological restoration encompasses roughly 15 acres south of Sackett Brook and east of Ashley Brook in an area of level to gently sloping terrain. A delineated wetlands complex is situated along the brook in an area mapped as poorly drained Limerick soils, with moderately well drained Hero soils abutting the wetlands to the south, and well drained Copake soils located on the higher slopes rising at the south end of the park adjacent to the residential subdivision.

Previous research in the region has indicated that well-drained terrace and knoll formations are typically considered to have high potential to contain archaeological sites, but the lower, poorly drained soils generally have a low potential to contain such sites.

Consultation with Native American Tribes

As noted above, AECOM sought input from the Stockbridge-Munsee Band of Mohicans, the Wampanoag Tribe of Gay Head (Aquinnah), the Schaghticoke Tribal Nation, and the Schaghticoke Indian Tribe via email or U.S. postal mail regarding the locations of traditional Native American cultural properties in the vicinity of the Kirvin Park project. No specific information on such resources was provided, but the Stockbridge-Munsee Tribal Historic Preservation Officer did note the overall general archaeological sensitivity of the region around the confluence of Sackett Brook and the Housatonic River.

2.11.2 Visual Site Reconnaissance

AECOM archaeologist Dr. Daniel Cassedy conducted a field inspection in August 2022 to visually assess and document the environmental characteristics of the project area and to search for visible above-ground cultural resources. This inspection included walking back and forth across the area; no subsurface investigations were conducted. The visual reconnaissance indicated that the formerly open agricultural fields have become dominated by dense stands of small buckthorn trees interspersed with patches of goldenrod herbaceous meadows. No cultural surface features such as foundations were observed during the reconnaissance.

2.11.3 Cultural Resources Summary and Evaluation

Background research has indicated that the project area does not contain any previously recorded archaeological sites or historic structures, and no historic structures or features are documented on available maps other than a farm access road. The property appears to have been cleared and used for agriculture in the past.

The area proposed for wetland restoration/enhancement has a low potential to contain archaeological sites, and in the areas proposed for invasive species control, low-impact methods of vegetation removal will be used that do not represent any additional impacts more substantial than those created by past agricultural activities. No further studies should be required in either of these areas.

The areas of higher elevation and well-drained soils at the southern end of the park adjacent to the residential subdivision have a high potential to contain pre-contact archaeological sites. However, based upon reviews of historical aerial photographs, the area of the south staging area/pollinator meadow area was subjected to filling activity in the 1960s, and has remained largely open shrub/scrub/old field habitat since that time; it was also in active agricultural use prior to the 1960s. Under the current restoration plan, this area will not be excavated or have any soil/substrate disturbed, but will have soil/substrate from the excavated wetland creation area moved into it and graded consistent with the current rolling relief of this field. This additional fill material will preserve any historical/archaeological features that may be present in this previously disturbed area, as unlikely as that may be. Accordingly, the proposed use of this area does not represent any additional cultural resource impacts at this site beyond that occurring from past land uses, and no further cultural resource study of this area is warranted.

AECOM

3.0 Restoration Plan Objectives

As noted previously, Section 118.e of the CD and Section 5 of Attachment I to the SOW require GE to install and monitor a total of 12 acres, or the equivalent of 12 acres, of forested/wetland habitat, consisting of approximately 9.75 acres of floodplain forest habitat and 2.25 acres of freshwater palustrine wetlands, within a non-contaminated riparian area of the Housatonic River watershed outside of the CD Site (provided that GE elected not to use Former Oxbow Areas A and C). As also described previously, the portion of Kirvin Park selected for this off-site restoration area is a 13-acre area south of Sackett Brook, which flows westerly through the Park, and east of Ashley Brook, which flows northerly through the Park to join Sackett Brook, as supplemented by a smaller (two-acre) supplemental tree planting area north of Sackett Brook and further east of Ashley Brook and a two-acre staging area, to be converted into a pollinator meadow habitat, south of the main floodplain restoration area.

As a result of the presence of the two brooks, a large area of Kirvin Park is situated in a riparian/floodplain setting. Despite this suitable setting, much of the floodplain riparian zone south of Sackett Brook is heavily dominated by invasive plant species, which collectively impair the overall habitat diversity and ecological functions of this site. Accordingly, a key objective of the proposed restoration/ enhancement program is to convert the invasive vegetative cover to a plant community dominated by a diverse assemblage of native (or indigenous) floodplain/wetland/riparian zone plant species. The occurrence of wetland in the lower portion of the floodplain, much of which is also dominated by invasive species, presents the opportunity to expand and enhance that wetland part of the floodplain to meet the requirements cited above. Conversion of these floodplain habitats from the current invasive species infestation to indigenous floodplain/wetland species is considered more than just "vegetation management," but rather is intended to restore the full complement of edaphic and biotic conditions in this floodplain setting to contribute to restoration of ecological functions and values, further enhanced by the two additional areas described above.

In terms of areal extent, a baseline objective of the restoration/enhancement project is to meet or exceed the area Performance Standards set forth in the CD and SOW. As shown on **Figures 6-1 and 6-2**, the layout of the restoration/enhancement project accomplishes this basic goal, as follows:

- The overall main restoration area encompasses approximately 13 acres south of Sackett Brook, including both floodplain/riparian zone restoration/enhancement and wetland creation/enhancement, compared to the 12 acres required by the CD.
- Ten acres of the project comprise the floodplain forest restoration/enhancement area, again slightly more than the CD requirements. This will be augmented by the supplemental tree

planting area, consisting currently of approximately two acres of open meadow habitat north of Sackett Brook and within the floodplain of this brook.[12]

- Three acres of the project comprises the wetland creation/enhancement portion of the site (versus 2.25 acres required by the CD). Of this three-acre area, 1.2 acres currently consist of upland floodplain, which will be converted to wetland as part of the proposed regrading, 1.2 acres are currently wetland which will be improved by regrading and replanting (along with the creation area), and 0.6 acres of existing wetland will be improved by invasive species control and re-plantings.

Other Performance Standards established in the CD and set forth in Section 5.1 of Attachment I to the SOW specify several planting requirements for the restoration/enhancement area, some specific to floodplain forest restoration area and some specific to the wetland creation area. Those Performance Standards have been incorporated into the planting specifications for each of these restoration components, as described in the following Sections 4 and 5. As also required under these Performance Standards, the restoration will also include the placement of uncontaminated stumps and rock piles randomly throughout the vegetated areas to provide habitat for fossorial and ground-dwelling wildlife, as well as the placement of bluebird boxes along the edges of these areas at roughly 300-yard spacing. Additionally, at the Trustees' request and based on discussions with MNHESP, GE is proposing to create two wood turtle nesting areas in the floodplain at the project site. This enhancement is discussed further in **Appendix H4**. After further discussion, a more detailed nest creation plan will be developed, which will be submitted to the Trustees (and can be reviewed by MNHESP) as part of the final design plans prior to the construction/implementation of the restoration project.

In addition to the Performance Standards, Attachment I to the SOW sets forth (in Section 5.2) a number of other planting requirements for the restoration/enhancement area. In several cases, as described in Sections 4 and 5 below, modifications to these requirements are proposed where considered appropriate to reflect site-specific conditions; and in those cases, an explanation is provided for the proposed modifications.

Finally, GE will conduct the actions listed in the last column of ARARs table in **Appendix A** to achieve the ARARs for this restoration/enhancement project.

[12] The creation of a two-acre pollinator meadow habitat in the southern port of the site, which is not required by the CD and SOW, will provide a further enhancement of the overall habitat in the Kirvin Park area.

4.0 Floodplain Restoration Plan

Figures 6-1, 6-2, and **6-3** depict the overall floodplain/wetland restoration/enhancement area proposed at Kirvin Park, as well as the supplemental tree planting area and the new pollinator meadow habitat area (on **Figures 6-1** and **6-3**). While the project has multiple components, the implementation of the overall floodplain/wetland restoration/enhancement project will occur as a single operation. For example, some of the steps described below for the floodplain restoration component apply to the wetland creation/enhancement work as well. In addition, implementation of the work will be subject to refinement and adjustments in procedures as a construction contractor (and any other contractors or subcontractors) are selected and brought on board. In implementing both the various project components as one operation, efficiencies are anticipated in terms of many of the work elements, including access and staging, erosion and sedimentation control measures, protection of rare species, processing and use of soils, cutting/chipping and disposal of vegetation, seeding and planting, and monitoring (in both construction and post-construction phases).

The 10-acre portion of the site intended to comprise the forested floodplain restoration area directly abuts Sackett and Ashley Brooks in the northern/northwestern part of the site, and extends south, wrapping around the southern edge of the wetland creation/enhancement zone to approximately elevation 1040 feet, near to where conditions rise more sharply from the riparian woodland into an old open field (the south staging area planned for pollinator meadow habitat). While there is some desirable native plant growth in this floodplain/riparian woodland (including cottonwood, silver maple, American elm, black cherry, red maple, box elder, black willow, silky dogwood, and hawthorn), which will be targeted for preservation during the restoration process, much of this area is infested with common buckthorn, Morrow's honeysuckle, bittersweet, garlic mustard, bishop's goutweed, and multi-flora rose. Procedures will be implemented, as described below, to remove these undesirable invasive species and establish a native floodplain forest plant community.

Other than the transition zone between the floodplain restoration area and wetland creation zone, the main floodplain restoration is not anticipated to entail a re-grading effort or grubbing of the root zone; this will minimize the impact to desirable vegetation as well as issues associated with surface soil erosion. In some areas, depending on final specifications, scraping of the surface duff layer may be implemented to remove concentrations of buckthorn drupe (i.e., fruit), and some tilling of the soil surface will be conducted to promote cover crop development and contribute to attenuation of potential allelopathic effects (as described in Section 2.9.2). Soil testing and revegetation procedures will be implemented both to promote desirable plant species and to inhibit re-growth of invasive species and improve the soil conditions that may have been impaired by invasive plant growth.

These steps, and others, are further described below. As noted above, some of the steps apply to the overall floodplain/restoration area, while other aspects apply only to portions of the floodplain outside of the wetland creation/enhancement zone. Work specific to the wetland creation/enhancement zone is further described in Section 5.

The two-acre supplemental tree planting area north of Sackett Brook will not require significant site preparation prior to tree planting. No removal of existing vegetation is warranted, and soil conditions appear to be suitable for readily accepting the planted trees (further described in Section 4.5).

In the south staging area that will ultimately be converted to a pollinator meadow habitat, following the management of the existing vegetation. the soil/substrate material from the wetland creation area will be transported to and spread over that area, raising the elevation of the existing south staging area by several feet. Work specific to the creation of the pollinator meadow habitat in that area is further discussed in Section 6.

4.1 Access and Staging

The September 2024 Revised Conceptual Restoration Plan considered access routes into the restoration site from both the north and south directions. Based upon subsequent input from the City, as well as the potential disruption issues to neighboring properties, the access from the south has been discounted as both impracticable and undesirable (largely due to potential disturbance to the adjacent residential neighborhood). Further reviews of the surrounding areas south of the restoration area have revealed additional constraints on any other potential southern access routes; such constraints arise from the presence of wetlands, Ashley Brook, mature forests, and steep slopes. Accordingly, no southern access route is currently being carried forward for the restoration plan (although the south staging area will continue to be used as described below). All access into and out of the restoration area will occur from and to the north, using the main entrance into Kirvin Park and the existing cart path that affords access to the restoration plan area. The Revised Conceptual Restoration Plan also included establishing a north staging area in the location of the supplementary tree planting area north of Sackett Brook. However, based upon input from the City, that north staging area will instead be located along the western side of the access road on an existing gravel pad roughly 600 feet north of Sackett Brook. The supplementary tree planting area will be used only for the additional plantings, as described in Section 4.5.

Access from the north will need to include a temporary crossing of Sackett Brook into the restoration area. That crossing will consist of a simple timber mat spanning Sackett Brook from bank to bank in a previously disturbed location. As part of this crossing, it is possible that an existing abandoned 36-inch cast iron culvert situated just into the wetland on the southern side of Sackett Brook in the vicinity of the crossing could be used as part of the support structure. This culvert was apparently used historically for the farm road crossing of Sackett Brook; and upon the removal of that road crossing, the culvert was abandoned in the wetland bordering the brook. While this culvert will ultimately be removed from the site as part of the restoration work, it could prove useful as part of the temporary crossing to support the timber mat bridge while allowing flow through the area unimpeded. This option will be reviewed with the construction contractor in developing final design plans.

As noted above, the previously proposed south staging area will continue to be an important component of the restoration process, both during construction and also after construction as part of the habitat enhancement measures. The south staging area consists of a previously disturbed roughly two-acre area composed of open field with scattered shrubs and trees. Aerial photographs indicate that this area was entirely an open field until around 2000, and it has grown in with mostly invasive plant species over the past 25 years. although a 2016 aerial photograph indicates that most of the area was still open field at that time. Many of the shrubs and trees growing there currently are invasive species, including common buckthorn, multi-flora rose, bittersweet, and Morrow's honeysuckle. Much of the open meadow consists of dense goldenrod growth, a plant cover that precludes the growth of other native species and thereby limits habitat value. Although goldenrod does have some pollinator value, it is very much a monoculture rather than supporting a diverse plant cover.

Given that the current habitat value of the south staging area is very low, enhancing the habitat value of this area is a worthwhile addition to the site restoration plan. Considering the options available for habitat enhancement, establishing a high-quality diverse pollinator habitat over the nearly two-acre area would represent a significant contribution to biodiversity of Kirvin Park and the surrounding landscape. As described in Section 6 and **Appendix I**, pollinators are critical foundational components of ecosystems, facilitating plant reproduction and supporting wildlife. As the initial step in creating this pollinator meadow habitat, the existing invasive plant species will be removed and the excavated soil/subsoil material from the wetland creation/enhancement area will be transported to this south staging area and graded to mimic the current rolling terrain of this area. This use has the added benefit of reducing the trucking of excavated soil material off-site. Section 6 provides details on the planned creation of pollinator habitat in this southern portion of the site, with supporting information in **Appendix I**.

4.2 Site Preparation

Standard measures will be implemented in advance of construction to prepare the site and to comply with environmental protection requirements. Work limits will be established in the field and erosion and sedimentation control measures and BMPs will be established under the direction of a wetland/environmental scientist. The sedimentation and erosion control BMPs will be established and implemented in substantial compliance with the EPA NPDES Construction General Permit (CGP). **Figures 6-2** and **6-3** indicate the limits of work that will be subject to erosion control measures, **Figure 6-4** notes that such measures will be established as a first order of the sequencing, and **Figures 6-4** and **6-5** provide details of the erosion control barriers.[13]

Given the presence of Sackett Brook along the northern side of the site, Ashley Brook along the west, and wetland conditions along the northeastern side, it is anticipated that a combined "work-limit" and siltation control barrier will be established along the full lengths of these three sides of the work area. The installation of this control barrier will be done in concert with field surveys of the site for wood turtle protection. Depending on the time of year and wood turtle life cycle status, this typically entails having a biologist sweep the area for wood turtles as the siltation control barrier is installed; any wood turtles encountered will be moved outside of the siltation barrier, with the objective of having the completed siltation barrier also serve as an exclusion barrier to maintain wood turtles outside of the work zone. This process is more fully described in the wood turtle management plan included in **Appendix H3**, which has been developed to address the potential for construction work to occur outside the wood turtles' non-active period. As noted above, while the current schedule would involve the performance of on-site construction work during the non-active time of year for wood turtles (November to March), discussions with MNHESP are ongoing as to whether implementation of that wood turtle construction management plan would adequately protect wood turtles if construction occurred outside of that time period.

Other components of site preparation will include creation of stabilized construction entrance(s), preparation of temporary access road surfaces, and installation of temporary construction-phase orange fencing where needed to isolate public users of the Park from the construction area (such as along the walking/bike path that extends north-south along the western side of the construction area adjacent to Ashley Brook). Pre-construction site preparation will also include the flagging of desirable vegetation intended to be preserved on the site. It is anticipated that this will focus on preserving major tree specimens, including cottonwood, American elm, black willow, boxelder, silver maple, and black cherry.

[13] More specifics on the sedimentation and erosion control measures will be provided in the final design drawings based on input from the selected contractor(s). Those drawings will also include details of the sedimentation and erosion controls in the new pollinator meadow area. Since the supplemental tree planting area will be used only for supplemental tree planting, erosion control measures will not be needed there.

4.3 Invasive Plant Species Treatment

As described previously, the active invasive species treatment program for the floodplain forest restoration will focus on several woody invasive plant species: common buckthorn, Morrow's honeysuckle, Asian bittersweet, and multi-flora rose, basically in decreasing order of prioritization given their respective prevalence and overall impact at the site. Fortunately, the treatment program for the primary invasive species of concern, buckthorn, will also encompass the treatment program for these other woody invasive species; the treatment program for the buckthorn is based on extensive research on this plant species including gaining experience from similar control programs in the upper Midwest (see **Appendix D**). There are also several herbaceous invasive species at the site, notably garlic mustard and bishop's goutweed, which will be pre-treated with herbicides prior to the woody cutting effort, and will have follow-up treatments in the longer-term monitoring and management process.

For the primary woody invasive species listed above, it is anticipated that these species will be cut flush (or close) to the ground surface, followed by immediate application of herbicide to the stumps, and the cut vegetation will then be chipped at the site and removed by truck from Kirvin Park to an acceptable disposal site. The south staging area or other location(s) within the floodplain restoration area may be used for the on-site chipping operation. It is also anticipated that the honeysuckle, bittersweet, and multiflora rose will be cut and treated in the understory of the buckthorn first, likely in discrete sections, followed by the more significant process of cutting/treating the buckthorn.

There are several options available in terms of timing for cutting and herbicide application, with both summer and fall options available. These are described in **Appendix D**. Either option has been shown to be effective for initial control, but follow-up treatments will be needed and conducted (see Section 4.6). As noted previously, the root systems of these woody invasives will not be grubbed in the floodplain restoration area; the systemic action of the herbicides is intended to kill the root systems (which are shallow for all the woody invasive species being treated here). As currently anticipated, the cutting and herbicide operation will be conducted in November (and possibly into December), which remains within the effective season for herbicide systemic treatment, likely using glyphosate (Round-up) for the stump treatments.

These methods and procedures are subject to further review and modification as the final design process is completed with the input of the selected contractor(s), as well as further review by the Trustees and the City.

4.4 Surface Soil Preparation

Upon the removal of the woody invasive species from the floodplain restoration area and treating the stumps with herbicide, the surface soils will be tested and further prepared for re-vegetation. Soils will be tested for conditions that may affect plant growth and productivity at an approved facility (such as the UMass Agricultural Experiment Station). This will include standard fertility testing such as testing for pH, acidity, extractable nutrients (phosphorus, potassium, calcium, magnesium, iron, manganese, zinc, copper, boron), lead, and aluminum, cation exchange capacity, percent base saturation, organic matter, and soluble salts. In areas observed to contain large amounts of buckthorn drupes or even buckthorn leaves, the upper 1-2 inches of soil may be scraped up and removed to a temporary stockpile area for either removal from the site or use in the deeper levels of the filled soil material in the south staging area/pollinator meadow. This may be done in conjunction with machine raking of the soil surface to clear out remaining woody debris.

Shallow tilling, or cultivating (or perhaps surface scarification), of the soil surface is likely to be conducted after removal of the invasive species to counteract soil compaction occurring during the invasives cutting and removal. This cultivating is significant to the removal/destruction of buckthorn and other invasive seedlings that may have been missed in the initial removal, and is intended to break up compacted soils, improve and soil structure and aeration, aid in the infiltration of precipitation, and improve the retention and germination of seeding. It has also been shown to impede the germination of buckthorn seeds and also to aid in identifying sprouting invasive plants for follow-up treatment.

No soil preparation is anticipated to be necessary in the supplemental tree planting area north of Sackett Brook. Soil conditions in that area appear suitable under existing conditions to support the tree plantings.[14]

4.5 Revegetation (Seeding and Planting)

After preparation of the soil surface, a revegetation program will be implemented in the forested floodplain restoration area. As noted previously, this revegetation/planting program will comply with the Performance Standards specified in Section 5.1 of Attachment I to the SOW where applicable. Other components of the revegetation program have been adapted from Section 5.2 of Attachment I to the SOW (Implementation) with some modifications to reflect site-specific conditions for the Kirvin Park floodplain and consistent with current standards. These are described further below. **Figure 6-3**

[14] Soil preparation in the south staging area/pollinator meadow habitat is covered by Section 6.2.

depicts the planting zones proposed for the floodplain restoration and wetland creation/ enhancement areas, as well as the supplemental tree planting area.[15]

The revegetation process will begin with broadcast seeding of a cover crop of annual rye along with the New England Conservation Wildlife Mix[16] (or a comparable seed mix), which is consistent with the herbaceous seed mixture of native grass and wildflower species specified in SOW Attachment I. This mixture will be seeded at a rate of 25 pounds per acre, which is consistent with (or higher than) that specified in Section 5.2 (25 pounds per acre with a nurse crop of annual rye grass not to exceed 10% of the seed mixture). The higher rate of annual rye seeding will be used to aid in controlling buckthorn re-growth. This cover crop will be allowed to become established for one growing season before implementing additional plantings. A determination will be made based on the time of year and prevailing weather conditions as to whether this seeding will occur late in the fall or early the following spring as the cutting/chipping operation is completed. In either case, it is anticipated that the additional plantings will occur after a full growing season of cover crop establishment. This cover crop growth will inhibit regrowth of buckthorn seedlings and other invasive species seedlings, as well as allow the cover crop root systems to stabilize the soil surfaces and improve soil conditions (and has also been shown to attenuate potential allelopathic effects remaining from invasives such as buckthorn). During this year of cover crop growth, monitoring will be conducted for sprouting invasive plants and follow-up herbicide treatments and/or hand pulling will be conducted.

After the year of cover crop growth, additional application of native cover crop seeding will be conducted (where needed) and native forested floodplain species will be planted over the entire restoration area, with the exception of areas where preserved desirable plant species occur (as shown on **Figure 6-3**). The planting notes, specifications, and schedule for the forested floodplain restoration area and the supplemental tree planting area are included on **Figures 6-4** and **6-5**.

The January 31, 2023 Conceptual Restoration Plan specified that, in accordance with the Performance Standards in Section 5.1 of SOW Attachment I, floodplain tree species would be planted at a density of 683 trees/acre in a heterogeneous pattern, resulting in the planting of 6,825 trees over the planned 10 acres of floodplain.[17] It noted, however, that such a high density of trees may be difficult to

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[15] The vegetation to be planted in the planned new pollinator meadow habitat in the south staging area is described in Section 6.3.

[16] Available from New England Wetland Plants, Amherst, MA.

[17] Section 5.1 of SOW Attachment I states that the trees in the floodplain area shall be planted at a density of 700/acre, but may be spread out over a larger area provided that the same number of trees are planted. Planting 700 trees/acre over the required floodplain area of 9.75 acres would require 6,825 trees. Planting that same number of trees over the planned 10 acres of floodplain would involve planting 683 trees/acre. As discussed below, if the planting of the same number of trees is spread out over the entire 13-acre restoration area plus the two-acre supplemental tree planting area, the planting density is 400 to 463 trees/acre.

sustain. The Trustees commented that alternative planting densities/arrangements should be considered, as well as tree planting in other locations at Kirvin Park outside the designated restoration area. On further review, given that the Performance Standards indicate that the plantings may be spread out over larger areas provided that the required total number of plants are installed, GE revised its planting plan in the September 2024 Revised Conceptual Restoration Plan to provide for the planting of 6,025 trees in the overall restoration area of 13 acres (10 acres of floodplain plus three acres of wetlands), for an average of 463 trees/acre in that area, plus the planting of 800 trees in the two-acre supplemental tree planting area, for an average of about 400 trees/acre in that area. This plan thus results in the planting of the required total number of 6,825 trees.

The following species of trees will be planted in the floodplain restoration area at the following percentages: silver maple (25%), cottonwood (25%), box elder (20%), red maple (5%), black willow (20%), and pin oak (5%).[18] Three of these species (cottonwood, box elder and black willow) were included in the tree species listed in Section 5.2 of SOW Attachment I, along with American elm. American elm is not proposed to be planted because: (1) there is concern for Dutch elm disease (as noted in Section 5.2); and (2) there are sufficient numbers of American elm on the site which will be preserved under the restoration plan. A greater amount of black willows (20%) will be planted than specified in Section 5.2 (5%) because black willow is currently an important tree species growing in the Kirvin Park floodplain (especially outside of the restoration area) and has shown high resilience to the effects of beaver flooding on the site. Silver maple, red maple, and pin oak have been added to the tree planting list for the floodplain to contribute to the diversity of tree species by indigenous floodplain species found in the Housatonic floodplain. The trees will be planted on approximately 9.7-foot centers to achieve the intended density. Given this density, rather than planting container-grown trees four feet to six feet in height (as stated in Section 5.2), the trees to be planted will be 18-inch to two-foot tall specimens. Planting these slightly smaller trees is consistent with recent experience and guidance indicating that this size of planted trees has a greater success rate (likely due to reduced stress to root systems supporting taller specimens) (Jackson and Lunt 2014). The above-listed tree species are relatively fast-growing; and once root systems have adjusted to planted conditions, the height of the trees will quickly make up the difference in original plant height. The same tree species and percentages will be planted in the supplemental tree planting area north of Sackett Brook, except that speckled alder will be planted instead of black willow. Trees in the supplemental tree planting area will be planted at 10.5-foot spacing (for a total density of 400 trees/acre).

[18] The tree species to be planted in the wetland creation/restoration area are specified in Section 5.3 below.

As also required by the Performance Standards in Section 5.1 of SOW Attachment I, floodplain shrub species will be planted at a density of 712 shrubs/acre over the floodplain restoration area of 10 acres, resulting in the planting of a total of 7,118 shrubs.[19] The shrubs will be planted (to the extent practicable) in oblong patches of 30 feet by 50 feet, with a minimum distance of 40 feet between patches, and with plantings in each patch on four-foot centers (as provided in SOW Attachment I).

The shrub species to be planted will consist of equal numbers of the following four species: silky dogwood, pussy willow, arrowwood, and elderberry. Although Section 5.2 of SOW Attachment I lists serviceberry (*Amelanchier canadensis*) instead of elderberry as one of the shrub species to be planted, elderberry has been shown to be an effective species inhibiting the re-growth of buckthorn, is already present in small quantities on the site currently, and therefore has been selected as a replacement for serviceberry. The shrubs to be planted will consist of 18-inch container-grown shrub specimens (versus 2-3-foot tall shrubs specified in Section 5.2) to minimize the effects of stress typically observed from planting taller specimens, particularly at the specified density.

The January 31, 2023 Conceptual Restoration Plan also specified that, in accordance with the Performance Standards in Section 5.1 of SOW Attachment I, vines would be planted at a density of 40/acre in the floodplain, although, again, GE expressed the concern that such a density of vines could threaten the growth of the small/young trees and shrubs. To address this concern, GE revised its planting plan in the Revised Conceptual Restoration Plan to provide for the planting of vines at a net density of 30 vines per acre over the entire 13 acres of the restoration area. This will result in the planting of a total of 390 vines, which is the same number required by the applicable Performance Standard.[20] Vines will not be planted in the supplemental tree planting area.

The vine species to be planted will consist of equal numbers of river grape and Virginia creeper, with the latter species added to the grape species specified in Section 5.2 to increase diversity using an indigenous floodplain vine species. In compliance with the Performance Standards, the vines will be planted in small oblong patches of 15 feet by 30 feet, with a minimum distance of at least 150 feet between patches and with plantings in each patch on four-foot centers.

[19] The Performance Standard in Section 5.1 of SOW Attachment I specified the planting of 730 shrubs/acre. Planting at that density over the required floodplain area of 9.75 acres would require the planting of 7,118 shrubs. Planting that same number of shrubs over the planned 10 acres of the floodplain restoration area would involve planting 712 shrubs/acre.

[20] Planting at a density of 40 vines/per acre, as required by the Performance Standard in Section 5.1 of SOW Attachment I, over the required floodplain area of 9.75 acres would require planting 390 vines.

4.6 Installation of Structures and Wood Turtle Nesting Areas

As also required by the SOW Attachment I Performance Standards, the floodplain restoration will include the placement of uncontaminated stumps – or coarse woody material (CWM) – and rock piles randomly throughout the vegetated areas to provide habitat for fossorial and ground-dwelling wildlife.

The intent of adding CWM is to add habitat functions to the restored site. CWM includes such materials as logs (ideally, a mix of hardwoods for longevity and softwoods), stumps, smaller branches, and standing snags, but not woodchips or mulch made from wood, which breaks down much more quickly. During the restoration work, consideration will be given to leaving any standing dead woody vegetation in place. In the first years, if a tree remains upright, the greatest volume of its litter may consist of bark, twigs, and small branches. Later, as insects and fungus weaken the aerial framework, larger limbs and sections of the trunk tumble to the ground where decay occurs under quite different conditions. On the forest floor, well-decomposed logs may sustain greater faunal richness. In an ideal situation, there would be an uninterrupted supply of woody litter in various sizes and stages of decay providing a diverse range of habitats. Decomposition is one of the natural processes in a healthy forest (USACE NED 2020). During the restoration work, the wetland scientist will work with the selected contractor(s) to add stumps or other CWM, as well as rocks, to achieve the intent of improving habitat functions.

In addition, as required by the SOW Attachment I Performance Standards, bluebird boxes will placed along the edges of the vegetated areas at roughly 300-yard spacing. This will involve the installation of approximately five bluebird boxes. Locations for these bluebird boxes are shown on **Figure 6-3.**

As discussed in Section 3, as an addition to the requirements of the Performance Standards, in response to comments from the Trustees, two wood turtle nesting areas will be constructed within the floodplain restoration area. One of these nesting habitat areas will be located in the northwestern part of the floodplain restoration area, near the confluence of Ashley and Sackett Brooks. The second nesting area will be located in the central portion of the site, just south of the created wetland boundary. The locations of these nesting areas are shown on **Figure 6-2**. As noted above, such measures have been discussed with MNHESP, which suggested having more than one such nesting area and locating one higher in the floodplain, as has been done. The nesting areas will consist of relatively small (i.e., <2,000 square foot) areas where sandy gravelly material will be deposited and maintained (for the five-year maintenance period) with minimal vegetated cover. Further details of the wood turtle nesting areas will be presented in the final nest creation plan, which will be submitted to the Trustees (and can be reviewed by MNHESP) as part of the final design plans prior to construction/implementation of the restoration project.

5.0 Wetland Creation and Restoration Plan

As described in Section 4, the wetland creation/restoration work will be integrated with the forested floodplain restoration work to maximize efficiencies in many of the work elements, including access and staging, erosion and sedimentation control measures, protection of rare species, processing and use of soils, cutting/chipping and disposal of vegetation, seeding and planting, and monitoring (in construction and post-construction phases). Those integrated work elements are not fully repeated in this section. This section describes the specific implementation of work within the wetland portion of the restoration area that is distinct from the floodplain work.

5.1 Invasive Plant Species Treatment

The initial stage in the wetland creation and restoration work will be similar to that in the adjacent floodplain restoration area and will be conducted as part of that operation. Since the wetland portion of the work area contains many of the same woody invasive species as the adjacent floodplain area (i.e., common buckthorn, Morrow's honeysuckle, Asian bittersweet, and multi-flora rose), the initial treatment program will be the same and will be conducted as a single operation. As described in Section 4.3, this will involve cutting of these invasive species to the ground level and applying herbicide to the cut stumps, with the cut woody stems being chipped on-site and subsequently removed and disposed of by the contractor.

Upon removal of the invasive woody vegetation from the three-acre wetland creation/restoration area, some additional cutting of non-invasive plants will be needed within the 2.4-acre portion of the wetland/upland complex that will be subjected to re-grading. It is noted, however, that the vast majority of this area is dominated by invasive plants. Within this zone, grubbing of the root zone will occur in preparation of the re-grading work described below. It is anticipated that the grubbed root masses will also be processed on-site, likely with preliminary grinding, and will ultimately also be chipped (which may require different equipment than used for woody stems). Again, this chipped woody material will be transported from the site for off-site disposal in an approved area.

5.2 Wetland Creation/Enhancement Area Re-Grading

The wetland creation/enhancement effort involves re-grading a roughly three-acre area of the site to improve the hydrology, flood storage capacity, and ultimately the wetland habitat conditions within this area. **Figure 6-2** shows the proposed grades to be achieved in this area, which spans from the beaver-impounded portion of the wetland across the northern tier of the site toward the existing foot trail that runs south from the Sackett Brook footbridge. In general, surface grades through this area will be lowered one to two feet. The re-grading will include the removal of the historical fill associated with the old farm road that extended through the wetland floodplain area. On-site investigations during wetland delineation efforts included examining the composition of this fill as it forms part of the wetland boundary. In all cases, the fill material observed within the old farm road appeared to consist of clean sandy loam with no signs (visual or olfactory) of contamination. Removing this fill, followed by lowering the surface grades to the west of this filled causeway, will allow surface water that is impounded by the beaver dam where it ties into the farm road to disperse across the re-graded wetland/floodplain surface. Lowering the grades in this area from the current typical level of 1019-1021 feet to mostly 1018-1020 feet will bring this area within the range of the 1-2 year flood levels (see Section 2.3) and also the seasonal high water table apparent from groundwater monitoring and soil profile characteristics. These actions are consistent with the wetland Performance Standard in Section 5.1 of SOW Attachment I stating that "GE shall take actions (such as grading that encourages the ponding of water) designed to create such wetlands."

The first step in this re-grading process will be the vegetation clearing and grubbing described above. Common buckthorn, the primary invasive woody plant growing in this area, has a shallow root zone that largely occurs in the top one foot of the soil, with some extension to two feet deep. Accordingly, the grubbing operation will initiate the removal of the topsoil as the top one to two feet of soil will be excavated and segregated from deeper soils to allow for potential re-use of the topsoil for the wetland creation area. The topsoil will be transported to the south staging area and stockpiled separately there, and will be screened to remove roots, rocks, and other unsuitable material. After excavation of the topsoil, the subsoil will be excavated to roughly one foot lower than the final grades shown on the grading plan to allow for final placement of one foot of the screened topsoil (with at least 12% organic matter or 7% organic carbon) that had been stockpiled at the south staging area. Further, the subgrade of the wetland excavation zone will be machine-compacted, possibly with a less permeable silt layer, to reduce the infiltration rate of surface water into this area from the east and south. The final (upper) one-foot layer of topsoil placement will be conducted in a manner to minimize the compaction of this soil, and the surface will be scarified/raked and lightly mulched with straw prior to seeding and planting, as described below.

The grading for the wetland creation area will result in an increase in flood storage volume within the floodplain at Kirvin Park. The net increase in flood storage volume due to the creation of the wetland will be greater than 7,000 cubic yards. Further, there will be an increased volume of flood storage at each one-foot elevation increment up to the 100-year flood level. This means that, even for more frequent flood events such as the one-year or two-year flood event, more flood storage will be available at the site after the wetland creation work than exists there currently.[21] Overall, there will be

[21] As described in Section 4.6, two small wood turtle nesting areas (<2,000 square feet each) will result in the placement of minor amounts of fill in the floodplain (total of 600-700 cubic yards). Factoring this fill into the

a net balance of cut and fills on the site, since excavated soil/substrate material from the wetland floodplain area will be brought to the south staging area for regrading outside of the floodplain, as discussed in Section 6.2.

Again, the methods and procedures described in this section are subject to review and modification as the design process is completed with the input of the selected contractor(s), as well as further review by the Trustees and the City. These activities will be conducted in accordance with the substantive provisions of the ARARs that relate to work in wetlands, as described in **Appendix A**.

5.3 Revegetation (Seeding and Planting)

The Performance Standards in Section 5.1 of SOW Attachment I state that, for the area targeted for the creation of freshwater palustrine wetlands, GE will "plant ½ of the wetlands area with species typical of a circumneutral shrub swamp community and ½ with species typical of a graminoid marsh community." The currently proposed planting program for the wetland area has been developed to meet this standard, as well as to be largely consistent with the implementation specifications presented in Section 5.2 of SOW Attachment I, with some modifications as described below.

Figure 6-3 presents the planting zones and **Figures 6-4** and **6-5** include the planting notes, specifications, and schedule for the wetland creation/restoration area. As shown on these figures, rather than attempting to distinguish between portions of the wetland supporting a shrub swamp versus portions supporting a marsh community, the entire wetland creation/enhancement area will be planted with species comprising both of these wetland types. This is more consistent with conditions typical of a floodplain wetland setting and is intended to ensure coverage of the entire area with both wetland herbaceous species and shrub species to better control regrowth of buckthorn and other invasive plant species and also to promote a heterogeneous cover type of floodplain wetland supporting a mixture of shrub and marsh species. In addition, as discussed above, wetland tree species will be planted to encourage the development of floodplain wetland forest along the Sackett Brook riparian zone for both habitat enhancement and invasive species control. The specifics of the revegetation in the wetland area are presented in the following paragraphs.

Herbaceous vegetation coverage throughout the wetland portions of the restoration area will be accomplished with the seeding of a wetland seed mix (New England Wetmix or a comparable seed mix) (see **Figure 6-4** for seed mix specifications), along with the seeding of a buckthorn-resistant native annual rye cover crop. This wetland seed mixture is consistent with that specified in Section 5.2 of SOW Attachment I, and the rye cover crop will be added for invasive species control. The seeding

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calculation of flood storage volume changes in the floodplain at the site does not appreciably alter the flood storage volume assessment (with a net increase of more than 7,000 cubic yards), nor does it change the finding of a net increase in flood storage volume in each one-foot elevation increment in the floodplain at the site.

will be conducted at a higher rate than specified in Section 5.2 – 25 lbs/acre of the Wetmix (vs. one pound per 2,500 square feet, which is 17.4 lbs/acre, in Section 5.2) and 25 lbs/acre of annual rye (vs. none specified in Section 5.2 for the wetland area).

As with the floodplain planting schedule, the cover crop and wetland seed mix will be allowed to become established for one growing season before implementing additional plantings. This will allow the cover crop root systems to inhibit regrowth of buckthorn seedlings and other invasive species seedlings, as well as to stabilize the soil surfaces and improve soil conditions, and has also been shown to attenuate potential allelopathic effects remaining from invasives such as buckthorn. During this year of cover crop growth, monitoring will be conducted for sprouting invasive plants and follow-up herbicide treatments and/or hand pulling will be conducted. In addition, during this year, the hydrology of the site will be monitored to assess the suitability of the final grading to achieve the intended conditions.

Wetland shrub species will be planted in the wetland creation/enhancement area at an overall density of 730 shrubs/acre. The following species of shrubs will be planted at the following percentages: silky dogwood (25%), pussy willow (25%), winterberry holly (15%), meadowsweet (10%), and steeplebush (10%). These five species have been substituted for two shrub species listed in Section 5.2 of SOW Attachment I (red-osier dogwood and spicebush) to add to the overall diversity of shrub species in this wetland. As also specified in the floodplain planting program, these shrubs will be planted in the wetland area on four-foot centers in oblong patches of 30 feet by 50 feet, with a minimum distance of 40 feet between patches. Again, the shrubs to be planted will consist of 18-inch container-grown shrub specimens (rather than 2-3-foot tall shrubs specified in Section 5.2 of SOW Attachment I) to minimize the effects of stress typically observed from planting taller specimens.

Section 5.2 of SOW Attachment I also specified the planting of herbaceous plants in the marsh portion of the wetland on four-foot centers, using two-inch peat pots of six species of wetland grass, sedge, rush, and forbs. These species, or their equivalents, are all included in the wetland seed mix described above and therefore are not proposed for planting as two-inch peat pots, particularly given the higher seeding rate currently proposed for the seed mix. Further, instead of these plantings, three species of wetland ferns will be planted at a density of 200/acre in a clustered configuration in the following percentages: sensitive fern (40%), ostrich fern (30%), and cinnamon fern (30%).

Finally, consistent with the discussion above and in accordance with the tree planting density specified for the restoration area in Section 4.5, wetland tree species will be planted in the wetland area at a density of 463 trees/acre, using 18-inch specimens of the following species at the following percentages: speckled alder (25%), silver maple (25%), red maple (25%), black willow (20%), and cottonwood (5%). These are all species adapted to growing in wetland floodplains in the Housatonic River Valley. They will be planted on approximate 9.7-foot centers.

6.0 Pollinator Meadow Habitat

As noted previously in this document, a recent addition to the Kirvin Park habitat restoration plan is the creation of a pollinator meadow habitat in the south staging area as a further habitat enhancement measure on the site. This section provides a description of this habitat enhancement feature, including the overall objectives and a summary of the components of the pollinator habitat and the steps for establishing it. **Figures 6-6** and **6-7** provide details on the layout of the pollinator habitat and plant species to be selected in establishing this habitat, and **Appendix I** provides further background information on the recent initiatives of pollinator habitat creation in the Berkshires, as well as additional technical information on such habitats.

6.1 Overview and Objectives

The south staging area consists of a previously disturbed roughly two-acre area composed of open field with scattered shrubs and trees (see photographs in **Appendix I**). As noted in Section 4.1, aerial photographs indicate that this area was entirely an open field until around the year 2000, and that it has grown in with mostly invasive plant species over the past 25 years, especially the last 10 years. Many of the shrubs and trees growing there currently are invasive species, including common buckthorn, multi-flora rose, bittersweet, and Morrow's honeysuckle. As also noted in Section 4.1, much of the open meadow consists of dense goldenrod growth, a plant cover that precludes the growth of other native species and thereby limits habitat value.

In short, the current habitat value of the south staging area is very low. Accordingly, enhancing the habitat value of this area by establishing a high-quality diverse pollinator habitat there after moving the excavated soil/subsoil material from the wetland creation/enhancement area will contribute significantly to biodiversity of Kirvin Park and the surrounding landscape. Pollinators are critical foundational components of ecosystems, facilitating plant reproduction and supporting wildlife. Research indicates that many pollinator species, such as native bees and monarch butterflies, are declining due to habitat loss, pesticide exposure, and agricultural intensification. In Massachusetts, for example, populations of three bumblebee species have declined by over 90% in the past 30 years, highlighting the urgency of conservation efforts (e.g., Mass Audubon 2025; MAPN 2025).

Creating a pollinator habitat at Kirvin Park is consistent with other efforts along the Housatonic River Valley from the Connecticut border to Pittsfield, as described in **Appendix I**. Establishing a network of pollinator habitats through the valley is crucial for supporting local ecosystems and biodiversity. Pollinators, such as bees, butterflies, and moths, are essential for the reproduction of many plants, which in turn support food production and wildlife. Given the above-mentioned decline in many pollinator species due to habitat loss, pesticide use, and agricultural intensification, conservation efforts are vital. The pollinator habitat to be established in the south staging area will consist of a diverse assemblage of native wildflowers (e.g., milkweeds, asters, coneflowers) with scattered shrubs and small trees (e.g., viburnums, chokeberries, crabapples, red maple), creating landscapes as shown in photographs in **Appendix I**. The habitat will be integrated with the main floodplain restoration area. Informational signs may be included to educate visitors about the importance of pollinators, listing species like monarch butterflies and native bees and providing tips for supporting them. This aligns with community engagement efforts, such as those by the 1001 Pollinator Gardens initiative (https://1001pollinatorgardens.wordpress.com/home/), which includes members of the local community in and around Pittsfield. While this project will establish a pollinator habitat at Kirvin Park, it is also to serve as a catalyst to encourage community stewardship to collectively contribute to the long-term sustaining of this habitat feature in Kirvin Park.

The content and composition of the proposed pollinator habitat at Kirvin Park have drawn from other recent pollinator habitat initiatives in the Berkshires. In particular, recent efforts in Egremont and Great Barrington, Massachusetts (described in **Appendix I**) have been consulted and many details from these initiatives have been incorporated into the Kirvin Park pollinator habitat plan.[22] The following sections summarize the steps for the creation of this pollinator habitat, with reference to **Figures 6-6** and **6-7** for additional details.

6.2 Site Preparation

Site preparation for the pollinator habitat is closely tied to the use of the two-acre area as part of the staging area for the floodplain/wetland restoration operations described above. The use of this area to support the floodplain and wetland restoration work prior to the establishment of the pollinator habitat will include the following:

- Temporary stockpiling of brush cut from the floodplain/wetland areas, including chipping of woody plant material prior to removal from the site;
- Temporary stockpiling and processing (e.g., screening and sorting) of soil/substrate excavated from the wetland creation area; and
- Deposition of the soil/substrate material excavated from the wetland creation area and grading of this material to raise the surface elevation of the future pollinator meadow habitat by several feet, with suitable topsoil conditions at the surface to accommodate the pollinator habitat.

As part of the site preparation for these uses, and for the forthcoming pollinator meadow creation, management of existing vegetation in the south staging area will be conducted. This will include

[22] See https://www.egremont-ma.gov/DocumentCenter/View/234/Pollinator-Pathway-PDF?bidId= greatbarringtonpollinatoractionplan2018.pdf

cutting and herbicide stump treatment of invasive woody species (such as buckthorn, Morrow's honeysuckle, and multiflora rose), consistent with the procedures employed on the floodplain area described above. Some existing native tree species in the south staging area will be flagged for preservation if possible (although filling of this area may preclude such preservation). The existing topsoil in the south staging area will be evaluated for possible re-use for the pollinator meadow habitat. As chipped woody vegetation is removed from the area, the soil/substrate material transported from the wetland creation area and then screened/sorted will be spread over the south staging area. This graded material will raise the elevation of the existing south staging area by several feet. This will be conducted in a manner to preserve the current rolling terrain of this site and to maintain the form and function of the existing swale area that runs south-to-north along the eastern side of the area. The proposed grades of this area shown on **Figure 6-6** reflect this grading operation. The material to be used as surface topsoil, which will consist of either re-use of the existing topsoil in the south staging area or new topsoil obtained from an off-site source, will be evaluated by the on-site environmental scientist to ensure that it is suitable for the growth of the pollinator meadow habitat described below. If suitable, that topsoil will then be placed and graded over the area.

As noted previously, the movement of excavated soil/substrate material from the wetland creation area to the south staging area and its placement there to raise the elevation of the latter area will result in a net balance of cut and fill on the overall site. It will not affect the overall increase in flood storage volume in the floodplain at the site since the south staging area is outside of the floodplain. This movement and re-use of more than 7,000 cubic yards of excavated soil/substrate within the restoration site will also limit the need for trucking this material off-site, reducing the impact of such trucking on the Kirvin Park users and their activities.

6.3 Plant Community Composition

After final grading of the topsoil on the south staging area, an initial cover of a meadow cover seed crop will be sown, including fast-germinating grasses such as Canada rye or annual rye (e.g., the New England Conservation Wildlife Mix described in Section 4.5), to assist in soil stabilization as well as minimizing weed invasion. The seeding will also include both annual and perennial native wildflower species selected to include a variety of sizes, colors, flowering times, and growth forms, as well clump-forming grasses such as little bluestem and Indian grass. **Figure 6-7** provides lists of acceptable seed mixes and of the tree and shrub species anticipated to be installed at the pollinator area, but the final selection will reflect input from the selected contractor based on availability, timing, and other factors.

Following the Egremont pollinator plan, which fits with the setting of the Kirvin Park pollinator habitat area, three pollinator zones will be created, as shown on **Figure 6-6** and summarized as follows:

- Upland Meadow: This pollinator habitat will comprise the major portion of the Kirvin Park pollinator habitat area, extending from the western edge across the higher elevation portion of the area up towards the northern end. This area will emphasize upland wildflowers with less than 25% grass cover and patches of flowering shrubs such as meadowsweet, dogwoods, and steeplebush (see **Figures 6-6** and **6-7**). A mowed trail will extend in a circuitous route through this area, connecting to the existing trail near to Ashley Brook along the western side of the site. A bench will be situated at the northern end of the trail for visitors to rest and observe the meadow. A number of bee nesting strips will be included within this planting zone, as shown on **Figure 6-6**, given that 70% of native bee species are ground nesting (UMass Amherst 2025).
- Wet Meadow: This habitat zone will extend along the existing swale in the eastern part of the area. While this swale is not technically a wetland, it receives sufficient runoff from the surrounding landscape that species adapted to periodic wet soils will be established here. Some willow shrubs will be included with the wildflower and grass seed mix used for this zone.
- Woodland Edge: This planting zone will wrap around the northern and eastern edges of the area where existing tree cover occurs and will accommodate a transition between open meadow and woodland conditions. Small trees, such as shrub willows, crabapple, and shadbush, will be planted in this zone along with shrubs and wildflower species adapted to more shaded conditions.

6.4 Sequence of Steps to Establish the Pollinator Habitat

Creation of the pollinator habitat area is not a "one-time" short event, but rather requires a sequence of steps over several years, as discussed in **Appendix I.** Both the Egremont and Great Barrington examples mentioned above include a three-year process with evolving plant succession and associated management during each year. Consistent with the preferred approach, during the first year of growth, when the average height of vegetation in a seeded area is approximately 12 inches, the area will be weed whacked or brush hogged to a height of no less than eight inches. This will reduce annual weed growth and also allow young perennial plants to become established below the mowed height. During the second year, the faster-growing perennials will become more established. In that year, if the majority of vegetation in a given area is native species from the seed mixes, the mowing will transition to a once-a-year mowing; but if the majority of vegetation in an area remains non-native grasses and/or weeds, then mowing will be continued to keep the overall height of plants between eight and 12 inches. In either case, control of weeds and invasive species will continue. By the third year, the native meadow plants should be fairly dominant in the area and should be able to resist invasive species and weeds with minimal management. In that year, the mowing can be conducted annually for all or portions of the area to protect dormant insects.

7.0 Management and Monitoring

Management and monitoring of the entire restoration process will be critical to success of the project. This section describes such measures for both the construction and post-construction phases.

7.1 Construction-Phase Management and Oversight

A wetland scientist with specific experience in the implementation of habitat restoration/mitigation projects will oversee the entire restoration/enhancement project. This oversight will include, but will not be limited to, coordination of wood turtle sweeps during set-up and throughout construction (if conducted during the wood turtles' active period), oversight of erosion control monitoring, direction on preservation of desirable vegetation and on invasive species identification and treatments, oversight of staging area operations and disposition of cut and chipped woody vegetation, review and input on soil management during grading operations, and oversite of vegetation seeding and planting, follow-up herbicide treatment, and installation of the structures described in Section 4.6. In addition, a certified arborist will be involved in selecting and reviewing the vegetative materials/plants before and during seeding and planting, unless the wetland scientist is approved by the Trustees as an alternative or is acting under the direction of the certified arborist.

Note that the wood turtle monitoring before and during construction, if conducted during the wood turtles' active period (which is not currently anticipated), is described in detail in the wood turtle management plan in **Appendix H3**, and will be followed before and during any construction activities conducted during that period. This monitoring, if required, would include monitoring by a qualified herpetologist who will conduct surveys (sweeps) before and during construction for wood turtles within the work area, translocating wood turtles found within the work area to safe locations outside of the work area, contractor education on the identification and safe handling of wood turtles, and reporting any encountered wood turtles (or other state-listed species) to MNHESP. In addition, the herpetologist will inspect the sandy-gravelly material proposed for the wood turtle nesting areas to ensure that it meets intended composition. This material may be available from the excavated wetland area (in addition to the subsoil to be moved to the south staging area), where the subsoil conditions have been documented to include a coarse sand and gravel component which, if approved by the herpetologist, could provide the appropriate nesting habitat material.

A traffic control plan will be prepared, submitted to the City for review and acceptance, and finalized based on the City's comments for inclusion in the final design/construction documents. The traffic control plan is expected to include use of advance warning signs on approaches to the Park intersection on Williams Street. Additionally, given the narrow geometry of the intersection and obstructed sight distances on both directions of Williams Street due to elevation changes, it is anticipated that flaggers will be needed to temporarily halt traffic in order to safely allow the ingress and egress of construction vehicles to and from the site. Further, the anticipated hours of operation during which this plan would be in effect will be submitted to the City for its comments and acceptance. This will take into account local conditions; for example, given that Williams Elementary School is nearby, the City may establish restrictions on traffic stoppages on Williams Road during certain hours of the day based on school traffic. Scheduled athletic or other events at Kirvin Park will also need to be considered in the traffic detail. Signs along the access road through the Park will be considered, as well as flaggers along the access road when trucks are moving into or out of the site.

7.2 Post-Construction Monitoring and Maintenance and Reporting

The post-construction monitoring, inspections, and maintenance of the installed communities will be conducted in accordance with the applicable Performance Standards and other requirements set forth in Section 8 of Attachment I to the SOW. The floodplain/wetland restoration area will be monitored for re-growth of invasive plants for a period of five years following completion of planting, and needed follow-up herbicide treatments will be implemented throughout this monitoring period. Additionally, the staging area will be monitored during this same five-year period to ensure site stabilization and control of invasive species. This monitoring will also be conducted in the supplemental tree planting area if it is used for staging prior to planting. However, if that area not used for staging, it will be monitored for a similar five-year period, but only for the success of the tree plantings. As described in Section 6.4, the pollinator meadow habitat will require a three-year grow-in period where management such as mowing will vary each year depending on the successional plant growth. However, that area will be monitored for the same five-year period as the other restored areas. In accordance with Attachment I to the SOW, after the five-year monitoring period, GE will not have responsibility for the property (with the single exception noted in the next paragraph).

During the five-year monitoring period beginning at the completion of planting, monitoring and inspections will be conducted two times per year for the first three years after planting, and once during the fifth year after planting. In each of the first three years after plantings, GE will inspect each of the planting areas in the late spring after the first leaf flush (May/June) and in the summer (July/August) to assess plant survival. During the fifth year after plantings, GE will inspect each of the planting areas in the summer (July/August). During these events, based on stem counts, any dead trees or shrubs in excess of 20% of the original planting will be replaced to ensure an 80% survival rate. A 100% coverage of bare ground (outside of the foliar coverage of the trees) will be maintained. In addition, GE will ensure that, during each monitoring event, the certified arborist who observed the plant installation (or an approved wetland scientist) will inspect the planted vegetation for apparent vigor and growth, using best professional judgment based on accepted restoration standards and familiarity with local planting conditions, and will make recommendations to GE and the Trustees in the event he or she concludes that the vegetation on average is not growing at an acceptable rate. In the event of a loss of plantings or growth failure over an area of ¼ acre or more, GE will replant that area and the monitoring of that area will be restarted (as provided in Section 8.2 of Attachment I to the SOW), so that a total monitoring period for that area will exceed five years.[23] Notwithstanding the above requirements, GE will not replant an area if the loss of vegetation or growth failure is caused solely by the actions of a third party (excluding GE contractors). A final inspection will occur at the end of the monitoring period by a certified arborist or approved wetland scientist to again determine the acceptability of vegetation growth rates, and if necessary, recommendations will be made. As noted above, however, GE will not have responsibility to implement any recommendations for activities after the end of the monitoring period.

In addition to the above monitoring requirements, GE will implement measures during the five-year monitoring period to control the growth of invasive species within both the floodplain and wetland restoration areas, as well as in the pollinator meadow habitat.[24] The goal of this control, as stated in the Performance Standards, is to ensure that no greater than 5% of any area subject to restoration is covered with invasive species. However, should efforts to achieve of this goal be to the detriment of the growth of indigenous plant species and/or the overall provision of habitat functions at the site, an alternative control standard may be presented to the Trustees for approval. Invasive species control will be implemented using an appropriate manner for the species being targeted; this may include herbicide applications, hand pulling, girdling, black plastic coverings, biological control, or other methods as approved by the Trustees.

As part of the monitoring, GE will also inspect the integrity of the bluebird boxes, rock piles, and tree stumps/CWM on an annual basis for a three-year period after they are installed. GE will inspect bluebird boxes to ensure that they have not become damaged by storms, tree blowdowns, or vandalism. If the damage is sufficient to render the boxes uninhabitable by bluebirds, then they will be replaced. Rock piles and stumps/CWM will be inspected to ensure that major damage from acts such as vandalism have not leveled or relocated the structures. Due to the use of these structures by small mammals for the creation of dens, GE will conduct maintenance of the rock piles and stumps/CWM (e.g., restacking the rock piles and/or reorienting the stumps/CWM) only in the case of catastrophic damage to the structures.

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[23] This situation is the only exception to the termination of GE's responsibility for the property after the initial five-year monitoring period.

[24] As indicated above, such measures will not be conducted in the supplemental tree planting area since that area will not be used for staging; the monitoring of that area will apply only to the success of the tree plantings and will not include invasive species monitoring and control.

Finally, monitoring of the condition and use of the new wood turtle nesting areas will also occur during the five-year monitoring period. This will include some observations of the potential use of these areas for nesting by wood turtles (although not to a degree which could impair the areas' use for nesting), as well as monitoring and management of the growth of vegetation on the surface of the nesting substrate.

GE will prepare and submit to the Trustees a report on each of these inspections, including the results of the inspection and any maintenance or repair activities performed or proposed. The report will be prepared using field notes and other information collected during each of the monitoring visits, and will include photographic documentation of the conditions of the project area. Copies of these reports will be provided to EPA, MassDEP, and MNHESP. GE will make an effort to submit each event-specific report within 30 days after the inspection, but in no event will it be submitted later than 90 days after the inspection.

8.0 Next Steps

Following review and approval of this Final Restoration Plan by the Trustees (after receipt of any public comments), GE will develop 90% design plans and a construction bid package, including details and specifications, for provision to potential contractors. GE will also conduct additional discussions with the City, including discussions regarding measures to ensure that public use of the Park is maintained during construction. A contractor (or contractors) will then be selected to implement the construction phase of this restoration project, with any necessary subcontractors. Following the contractor selection, a revised Design Plan or Addendum to this Final Restoration Plan, including final design/construction drawings, will be prepared based on contractor input and will be submitted to the Trustees (and the City) for approval. It is anticipated that construction will be initiated in approximately November 2025, with landscaping and planting in 2026 and into 2027.

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Tables

Table 1. Monitoring well installation survey results

WELL ID	LOCATION	NORTHING (NAD 83)	EASTING (NAD 83)	ELEVATION (NAVD 1988)
MW-1	GROUND	2984496.41	195681.28	1018.64
	MARK ON CAP	2984496.07	195681.14	1021.85
MW-2	GROUND	2984308.84	195834.00	1020.63
	MARK ON CAP	2984308.53	195833.73	1023.52
MW-3	GROUND	2984066.30	195995.66	1022.71
	MARK ON CAP	2984066.12	195995.20	1025.19

1. NAVD 1929 is 0.49 feet higher than these elevations in this area.
2. Northing and Easting presented in projected coordinate system NAD 1983, State Plane, Massachusetts, Mainland (FIPS 2001, Feet)

Table 2. Groundwater summary statistics for 2022-2025

	MW-1				
	Elevation (NAVD 1988)				
Year	n	Min	Max	Mean	±SE
2022	479	1014.30	1017.56	1014.96	0.021
2023	730	1014.56	1018.57	1015.63	0.022
2024	732	1013.78	1018.41	1015.03	0.034
2025	282	1014.32	1017.24	1015.22	0.038
All	2223	1013.78	1018.57	1015.24	0.016
	Feet below ground surface				
2022	479	1.08	4.34	3.67	0.021
2023	730	0.07	4.08	3.01	0.022
2024	732	0.23	4.86	3.61	0.034
2025	282	1.40	4.32	3.42	0.038
All	2223	0.07	4.86	3.40	0.016
	MW-2				
	Elevation (NAVD 1988)				
2022	467	1016.35	1020.10	1017.25	0.030
2023	730	1016.96	1020.09	1018.41	0.026
2024	732	1016.36	1020.04	1017.75	0.040
2025	282	1016.98	1019.59	1018.25	0.045
All	2211	1016.35	1020.10	1017.93	0.020
	Feet below ground surface				
2022	467	0.54	4.29	3.38	0.030
2023	730	0.54	3.67	2.22	0.026
2024	732	0.59	4.27	2.88	0.040
2025	282	1.04	3.66	2.38	0.045
All	2211	0.54	4.29	2.70	0.020
	MW-3				
	Elevation (NAVD 1988)				
2022	479	1017.54	1020.85	1018.65	0.030
2023	730	1018.01	1021.38	1019.49	0.024
2024	732	1017.43	1021.02	1018.83	0.038
2025	282	1018.17	1020.58	1019.38	0.042
All	2223	1017.43	1021.38	1019.08	0.019
	Feet below ground surface				
2022	479	1.86	5.17	4.06	0.030
2023	730	1.33	4.70	3.22	0.024
2024	732	1.69	5.28	3.88	0.038
2025	282	2.12	4.54	3.33	0.042
All	2223	1.33	5.28	3.63	0.019

Table 3. Vascular plant species observed in the main restoration/enhancement area

Scientific Name	Common Name
Herbaceous Sedges, Rushes, Grasses and Forbs	
*Aegopodium podagraria**	Goutweed
*Alliaria petiolata**	Garlic mustard
Angelica atropurpurea	Purplestem angelica
*Arctium minus***	Common burdock
Artemisia vulgaris	Mugwort
Asclepias syriaca	Common milkweed
Boehmeria cylindrica	Small spike false nettle
Carex lacustris	Lake sedge
Carex stricta	Upright sedge
Carex vulpinoidea	Fox sedge
Circaea canadensis	Broad-leaved enchanter's-nightshade
Cirsium vulgare	Common thistle
Daucus carota	Wild carrot
Dryopteris carthusiana	Spinulose wood fern
Echinocystis lobata	Wild cucumber
Eleocharis sp	Spikerush
Epilobium coloratum	Purple-leaved willow herb
Euthamia graminifolia	Grass-leaved-goldenrod
Eutrochium maculatum	Spotted Joe-Pye weed
Fragaria virginiana	Common strawberry
Galium aparine	Cleavers
Galium mollugo	Hedge bedstraw
Galium palustre	Marsh bedstraw
Geum canadense	White avens
Herbaceous Sedges, Rushes, Grasses and Forbs (Cont.)	
Scirpus cyperinus	Woolgrass
Solidago canadensis	Canada goldenrod
Solidago gigantea	Smooth goldenrod
Solidago rugosa	Roughstem goldenrod
Symphyotrichum puniceum	Purple-stemmed American-aster
Thalictrum pubescens	Tall meadow-rue
*Typha latifolia***	Broad-leaved Cattail
Urtica dioica	Stinging nettle
Veratrum viride	False hellebore
Verbena urticifolia	White vervain
Viola sororia	Woolly blue violet
Woody Shrubs and Vines	
Alnus incana	Speckled alder
Amelanchier canadensis	Shadbush serviceberry
*Berberis thunbergii**	Japanese barberry
*Celastrus orbiculatus**	Oriental bittersweet
Cornus amomum	Silky dogwood
Crateagus sp.	Hawthorne
*Euonymus alatus**	Burningbush
*Ligustrum vulgare**	European privet
*Lonicera morrowii**	Morrow's honeysuckle
Parthenocissus quinquefolia	Virginia creeper
*Rhamnus cathartica**	Common buckthorn
Ribes cynosbati	Eastern prickly gooseberry

Scientific Name	Common Name	Scientific Name	Common Name
*Hesperis matronalis**	Dame's rocket	*Rosa multiflora**	Multiflora rose
Impatiens capensis	Jewelweed	*Rubus allegheniensis*	Alleghany blackberry
Ipomoea purpurea	Common morning-glory	*Salix discolor*	Pussywillow
Juncus tenuis	Slender rush	*Spiraea latifolia*	Meadowsweet
*Lychnis flos-cuculi***	Ragged robin	*Spiraea tomentosa*	Steeplebush
Lycopus uniflorus	Northern water-horehound	*Toxicodendron radicans*	Poison ivy
Lysimachia ciliata	Fringed loosestrife	*Viburnum trilobum*	Cranberry-bush viburnum
*Lythrum salicaria**	Purple loosestrife	*Vitis riparia*	River grape
Maianthemum canadense	Canada-mayflower	***Trees***	
Maianthemum racemosum	Feathery false Solomon's-seal	*Acer rubrum*	Red maple
Matteuccia struthiopteris	Ostrich fern	*Acer negundo*	Boxelder maple
Onoclea sensibilis	Sensitive fern	*Acer saccharinum*	Silver maple
*Pastinaca sativa**	Wild parsnip	*Acer saccharum*	Sugar maple
Persicaria hydropiper	Water-pepper smartweed	*Fraxinus americana*	White ash
Persicaria virginiana	Jumpseed	*Pinus strobus*	White pine
Persicaria sagittata	Arrow-leaved tearthumb	*Populus deltoides*	Eastern cottonwood
Phleum pratense	Timothy grass	*Prunus serotina*	Black cherry
Pilea pumila	Canada clearweed	*Salix babylonica*	Weeping willow
Potentilla simplex	Common cinquefoil	*Salix nigra*	Black willow
Ranunculus sp.	Buttercup	*Ulmus americana*	American Eem
Rudbeckia laciniata	Green-headed coneflower		
Scirpus atrovirens	Dark green bullrush		

* Listed as Invasive by the Massachusetts Invasive Plants Advisory Group (MIPAG) and in Appendix K of the New England District Compensatory Mitigation Guidance as an Invasive or Other Unacceptable Plant Species.

**Listed in Appendix K of the New England District Compensatory Mitigation Guidance as an Invasive or Other Unacceptable Plant Species.

Table 4. Habitat cover type mapping in main restoration/enhancement area

Cover Type	Total Area (Acres)	Percent of Total Area
Forested Cover, Native Trees Dom.	1.2	9.0
Herb / Shrub Cover, Invasive Plants Dom	9.2	69.9
Herb / Shrub Cover, Native Plants Dom.	2.0	15.4
Herb Cover, Native Plants Dom.	0.6	4.5
Trail	0.2	1.2
Grand Total	**13.1**	**100.0**

Table 5. Relative dominance of all plant species observed in vegetation plots in main restoration area

Scientific Name	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	MEAN
Solidago canadensis			50.5			56.2				65.6							44.3	83.4		60.0
Spiraea alba																			40.8	40.8
*Rhamnus cathartica**		52.1		63.0	29.5		25.6	28.0	33.4	7.0	26.0	22.5	21.8	16.7	0.9	35.8	5.4			26.3
Salix nigra																			24.6	24.6
*Alliaria petiolata**			5.4	13.2	0.9	36.1		18.0	29.1	25.4	26.0	13.6	16.0	22.6	19.6	31.3	10.6			19.1
Mosses		20.2			25.8		11.4		33.4		26.0	3.8	21.8	5.4		23.0				19.0
Populus deltoides								18.0												18.0
Ulmus americana							25.6					13.6			26.6		5.4			17.8
Carex sp	29.6	10.9												10.1						16.8
Persicaria hydropiper	16.0																			16.0
Prunus serotina													5.2		19.6					12.4
Impatients capensis	49.0	5.6		1.9		1.7													1.9	12.0
Solidago rugosa				1.9	19.0									0.8			32.6	2.6		11.4
Vitis riparia							18.9	10.8				13.6	16.0		6.4			2.6		11.4
*Celastrus orbiculatus**								3.0			3.2	22.5			11.8					10.1
Galium aparine			44.1				0.9			2.0					3.3		1.6	8.9		10.1
Acer negundo								5.8	1.0		11.6			22.6		3.8				9.0
Persicaria sagittata																			6.8	6.8
Viburnum trilobum																			6.8	6.8
Parthenocissus quinquefolia													2.7	10.1						6.4
*Aegopodium podagraria**					6.2															6.2
Fraxinus americana								10.8				1.1	9.7			1.1				5.7
*Lonicera morrowii**				6.8	11.4		11.4	0.9	1.0		6.2	7.3	2.7	5.4	6.4				1.9	5.6
Onoclea sensibilis						6.0					0.9			0.8				2.6	13.3	4.7
Geum canadense		10.9		13.2	3.2		3.1	3.0	1.0				2.7	0.8	3.3	1.1				4.2
Viola sororia							3.1													3.1
Cirsium vulgare	2.3																			2.3

Scientific Name	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	MEAN
Symphyotrichum puniceum	2.3																			2.3
Euthamia graminifolia																			1.9	1.9
Ipomoea purpurea																			1.9	1.9
Ligustrum vulgare**					3.2				1.0			1.1	0.8	2.8	0.9					1.6
Pilea pumila											0.2	1.1		0.1		3.8				1.3
Rosa multiflora*					0.9									0.8	0.9					0.9
Echinocystis lobata								0.9												0.9
Ribes cynosbati								0.9												0.9
Dryopteris carthusiana														0.8						0.8
Fragaria virginiana													0.8							0.8
Epilobium coloratum	0.4																			0.4
Lycopus uniflorus	0.4																			0.4
Verbena urticifolia		0.3																		0.3
Maianthemum canadense															0.2					0.2
Circaea canadensis														0.1						0.1

Table 6. Importance values of plant species occurring in three or more vegetation plots in main restoration area

Scientific Name	Common Name	# of Plots	D_R	F_R	IV_{ave}
Rhamnus cathartica	common buckthorn	14	22.89	11.38	17.14
Alliaria petiolata	garlic-mustard	14	16.68	11.38	14.03
Bryophyte	mosses	9	12.07	7.32	9.70
Solidago canadensis	Canada goldenrod	5	10.99	4.07	7.53
Lonicera morrowii	Morrow's honeysuckle	11	4.33	8.94	6.64
Geum canadense	white avens	10	2.36	8.13	5.24
Vitis riparia	river grape	6	5.19	4.88	5.03
Ulmus americana	American elm	4	5.05	3.25	4.15
Acer negundo	boxelder maple	5	3.63	4.07	3.85
Galium aparine	scratch bedstraw	6	2.66	4.88	3.77
Solidago rugosa	wrinkle-leaved goldenrod	5	3.11	4.07	3.59
Celastrus orbiculatus	asiatic bittersweet	4	2.81	3.25	3.03
Impatients capensis	Jewelweed	5	1.90	4.07	2.98
Ligustrum vulgare	European privet	6	0.76	4.88	2.82
Fraxinus americana	white ash	4	1.89	3.25	2.57
Onoclea sensibilis	sensitive fern	5	0.92	4.07	2.49
Carex sp	sedge	3	2.22	2.44	2.33
Pilea pumila	Canada clearweed	4	0.33	3.25	1.79
Rosa multiflora	multiflora rose	3	0.21	2.44	1.32

$\mathbf{D_R}$ = Relative Dominance; $\mathbf{F_R}$ = Relative Frequency; $\mathbf{IV_{ave}}$ = Average Importance Value

Figures

Figures:

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- 4a MW-1 Groundwater Elevations
- 4b MW-2 Groundwater Elevations
- 4c MW-3 Groundwater Elevations
- 4d Historic Weather Conditions in Pittsfield, MA, Lakewood Station

Figure 5: Vegetation Cover Types (Main Restoration/Enhancement Area)

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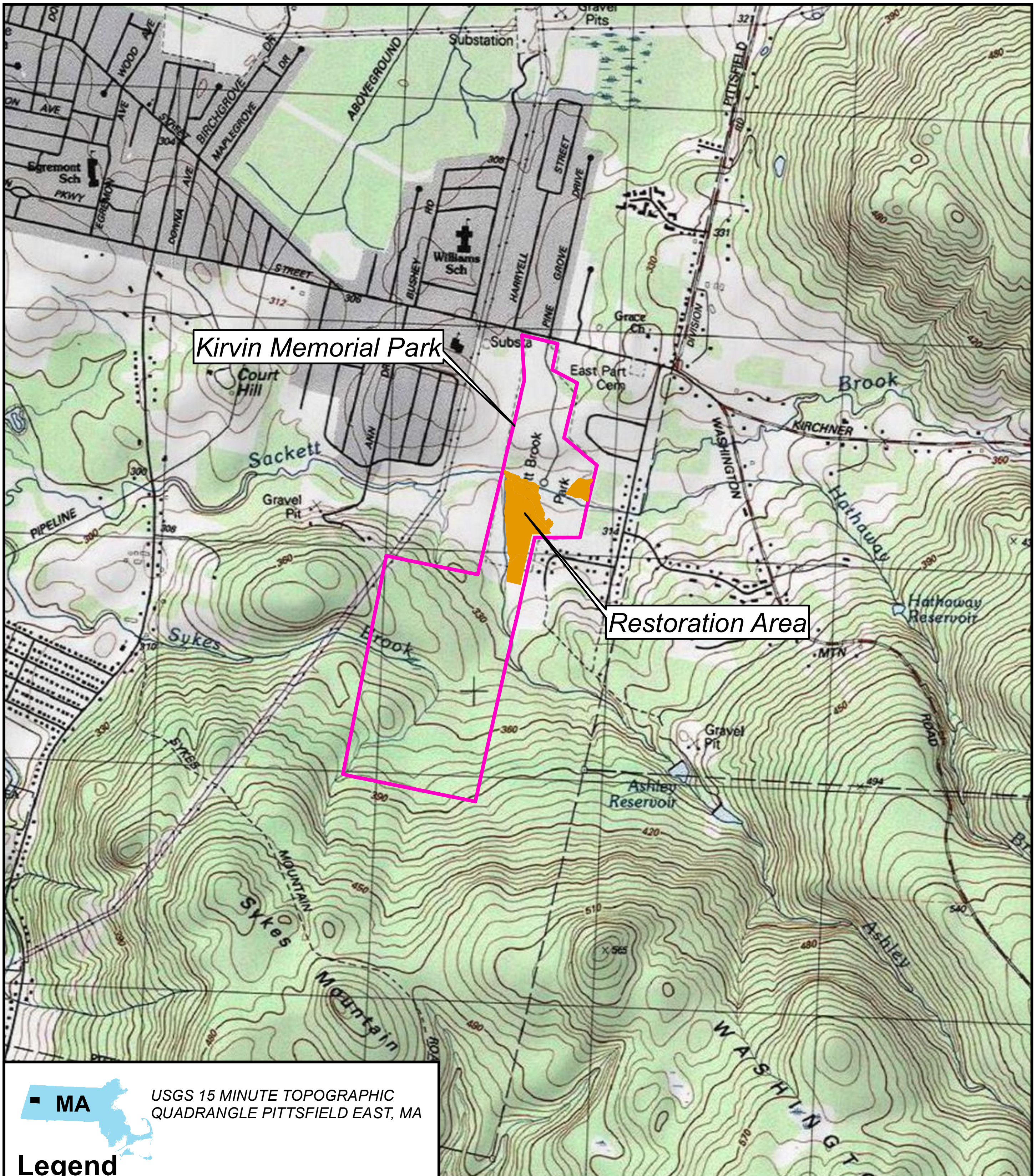
- 6-2 Proposed Grading Plan
- 6-3 Planting Zones
- 6-4 Planting and Construction Notes – Page 1
- 6-5 Planting and Construction Notes – Page 2
- 6-6 Proposed Grading and Planting Zones for Pollinator Habitat Creation Area
- 6-7 Recommended Species List for Pollinator Habitat Area



USGS 15 MINUTE TOPOGRAPHIC QUADRANGLE PITTSFIELD EAST, MA

MA

Legend

- Kirvin Park Property Boundary
- Restoration Area Limits
- NHESP Priority Habitats (2021)

0 1,000 2,000 4,000 Feet

SITE LOCUS and NHESP PRIORITY HABITATS

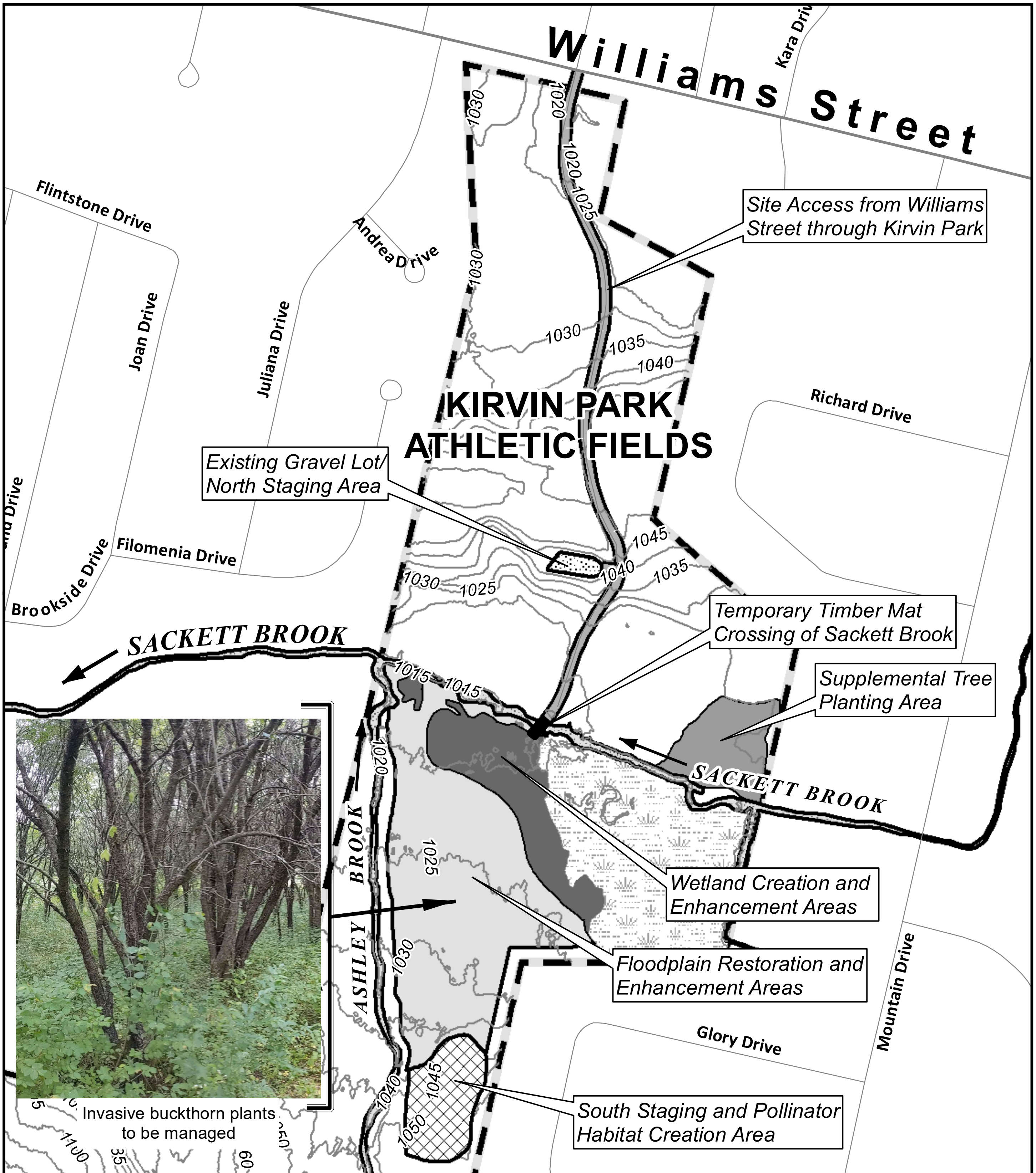
Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
1:24,000	5/22/2025	04191406

AECOM

Figure Number

1-1



Kirvin Park Floodplain and Wetland Enhancement Areas

Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
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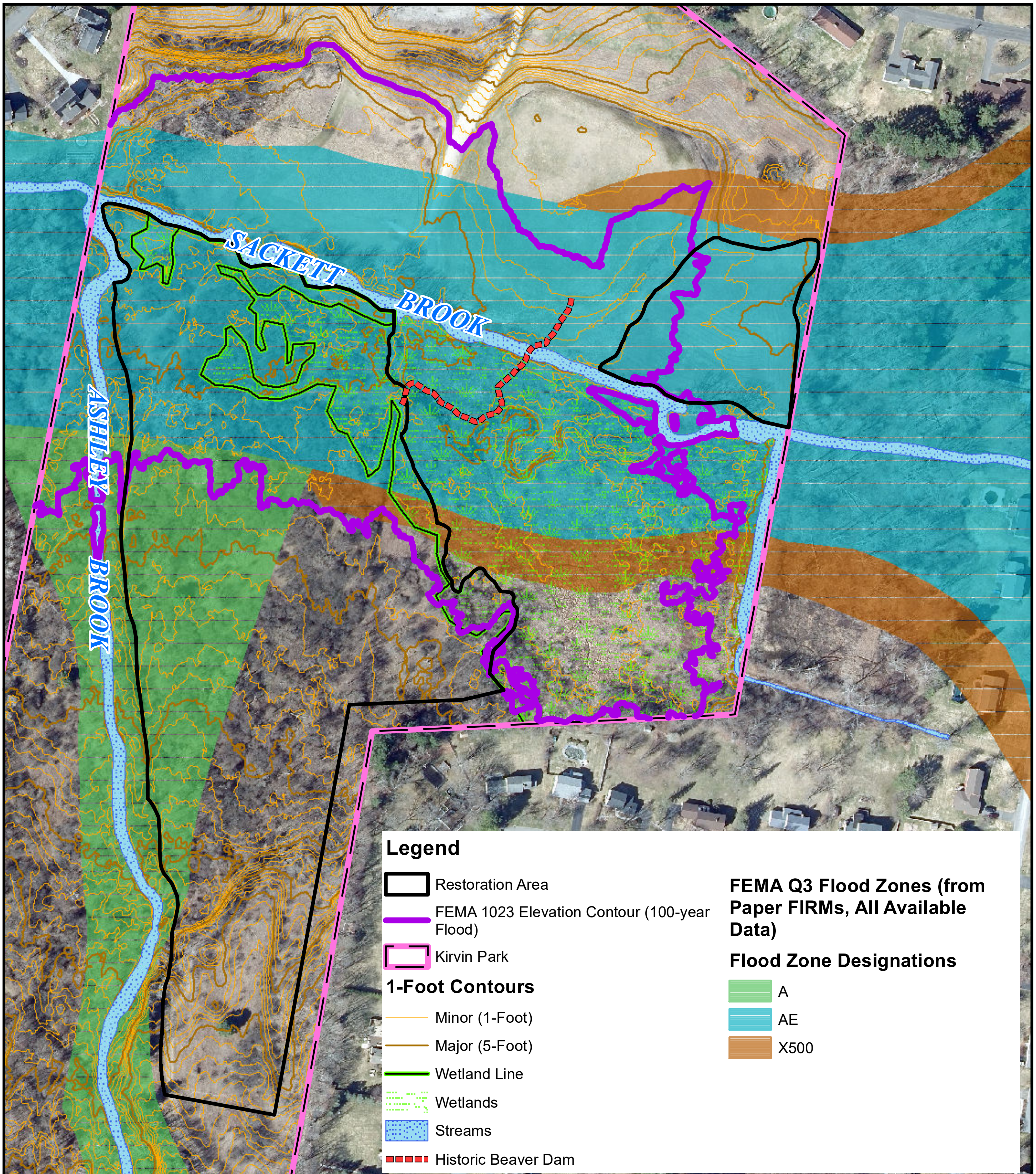
AECOM

Figure Number

1-2



FEMA Q3 Flood Zones from Paper FIRMs

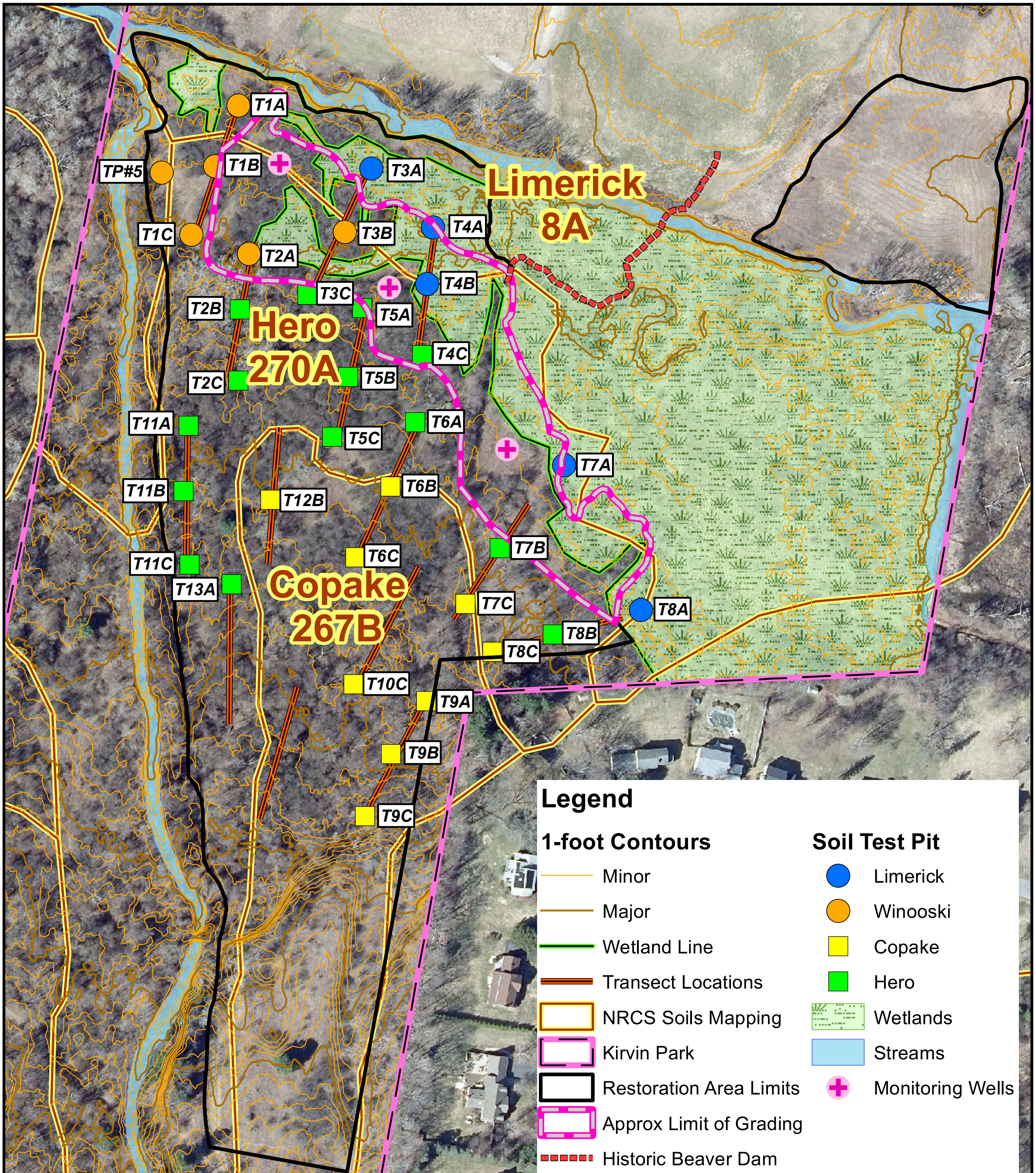
Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
1:3,000	5/19/2025	04191406

AECOM

Figure Number

2



0 100 200 400 Feet

N

NRCS Soil Series Mapping and Site-Specific Soil Survey

Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
1:2,400	5/19/2025	04191406

AECOM

Figure Number

3

Figure 4: Groundwater Monitoring Data and Precipitation Data, May 2022 to May 2025

Figure 4a. MW-1 Groundwater Elevations

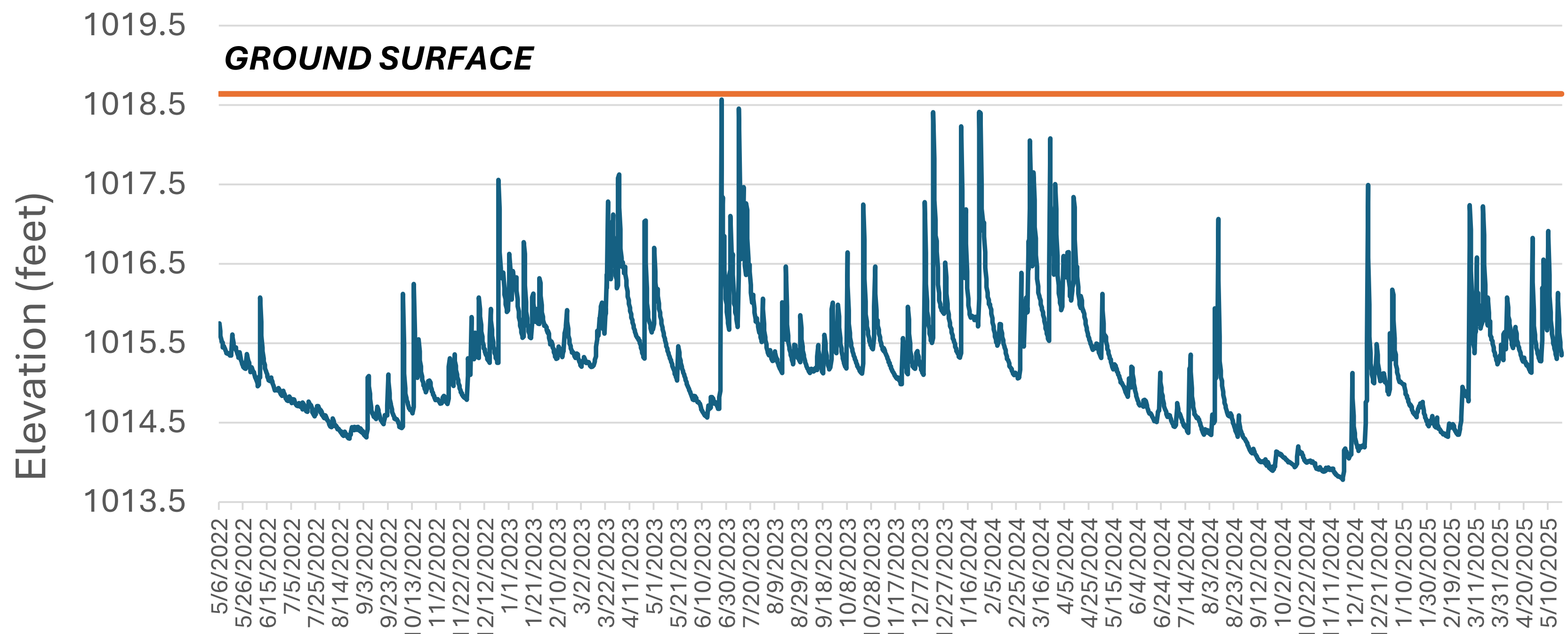


Figure 4b. MW-2 Groundwater Elevations

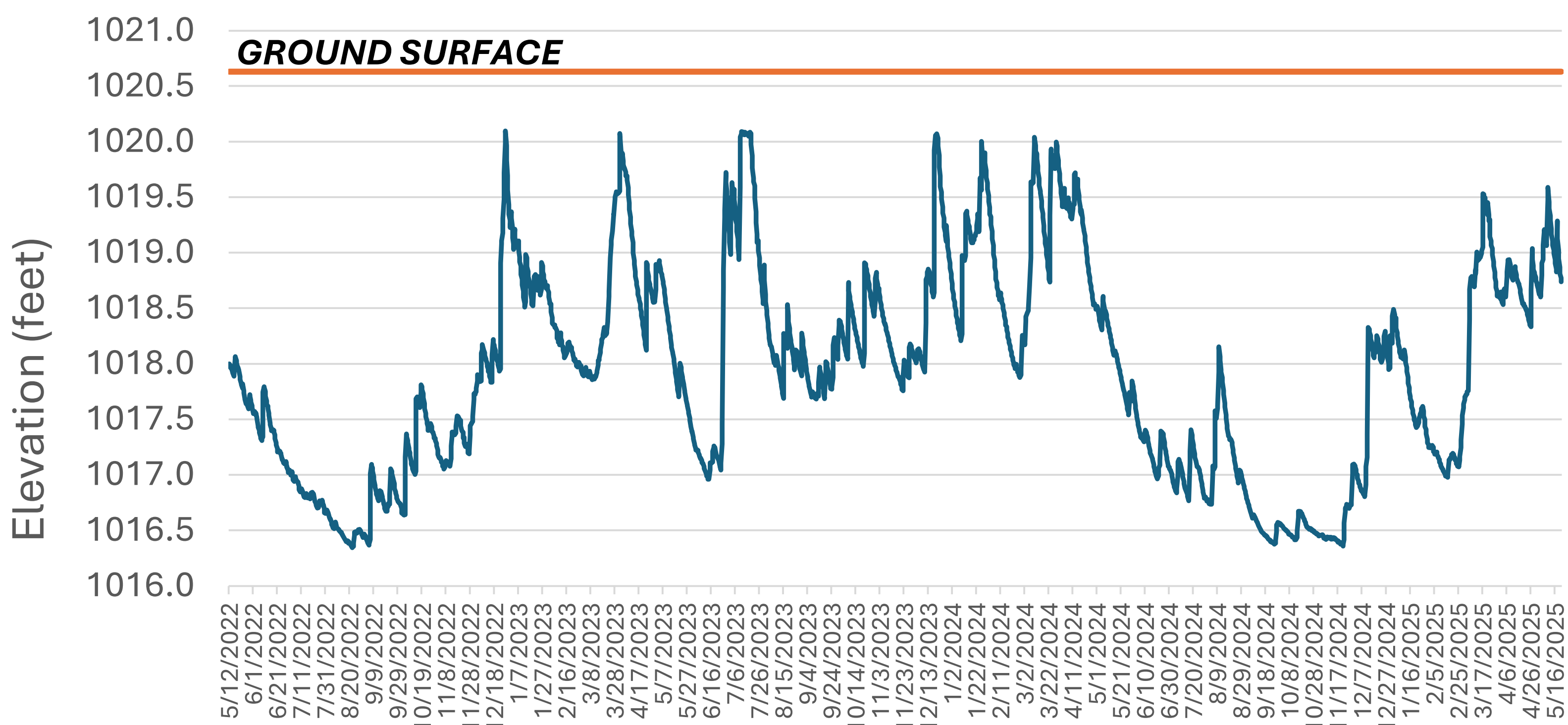


Figure 4c. MW-3 Groundwater Elevations

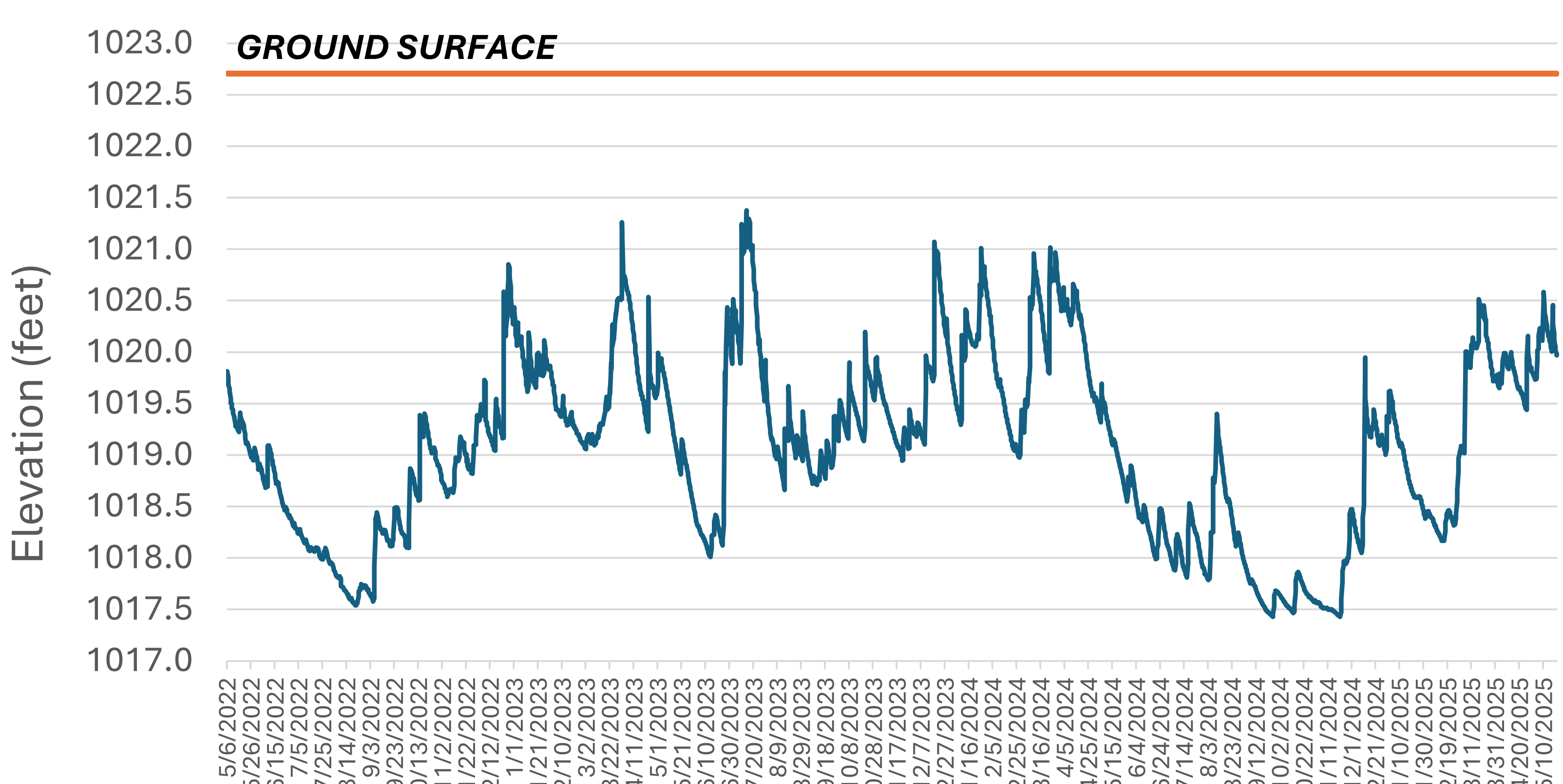
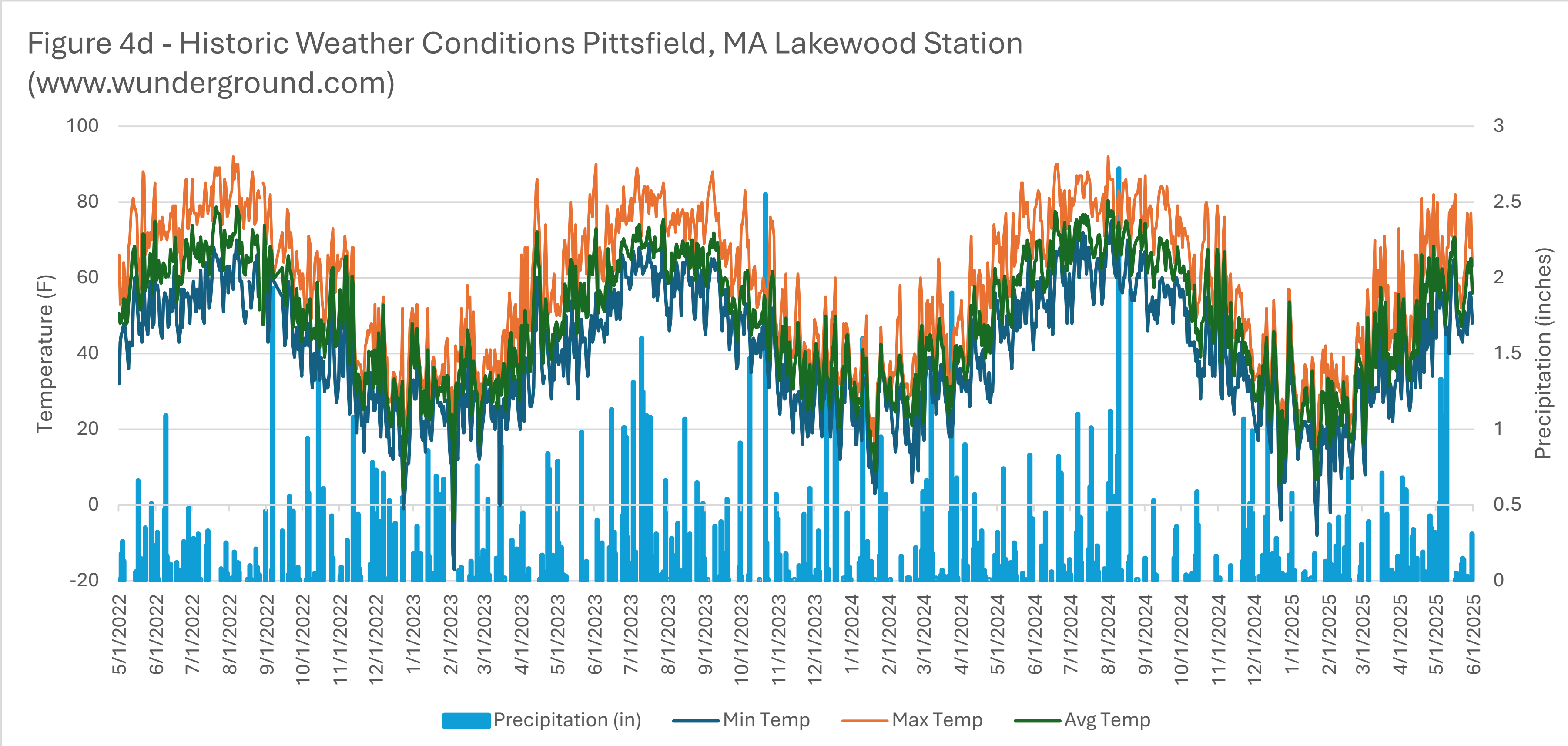
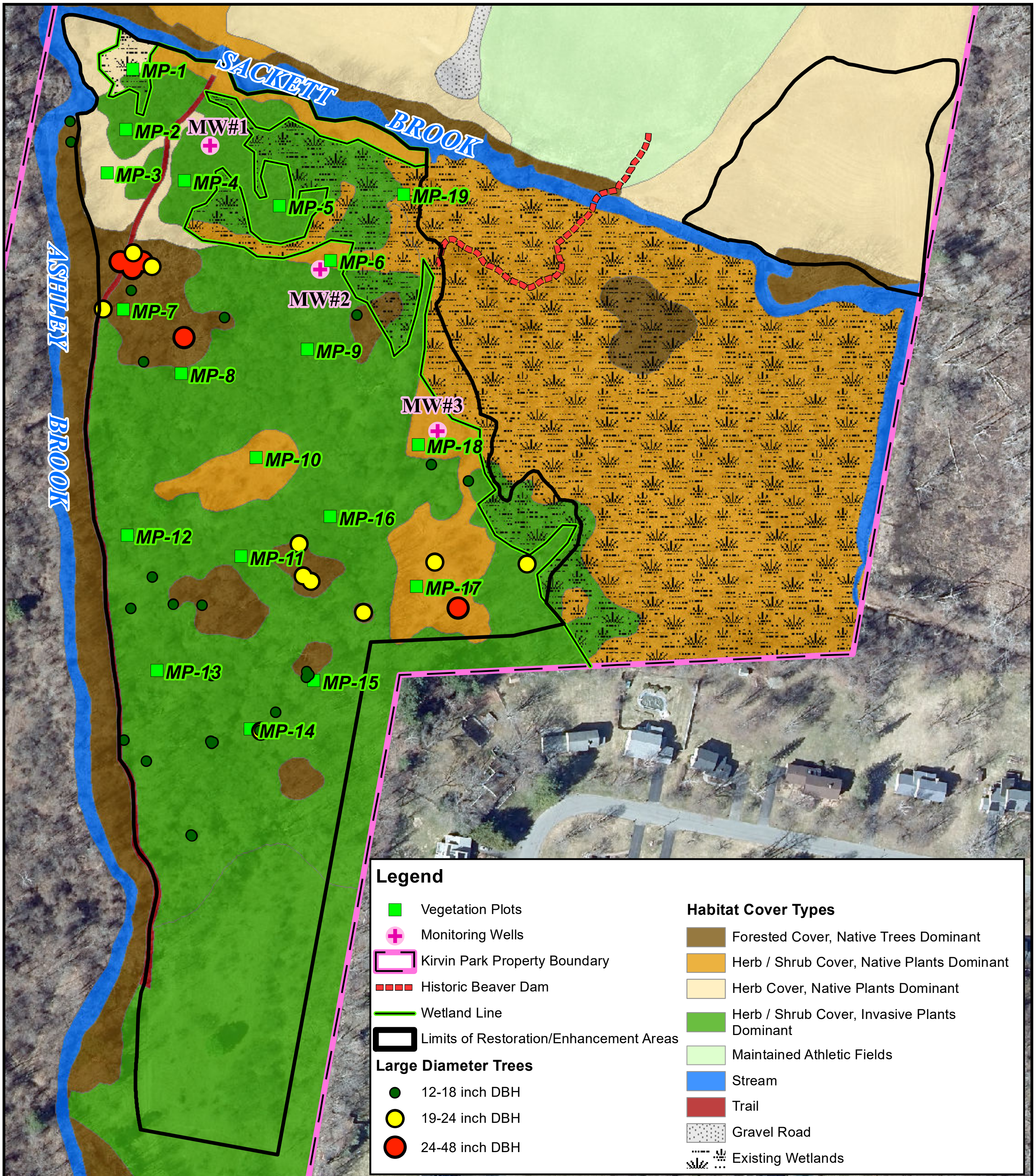


Figure 4: Groundwater Monitoring Data and Precipitation Data, May 2022 to May 2025





Vegetation Cover Types

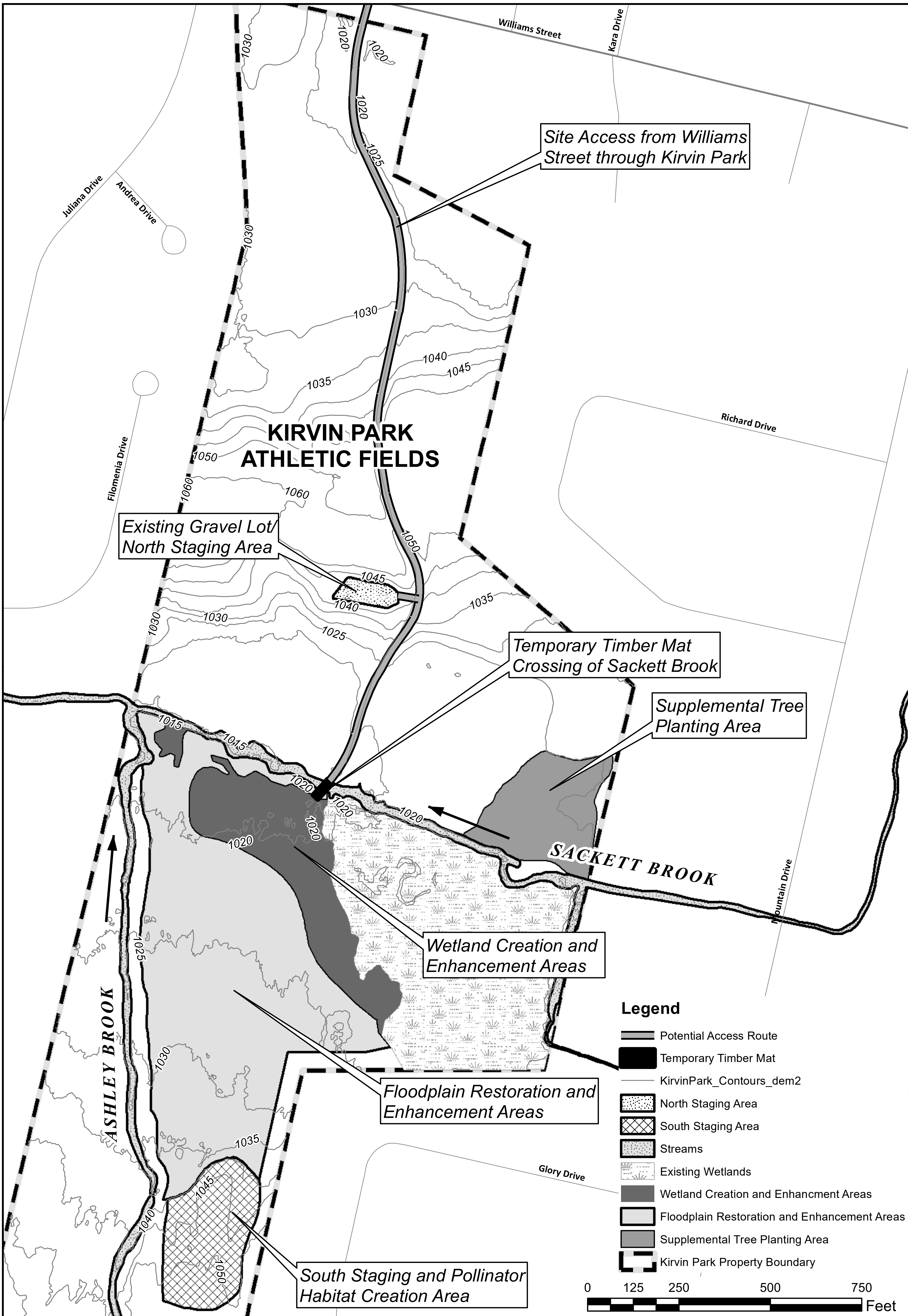
Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
1:2,400	5/19/2025	04191406

AECOM

Figure Number

5



1 inch = 250 feet

NO.	DATE	REVISIONS	BY	CHK	APP	APP

AECOM
AECOM Environment
250 Apollo Drive
Chelmsford, MA 01824

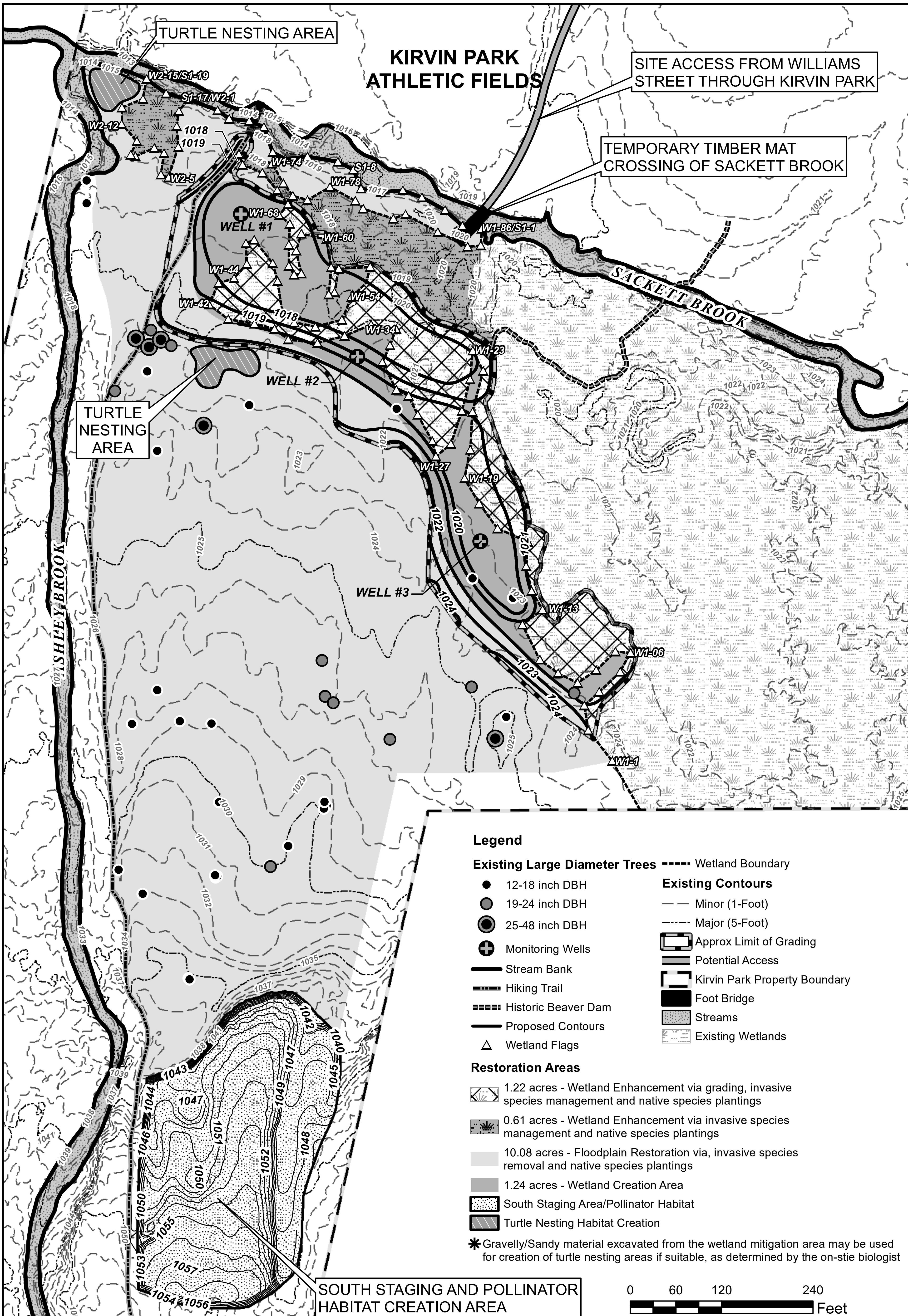
Overview of Site Restoration Areas and Potential Access & Staging

Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

PROJ. NO.: 60605466 DATE: 7/7/2025

SHEET NUMBER: 1 OF 7

DRAWING NUMBER: 6-1



1 inch = 120 feet

NO.	DATE	REVISIONS	BY	CHK	APP	APP

AECOM

AECOM Environment
250 Apollo Drive
Chelmsford, MA 01824

Proposed Grading Plan

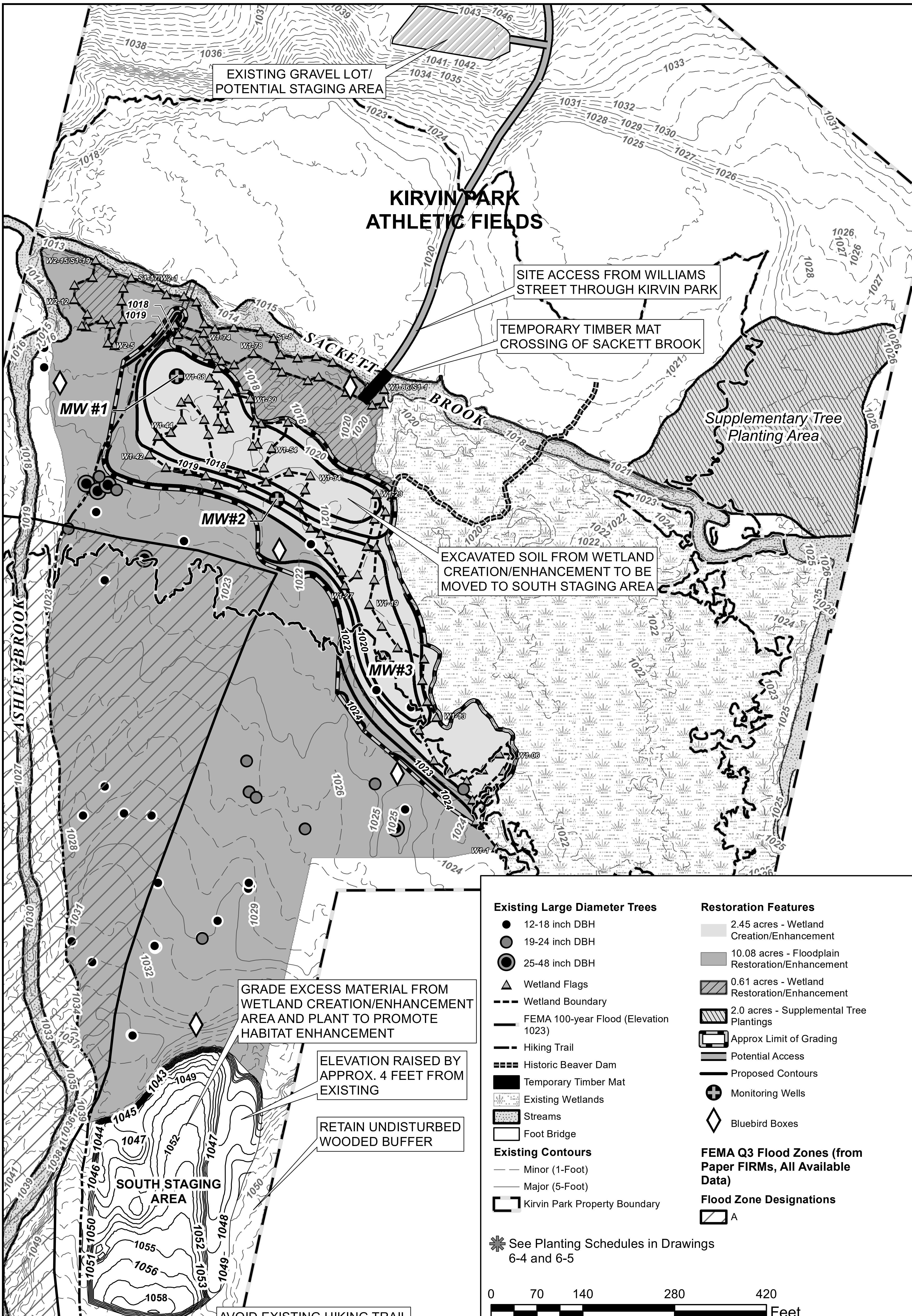
Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

PROJ. NO.: 60605466

DATE: 7/7/2025

SHEET NUMBER: 2 OF 7

DRAWING NUMBER: 6-2



N W E S

1 inch = 140 feet

NO.	DATE	REVISIONS	BY	CHK	APP	APP

AECOM
AECOM Environment
250 Apollo Drive
Chelmsford, MA 01824

Planting Zones

Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

PROJ. NO.: 60605466

DATE: 7/7/2025

SHEET NUMBER: 3 OF 7

DRAWING NUMBER: 6-3

WETLAND CREATION AND FLOODPLAIN RESTORATION PLANTING SPECIFICATIONS

1. REFER TO FIGURES 6-1 TO 6-3 FOR ADDITIONAL BASEMAP INFORMATION.
2. ALL WORK WILL FOLLOW THE CONSTRUCTION SEQUENCE DEFINED ON THE APPROVED SITE PLANS. TOPSOIL PLACEMENT AND PLANTING WILL BE PERFORMED UNDER DIRECT SITE SUPERVISION BY A DESIGNATED WETLAND SCIENTIST. FOLLOW-UP MONITORING OF THE PLANTINGS PROPOSED IN THE PLANS WILL BE PERFORMED AS DESCRIBED IN THE FLOODPLAIN/WETLAND RESTORATION PLAN.
3. PRIOR TO THE START OF SITE WORK, ALL SEDIMENTATION AND EROSION CONTROL FENCING WILL BE INSTALLED BY THE CONTRACTOR AS DESCRIBED ON THE PLANS. AN ADEQUATE SUPPLY OF REPLACEMENT EROSION CONTROL MATERIALS WILL BE AVAILABLE ON SITE FOR EMERGENCY PURPOSES. EROSION CONTROL STRUCTURES WILL BE INSPECTED ON A REGULAR BASIS AND MAINTAINED IN GOOD ORDER UNTIL ALL EXPOSED SOILS ARE VEGETATED AND STABLE.
4. FOR EXCAVATIONS EXTENDING TO 1 FOOT BELOW EXISTING GROUND SURFACE THAT ARE ADJACENT TO MATURE TREES, THE CONTRACTOR SHALL PERFORM SUCH EXCAVATIONS BY HAND UNDER OVERSIGHT BY THE WETLAND SCIENTIST.
5. THE WETLAND CREATION AREA SHALL BE OVER-EXCAVATED BY A DEPTH OF ONE FOOT AND BROUGHT UP TO FINISH ELEVATIONS IN LOOSE LIFTS WITH SUITABLE SOILS. SOILS SHALL HAVE SUITABLE ORGANIC MATTER CONTENT (MINIMUM ORGANIC CARBON CONTENT OF 7% TO 12% [12% TO 20% ORGANIC MATTER] ON A DRY WEIGHT BASIS) AND GRAIN SIZE (SILT-LOAM TO LOAM TEXTURE).
6. THE PLANTING PLAN PROVIDED FOR THE WETLAND CREATION AND FLOODPLAIN RESTORATION SHALL NOT BE DEVIATED FROM WITHOUT THE APPROVAL OF THE DESIGNATED WETLAND SCIENTIST. IT IS RECOGNIZED THAT NOT ALL SPECIES MAY BE AVAILABLE AT THE TIME OF PLANTING AND SUBSTITUTIONS ARE ALLOWED WITH APPROVAL OF THE WETLAND SCIENTIST.
7. A WETLAND SEED MIX AND ANNUAL RYE WILL BE BROADCAST AT THE APPROPRIATE RATES THROUGHOUT THE WETLAND CREATION AREA TO FORM A HERBACEOUS GROUNDCOVER LAYER. NEW ENGLAND WET MIX (NEW ENGLAND WETLAND PLANTS, AMHERST MA) IS RECOMMENDED BUT COMPARABLE ALTERNATIVE SOURCES MAY BE APPROVED BY THE WETLAND SCIENTIST.
8. AN UPLAND/CONSERVATION SEED MIX AND ANNUAL RYE WILL BE BROADCAST AT THE APPROPRIATE RATES OVER ALL FLOODPLAIN AREAS DISTURBED BY THE PROJECT AND SIDE SLOPES OF THE WETLAND CREATION AREA. NEW ENGLAND CONSERVATION/WILDLIFE MIX (NEW ENGLAND WETLAND PLANTS, AMHERST MA) IS RECOMMENDED BUT COMPARABLE ALTERNATIVE SOURCES MAY BE APPROVED BY THE WETLAND SCIENTIST.
9. SEED SHOULD ALWAYS BE PLACED ON BARE SOIL AND LIGHTLY RAKED OR ROLLED TO ENSURE PROPER SOIL-SEED CONTACT.
10. TREES, SHRUBS AND HERBACEOUS PLANTS WILL BE SIZED AS SPECIFIED ON FIGURE 6-4. PLANT MATERIAL WILL BE INSPECTED WHEN PICKED UP AT THE NURSERY, AS WELL AS UPON DELIVERY TO THE SITE. THE PLANTING SEASON WILL BE IN THE SPRING FROM APRIL 1 THROUGH JUNE 30, AND FALL FROM AUGUST 15 THROUGH DECEMBER 15.
11. THE FOLLOWING PLANTING PROTOCOL WILL BE FOLLOWED: 1) THE PLANTING CONTRACTOR SHALL MAINTAIN THE ORIGINAL GRADE OF ROOT FLARE AFTER BEING TRANSPLANTED FROM THE NURSERY; 2) THE TREE/SHRUB PIT SHALL BE 3 TIMES THE SIZE OF THE ROOT BALL AND SHALL BE BACKFILLED WITH A PLANTING SOIL MIXTURE OF LOAM, COMPOST, AND PEAT MOSS; 3) NO FERTILIZER WILL BE USED IN WETLAND AREAS; 4) A TEMPORARY EARTH SAUCER WILL BE MADE; 5) PLANT MATERIAL WILL BE IMMEDIATELY WATERED.
12. ANY COARSE WOODY DEBRIS (LOGS 4-8" IN DIA) FOUND ON OR ADJACENT TO THE SITE MAY BE DISTRIBUTED RANDOMLY THROUGHOUT THE WETLAND CREATION AREA AT THE DESCRETION OF THE WETLAND SCIENTIST.
13. ADDITIONAL EROSION CONTROL MATTING SHALL BE PLACED ON DISTURBED AREAS AS NEEDED, OR AT THE DIRECTION OF THE WETLAND SCIENTIST.
14. FOLLOWING COMPLETION OF THE WORK EROSION CONTROLS, WHICH SURROUNDS THE WETLAND AND FLOODPLAIN AREAS MUST BE REMOVED ONCE STABILIZATION HAS BEEN ACHIEVED.
15. THE RESTORATION SHALL ALSO INCLUDE THE PLACEMENT OF UNCONTAMINATED STUMPS AND ROCK PILES, RANDOMLY THROUGHOUT THE VEGETATED AREAS TO PROVIDE HABITAT FOR FOSSORIAL AND GROUND-DWELLING WILDLIFE.
16. FIVE BLUEBIRD BOXES WILL BE INSTALLED AROUND THE PERIMETER OF THE RESTORATION AREA AS SHOWN ON FIGURE 6-3

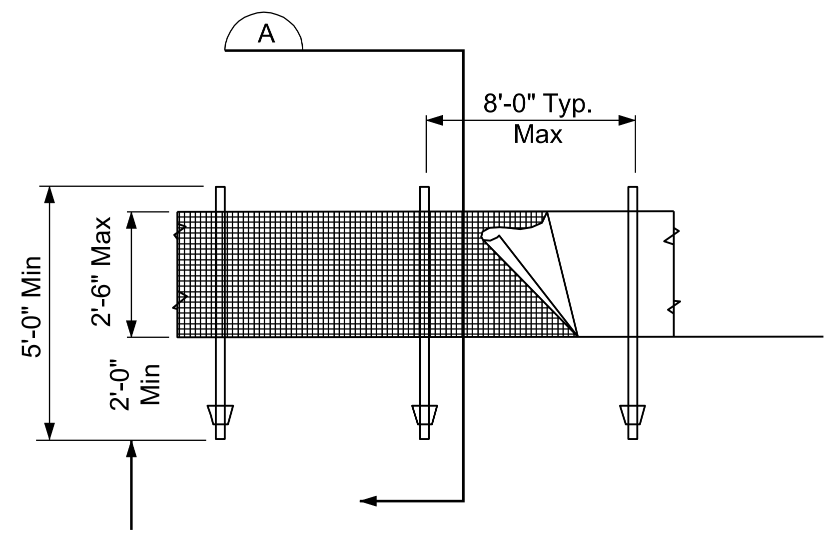
Table 1. New England Wetland Plants "WetMix"

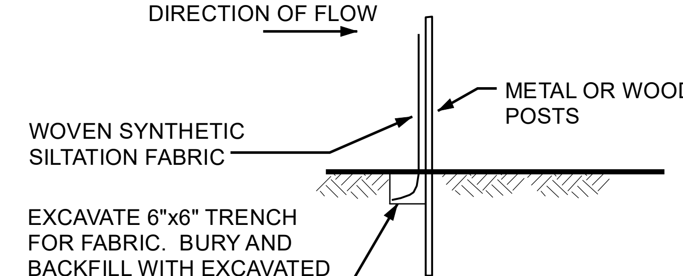
Botanical Name	Common Name	Indicator
Carex vulpinoidea	Fox Sedge	OBL
Carex scoparia	Blunt Broom Sedge	FACW
Carex lurida	Lurid Sedge	OBL
Carex lupulina	Hop Sedge	OBL
Poa palustris	Fowl Bluegrass	FACW
Bidens frondosa	Beggar Ticks	FACW
Scirpus atrovirens	Green Bulrush	OBL
Asclepias incarnata	Swamp Milkweed	OBL
Carex crinita	Fringed Sedge	OBL
Vernonia noveboracensis	New York Ironweed	FACW
Juncus effusus	Soft Rush	FACW
Symphyotrichum lateriflorum	Starved/Calico Aster	FACW
Iris versicolor	Blue Flag	OBL
Glyceria grandis	American Mannagrass	OBL
Mimulus ringens	Monkey Flower	OBL
Eutrochium maculatum	Spotted Joe Pye Weed	OBL

Table 2. New England Conservation/Wildlife Mix

Botanical Name	Common Name
Elymus virginicus	Virginia Wild Rye
Schizachyrium scoparium	Little Bluestem
Andropogon gerardii	Big Bluestem
Festuca rubra	Red Fescue
Panicum virgatum	Switch Grass
Chamaecrista fasciculata	Partridge Pea
Desmodium paniculatum	Panicledleaf Tick Trefoil
Sorghastrum nutans	Indian Grass
Verbena hastata	Blue Vervain
Asclepias tuberosa	Butterfly Milkweed
Rudbeckia hirta	Black Eyed Susan
Helenium autunale	Common Sneezeweed
Symphyotrichum pilosum	Heath Aster
Solidago juncea	Early Goldenrod
Agrostis perennans	Upland Bentgrass

ELEVATION

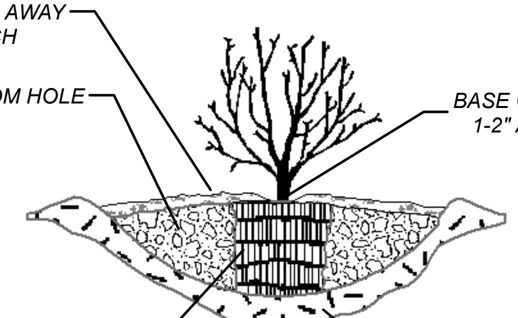




SECTION A

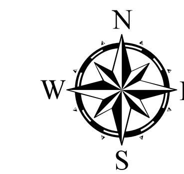
SILTATION FENCE DETAIL 2

NOT TO SCALE



PLANTING DETAIL 3

NOT TO SCALE



1 inch = 100 feet

NO.	DATE	REVISIONS	BY	CHK	APP	APP

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Chelmsford, MA 01824

Planting and Construction Notes

Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

DATE: 7/7/2025

PROJ. NO.: 60605466

DRAWING NUMBER:
6-4

SHEET NUMBER:
4 OF 7

Table 1. Proposed Planting Schedule for Wetland Creation/Restoration Areas

Plant Strata/Type	Plant Species		Plant Size/Type	Planting Quantities[1]	
	Scientific Name	Common Name		% of Total Planted	Total Number of Plants
Tree	*Alnus incana*	Speckled alder	18-24” Container	25%	348
	Acer saccharinum	Silver maple	18-24” Container	25%	348
	Populus deltoides	Cottonwood	18-24” Container	5%	70
	Acer rubrum	Red maple	18-24” Container	25%	348
	Salix nigra	Black willow	18-24” Container	20%	278
Shrub	*Cornus amomum*	Silky dogwood	18” Container	25%	548
	Viburnum dentatum	Arrowwood	18” Container	15%	330
	Ilex verticillata	Winterberry	18” Container	15%	330
	Salix discolor	Pussy willow	18” Container	25%	548
	Spiraea alba	Meadowsweet	18” Container	10%	219
	Spiraea tomentosa	Steeplebush	18” Container	10%	219
Vine	*Vitis riparia*	River grape	2” rhizome	50%	15
	Parthenocissus quinquefolia	Virginia creeper	2” rhizome	50%	15
Herb	*Onoclea sensibilis*	Sensitive fern	2” rhizome	40%	240
	Matteuccia struthiopteris	Ostrich fern	2” rhizome	30%	180
	Osmundastrum cinnamomeum	Cinnamon fern	2” rhizome	30%	180
	New England WetMix**		Seed mix	25 lbs/acre	75 lbs
	Secale cereale	Annual rye	Seed	25 lbs/acre	75 lbs

1. Trees to be planted at overall density of 463/acre; shrubs to be planted on 4-foot centers at overall density of 730/acre in 30’x50’ oblong patches with minimum distance between patches of 40 feet; Ferns to be planted in clusters at overall density of 200/acre.
2. Total area of wetland creation/restoration/enhancement is 3 acres.
3. See Figure 6-4 for seed mix composition and specification. Specified seed mix or comparable to be approved by wetland scientist.

Table 2: Proposed Planting Schedule for Floodplain Restoration Areas.

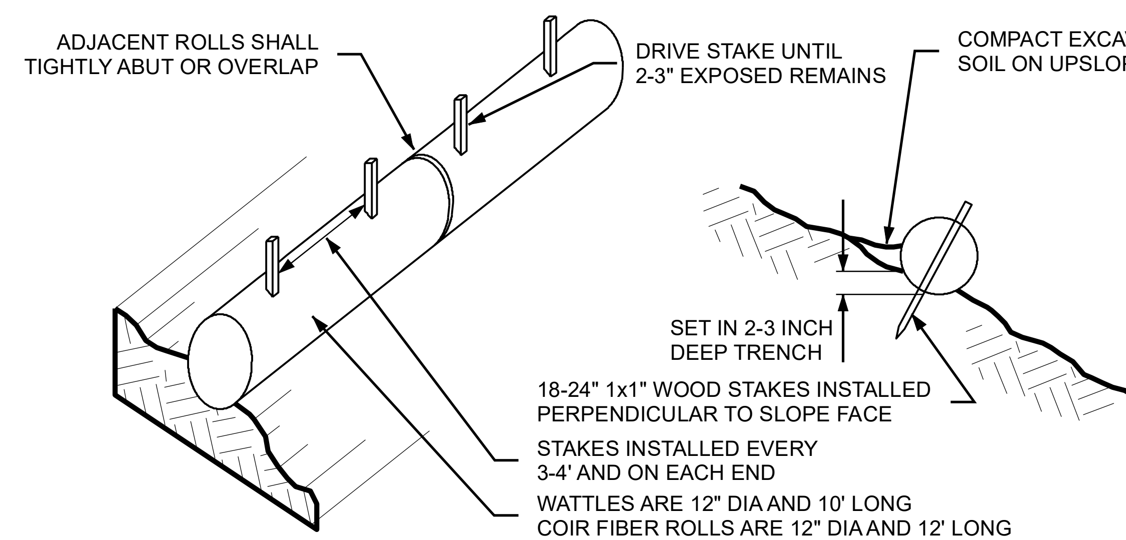
Plant Strata/Type	Plant Species		Plant Size/Type	Planting Quantities[1]	
	Scientific Name	Common Name		% of Total Planted	Total Number of Plants
Tree	*Populus deltoides*	Cottonwood	18-24” Container	25%	1158
	Acer saccharinum	Silver maple	18-24” Container	25%	1158
	Quercus palustris	Pin oak	18-24” Container	5%	232
	Acer rubrum	Red maple	18-24” Container	5%	232
	Acer negundo	Box elder	18-24” Container	20%	927
	Salix nigra	Black willow	18-24” Container	20%	927
Shrub	*Cornus amomum*	Silky dogwood	18” Container	25%	1844
	Viburnum dentatum	Arrowwood	18” Container	25%	1844
	Sambucus canadensis	Elderberry	18” Container	25%	1844
	Salix discolor	Pussy willow	18” Container	25%	1844
Vine	*Vitis riparia*	River grape	2” rhizome	50%	202
	Parthenocissus quinquefolia	Virginia creeper	2” rhizome	50%	202
Herb	New England Conservation Wildlife/Mix**		Seed mix	25 lbs/acre	252 lbs
	Secale cereale	Annual rye	Seed	25 lbs/acre	252 lbs

1. Trees to be planted heterogeneously at overall density of 463/acre; shrubs to be planted on 4-foot centers at overall density of 730/acre in 30’x50’ oblong patches with minimum distance between patches of 40 feet; vines to be planted on 4-foot centers at overall density of 40/acre in 15’x30’ oblong patches with minimum distance between patches of 150 feet.
2. Total area of floodplain restoration/enhancement is 10.1 acres.
3. See Figure 6-4 for seed mix composition and specification.

Table 3: Proposed Planting Schedule for Supplemental Planting Area North of Sackett Brook.

Plant Strata/Type	Plant Species		Plant Size/Type	Planting Quantities[1]	
	Scientific Name	Common Name		% of Total Planted	Total Number of Plants
Tree	*Populus deltoides*	Cottonwood	18-24” Container	25%	200
	Acer saccharinum	Silver maple	18-24” Container	25%	200
	Quercus palustris	Pin oak	18-24” Container	5%	40
	Acer rubrum	Red maple	18-24” Container	5%	40
	Acer negundo	Box elder	18-24” Container	20%	160
	Alnus incana	Speckled alder	18-24” Container	20%	160

1. Trees to be planted heterogeneously at overall density of 400/acres.
2. Total area is 2.0 acres.
3. See Figure 6-4 for seed mix composition and specification.



COIR FIBER ROLL AND STRAW WATTLE DETAIL 1

NOT TO SCALE

1 inch = 100 feet

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Planting and Construction Notes

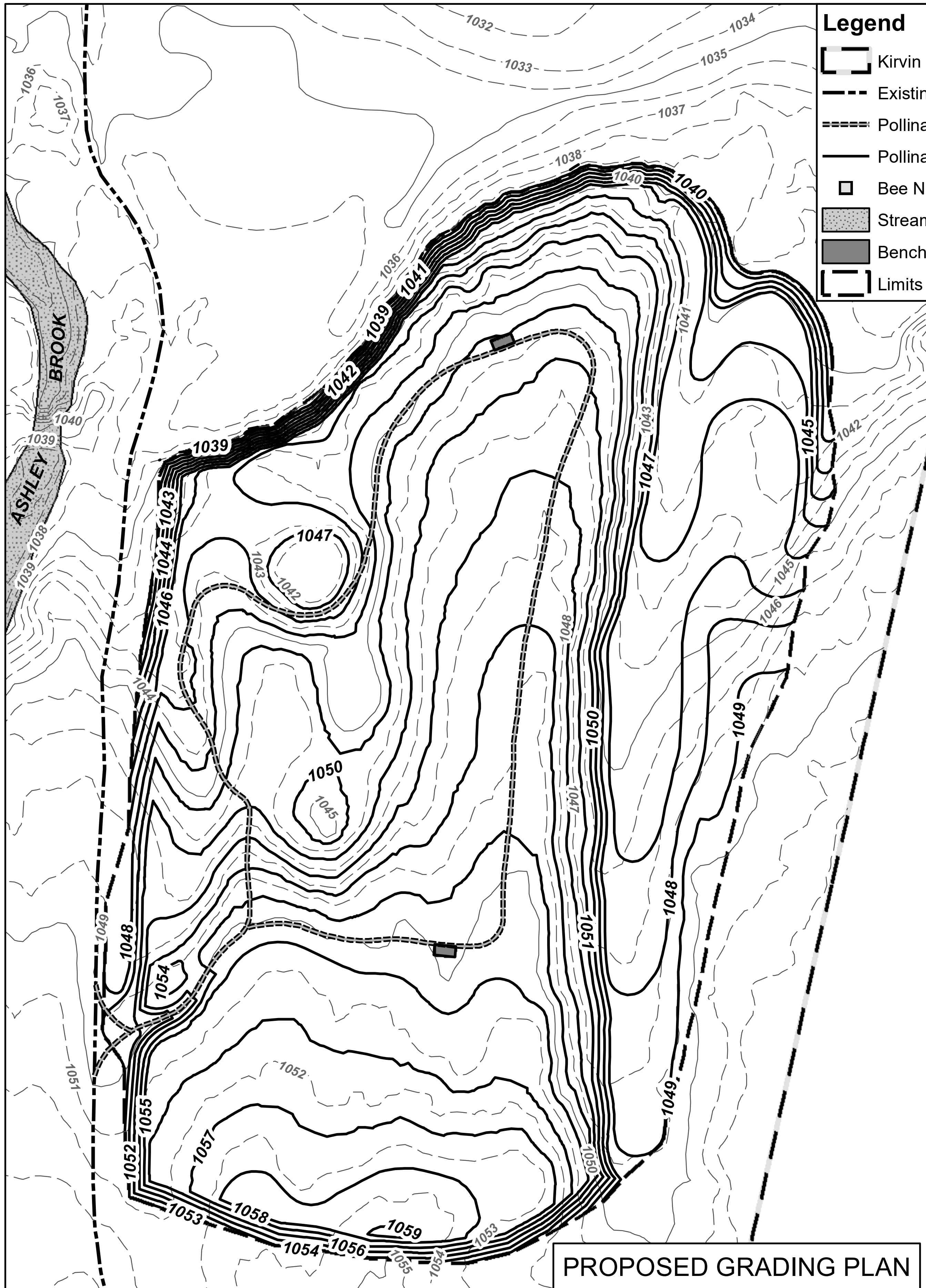
Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

DATE: 7/7/2025

PROJ. NO.: 60605466

DRAWING NUMBER: **6-5**

SHEET NUMBER: 5 OF 7

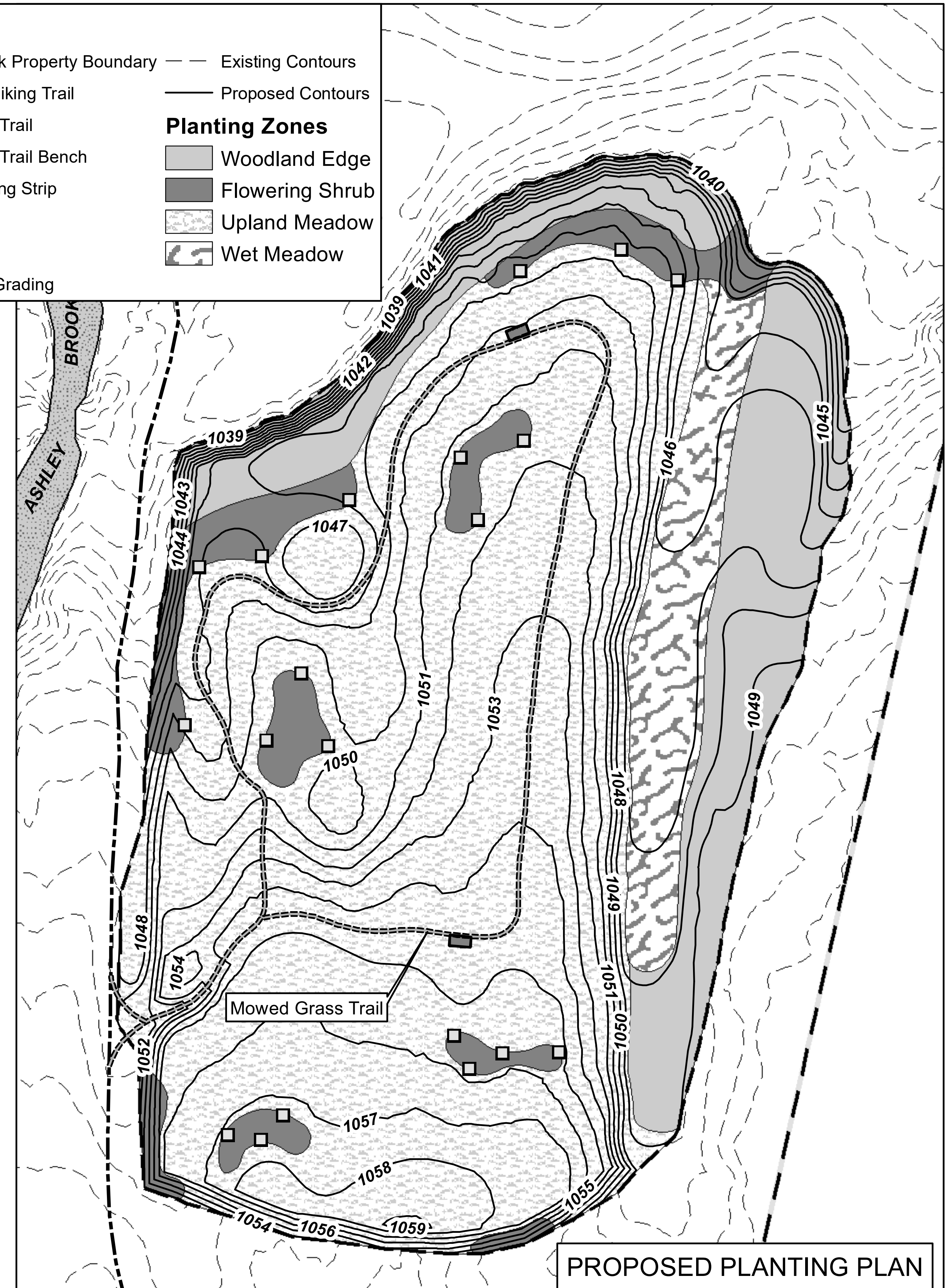


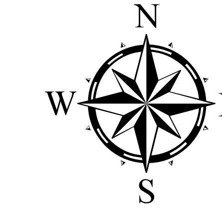
Legend

- Kirvin Park Property Boundary
- Existing Hiking Trail
- Pollinator Trail
- Pollinator Trail Bench
- Bee Nesting Strip
- Streams
- Bench
- Limits of Grading
- Existing Contours
- Proposed Contours

Planting Zones

- Woodland Edge
- Flowering Shrub
- Upland Meadow
- Wet Meadow





1 inch = 50 feet

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Proposed Grading and Planting Zones for Pollinator Habitat Creation Area

Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

DATE: 7/7/2025

PROJ. NO.: 60605466

DRAWING NUMBER:
6-6

SHEET NUMBER:
6 OF 7

Reccomended seed mixtures for Upland Meadow and Wet Meadow habitats as shown on Figure 6-6.

Table 1. New England Wetland Plants "WetMix"

Botanical Name	Common Name	Indicator
Carex vulpinoidea	Fox Sedge	OBL
Carex scoparia	Blunt Broom Sedge	FACW
Carex lurida	Lurid Sedge	OBL
Carex lupulina	Hop Sedge	OBL
Poa palustris	Fowl Bluegrass	FACW
Bidens frondosa	Beggar Ticks	FACW
Scirpus atrovirens	Green Bulrush	OBL
Asclepias incarnata	Swamp Milkweed	OBL
Carex crinita	Fringed Sedge	OBL
Vernonia noveboracensis	New York Ironweed	FACW
Juncus effusus	Soft Rush	FACW
Symphyotrichum lateriflorum	Starved/Calico Aster	FACW
Iris versicolor	Blue Flag	OBL
Glyceria grandis	American Mannagrass	OBL
Mimulus ringens	Monkey Flower	OBL
Eutrochium maculatum	Spotted Joe Pye Weed	OBL

Recommended Application Rate: 1 pound per 2,500 square feet

Table 2. New England Conservation/Wildlife Mix

Botanical Name	Common Name
Elymus virginicus	Virginia Wild Rye
Schizachyrium scoparium	*Little Bluestem*
Andropogon gerardii	*Big Bluestem*
Festuca rubra	Red Fescue
Panicum virgatum	Switch Grass
Chamaecrista fasciculata	Partridge Pea
Desmodium paniculatum	Panicledleaf Tick Trefoil
Sorghastrum nutans	Indian Grass
Verbena hastata	Blue Vervain
Asclepias tuberosa	Butterfly Milkweed
Rudbeckia hirta	Black Eyed Susan
Helenium autunale	Common Sneezeweed
Symphyotrichum pilosum	Heath Aster
Solidago juncea	Early Goldenrod
Agrostis perennans	Upland Bentgrass

Recommended Application Rate: 1 pound per 1,750 square feet

Table 3. New England Showy Wildflower Mix

Botanical Name	Common Name
Schizachyrium scoparium	Little Bluestem
Chamaecrista fasciculata	Partridge Pea
Sorghastrum nutans	Indian Grass
Festuca rubra	Red Fescue
Elymus canadensis	Canada Wild Rye
Elymus riparius	Riverbank Wild Rye
Heliopsis helianthoides	Ox Eye Sunflower
Coreopsis lanceolata	Lance Leaved Coreopsis
Rudbeckia hirta	Black Eyed Susan
Liatris spicata	Marsh Blazing Star
Asclepias syriaca	Common milkweed
Veronia noveboracensis	New York Ironweed
Symphyotrichum novae-angliae	New England American-aster
Eutrochium purpureum	Purple Joe-Pye Weed
Asclepias tuberosa	Butterfly Milkweed
Solidago juncea	Early goldenrod

Recommended Application Rate: 1 pound per 1900 square feet

Table 4. Proposed Planting Schedule for Woodland Edge Habitats

Plant Strata/Type	Plant Species		Plant Size/Type	Planting Quantities[1]	
	Scientific Name	Common Name		% of Total Planted	Total Number of Plants
Tree	Cercis canadensis	Eastern Redbud	18-24" Container	10%	4
	Salix humilis	Prairie willow	18-24" Container	15%	5
	Amelanchier canadensis	Eastern shadbush	18-24" Container	35%	13
	Acer saccharum	Sugar maple	18-24" Container	20%	7
	Prunus serotina	Black cherry	18-24" Container	20%	7
Shrub	Ribes rubrum	Red Currant	18" Container	10%	3
	Spiraea alba	Meadowsweet	18" Container	25%	7
	Swida racemosa	Gray dogwood	18" Container	15%	4
	Vaccinium corymbosum	Highbush Blueberry	18" Container	30%	8
	Vaccinium macrocarpon	American Cranberry	18" Container	20%	5

1. Trees and shrubs in the woodland edge habitats to be planted at overall density of 100 plants/acre; shrubs to be planted along the borders with open fields.

Table 5: Proposed Planting Schedule for Flowering Shrub Habitats.

Plant Strata/Type	Plant Species		Plant Size/Type	Planting Quantities[1]	
	Scientific Name	Common Name		% of Total Planted	Total Number of Plants
Shrubs	Ribes rubrum	Red Currant	18" Container	15%	6
	Rosa carolina	Carolina rose	18" Container	5%	2
	Rubus odoratus	Purple-flowering Raspberry	18" Container	10%	4
	Sambucus nigra	Black Elderberry	18" Container	10%	4
	Spiraea alba	Meadowsweet	18" Container	15%	6
	Spiraea tomentosa	Steeplebush	18" Container	5%	2
	Swida racemosa	Gray dogwood	18" Container	5%	2
	Swida sericea	Red-osier dogwood	18" Container	10%	4
	Vaccinium corymbosum	Highbush Blueberry	18" Container	10%	4
	Vaccinium macrocarpon	American Cranberry	18" Container	15%	6

1. Shrubs to be planted heterogeneously at overall density of 300 plants/acre.

Planting Zones	Total Area (Ac)	Total Area (SF)
Flowering Shrub	0.14	6,246.6
Upland Meadow	1.29	56,172.5
Wet Meadow	0.13	5,838.6
Woodland Edge	0.36	15,507.2
SUM:	*1.92*	*83,764.9*

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Reccomended Species List for Pollinator Habitat Areas

Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

DATE: 7/9/2025

PROJ. NO.: 60605466

DRAWING NUMBER:
6-7

Appendices

Appendix A

Applicable or Relevant and Appropriate Requirements (ARARs) for Kirvin Park Restoration Project

Applicable or Relevant and Appropriate Requirements for Kirvin Park Restoration Project

Statute/ Regulation	Citation[1]	Synopsis of Pertinent Requirements	Status	Action(s) to be Taken to Achieve ARARs
CHEMICAL-SPECIFIC ARARs				
Federal ARARs				
None				
State ARARs				
None				
LOCATION-SPECIFIC ARARs				
Federal ARARs				
Clean Water Act (CWA) – Section 404 and Implementing Regulations	33 USC 1344 33 CFR Parts 320-323, 325, 332 (Army Corps of Engineers [ACOE]) 40 CFR Part 230 (EPA)	For discharge of dredge or fill material to waters of the United States, including wetlands: (a) there must be no practicable alternative with less adverse impact on aquatic ecosystem (including wetlands); (b) the discharge cannot jeopardize the existence of any threatened or endangered (T&E) species; (c) the discharge cannot cause or contribute to significant degradation of waters of the U.S., including significant adverse effects on human health or welfare, aquatic life, aquatic ecosystem, or recreational, aesthetic, and economic values; and (e) the discharger must take appropriate and practicable steps to minimize or mitigate potential adverse effects on aquatic ecosystem. Mitigation/restoration is required for unavoidable impacts to aquatic ecosystem. The ACOE has a Massachusetts General Permit (GP) program (NAE-22-02649) that applies to projects with general permits. One such GP is GP 10, which covers Aquatic Habitat Restoration, Enhancement, and Establishment Activities, including restoration and enhancement of wetlands. The GP	Applicable to the extent that the Kirvin Park Restoration Project will involve the discharge of “fill material” to a water of the U.S. (which includes the brooks and wetlands at Kirvin Park). (The Project will not involve dredging or discharge of dredged material or the change of any wetland or waterbody into dry land.) This Project would be covered by Massachusetts GP 10.	To the extent that the Kirvin Park Restoration Project will involve the discharge of fill material into a water of the U.S., including wetlands, that activity will be conducted in accordance with these requirements – notably, the substantive requirements of the Massachusetts GP issued by the ACOE. The Project purpose and need were established by Paragraph 118.e of the Consent Decree. Given that purpose, there would be no practicable alternative with less adverse impact on the aquatic ecosystem (including wetlands); and the Project has been designed to minimize potential adverse impacts on the aquatic ecosystem. No loss or degradation of wetlands or other aquatic habitat will occur, rather, such aquatic resources will be improved in terms of habitat, flood storage, water quality and groundwater functions. The Project will not jeopardize federally listed threatened or endangered species or their critical habitat, as described below under the Endangered Species Act. Implementation of the Project will be conducted in a manner that complies with the applicable substantive conditions of the Massachusetts GP.

Applicable or Relevant and Appropriate Requirements for Kirvin Park Restoration Project

Statute/ Regulation	Citation[1]	Synopsis of Pertinent Requirements	Status	Action(s) to be Taken to Achieve ARARs
		specifies numerous requirements, including mitigating adverse impacts on wetlands, not jeopardizing federally listed threated or endangered species or their critical habitat, using appropriate equipment, stabilizing disturbed wetlands, avoiding the introduction of invasive species, and other conditions to avoid, minimize, or mitigate impacts on waters and wetlands.		
National Historic Preservation Act and Regulations	54 USC 300101 *et seq*. 36 CFR Part 800	A federal agency must take into account the project's effect on properties included or eligible for inclusion in the National Register of Historic Places (NRHP).	Applicable	A cultural resource assessment (CRA) conducted for GE has determined that the Project area does not contain any known cultural resources that are listed or meet the eligibility criteria for listing on the NRHP. It has further determined that the wetland restoration area has a low potential to contain archaeological sites and that, in the other Project areas, the construction activities will not result in greater impacts than prior land use activities or will simply cover the area (with no intrusive activities) thus preserving any archaeological features that may be present.
Endangered Species Act and Regulations	16 USC 1536(a)-(d) 50 CFR Part 402, Subparts A&B 50 CFR 17	A federal agency must ensure that any action authorized, funded, or carried out by it is not likely to jeopardize the continued existence of a listed threatened or endangered (T&E) species or result in destruction or adverse modification of critical habitat, unless an exemption is granted. If a listed species or critical habitat may be present in the action area, the steps set forth in the regulations must be followed, including implementation of reasonable and prudent mitigation measures where necessary.	Applicable	The Final Restoration Plan identified habitat for and the potential presence within the Project site of two species that have been proposed for federal listing – the tricolored bat and the monarch butterfly. As indicated in the Final Restoration Plan, the restoration activities are not expected to adversely affect those species. No mature trees that might provide habitat for the tricolored bat will be cut and the thickets that will be removed do not provide desirable habitat for that bat. In addition, the Project area does not contain preferred habitat for the monarch butterfly; and if anything, the restoration activities, including the removal of invasive plant

Applicable or Relevant and Appropriate Requirements for Kirvin Park Restoration Project

Statute/ Regulation	Citation[1]	Synopsis of Pertinent Requirements	Status	Action(s) to be Taken to Achieve ARARs
				species and replacement with native species, will likely result in improved habitat for that species.
Executive Order for Protection of Wetlands	Executive Order 11990 (1977)	Federal agencies are required to avoid adversely impacting wetlands unless there is no practicable alternative, and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use.	To be considered	Given the purpose of this Project, there would be no practicable alternative to performing this restoration work in wetlands. In any case, the Restoration Project will not adversely affect the wetlands, but will result in an improvement in the wetlands habitat.
Executive Order for Floodplain Management	Executive Order 11988 (1977)	A federal agency proposing action in a floodplain must consider alternatives to avoid adverse effects on the floodplain, and if there is no practicable alternative, must design or modify the action to minimize harm to or within the floodplain.	To be considered	Given the purpose of this Project, there would be no practicable alternative to performing this project in the floodplain. The Project will be designed to minimize harm to the floodplain and, in fact, will improve the floodplain habitat.
State ARARs				
Massachusetts Wetlands Protection Act (MWPA) and Regulations	MGL c. 131, section 40 310 CMR 10.00	These requirements govern removal, dredging, filling, or altering of designated resource areas, including Bordering Vegetated Wetland (BVW), Bordering Land Subject to Flooding (BLSF), Bank, Land Under a Waterbody (LUW), and Riverfront Area. The requirements are intended to protect the interests that these resource areas serve, including flood control, prevention of pollution and storm damage, and protection of public and private water supplies, groundwater supply, fisheries, land containing shellfish, and wildlife habitat. These regulations contain specific provisions for two types of restoration projects: • Ecological Restoration Project (ERP; 310 CMR 10.13), which includes rare species habitat restoration (10.13(6)); and	Applicable because restoration work will occur in BVW, BLSF, and Riverfront Area and buffer zone of BVW and Bank	The Kirvin Park Restoration Project will meet the substantive requirements of these regulations for both an ERP and ELRP. It will not only avoid adverse impacts to resource areas, but is designed to improve the habitat in those areas and their natural capacity to protect the interests identified in the MWPA. With specific respect to impacts on rare species, as discussed below under MESA, the state-listed species that have been identified for MESA project review purposes as potentially occurring in the Project Area are the dion skipper and the wood turtle. As further discussed under MESA, the Restoration Project is expected to have no adverse impact on the dion skipper, and on-site construction work will either be conducted during the wood turtle's inactive period or else will comply with a wood turtle management plan.. As also discussed under MESA, two other rare species have been identified for species conservation purposes as potentially occurring in the vicinity of the site – the

Applicable or Relevant and Appropriate Requirements for Kirvin Park Restoration Project

Statute/ Regulation	Citation[1]	Synopsis of Pertinent Requirements	Status	Action(s) to be Taken to Achieve ARARs
		• Ecological Restoration Limited Project (ERLP; 310 CMR 10.53(4)), which includes unspecified restoration projects that will improve the natural capacity of a resource area to protect the interests identified in the MWPA.. The substantive requirements for these projects include, but are not limited to, that the project will: (a) have no adverse effect on specified habitat of Rare Species (i.e., species listed under the Massachusetts Endangered Species Act [MESA]) or be carried out in accordance with a habitat management plan approved by the Massachusetts Natural Heritage and Endangered Species Program (MNHESP); (b) avoid or minimize adverse impacts to resource areas to the extent practicable; (c) be carried out in accordance with restrictions (if any) imposed by the MA Division of Fisheries and Wildlife; and (d) not reduce the capacity of the resource areas to serve their habitat functions (for an ERP) or to protect the interests identified in the MWPA (for an ELRP).		ocellated darner and the bridle shiner – but the project is very unlikely to adversely affect those species.
Clean Water Act – Water Quality Certification Regulations	314 CMR 9.00 et seq., notably 9.06	For discharge of dredged or fill material to waters of the U.S. in Massachusetts, section 9.06 requires, *inter alia*, that: (a) no such discharge is allowed if there is a practicable alternative with less adverse impact on the aquatic ecosystem (including wetlands); (b) appropriate and practicable steps must be taken to avoid and minimize adverse effects on wetlands; (c) there must be no discharge that would adversely affect estimated habitat of rare wildlife species under the MWPA; and (d) stormwater discharges must be controlled with best management practices (BMPs).	Applicable to the extent that the Kirvin Park Restoration Project will involve the discharge of "fill material" to a water of the U.S. (which includes the brooks and wetlands at Kirvin Park). (The Project will not involve dredging or discharge of dredged material or the change of any wetland or waterbody into dry land.)	To the extent that the Restoration Project will involve the discharge of fill material into a water of the U.S., including wetlands, it will meet the requirements of these regulations. There is no practicable alternative with less adverse impact on the aquatic ecosystem (including wetlands); appropriate and practicable steps will be taken to avoid and minimize adverse effects on wetlands (and, in fact, the wetlands habitat will be improved); there will be no discharge that would adversely affect estimated habitat of rare wildlife species under the MWPA (see discussion of MESA below); and stormwater discharges will be

Applicable or Relevant and Appropriate Requirements for Kirvin Park Restoration Project

Statute/ Regulation	Citation[1]	Synopsis of Pertinent Requirements	Status	Action(s) to be Taken to Achieve ARARs
		These regulations except certain activities, including an Ecological Restoration Project (314 CMR 9.03(8)). Further, Massachusetts has issued a general water quality certification for all General Permits (GPs), including GP 10 (described above), provided that the activity meets the conditions for the exemptions in 314 CMR 9.03.	This Project would be covered by Massachusetts GP 10.	controlled with BMPs. In any event, the Project will meet the requirements for an Ecological Restoration Project (as described above under the MWPA regulations) and will meet the substantive requirements of the Massachusetts GP issued by the ACOE (as noted above under CWA Section 404 and implementing regulations).
Massachusetts Endangered Species Act (MESA) and Regulations	MGL c. 131A. 321 CMR 10.00	A proposed activity in Priority Habitat for a state-listed threatened or endangered species or species of special concern, or other area where such a species has occurred may not result in a “take” of such species, unless it has been authorized through a conservation and management plan that provides a long-term net benefit to the conservation of the affected state-listed species. The MESA regulations provide a habitat management exemption for “the active management of State-listed Species habitat, including but not limited to … removing exotic or invasive species, for the purpose of maintaining or enhancing the habitat for the benefit of rare species, provided that the management is carried out in accordance with a habitat management plan approved in writing by the [MNHESP]” (321 CMR 10.14(15)).	Applicable	As discussed in the Final Restoration Plan, the state-listed species identified for MESA project review purposes as potentially present in the Project area are the dion skipper, a state-listed threatened species of moth, and the wood turtle, a state-listed species of special concern. As also discussed in that plan, the Project area does not contain preferred habitat for the dion skipper, monitoring will be conducted before and during construction for dion skipper presence, and construction activities will avoid any area where this species is observed; and it is anticipated that the restoration work will improve the habitat for dion skipper after construction. For wood turtle, the current schedule would not involve on-site construction work during the wood turtles’ active period, and GE has developed a wood turtle management plan (included in the Final Restoration Plan) to protect such turtles in the event that work did occur during that period. GE will coordinate with MNHESP regarding the management of wood turtles. Accordingly, the Restoration Project will comply with the substantive MESA requirements (including for the habitat management exemption if applicable). In addition, GE is planning to establish wood turtle nesting areas at the Project site, which has been endorsed by MNHESP.

Applicable or Relevant and Appropriate Requirements for Kirvin Park Restoration Project

Statute/ Regulation	Citation[1]	Synopsis of Pertinent Requirements	Status	Action(s) to be Taken to Achieve ARARs
				It should also be noted that two other state-listed species have been identified for species conservation purposes as potentially occurring in the vicinity of the site – the ocellated darner (a state-listed dragonfly) and the bridle shiner (a state-listed fish). As discussed in the Final Restoration Plan, the current schedule would not involve on-site construction during the ocellated darner's flight season and the Project area does not contain preferred habitat for this species, and the Project is very unlikely to affect the aquatic habitat of the bridle shiner.
Massachusetts Historical Commission Act and Regulations	MGL c. 9, section 27c 950 CMR 71.07	If a project has an area of potential impact that could cause a change in the historical, architectural, archaeological, or cultural qualities of a property on the State Register of Historic Places, these provisions establish a process for notification, determination of adverse impact, and evaluation of alternatives to avoid, minimize or mitigate such impacts.	Relevant and appropriate	A CRA has determined that the project area does not contain any property on the State Register of Historic Places. Thus, no further action is required to meet these requirements.
ACTION-SPECIFIC ARARs				
Federal ARARs				
Clean Water Act – NPDES Regulations (stormwater discharges)	40 CFR 122.26(c)(1)(ii)(C) 40 CFR 122.44(k) EPA's NPDES Construction General Permit (Jan. 18, 2022)	Best management practices (BMPs) must be employed to control pollutants in stormwater discharges during construction activities.	Applicable	The Restoration Project will meet the substantive requirements of these regulations and the Construction General Permit through implementation of erosion and sedimentation control measures during construction to control stormwater discharges of pollutants.

<u>Note</u>:ARARs consist only of the substantive requirements of the provisions cited in this column, not any administrative requirements included therein, including any requirement to obtain permits for on-site actions.

Appendix B

Community Outreach Plan

Community Outreach Plan

Floodplain/Wetland Restoration Action Plan for Kirvin Memorial Park Williams Street, Pittsfield Massachusetts

Introduction and Overview

This Community Outreach Plan has been prepared by the General Electric Company (GE) to describe the public outreach and engagement process anticipated to be implemented as part of the floodplain/wetland restoration project south of Sackett Brook at Kirvin Memorial Park in Pittsfield, Massachusetts. Based upon a site selection assessment prepared by the Massachusetts Department of Environmental Protection (MassDEP) on behalf of the Housatonic River natural resource trustees (Trustees) and preliminary reviews and discussions among the Trustees, the City of Pittsfield (the City), and GE, a portion of Kirvin Memorial Park in Pittsfield was selected as the site for a floodplain/wetland restoration/enhancement project required by the Consent Decree (CD) for the GE-Pittsfield/Housatonic River Site.[1]

On January 31, 2023, GE submitted a Conceptual Restoration Design/Restoration Action Plan (Restoration Plan) for this project; on September 13, 2024, it submitted a Revised Conceptual Restoration Plan; and it has now prepared and submitted a Final Restoration Plan. In brief, the current restoration plan will improve the natural resource conditions in approximately 17 acres of the floodplain of Sackett and Ashley Brooks at Kirvin Park, largely in the form of removing invasive plant species and establishing native vegetation, as well as expanding wetland conditions in a portion of this floodplain area and creating a pollinator meadow habitat outside of the floodplain.

In 2024, the Trustees requested GE to develop a written Community Outreach Plan to make the community aware of the project, address public input on the project design, and provide notice to the abutters of affected properties. This document constitutes an updated version of that plan. For guidance on the approach to public engagement, as requested by the Trustees, GE has drawn from the Massachusetts Environmental Policy Act (MEPA) Public Involvement Protocol for Environmental Justice Populations (January 1, 2022; MEPA EJ Protocol). Section II.B of that protocol identifies a list of specific outreach and engagement strategies. The protocol notes that the specific forms of outreach and community engagement should be tailored to the specifics of each project and its residents and neighborhoods. With that guidance in mind, it is emphasized that this is a natural resource enhancement/restoration project in a semi-rural environment (the outskirts of Pittsfield) within a park setting which primarily supports passive recreation (hiking, dog walking, biking, bird watching, fishing), with some organized recreation (soccer, frisbee), and with most of the restoration activity to be conducted in an area that is not used by most visitors to the park. Accordingly, the

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[1] Paragraph 118.e of the CD requires GE to install and monitor a total of approximately 12 acres of forested/wetland habitat, consisting of approximately 9.75 acres of floodplain forest habitat and 2.25 acres of freshwater palustrine wetlands, within a non-contaminated riparian area within the Housatonic River watershed outside of the CD Site. A portion of Kirvin Park was selected for that project. The current project includes some enhancements that go beyond the requirements of the CD,

focus of the public outreach is to facilitate the understanding of park natural resources and how this project is intended to improve the quality and functions of those natural resources.

Components of Community Outreach Program

Public involvement activities that are included in the MEPA EJ Protocol and will be implemented for the Kirvin Park restoration project include, but are not necessarily limited to, the following:[2]

- GE will disseminate a written project summary with basic project details to the local neighborhood. It is anticipated that this process will include a mailing to direct abutters to Kirvin Park and that the project summary will use the attached summary sheet.
- GE will make project information available through a website that will provide the public with convenient access to such information. It is anticipated that this will be done through the MassDEP/Trustees' website: https://www.mass.gov/info-details/kirvin-park-floodplain-and-wetland-restoration.
- GE will organize public education efforts for technical aspects of the project, such as preparation of fact sheets with visuals that include a summary of the project and associated technologies and processes, using lay-person language and terms in an effort to ensure that the community understands the potential impacts of the project and can provide meaningful input, and holding "science fair" type presentations or teach-ins broken by topics. These efforts may include a presentation to the Pittsfield Conservation Commission and/or Parks and Recreation Department which would be advertised and available to the public.
- GE will post temporary signs at and adjacent to Kirvin Park; a draft sign is attached to this document for review.
- GE believes that the Trustees, rather than GE, should solicit public comments on project design documents (through notice in the Environmental Monitor or other methods) and should hold any public meetings on the project. GE will cooperate with the Trustees in these efforts by preparing appropriate documents for use in the public comment request or public meetings and assisting the Trustees in any presentations as well as responding to public comments on the Final Restoration Plan.
- GE will directly notify abutters of Kirvin Park of the scope of and schedule for on-site project activities through periodic emails, hardcopy mailings, telephone calls, or property visits. These communications will be made in advance of key milestones in the restoration project (e.g., project start, initial stages of invasive plant removal, start of native species plantings).

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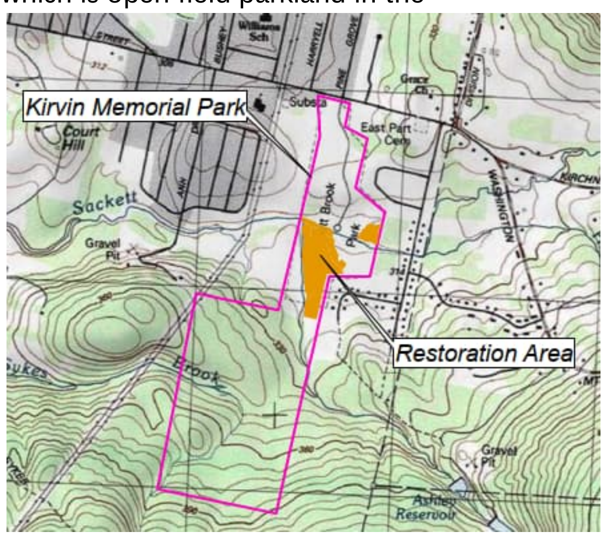
[2] The community outreach program already began through the holding of a public meeting on June 11, 2025, at which GE's consultant made a detailed slide presentation on the proposed restoration plan followed by a question and answer period. That presentation along with other information is available on-line via the MassDEP/Trustees' website: https://www.mass.gov/info-details/kirvin-park-floodplain-and-wetland-restoration

Summary of Kirvin Park Restoration Plan

The General Electric Company (GE), in cooperation with the Housatonic Natural Resource Trustees and the City of Pittsfield, is planning to implement a natural resource restoration/enhancement project in the Housatonic River watershed in accordance with the Consent Decree (CD) for the GE-Pittsfield/Housatonic River Site. Based upon a site selection assessment prepared by the Massachusetts Department of Environmental Protection (MassDEP) on behalf of the Housatonic River natural resource trustees (Trustees) and preliminary reviews and discussions among the Trustees, the City of Pittsfield (the City), and GE, a portion of Kirvin Memorial Park in Pittsfield was selected as the site for a floodplain/wetland restoration/enhancement project required by the Consent Decree (CD) for the GE-Pittsfield/Housatonic River Site.

In July 2025, GE submitted a Final Restoration Design/Restoration Action Plan (Restoration Plan) for this project. In brief, the Final Restoration Plan calls for improving the natural resource conditions in approximately 17 acres of the floodplain of Sackett and Ashley Brooks at Kirvin Park, largely in the form of removing invasive plant species and establishing native vegetation, as well as expanding wetland conditions in a portion of this floodplain area, and creating a pollinator habitat outside of the floodplain.

Kirvin Park encompasses 226 acres, roughly one-fourth of which is open field parkland in the northern part, with the remainder consisting mostly of forested habitat extending south into the lower parts of Washington Mountain. A residential neighborhood borders the park to the southeast. The portion of Kirvin Park selected for the restoration project is primarily to the south of Sackett Brook, which flows westerly through the Park, and to the east of Ashley Brook, which flows north through the Park to join Sackett Brook (*see Site Locus Figure*). Due to the presence of these two brooks, a large area of Kirvin Park is situated in a riparian/floodplain setting. However, much of the floodplain riparian zone south of Sackett Brook is heavily dominated by invasive plant species, which collectively impair the overall habitat diversity and ecological functions of this site. In particular, large portions of the site are dominated by the invasive shrub/small tree common buckthorn, forming in many areas a dense mat which has been expanding on the site over the past several decades. In addition, there are several other primary invasive species that warrant control efforts at the site, notably Morrow's honeysuckle, Asian bittersweet, multiflora rose, garlic mustard (*Allaria petiolata*), and bishop's goutweed (*Aegopodium podagraria*). These invasive species substantially impact the ecological integrity and functions of the floodplain community at the Kirvin Park site. Accordingly, a primary objective of the proposed restoration/enhancement program is to convert the existing invasive vegetative cover to a plant



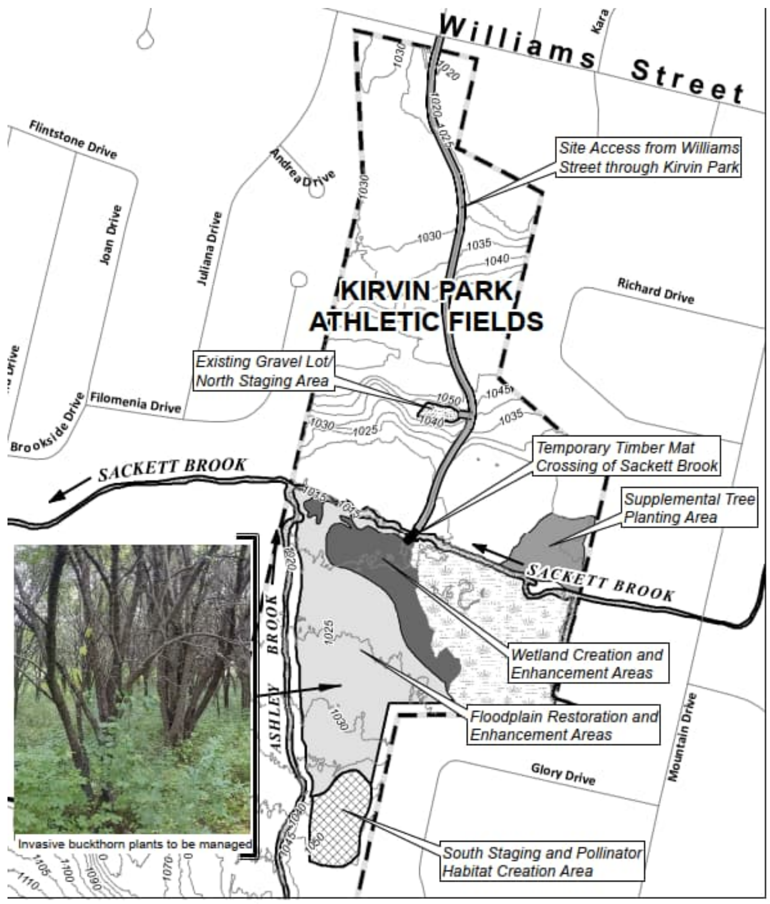
community dominated by diverse assemblage of native (or indigenous) floodplain/wetland/riparian zone plant species. Concurrently, wetland resource enhancement will be accomplished by expanding the area of wetland at the site, an area of supplemental tree plantings will occur in an open meadow north of Sackett Brook, and a pollinator habitat will be created south of the floodplain restoration area.

The locations of the floodplain and wetland enhancement areas are shown on the figure below, with Sackett and Ashley Brooks as well as the main Kirvin Park athletic and open recreational fields shown for context. A photo of the invasive buckthorn forest is also provided; this is representative of much of the proposed restoration area.

Implementation of the plan will require brush cutting of the invasive woody species (with targeted herbicide treatment of the cut stumps), removal of the cut vegetation from the site, and planting of native floodplain and wetland species throughout the cleared area. Nearly 7,000 trees will be planted, along with nearly 17,000 shrubs within the restoration area. Existing desirable native tree species will be preserved within the restoration area.

It is anticipated that construction on this project will begin in approximately November 2025, with landscaping and planting in 2026 and into 2027.

Recreational activities at Kirvin Park are anticipated to continue during implementation of the plan, although access south of Sackett Brook through the floodplain area will have some restrictions during the landscaping work.



Kirvin Park Floodplain/Wetland Enhancement Areas

0 200 400 800 1,200 Feet
N

Draft Signage for On-Site Notice of the Kirvin Park Restoration Plan

RESTORING AND ENHANCING NATURAL HABITAT IN KIRVIN PARK

A project to replace harmful invasive species with native plants and enlarge wetlands for ecological improvement

A team of specialists is working to improve the conditions of approximately 13 acres in the floodplain of Sackett and Ashley Brooks in the south end of Kirvin Park, largely by removing invasive plant species and establishing native vegetation, as well as expanding wetland conditions in a portion of the floodplain area. These invasive plants collectively impair the overall habitat diversity and functions of the ecosystem.

- **PROJECT DATES:** November 2025 - November 2026
- **LOCATION:** 17 acres, including 15 acres in the floodplain of Sackett and Ashley Brooks
- **ENHANCEMENTS:** Nearly 7,000 trees and 17,000 shrubs will be planted following removal of invasive plant species.
- **PRIVATELY FUNDED**

SPECIES ARE:


COMMON BUCKTHORN

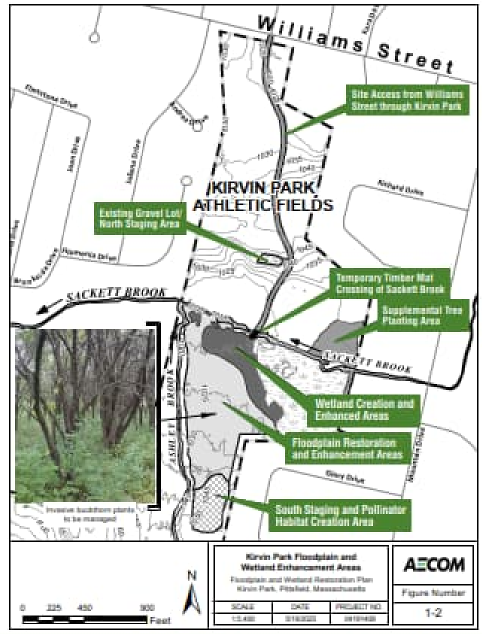

MORROW'S HONEYSUCKLE


ASIAN BITTERSWEET


MULTIFLORA ROSE


GARLIC MUSTARD


BISHOP'S GOUTWEED



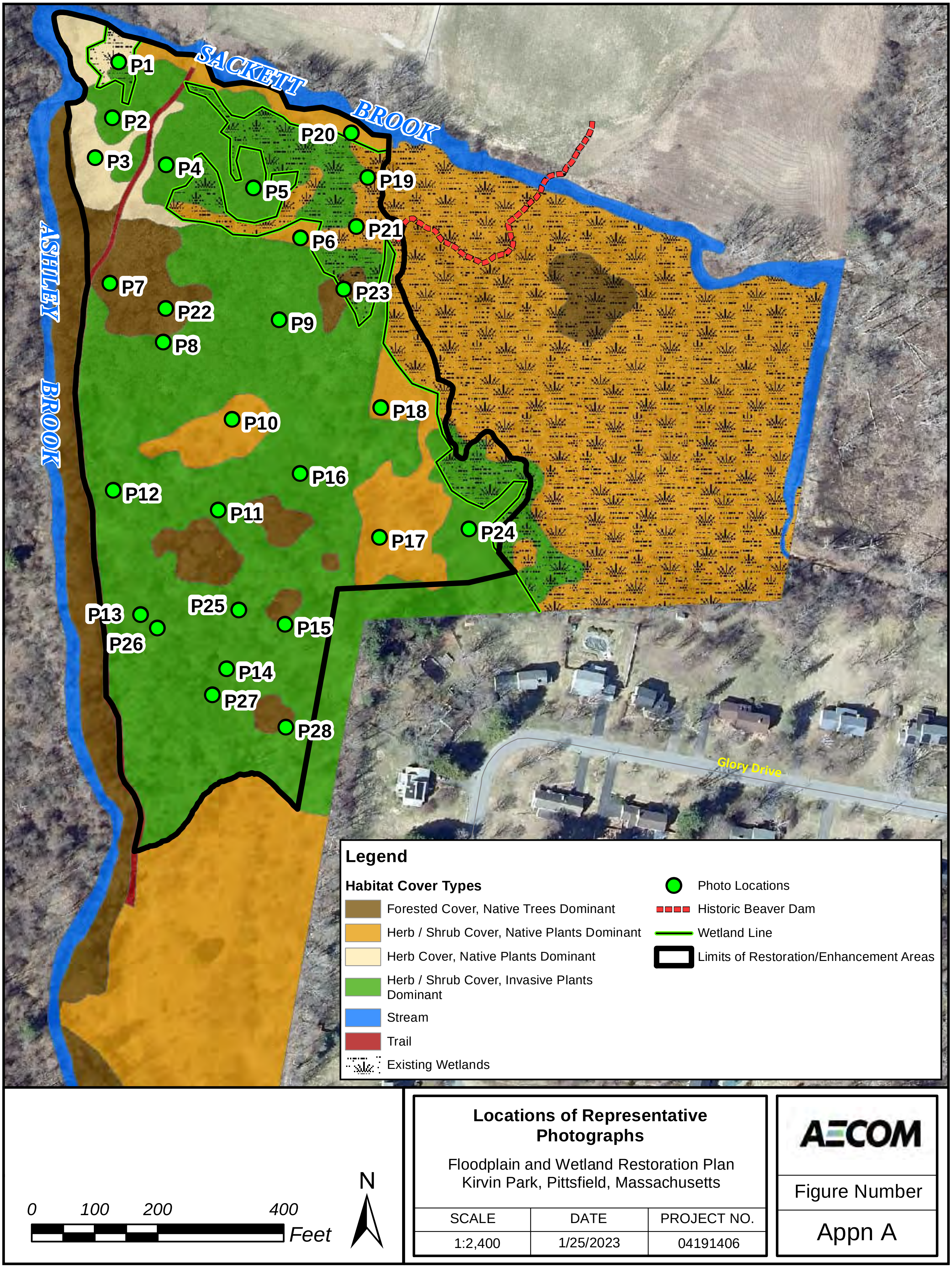
The park will remain open for recreational activities throughout the project.

For more information, please scan the QR code or call 866-596-3655.

A cooperative project of the General Electric Co., the Housatonic River Natural Resources Trustees and the City of Pittsfield

Appendix C

Representative Photographs



Locations of Representative Photographs

Floodplain and Wetland Restoration Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
1:2,400	1/25/2023	04191406

AECOM

Figure Number

Appn A

AECOM

PHOTOGRAPHIC LOG

Client Name: General Electric Company	**Site Location:** Floodplain and Wetland Restoration Plan - Kirvin Park, Pittsfield, MA	**Project No.** 60605466

Photo No. 1	**Date:** 8/9/2022	**Photo No. 2**	**Date:** 8/9/2022
Description: View North – Vegetation Monitoring Plot, MP-1		**Description:** View North – Vegetation Monitoring Plot, MP-2	

Photo No. 3	**Date:** 8/9/2022	**Photo No. 4**	**Date:** 8/9/2022
Description: View North – Vegetation Monitoring Plot, MP-3		**Description:** View North – Vegetation Monitoring Plot, MP-4	

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
General Electric Company	Floodplain and Wetland Restoration Plan - Kirvin Park, Pittsfield, MA	60605466

Photo No. 5	**Date:** 8/9/2022	**Photo No. 6**	**Date:** 8/9/2022
Description: View North – Vegetation Monitoring Plot, MP-5		**Description:** View North – Vegetation Monitoring Plot, MP-6	

Photo No. 7	**Date:** 8/9/2022	**Photo No. 8**	**Date:** 8/9/2022
Description: View Northeast – Vegetation Monitoring Plot, MP-7		**Description:** View North – Vegetation Monitoring Plot, MP-8	

PHOTOGRAPHIC LOG

Client Name: General Electric Company	Site Location: Floodplain and Wetland Restoration Plan - Kirvin Park, Pittsfield, MA	Project No. 60605466

Photo No. 9	**Date:** 8/9/2022	**Photo No. 10**	**Date:** 8/9/2022
Description: View West – Vegetation Monitoring Plot, MP-9		**Description:** View Southwest – Vegetation Monitoring Plot, MP-10	
			

Photo No. 11	**Date:** 8/9/2022	**Photo No. 12**	**Date:** 8/9/2022
Description: View North – Vegetation Monitoring Plot, MP-11		**Description:** View Northwest – Vegetation Monitoring Plot, MP-12	
			

PHOTOGRAPHIC LOG

Client Name: General Electric Company	**Site Location:** Floodplain and Wetland Restoration Plan - Kirvin Park, Pittsfield, MA	**Project No.** 60605466

Photo No. 13	**Date:** 8/23/2022	**Photo No. 14**	**Date:** 8/23/2022
Description: View Southwest – Vegetation Monitoring Plot, MP-13		**Description:** View Southwest – Vegetation Monitoring Plot, MP-14	

Photo No. 15	**Date:** 8/23/2022	**Photo No. 16**	**Date:** 8/23/2022
Description: View Northwest – Vegetation Monitoring Plot, MP-15		**Description:** View Southwest – Vegetation Monitoring Plot, MP-16	

PHOTOGRAPHIC LOG

Client Name: General Electric Company	**Site Location:** Floodplain and Wetland Restoration Plan - Kirvin Park, Pittsfield, MA	**Project No.** 60605466

Photo No. 17	**Date:** 8/23/2022	**Photo No. 18**	**Date:** 8/23/2022
Description: View North – Vegetation Monitoring Plot, MP-17		**Description:** View North – Vegetation Monitoring Plot, MP-18	

Photo No. 19	**Date:** 8/23/2022	**Photo No. 20**	**Date:** 8/23/2022
Description: View North – Vegetation Monitoring Plot, MP-19		**Description:** View South – Buckthorn growing in floodplain wetland along river.	

Client Name:	Site Location:	Project No.
General Electric Company	Floodplain and Wetland Restoration Plan - Kirvin Park, Pittsfield, MA	60605466

Photo No. 21	**Date:** 8/23/2022	**Photo No. 22**	**Date:** 4/13/2021
Description: View North – Open wet meadow dominated by goldenrods, asters and sensitive fern		**Description:** View North – Approximately 41-inch DBH Cottonwood	
			

Photo No. 23	**Date:** 8/23/2022	**Photo No. 24**	**Date:** 8/23/2022
Description: View South – Floodplain area dominated by buckthorn, honeysuckle, river grape and goldenrods		**Description:** View North – Area dominated by buckthorn and goldenrod.	
			

Client Name: General Electric Company	**Site Location:** Floodplain and Wetland Restoration Plan - Kirvin Park, Pittsfield, MA	**Project No.** 60605466

Photo No. 25	**Date:** 8/23/2022	**Photo No. 26**	**Date:** 8/23/2022
Description: View North – Opening in buckthorn canopy		**Description:** View South – Opening in buckthorn canopy with dead tree snag in background.	

Photo No. 27	**Date:** 8/23/2022	**Photo No. 28**	**Date:** 8/23/2022
Description: View East – Area dominated by buckthorn with understory of garlic mustard		**Description:** View East – Approximately 0.07-acre dominated by young American elm trees	

Appendix D

Technical Assessment of Common Buckthorn Control and Management

AECOM

Technical Assessment of Common Buckthorn (*Rhamnus cathartica*) Control and Management

Prepared for General Electric Company
Pittsfield, Massachusetts

January 2023; Revised July 2025

Prepared by AECOM Environment

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1.0 Introduction

Much of the floodplain riparian zone south of Sackett Brook is heavily dominated by invasive plant species which collectively impair the overall habitat diversity and ecological functions of this site. In particular, large portions of the site are dominated by the invasive shrub/small tree common buckthorn (*Rhamnus cathartica*), forming in many areas a dense monoculture which has been expanding on the site over the past several decades. In addition to buckthorn, there are several other primary invasive species which warrant control efforts at the site, notably Morrow's honeysuckle (*Lonicera morrowii*), oriental bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*), garlic mustard (*Allaria petiolata*), and bishop's goutweed (*Aegopodium podagraria)*. These species, and especially the buckthorn, substantially impact the ecological integrity and functions of the floodplain community at the Kirvin Park site. Accordingly, a primary objective of the proposed restoration/enhancement program is to convert the existing invasive vegetative cover to a plant community dominated by a diverse assemblage of native (or indigenous) floodplain/wetland/riparian zone plant species. To accomplish the invasive species control objectives, extensive background research has been conducted on the most abundant invasive species at the site, common buckthorn, to best understand the species biology and ecology and develop management strategies with the highest potential for success in ecological restoration.

Common buckthorn, referred to as buckthorn in this report, has been classified as an Invasive plant by the Massachusetts Invasive Plant Advisory Group as early as 2005 (MIPAG 2005) and remains on the current 2022 MIPAG list of Invasive species (MIPAG 2022). Invasive plants are defined by MIPAG as "*non-native species that have spread into native or minimally managed plant systems in Massachusetts, causing economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems.*"

It was generally believed that buckthorn was introduced to North America in the mid-19th century as an ornamental (Seltzner and Eddy 2003) and used as hedges by mid- late 19th century (Heneghan et al. 2007). However, more recent research of early records to more accurately establish the history of buckthorn presents strong evidence of the specie's introduction prior to the 19th century due to its medicinal purposes (Kurylo and Endress 2012). The following historical accounting of buckthorn introduction and establishment in the United States is provided through research of historical archives by Kurylo and Endress (2012) that have become increasingly digitally available:

The buckthorn hedge was first reported after the Essex Agricultural Society from Essex County, MA visited the farm of Hersy Derby who successfully established the buckthorn hedge in 1809 in Salem, MA. Information spread describing buckthorn as a "*superior*" hedge species in an 1824 issue of *New England Farmer* magazine (Proctor 1824). Derby propagated his hedge from plants dug beneath a buckthorn tree in the local physician's garden (Derby 1834) who had "*long used the fruit as a cathartic in his medical practice*" and whose tree was claimed as "*the oldest plant of this species known in this country"* (Anonymous 1847a), clarifying that buckthorn was brought to North America as a medicinal plant before its use as a hedge. By the early 19th century, buckthorn was common in hedges around Philadelphia, PA and so commonly found in parts of New England that early plant catalogues categorized it as indigenous to New York (Eaton 1817, Green 1814). With the understanding that buckthorn may take 9-20 years to reach reproductive maturity (Gourley 1985) along with the common understanding in the early 1820's of the presence of buckthorn being "*native or at least naturalized*" over a large area of the northeastern United States, comes the realization that buckthorn was introduced before the turn of the 19th century (Kurylo and Endress 2012).

Derby had been unsuccessful using other species for hedges and declared of buckthorn, "*so hardy a plant, and so well adapted to hedges*" (Derby 1834). Others commented, "*its bark and leaf are offensive to insects, and the borer, the aphis, and others…remarkable for its hardiness, its robustness, and its power of adapting itself to any soil…one of the easiest to propagate*" (Anonymous 1847b). A few years after establishment of his buckthorn hedge and realizing its reliability as a hedge plant, Derby "*furnished and distributed into different sections of the United States, plants sufficient to extend several miles*" (Derby 1836). Kurylo et al. (2012) conjecture *"the taxon could have found its way to the Midwest via Mr. Derby, but it could also have come earlier with settlers,*" and further provide evidence of buckthorn establishment in the Midwest by 1839. Buckthorn continued to expand across North America and by the mid-19th century was desirable for its use to form hedgerow cultivars (Seltzner and Eddy 2003). Its rapid dispersal across the continent was beyond its natural invasiveness, expedited by humans as buckthorn seed was sold "*by the pound*" to midwestern states as a hedge plant from the northeastern United States (Kurylo et al. 2012). Buckthorn appeared in taxonomic collections by the 1880's (Wolf 1938). By the 1900's, buckthorn had become naturalized and widespread in northeastern and midwestern U.S.

Defining the early and progressive history of buckthorn helps to bring awareness to its invasive nature and attentive demands to the complex characteristics enabling its prolific invasive success, promoting a better understanding of human-invasive species interactions (Kurylo and Endress 2012). Continued research strives to provide beneficial information for methods in its difficult control and management.

2.0 Factors Contributing to Buckthorn's Invasiveness

Buckthorn is a tall understory naturalized shrub or small tree that is successfully invasive and becomes dominant in a wide range of temperate habitats by outcompeting native species. "It can form dense thickets across a variety of habitats, moisture gradients, and light levels" (Kurylo et al. 2007). The nature and extent of the effects of this invasive plant on native species is still not clearly understood. Many studies demonstrate that the presence of buckthorn results in a change in the ecological community. "Invasive plant species are changing the way natural communities look by altering the size and shape of the available trait space, which could lead to exclusion of non-adaptive species or lead to growth constraints" (Perry 2015). Based on their observations, Mascaro and Schnitzer (2007) suggest *"common buckthorn is a particularly successful invasive species in eastern deciduous forests of North America and is capable of acting as an ecosystem dominant.*"

A comprehensive review of research and knowledge of the ecology and impacts of buckthorn discusses specialized inherent traits suggested to enable buckthorn's powerful invasiveness to outcompete native species in various ecological communities (Zouhar 2011) in which Knight et al. (2007) best summarize the numerous successfully invasive and possible adaptive and phenological traits of buckthorn: *"Physiological studies have uncovered traits including shade tolerance, rapid growth, high photosynthetic rates, a wide tolerance of moisture and drought, and an unusual phenology that may give R. cathartica an advantage in the environments it invades. Its high fecundity, bird-dispersed fruit, high germination rates, seedling success in disturbed conditions, and secondary metabolite production may also contribute to its ability to rapidly increase in abundance and impact ecosystems. R. cathartica impacts ecosystems through changes in soil N (nitrogen), elimination of the leaf litter layer, possible facilitation of earthworm invasions, unsubstantiated effects on native plants through allelopathy or competition, and effects on animals that may or may not be able to use it for food or habitat."* Seltzner and Eddy (2003) also emphasize the unique physiological traits of buckthorn stating, *"several factors contribute to the success of R. cathartica outside its native range: lack of natural predators, wide habitat tolerance, rapid growth rate and vigorous vegetative regeneration, prolific fruit/seed production and potential for long distance seed dispersal, and* *phenotypic plasticity that enables R. cathartica to exploit varying environmental conditions, notably in response to light."* Although there have been many observations indicating these traits to be advantageous for buckthorn to outcompete native species and dominate sites, it has been very difficult to explain how these traits work to quantify the extent of effects of buckthorn invasion on native species. *"There is, they claim, still much to learn about the impacts of buckthorn on above and belowground systems"* (Pepper and Heneghan 2016). Notably, research on the invasion of buckthorn populations in northeastern United States is limited compared to the Great Lakes region.

2.1 Habitat Tolerance

MIPAG (2005, 2022) describes invasive buckthorn as "*a shrub or tree occurring in all regions of the state in upland and wetland habitats. Grows in full sun to full shade. Produces fruit in fall; grows in multiple habitats; forms dense thickets.*" In the first classification listing of the US Fish and Wildlife Service National Wetlands Plant List (USFWS NWPL) in 1988, *Rhamnus cathartica*, buckthorn, was not listed, indicating it to be a strictly upland species in the Northeast Region as it is clearly stated "*if a species does not occur in wetlands in any region, it is not on the National List*" (Reed 1988). By 1996, *Rhamnus cathartica* was listed as a Facultative Upland wetland plant species in the northeast indicating it to *"usually occur in nonwetlands (estimated probability 67%-99%), but occasionally found in wetlands (estimated probability 1%-33%)*. As of 2012, *Rhamnus cathartica* was listed as a Facultative plant species in the Northeast Region indicating it "*equally likely to occur in wetlands or nonwetlands (estimated probability 34%-66%)"* and remains currently (USACE NWPL 2020) as Facultative on the National Wetlands Plant list. This chronological summary emphatically illustrates the extent of buckthorn adaptability and expanse of habitats successfully invaded over the last 35 years in the Northeast, as well as an evolving understanding of this species occurrence in varied habitats.

The key underlying characteristic of invasive buckthorn habitats is disturbance of the natural habitat. "Disturbance of natural communities through drainage, fire, woodland grazing and cutting" facilitates spread of buckthorn (Converse 1984). A comprehensive review of buckthorn research reveals *"no evidence was found suggesting that common buckthorn occurs in undisturbed forest or woodland in the northeastern United States"* (Zouhar 2011). In North America, many studies report distribution of buckthorn frequently occurs in human-modified environments including pastures, field edges, along fence rows, roadsides, railroads, vacant lots, hedgerows, clearings, woodlots and disturbed woods, cultivated areas, and around dwellings (Zouhar 2011). In New England, buckthorn is found most often on disturbed, open, moist sites and successfully invades abundant habitats including "*abandoned fields and pastures, open woods, early successional forests, edges, planted forests, floodplain and riparian forests, wet meadows, ravines, open disturbed areas, roadsides, fencerows, vacant lots, and yards or gardens*" (IPANE 2007).

Buckthorn dominates the understory of many temperate forests of northeastern North America. Buckthorn outcompetes native understory species for light, nutrients and moisture potentially forming monotypic stands that suppress plant and animal diversity. Old field areas of this region most often show buckthorn abundance and preference on sites with a history of plowing compared to former pastures or continuously forested woodlots (McDonald et al. 2008a). *"The current and historical landscape context and soil characteristics along with disturbance determine the invasiveness and establishment of buckthorn, and its distribution over a region"* (McDonald et al. 2008a).

Invasive buckthorn threatens native species of a habitat community, changing its composition as buckthorn becomes dominant. A study conducted in Maine looked at areas of native plants with and without buckthorn to determine the effects of buckthorn on native plants (Perry 2015). This study highlighted that *"the presence of buckthorn resulted in a change in the community as the functional trait distributions of native plants including plant height, chlorophyll, and SLA (specific leaf area) values all shifted in response to buckthorn, resulting in plants that were taller and had thinner leaves with less chlorophyll. Invasive plant species are changing the way natural communities look by altering the size and shape of the available trait space, which could lead to exclusion of non-adaptive species or lead to growth constraints"* (Perry 2015). Along the Lower Wisconsin River, Aslum (2003) observed differences in the composition of woody species between buckthorn invaded and uninvaded sites. Buckthorn invaded sites had "*higher density of woody seedlings (including common buckthorn), lower herbaceous cover, more weedy and nonnative species, fewer sensitive native plant species, lower density of several native woody species, and greater density of invasive honeysuckles than sites without common buckthorn*" (Aslum 2003). With the invasion of buckthorn and its establishment, the habitat community may experience additional effects such as the insect herbivory preferences between native and nonnative species, which contribute to site increases in buckthorn abundance and an associated decline in native species abundance. "*Herbivory on 8 native species averaged 4.3% of leaf area lost, significantly more than the 0.8% loss to herbivory on common buckthorn*" (Heneghan 2005). Bisikwa et al. (2005) discuss the effect of buckthorn dominance on an ecological site as it crowds out and displaces the native plants, including desirable shrubs and trees in the understory of the forest where many bird species nest. Predation is a greater risk for nesting birds in the buckthorn understory. Bisikwa et al. (2005) emphasize the causal devastating effect of loss of wildlife dependent upon native vegetation such as *"Cornus sp. (dogwood), Corylus sp. (hazel), and Prunus sp. (cherries).*"

2.2 Soil Moisture Tolerance

Buckthorn in the northeastern United States is classified Facultative (USACE NWPL 2020) and is commonly found in uplands through soil moisture ranges including wetland edges and floodplain forests (Snyder et al. 2004). In New Jersey, for example, buckthorn is found in woodlands and thickets, floodplain forests, and margins of sinkhole ponds, but is most frequently found along fen edges and open woodlands adjacent to fens (Snyder et al. 2004). The edge of a riparian forest in Vermont along the slow moving Little Otter Creek floods each spring to distances of about 328 feet from the stream edge. "*Buckthorn was found in shrub-dominated plots 16 to 82 feet (5-25 m) from the stream edge but was not found in the forest understory plots 164 to 328 feet (50-100 m) from the stream*" (Hughes and Cass 1997). In Wisconsin, a study along the Wisconsin River found that increased edge habitat, more roads, and *"altered"* flood regimes promoted buckthorn invasion, whereas *"unfragmented forest and intact flood regime"* inhibited its invasion. Data showed buckthorn abundance in disturbed 100-year floodplain reaches of the south-central Wisconsin River, and not in the north-central or southwestern undisturbed Wisconsin River areas (Predick and Turner 2008).

Kurylo et al. (2015) conducted a study to explain the growth of buckthorn in wetland habitats by assessing buckthorn growth over multiple flooding treatments. A soil moisture gradient from upland mesic soil moisture to a moisture range of wetland habitat sites designated as saturation within 30 cm of the surface, periodic flooding, and permanently flooded was used to measure buckthorn growth of young saplings compared to old saplings. Buckthorn growth, architecture and biomass allocations were evaluated. Under these treatments, it was shown by buckthorn growth patterns that *"young saplings were able to tolerate saturated soil conditions while old saplings were able to tolerate periodic flooding."* Both young and old saplings exhibited similar biomass allocation patterns to above versus belowground tissues according to soil moisture treatment. This study suggests overall that buckthorn exhibits tolerance to periodic flooding which may explain its successful invasion of and presence in certain wetland habitats in North America. "*A more plausible alternative reason for the observed distribution of R. cathartica in* *wetlands may be that this species exhibits phenotypic plasticity, where the genotypes exhibit different growth patterns in relation to soil moisture*" (Kurylo et al. 2015).

A survey of the University of Wisconsin Arboretum revealed buckthorn is most common and growing best on open or moist sites, or a combination of both site types (Gourley 1985, Gourley and Howell 1984). The survey established that nearly level, open canopy wetlands with deep poorly to very poorly drained soils (seasonal high water table at or near the surface, <1 foot deep) grow the largest buckthorn trees and the greatest density of buckthorn. Buckthorn was also found to grow well on wet and relatively shady sites. An area of extremely wet and mucky soils was found to grow the largest buckthorn trees (measuring 37" in circumference) in the Arboretum, however many had fallen over as these soils were unable to support their shallow root system as the trees grew too top-heavy (Gourley 1985). Findings that a high winter water table or more waterlogged areas of wetlands may limit buckthorn were reported in studies cited by Kurylo et al. (2007), and further indicate that buckthorn prefers relatively drier microsites in some wetland areas. In the Arboretum, buckthorn growth was observed to be supported on drier soils, but to a more limited extent than wet areas. Further observations note that open, drier upland prairie sites with gently rolling, slightly irregular topography do not support buckthorn (Gourley 1985).

In another study, evidence suggests that buckthorn germination and seedling establishment, growth, and frost resistance on relatively wet sites may be severely impacted by prolonged flooding. In north-central New York, observations at the Chaumont Barrens Preserve revealed the lack of buckthorn seedlings, saplings and trees in alvar grasslands (poor limestone soils) suggesting an inhibition effect of seasonal flooding on seed germination (Samuels 2002). In silver maple dominated wetlands in southeastern Wisconsin, buckthorn was studied in both the floodplain and basin forested wetlands (Frye and Grosse 1992). "*The water table is at or near the soil surface most of the year in both site types, although basin soils always have 14 to 16 inches of standing water in spring, while floodplain soils are flooded every 2 to 3 years, usually in spring. Buckthorn growth in the shrub layer on both sites were found to be similar, however seedling growth was found to be significantly higher on floodplain sites than basin sites. No buckthorn trees were found on either site. Assessed saplings the following year indicated that buckthorn exhibited less height and diameter growth compared to controls. Previously flooded buckthorn individuals were also indicated to be more susceptible to frost injury during the period of recovery*" (Frye and Grosse 1992). In a greenhouse study, buckthorn that had been exposed to partial flooding exhibited reduced photosynthetic rate initially and then recovered, however, these plants remained significantly smaller than controls (Stewart and Graves 2004).

2.3 Shade Tolerance

Buckthorn has a wide tolerance range to light and shade giving it an advantage to invade a wide range of environments. Although buckthorn grows in open habitats in full or partial sunlight, its tolerance of deep shade is the trait for its success in invading and thriving in forest habitats. Seltzner and Eddy (2003) aptly portray this trait as *"a phenotypic plasticity that enables R. cathartica to exploit varying environmental conditions, notably in response to light."*

The composition of a forest understory is sensitive to and dependent upon, or limited by, the light available. Buckthorn benefits from a high shade tolerance, but its leaf phenological trait in combination liberates a superior edge to successfully invade a broad range of available light habitats of North American temperate forests. The phenology or seasonal timing of events in the case of buckthorn works to create an extended growing season that gives buckthorn an advantage in ecosystems it invades. The leaves of buckthorn emerge early in the spring and senesce late in the fall, as much as an average of 58 days longer leaf season than *Cornus racemosa* or *Prunus serotina* in southern Wisconsin (Harrington et al. 1989). Buckthorn benefits from an advantageous extended growing season enabling it to maximize available light and thereby maximize photosynthesis for greater carbon gain and rapid growth. Early leaf out allows a jump on photosynthesis, yearly carbon gain and growth before the leaves of taller shrubs and canopy trees block light from reaching buckthorn leaves. Buckthorn leaves persist later into the fall after leaf senescence of most native species, and buckthorn benefits from continued photosynthesis and growth providing an advantage to outcompete. The fall late leaf senescence phenology is common in many woody invasive species that benefit as this *"autumn niche"* provides up to 20% of a plant's annual carbon gain (Fridley 2012). Extended leaf longevity potentially increases buckthorn's seasonal carbon gain compared to associated native species (Archibold et al. 1997). In their study, Stewart and Graves (2004) found buckthorn grew faster due to its high carbon use efficiency.

A study was conducted to determine whether buckthorn's invasive ability is due to a high mid-season shade tolerance or from shade avoidance resulting as an effect of its early leaf out and late leaf senescence traits (Schuster et al. 2020). Canopy models did not find any significant relationship between buckthorn performance and summer light availability, however a tight correlation between buckthorn performance and spring and autumn light availability demonstrated that shade avoidance as a leaf trait of the buckthorn regulated its ability to succeed in temperate forests. Schuster et al. (2020) conclude therefore, that species with similar leaf trait phenology to extend spring and autumn canopy will offer the best resistance to buckthorn invasion, whereas shorter season leafless species are most vulnerable to buckthorn invasion. Another study by Schuster et al. (2021) further refines their findings of this phenological advantage of buckthorn to capture light both early and late in the growing season to outgrow and outcompete native species. Findings (from garden experiments) emphasized the spring leaf phenology of buckthorn to be comparable to the five native species in the study, *Sambucus canadensis, Sambucus racemosa, Corylus americana, Cornus racemosa* and *Acer saccharum*, four of which broke buds within 7 days after buckthorn and *Sambucus racemosa* consistently earlier than buckthorn. Fall phenology of buckthorn, however, demonstrated a contrast as the native species started to senesce up to 20 days earlier than buckthorn except for both *Sambucus* species which senesced slowly and held their leaves as late as buckthorn. With these findings, Schuster et al. (2021) concluded that the leaf phenology of buckthorn is not unique amongst understory species, and its spring leaf phenology specifically is demonstrably comparable to many native species. They furthermore state, *"forest communities rich in deciduous shrubs or trees that are phenologically similar to buckthorn (particularly Sambucus racemosa) likely limit buckthorn's critical spring and fall carbon gain and exert greater biotic resistance to invasion by buckthorn*." Therefore, destructive ecosystem impacts of buckthorn may be able to be managed by increasing the biotic resistance of an ecosystem by promoting *Sambucus racemosa* and other native species with extended leaf phenologies (Schuster et al. 2021).

Similarly, Kalkman et al. (2019) had the same conclusion of using shrub species competitively resistant to buckthorn invasion for its control. They compared the competitiveness of common and glossy buckthorn with two locally co-habiting native shrubs, hawthorn (*Crataegus* spp.) and gray dogwood (*Cornus racemosa* Lam.), established in forest edge habitat and understory habitat enviroments where buckthorn grows abundantly and colonizes rapidly in Southwest Michigan. Measures of light use efficiency, water use efficiency, chlorophyll content, and stomatal characteristics over two growing seasons in each habitat environment were compared using leaves of each shrub species. "*Shade-acclimated common buckthorn displayed only minor decreases in photosynthesis rate relative to leaves in sun-acclimated plants after exposure to a wide range of light intensities possibly because of its higher leaf chlorophyll content. Sun-acclimated hawthorn grew faster than both buckthorn species when exposed to higher light intensities and produced comparable growth rates to buckthorn species in the shaded understory*." Based on their findings, Kalkman et al. (2019) conclude that the "*restoration of buckthorn infested areas will require continuous mitigation of buckthorn", however, "once the buckthorn is removed, the selection of most competitive native species to plant or supplement with plantings, like hawthorn, could increase the likelihood that native plants can regain control of a habitat, offering more substantial resistance to buckthorn re-establishment*."

An extended growing season enhances the ability of buckthorn to outcompete by shading out the seeds of native plants as they try to germinate and grow under the already present shade of the buckthorn leaves, as well as compete with buckthorn seedlings for nutrients, and water. This was observed in Wisconsin where herbaceous layers were generally found under thickets of native shrubs, but not under buckthorn thickets, suggesting that due to the extended leaf season of buckthorn, there are no seasonal light fluctuations to allow germination and survival of herbaceous plants, shrubs, or tree seedlings (Gourley 1985). A further observation of the absence of any vegetation in the dense buckthorn understory of wetland areas suggests the shading out effect of the understory, but also acknowledges the potential impact by deer commonly found in these areas to impede vegetation growth.

The invasive buckthorn shrub dominates the understory of many temperate forests of northeastern North America due to its superior ability to outcompete native understory species for light and create monotypic stands. *"The ability of common buckthorn to tolerate both shady conditions and to grow quickly in open conditions may give it a successional advantage when canopy gaps are created in areas where it occurs in the understory"* (Barringer and Clemants 2003). Buckthorn distribution in forests demonstrates a need for a canopy-opening disturbance for it to establish. "*Buckthorn invasion in the Northeast will likely occur when a disturbance in an intact, closed canopy forest area creates an advantageous opening for nearby buckthorn seed sources"* (McCay et al. 2009). It was observed that high-intensity tree harvesting in 4 forest types in central and western Massachusetts including mixed-hardwood, oak, eastern hemlock, and white pine forests promoted invasion of buckthorn while low intensity tree harvesting did not promote buckthorn invasion and no association was found (McDonald et al. 2008b). In this study area buckthorn was found most often on formerly plowed sites, and less often on former pastures or continuously forested woodlots suggesting "*disturbance, soil characteristics, and the current and historical land use influence on distribution and regional patterns of invasive species*" (McDonald et al. 2008b). In Ohio, after thinning treatments in the Oak Openings Preserve, buckthorn cover and frequency were found to increase from 10% of control plots to 36% of thinned plots within 3 years (Archibold et al. 1997). Central New York studies also demonstrate the importance of canopy openings or edges for buckthorn establishment reporting, *"common buckthorn seed dispersal was lowest, seed predation highest, and seedling survival lowest in closed-canopy maple forests compared to plantations and old fields"* (McCay and McCay 2008).

As buckthorn continues to persist and establish, further invading a forested area to become increasingly dominant, it creates shadier areas throughout the growing season than forested areas not invaded by buckthorn, thus progressively shading out the native seedlings and saplings of herbaceous, shrub and tree layers and outcompeting most plants that try to grow beneath it. Observations suggest that if buckthorn is successful in suppressing native tree regeneration, open canopy edges will increase and promote buckthorn distribution, and succession may continue toward a more open canopy, whereas if tree regeneration is not suppressed, succession may result in a more closed canopy, which may eventually eliminate buckthorn (Hobbs 1988). Buckthorn seeds from a nearby seed source become established in a newly invaded site and grow to become mature, seedling producing buckthorn. Buckthorn seedlings and shrubs grow and increasingly shade out native species seedlings and understory, thereby changing the overstory and opening the canopy (McCay et al. 2009). Over time, buckthorn may outcompete the native and understory species for light forming a monoculture that suppresses the plant diversity and, consequently, the animal diversity of that ecological site. *"As buckthorn devastates native plant communities, habitat may be rendered inhospitable to most wildlife"* (USDA Northeastern Area State and Private Forestry 2022).

Buckthorn is less likely to be found in maple-beech or coniferous ecosystems than in oak-dominated ecosystems emphasizing the need for increased light availability through canopy opening disturbances for buckthorn to establish. *"Reduced growth and abundance of buckthorn at very low light levels suggests the very deep shade of these ecosystems, forests dominated by maple (Acer spp.), pine (Pinus spp.), or spruce (Picea spp.) and fir (Abies spp.), may limit common buckthorn invasion as compared with other deciduous forests, shrublands, and grasslands where common buckthorn is common"* (Gourley 1985). McCay and McCay (2008) studied the ability of buckthorn to invade three habitats of northeastern United States including abandoned conifer plantations, old fields, and sugar maple. The forest floor received the least amount of sunlight in the sugar maple habitat due to the thick and numerous leaves of sugar maple, resulting in high mortality rates of buckthorn seedlings in the first year preventing the continuation of the sugar maple habitat study. The sugar maple habitat succeeds in resistance to buckthorn invasion by exceeding the relatively high tolerance for shade of buckthorn seedlings.

To better understand the varying shade tolerance exhibited by buckthorn, the degree of canopy closure and light availability under which buckthorn may persist was researched (Schuster et al. 2020). It was found that almost complete mortality of buckthorn occurred under canopies allowing transmission of $\leq$ 3% light availability and that at this low light availability *"growth of surviving buckthorn was strongly tied to light availability or shade avoidance due to a longer growing season, but not canopy richness or mid-season light availability"* based on the mean of May, August and October light measurements.

As old fields in northeastern temperate forests undergo afforestation, there is potential for buckthorn to become dominant in the plant community, alter succession, and have other adverse impacts on the invaded community (Mascaro and Schnitzer 2007). Early succession after field abandonment may promote buckthorn seedling establishment according to a study that shows these open microsites help buckthorn to establish and persist better than those with herbaceous cover (Gill and Marks 1991), although one study did reveal that an open field with an herbaceous layer of dense, ungrazed bluegrass (Poa spp.) sod did not inhibit buckthorn establishment (Whitford and Whitford 1988). In southern Wisconsin, an open habitat promoted greater aboveground growth rates of buckthorn (0.58 g/g/year), more than double the growth compared to growth (0.23 g/g/year) in a hardwood forest understory (Harrington et al. 1989).

Intermediate light levels are observed to be best for promoting buckthorn reproduction at the University of Wisconsin Arboretum, as well as an observed reduction in shade tolerance with age. Open wetlands and shaded oak woodlands (with a 9%-23% light availability) both supported buckthorn growth and reproduction and produced similar numbers of seedlings. However, buckthorn trees in open wetlands were younger, larger and produced more fruit (also called drupes), and buckthorn seedlings matured and produced fruit at an earlier age than in the oak woodlands. Further observation in oak woodlands revealed abundant buckthorn seedlings growing under parent trees, however demonstrated inability to survive there as buckthorn saplings were only observed around the canopy opening perimeters (Gourley 1985). This may further suggest that buckthorn seedling success under parent shrubs may not be related solely to light availability, but also to phenotypic ability of mature buckthorn trees to facilitate initial seedling growth (such as via soil N), and a reduced competition with herbaceous species for water and nutrients.

An ecological site's susceptibility to buckthorn invasion may also be related to its abiotic characteristics (Whitfield et al. 2014). A study was conducted in oak forests of Minnesota to assess their impact on buckthorn abundance based on their resident plant species richness and phylogenetic diversity, and abiotic site characteristics including canopy openness, percent bare soil, soil pH, percent sand, an index of propagule availability, duff layer thickness as a measure of earthworm activity, an index of insolation, and slope. Results indicated that the more the plant phylogenetic diversity on a site, the less abundant was buckthorn. Also, the best predictors relating positively to buckthorn abundance were canopy openness and the amount of bare soil. "Overall, our results suggest that management strategies aimed at reducing disturbances that lead to increased bare soil and light levels may be more successful if they also maximize phylogenetic diversity of the resident plant community" (Whitfield et al. 2014).

2.4 Rapid Growth

Buckthorn has a rapid rate of growth due to its beneficial leaf phenology providing an extended growing season with increased potential of a high carbon use efficiency (Stewart and Graves (2004) and faster photosynthetic rates with a higher leaf chlorophyll content (Knight et al. 2007). Harrington et al. (1989) found buckthorn had faster photsosynthetic rates than the native shrub species gray dogwood (*Cornus racemosa* Lam.) and black cherry (*Prunus serotina*). The leaf phenology and high photosynthetic rate of buckthorn, in combination with its prolific ability to reproduce sexually to produce abundant seedlings (genets) and/or vigorously regenerate vegetatively to produce numerous shoots (gamets), enable it to quickly reach large size and dominate a site (Zouhar 2011). Seedling growth rate is *"comparatively rapid"* averaging about 2 inches (5.2 cm) tall 29 days after germination, and buckthorn saplings may grow 6.5 feet (2 m) in height per year (Qaderi et al. 2009). Even if growth rates between buckthorn and co-habitating shrubs are comparable, the extended seasonal growth provided by the leaf phenology of buckthorn allows it to produce more biomass annually.

In a southern Wisconsin study of mesic, floodplain, and swamp sites, shoots were found to be denser on buckthorn dominated sites than native species dominated sites (Mascaro and Schnitzer 2007). Furthermore, abundant buckthorn seedlings outnumbered the seedlings of native trees up to 8-10 inches DBH, thereby illustrating the ability of the buckthorn's dominance above the understory size classes. The buckthorn's ability to increase its density with thickets of sprouting shoots and seedlings to become dominant fundamentally altered forest structure in comparison to 8 native species dominant sites on similar soils (Mascaro and Schnitzer 2007). Buckthorn invades habitat sites by producing abundant seedlings that outcompete the native species seedlings. Buckthorn seeds and sprouts multiply to dense thickets inhibiting the survival of native species seedlings and saplings, thereby altering native tree species composition, canopy cover and the ecology of a site.

2.5 Prolific Fruit and Seed Production, and Dispersal

"High fecundity, high germination rates, high seedling success in disturbed conditions, prolific fruit and seed production, prolific potential for long distance seed dispersal, and potential allelopathic effect of secondary metabolites may enhance the ability of buckthorn to rapidly increase in abundance and impact ecosystems" (Knight et al. 2007).

2.5.1 Fruit (Drupe) Production

Natural reproduction in buckthorn occurs sexually by producing seeds where the population of males and females varies locally. However, buckthorn also sprouts vigorously from cut or damaged stems (Converse, 1984). It is unclear how long it takes for buckthorn to mature to fruit and seed production, and it is observed it may depend on growing conditions. It is reported that buckthorn typically requires 5 to 6 years to mature to produce fruit (Delanoy and Archibold 2007), while a review by Knight et al. (2007) states that observations by Gourley (1985) report buckthorn shrub reproduction occurs at 9 to 20 years old in North America. The USDA Northeastern Area State and Private Forestry (2022) indicates the age at fruit production depends on available light, stating buckthorn can produce fruit a few years after establishment in full sun, but fruit production may be delayed for 10 to 20 years in shaded habitats. It is also inconsistent as to when fruit drop occurs to initiate the seed germination process. Buckthorn fruits may persist on its branches. It has been observed that in some years, many fruits remain on buckthorn trees for 12 months, while in other years fruits start to drop in late autumn and continue intermittently over winter (Qaderi et al 2009). Other observations report fruits remaining until December (Stephens 1973) or later (Godwin 1943) or generally most fruits are shed in late winter or early spring (Qaderi et al. 2009). Catling and Porebski (1994) report that fruits remain on buckthorn shrubs until the following spring unless eaten. Buckthorn fruits are round about 1/3 inch in diameter, shiny, black and berry-like when ripe, forming clusters. Each contains 2 to 5 seeds, but they typically have 4 (Gleason and Conquist 1991), and usually only 1 or 2 mature (Stephens 1973).

Buckthorn fruit production is also likely affected by site conditions. Observations of buckthorn in southern Wisconsin found a higher fruit productivity in open wetlands than in oak woodland or lowland forest sites, although seedling numbers in each site type were similar (Gourley 1985).

2.5.2 Germination, Seed Viability, Seedling Viability

"*Seeds of common buckthorn achieve germination rates of 85% in North America and tolerate a wide variety of environments" (Knight et al. 2007)*. Buckthorn germination occurs only when seeds are separated from fruits as seedlings do not emerge from intact fruits, therefore fruits must decay or be eaten for seeds to germinate (Archibold et al. 1997). Seeds germinate the following spring giving the full growing season for seedling establishment. Gourley (1985) reports that seeds with pulp left on that overwintered in the field did not germinate, however germination of seeds that overwintered in the field was higher than for fresh seeds.

Zouhar (2011) provides the following comprehensive summary of buckthorn germination: "*With pulp removal, germination percentages ranged from 76% to 92%. Mean time to germination was about 42 days, and germination peaked at 34 to 40 days (Gourley 1985). Dupont and others (1997 as cited by [Qaderi et al. 2009]) suggested that the role of frugivores was more to remove the pulp of the fruit than to break dormancy or scarify seed during passage through the digestive system. Effects of passage of common buckthorn seeds through an animal's digestive system are unclear, though it may hasten germination. Scarification may increase germination rate (Qaderi et al. 2009). Some fully mature common buckthorn seeds lack dormancy (Tylkowski 2007), and several authors (Adams 1927, Godwin 1936, Qaderi et al. 2009, Tylkowski 2007) report some germination of fresh seeds. Cold stratification may not be required for germination; however, total percent germination and germination rate were higher for seeds that were either exposed to cold temperatures in the laboratory (Qaderi et al. 2009, Tylkowski 2007) or that overwintered under field conditions (Archibold et al.1997, Qaderi et al. 2009, Stewart and Graves 2004) than for fresh or unstratified seeds. This may be why some authors recommend prechilling or state that common buckthorn requires cold stratification (Baskin and Baskin 2001, Qaderi et al. 2009). Fresh, undried seeds of common buckthorn germinated without stratification when exposed to alternating temperature regimes (Becker et al. 1986)" (Zouhar 2011).*

Buckthorn seeds may remain viable in the soil for at least 2 years and possibly up to 6 years (Zouhar 2011). Dormant but viable seeds may remain in intact fruit on branches forming an aerial seedbank, while soil seed banks form from fallen fruit. Under field conditions, buckthorn seeds inside intact fruits may remain viable longer than seed separated from fruits (Zouhar 2011).

Converse (1984) observed seedling recruitment to generally be most successful in more open light conditions with a decline as shade increases. Field tests in open oak woodlands demonstrated that buckthorn seedling emergence is inhibited by a leaf litter or herbaceous layer (Bisikwa 2005, Gill and Marks 1991, Knight 2006) and is increased by soil disturbance (Bisikwa 2005, Gill and Marks 1991, Gourley 1985). Greater buckthorn seed germination was observed on bare soil in field tests in Minnesota than on soil with a dense litter layer where no light reaches the soil surface or under an herbaceous layer with approximately 10% light availability reaching the soil surface (Bisikwa 2005). Also, a greater number of buckthorn seedlings established on bare soil than the total number of seeds planted demonstrating the litter removal and exposure to light effects on buckthorn seeds already in the soil seedbanks. In both field and greenhouse studies, increasing litter depth inhibited buckthorn seedling emergence, height, and biomass, but litter depths up to 2 inches (5.1 cm) did not prevent seedling emergence and survival (Bisikwa 2005). Bisikwa (2005) reports that greater than 2 inches depth of surface litter decreased buckthorn seedling emergence and establishment of buckthorn, stating the effects of litter on buckthorn seedling establishment may be related to reduced light and lower temperatures associated with litter. Dormant, buried buckthorn seeds may be stirred up and become exposed to light with litter removal or soil disturbances resulting in germination initiation. Prescribed spring fires to remove surface litter was found to increase buckthorn seedling density (Bisikwa 2005). Observations of soil disturbance areas from Bell's honeysuckle removal report increased buckthorn seedling establishment (Gourley 1985). Another study demonstrated the effect of the herbaceous layer where cumulative emergence from early May to late June for buckthorn was 28%, 7%, and 23% in plots with bare soil, 1-year-old herbs, and 15-year-old herbs, respectively, suggesting that early successional herbs may inhibit buckthorn emergence (Gill and Marks 1991).

"The vigor of buckthorn germination and growth is directly related to light availability. Seedlings establish best in high light conditions but seeds also germinate and grow in the shade" (USDA Northeastern Area State and Private Forestry 2022). Once seedlings establish, buckthorn mature to produce seeds and aggressively spread, forming dense thickets which may grow into monotypic habitats, and also act as a seed source for invasion of nearby ecosystems.

2.5.3 Fruit and Seed Dispersal

Fruit (drupe) and seed production of buckthorn is prolific, as well as its potential for seed dispersal. Gravity and birds are the primary methods of dispersing buckthorn seeds, followed by animals and water as other sources of dispersal. Seed dispersal can occur anytime between

September and April (Gill and Marks 1991). Unripe fleshy fruit are protected from seed predators by containing the chemical anthraquinone emodin to prevent premature fruit consumption by causing severe diarrhea. Birds and small mammals are unable to detoxify emodin efficiently, especially when present in high concentrations in unripe fruit (Izhaki 2002). The laxative effect in smaller birds can be strong enough to result in death (Friends of the Mississippi River 2019). When the fruit ripens, the emodin subsides and functions mildly to encourage swift passage of the seed before seed viability diminishes, and seeds are dispersed by regurgitation and defecation (Seltzner and Eddy 2003, Archibold et al. 1997, Gourley et al. 1984). Although not a good food source nutritionally with a low protein and high carbohydrate content, birds eat buckthorn fruit and seeds despite the fruit's bitter taste, unpalatability and laxative affect when alternative food sources become scarce (Gourley and Howell 1984). Timing of buckthorn seed dispersal depends in part on the rate of removal by birds and therefore is related to their preference for it relative to other available plants (Gill and Marks 1991). "*Buckthorn seed dispersal has been attributed to generalist birds like the American Robin (Turdus migratorious L.) and Common Starling (Sturnus vulgaris L.) which eat buckthorn fruits and disperse seeds over a broad range of areas*" (Zouhar 2011). Similarly, mammals such as rodents and white-tailed deer may eat fruit and disperse seeds by defecating (Gill and Marks 1991, McCay et al. 2009, Myers et al. 2004).

Rivers and streams disperse seeds by carrying fruit which can float and remain viable in water for several hours in still water and up to 30 minutes in agitated water. It is also noted that buckthorn fruits can float for 6 days and seeds for 3.5 days and retain viability. A study in Saskatchewan demonstrated a decline in seed viability reporting 77% of buckthorn germinated after being placed in water for 2 weeks in spring with seeds becoming nonviable after 2 months of immersion suggesting that flooding by high water level spring runoff may decrease the buckthorn seed abundance in the soil seed bank (Archibold et al. 1997). In Vermont, Little Otter Creek floods each spring into a second growth riparian forest to distances of about 328 feet from the stream edge and recedes by mid-June. *"Common buckthorn occurred in shrub-dominated plots 16 to 82 feet (5-25 m) from the stream edge; it did not occur in the forest understory plots 164 to 328 feet (50-100 m) from the stream. Common buckthorn seeds were not detected in the seed rain 5 m from the stream; they occurred at a density of 16,000 seeds/ha at 15 m and at a density of 8,000seeds/ha at 25 m. Common buckthorn seeds were not detected in the soil seed bank either 5 or 25 m from the stream edge (the seed bank was not sampled at 49 feet (15 m) from the stream edge)"* (Hughes and Cass 1997). Prolonged flooding has been demonstrated to be detrimental to buckthorn germination, whereas the greatest germination success is found to occur in moist but not saturated soils (Gourley 1985).

As well as flooding, seed predation may affect buckthorn seed bank density. On some sites, herbivory may be a major cause of buckthorn seedling mortality. In old fields supporting an herbaceous layer in central New York, the survival of buckthorn seedlings was found to be 5 times lower growing under the herbs than seedlings growing in the open, illustrating herbivory as a major cause of buckthorn seedling mortality (Gill and Marks 1991). During the growing season, herbivory by rodents, "*especially meadow voles*", was the main source of mortality in both microsite types. Over winter, buckthorn seedling mortality due to frost damage was also observed. Frost heaving caused 62% of seedling mortality in open microsites and 40% under herbs, while herbivory caused 60% of mortality under herbs. Overall survivorship during the study was greatest in the open (Gill and Marks 1991).

A comparison study of the establishment and survival of European shrub species revealed that shrub species with the lowest mortality rates included buckthorn (Grubb et al. 1996). Causes of mortality of buckthorn seedlings included *"dessication, frost, fungal pathogens, herbivory, and competition for resources from other plant species"* (Gill and Marks 1991, Kollmann and Grubb 1999, McCay et al. 2008, Qaderi et al. 2009).

2.6 Ecosystem Impacts

"R. cathartica impacts ecosystems through changes in soil N (nitrogen), elimination of the leaf litter layer, possible facilitation of earthworm invasions, unsubstantiated effects on native plants through allelopathy or competition, and effects on animals that may or may not be able to use it for food or habitat" Knight et al. (2007).

2.6.1 Leaf Litter Decomposition, Changes in Soil Nitrogen

Pre-invasion data of buckthorn sites are not available, therefore invaded vs. uninvaded site soil property comparisons are *"unable to distinguish between differences due to the invasive species and differences that existed prior to invasion"* (Heneghan 2006). Research has indicated the invasion of buckthorn results in changes in soil properties including soil chemistry, nutrient composition and cycling, and soil fauna and microbial communities, likely leading ultimately to an effect on succession of the plant community in these invaded sites (Heneghan et al. 2002, 2004, 2007, Madritch and Lindroth 2009). Soils under buckthorn may exhibit higher percentages of nitrogen and carbon, modified nitrogen mineralization rates, and modified microbial communities compared to soils without buckthorn (Zouhar 2011). *"We found that soil in areas of the woodland where buckthorn dominates have a higher percentage of nitrogen (N)* *and carbon (C), modified nitrogen mineralization rates, elevated pH, and higher soil moisture than those areas where buckthorn was not present"* (Heneghan et al. 2006). The leaves of buckthorn are high in N and produce leaf litter high in N, 1.1-1.9% N in senesced leaves (Kennedy 2000) and 2.2% N in leaf litter (Heneghan et al. 2006). The decomposition of buckthorn's N rich leaf litter uniquely affects N and C cycling creating impacts on and altering ecosystem processes. Buckthorn produces leaf litter high in nitrogen which decomposes rapidly compared with native species. Consequently, soils associated with buckthorn may have higher available N (Heneghan et al. 2006, Pepper and Heneghan 2016). The leaf litter of buckthorn decomposes rapidly, increasing the N content in soils, which further affects the structure of forest floor communities (Heneghan et al. 2002, 2004). Buckthorn litter exhibited faster decomposition than the litter of *P. deltoides*, *P. serotina*, or *Quercus* spp., and furthermore, mixing the litter of buckthorn with each of these litter types caused more rapid decomposition of each litter type (Heneghan et al. 2002). Rapid litter decomposition under buckthorn stands may cause bare soil. Kollmann and Grubb (1999) found that litter was sparse under buckthorn compared to litter under other shrubs. More open areas with no buckthorn had two to six times greater biomass in their late summer litter layer than the litter (depending on the season) under buckthorn thickets (Heneghan et al. 2004).

Heneghan et al. (2006) suggest the rapid decomposition of the N rich leaf litter of invasive buckthorn favors growth and abundance of buckthorn while negatively impacting growth of native species. Buckthorn thickets depositing high N litter inputs caused the % soil N to double compared to surrounding forested areas (Heneghan et al. 2004, 2006). *"In dense thickets, the increased N was mostly in the form of organic N, which is not immediately available to plants. Forms of N available to plants, including NO3 and NH4, were similar"* (Heneghan et al. 2004). Other soil properties that differed in buckthorn thickets compared to the surrounding forested areas were pH which was significantly higher, the total carbon increased by 80%, and the gravimetric water content was 40% higher (Heneghan et al. 2004, 2006, Zouhar 2011). In contrast, earlier stages of invasion portrayed individual, mature buckthorn trees and soils near them exhibited greater N mineralization and soil NO3 than in areas away from the mature trees demonstrating enhancement for seedling growth (Knight 2006). *"R. carthatica seedling growth was positively correlated with soil NO3 levels, suggesting that soil fertilization by individual mature trees may cause greater growth of nearby seedlings"* (Knight et al 2007).

Buckthorn's phenological trait to retain its green leaves while other species undergo autumn canopy senescence helps to promote its success in a deciduous understory habitat. However, despite the N rich leaf litter buckthorn produces, this trait is observed to result in a loss of N in its leaf litter indicating the occurrence of an association of buckthorn promoting N-fixation in the soil. Ewing et al. (2015) conducted a study to measure the suggested association between buckthorn and N-fixation in soil. They used the acetylene reduction assay to compare nitrogenase activity in soils collected under buckthorn to soils collected from *Quercus* spp. (canopy species), *Prunus serotina* (understory shrub) and non-vegetated areas in an oak woodland in Minnesota. The acetylene reduction (AR) values of buckthorn soils were found to cover a range 10x the range of non-buckthorn soils, with mean AR varying with sample location. Results presented are the first measurement of AR activity associated with buckthorn and are *"consistent with the hypothesis that this plant supports associative N-fixation under some conditions"* (Ewing et al. 2015).

Another factor potentially affecting the high N level in soils under buckthorn is its fruit. *"Both ripe and unripe fruit of R. cathartica have greater %N (1.6–2.1%) than fruits of 11 other native and exotic woody plants"* (Sherburne 1972). There may occur a significant effect on soil N in areas where many fruit fall to the ground uneaten, however there is no research on the high N effect of fruit on decomposition and soil N (Heneghan et al. 2006).

Due to the similarly high nitrogen in their foliage, the effects of buckthorn foliage (2.2%N) were compared to the effects of *Acer saccharum* foliage (1.8%N), native sugar maple tree in southern Wisconsin, on four understory herb species (Klionsky et al. 2011). The leaves of buckthorn and *Acer saccharum* were compared to account for potential effects of structural differences of each including thickness, penetrability, and SLA (specific leaf area). Buckthorn litter and *Acer saccharum* litter in equivalent amounts in separate greenhouse experiments with each herb resulted in complete inhibition of seed germination of one of the herbs by both litter types, and buckthorn reduced seed germination of the three remaining to half the levels under *Acer saccharum* litter. After germination, there was no effect on growth of any herb species by either litter type (Klionsky et al, 2011). Observations of herb germination inhibition in this study support the observations of Heneghan et al. (2002, 2006) that **buckthorn changes the soil environment to negatively affect native species**. Pepper and Heneghan (2016) further observe litter enriched N soils under buckthorn and recognize the increased soil N as a soil altering trait to enable buckthorn to "*regulate*" the habitats it invades.

In order to discourage and reduce the growth of buckthorn and promote growth and health of native plant communities, methods of amending the soil have been researched. Iannone et al. (2013) studied the effects of applications of buckthorn mulch on its own reinvasion potential in the field over a 3 year period. The use of mulch, which is a high carbon to nitrogen material, may reduce reinvasion by stimulating microbial immobilization of N. Using the buckthorn from the removal process in mulch form eliminates the need to remove it from the site and the cost of acquiring mulch or soil amendments elsewhere. They found that whether tilled or not, buckthorn mulch did not decrease buckthorn reinvasion or soil N availability, however, the disturbance caused by tilling caused a significant prolonged reduction in reinvasion by killing small buckthorn seedlings (<5 cm tall) that were not detected during the initial removal. "*Tilling greatly reduced yearling density 8 weeks before the emergence of buckthorn seedlings. After seedlings emerged, yearling density changed very little, suggesting that recruitment of new buckthorn during the experiment was low and that buckthorn individuals establishing prior to treatment application, i.e., that were undetected during initial removal, were the major source of reinvasion. If so, killing undetected buckthorn individuals during the growing season following removal should greatly reduce reinvasion*" (Iannone et al. 2013). New buckthorn seedlings grew in during the experiment, but their rate of germination decreased rapidly over time, which suggested that buckthorn seed banks were greatly depleted within the 3 years after the initial treatment and, therefore, are short-lived. Results showed that although tilling buckthorn mulch into the soil did not decrease N availability as expected, there was an 82% reduction of yearling biomass compared to no effect on biomass when mulch was laid across the surface (Iannone et al. 2013). Three relevant recommendations resulted from this experiment:

1. Buckthorn mulch should not be used to limit reinvasion
2. Tilling can greatly reduce reinvasion by killing buckthorn individuals not detected during the initial removal
3. Reinvasion can be reduced by repeated, annual follow-up control of undetected and new growth individuals.

"*Prolonged reduction in reinvasion caused by tilling revealed that managers should consider using tilling as a control strategy… it could easily be applied without concern in open and degraded sites with no or few native seeds or native plants*" (Iannone et al. 2013).

Pepper and Heneghan (2016) further studied how amending soil quality by using buckthorn mulch affects the growth of buckthorn in a greenhouse setting, eliminating tilling and its effects. They found that buckthorn saplings grown in buckthorn mulch had reduced stem length and leaf production compared to control sites, leading the authors to suggest that amending soils with buckthorn mulch may result in reduced buckthorn growth in invaded areas desired for conservation and restoration of native species and biodiversity. Pepper and Heneghan (2016) hypothesized that buckthorn mulch would reduce the growth of buckthorn saplings. Their study concluded with the speculation that the "*mechanism determining the reduced growth was that the mulch which has a high carbon to nitrogen ratio would reduce the nitrogen available to the growing plants*" (Pepper and Heneghan 2016).

Buckthorn was also found to affect soil fauna beneath it as rapid rates of arthropod colonization formed in its litter (Heneghan et al. 2002). Heneghan et al. (2002, 2003) suggest this may foster rapid litter decomposition causing a diminished supply of food sources too early in the year, and as the base of food webs supporting mammals and birds, a consequent collapse in the soil arthropod community negatively affects associated mammal and bird communities by forcing their displacement.

Evidence indicates that buckthorn alters soil properties with potential to affect and change invaded area ecosystems. Invasive buckthorn is theorized to change the nitrogen content of soil through rapid decomposition of its nitrogen rich leaf litter in favor of buckthorn growth and abundance with a negative impact on growth of native species (Heneghan et al. 2006). It has been suggested that changes in ecosystem properties may have indirect effects on native plant species that may persist even after buckthorn is removed. Research in Chicago-area oak woodlands (Heneghan et al. 2004, 2006, 2007) and the University of Wisconsin Arboretum (Madritch and Lindroth 2009) showed altered soil properties under buckthorn including changes in soil chemistry, nutrient composition and cycling, and soil fauna and microbial communities, which are likely to impact plant community succession on invaded sites. These soil property changes have been considered as potentially having a *"legacy effect"* that impedes native plant establishment even after buckthorn is removed (Heneghan 2005). *"This legacy effect could have implications for restoration efforts for cleared sites"* (Heneghan et al. 2004), although buckthorn "*species effects on biogeochemistry may be short-lived once composition changes*" (Dijkstra et al. 2006). After review of results of effects of a buckthorn removal study, Heneghan et al. (2006) update, *"results suggest that some of the impacts are ameliorated over time."* Generally, these (legacy effect) implications have appeared to be resolved as not definitive as recent state and conservation agency literature promoting buckthorn removal, and management and control plans for land managers do not mention soil remediation for encouraging growth and revegetation of native species. Many state and conservation agencies currently encourage land managers to remove buckthorn with no acknowledgement of lingering soil effects or need of soil amending for native species growth and planting after buckthorn removal (Mass Audubon 2023; Minnesota DNR 2022; Wisconsin DNR 2023; USDA Forest Service/Northeastern Area

State and Private Forestry 2022; Friends of the Mississippi 2019 and 2022). Wragg et al. (2020), Schuster et al. (2022) and Greet et al. (2019) report and encourage revegetation immediately after buckthorn removal as a successful management and control strategy to eliminate buckthorn regrowth and reinvasion with no adverse interference by lingering soil effects. Larkin et al. (2014) also report successful restoration of native plant communities and biodiversity in managed buckthorn removal oak-woodland sites.

2.6.2 Facilitation of Earthworm Invasions: Leaf Litter

The invasive buckthorn and invasive European earthworm (Lumbricus terrestris) are each observed to affect the dynamics of forests of North America. Some indications have led to suggestions of a *"mutual facilitation possibly existing between the two invaders to successfully inhibit native species and promote buckthorn invasion and dominance of a site"* (Madritch and Lindroth 2009) or that *"the action of earthworms may provide a pathway through which buckthorn invades forests of the Upper Midwest United States"* (Roth et al 2015). It is thought that large densities of the European earthworm, *Lumbricus terrestris*, or nightcrawler, may be related to the presence of buckthorn. As an invasive earthworm and proficient detritivore, it has potential to alter ecosystems by "*changing seedbed conditions, soil characteristics, plant-herbivore interactions, and flow of water, nutrients and carbon"* (Frelich et al. 2006, Madritch and Lindroth 2009). European earthworm invasions into previously earthworm-free temperate and boreal forests of North America dominated by *Acer, Quercus, Betula, Pinus*, and *Populus* (Frelich et al. 2006) have been linked to forest habitat declines in diversity of native plants and in native soil micro- and mesofauna (Madritch and Lindroth 2009). Impacts of earthworm invasion vary with soil parent material, land use history, and the "*assemblage*" of earthworm species involved in the invasion (Frelich et al. 2006). Earthworm populations incorporate forest floor litter and humus material into deeper horizons of the soil profile, reduce the thickness of the organic layers, and increase the soil's bulk density. The mixing of organic and mineral materials consequently affect the soil food web by changing the distribution and composition of the soil microflora, and the above ground plant community by altering seedbed conditions for vascular plants (Frelich et al. 2006).

Woodland soils under buckthorn sites compared to soils in uninvaded buckthorn parts of the woodland have higher percentages of nitrogen and carbon, modified nitrogen mineralization rates, elevated pH and gravimetric water content, and modified microbial communities (Heneghan et al 2002, 2004, 2006). It has been suggested that these changes in soil may occur to promote growth of buckthorn seedlings (Gourley 1985, Heneghan 2004, Knight et al

2007, Knight 2006). Invasive European earthworms are suggested to facilitate invasion and growth of buckthorn seedlings by reducing the abundance of herbaceous plants that inhibit buckthorn germination and seedling growth including the genera *Aralia, Botrychium, Osmorhiza, Trillium, Uvularia*, and *Viola*. The European earthworm populations actions decrease availability and increase leaching of N and P in soil horizons where most fine roots are concentrated, promoting the growth of buckthorn. By these actions, European earthworms contribute to a "forest decline syndrome" (Frelich et al. 2006).

The invasive European earthworm has an amazing ability to differentiate preferred seeds within a large pool of diverse seed species options to selectively consume specific seeds, leaving buckthorn seeds to grow (Burilo et al. 2020). Buckthorn litter is high in nitrogen and has a low carbon:nitrogen ratio (Heneghan et al. 2004, 2006). In a decomposition experiment, due to its high nitrogen content, buckthorn litter was found to be preferred by European earthworms and was very rapidly decomposed (Heneghan 2003, Heneghan et al. 2007). As a result, very little litter accumulates beneath buckthorn sites (Archibold et al 1997, Heneghan 2002, 2007; Kollman and Grubb 1999). Consequently, rapid decomposition of buckthorn litter by European earthworms and soil microbes may change the soil biochemistry in invaded sites which may promote conditions for buckthorn seedling growth and inhibit growth of native and other plant species. Even in the absence of European earthworms, buckthorn litter is readily broken down by soil microbial decomposers because of its unusually high nitrogen content (Heneghan 2003).

It has been hypothesized that buckthorn and the European earthworm interact and work together to facilitate successful invasion of a habitat community. The soil biochemistry of invaded sites may be altered by rapid decomposition of buckthorn litter by European earthworms and soil microbes. Studies have shown that the litter of buckthorn dominated sites decomposed much faster than litter from the native northern red oak canopy at the University of Wisconsin Arboretum (Madritch and Lindroth 2009)) and litter from white oak, northern red oak, or sugar maple in Chicago-area woodlands (Madritch and Lindroth 2009, Heneghan et al. 2007). This observation in combination with the observation of the greatest abundance and biomass of invasive European earthworms in the buckthorn dominated sites compared to the white oak, northern red oak, or sugar maple sites, implied evidence of a *"synergy"* between buckthorn and the invasive European earthworm (Madritch and Lindroth 2009, Heneghan 2007). The abundance of the invasive shrubs buckthorn and honeysuckle (Lonicera x bella) found in northern hardwoods correlated positively with invasive European earthworms due to the high quality leaf litter each produced, resulting in increased rates of nutrient cycling

(Madritch and Lindroth 2008). An experimental invasive plant removal study conducted in two northern hardwood forest stands, one buckthorn dominant and another honeysuckle dominant, found a 50% reduction in the invasive earthworm population over the following 3 years. Consequently, whether "*synergy*" or not, it is related as a "positive feedback loop" in this study, and the conclusion is a positive ecological site effect when managed with buckthorn and honeysuckle removal (Madritch and Lindroth 2009). A more recent study of buckthorn and the invasive European earthworm distributions on 6 forested sites in Minnesota over a 7 year period found no evidence to support association or facilitation between the two species. Therefore, with no indication of specific interaction between buckthorn and earthworms towards invasion success, it was concluded and suggested that the relationship between these invaders may be more complicated than previously thought (Wyckoff et al. 2014). These buckthorn-earthworm relationships are of particular interest at the Kirvin Park restoration site, as earthworm soil casts have been observed to be prominent in the buckthorn-dominated portions of the floodplain along with a sparse litter layer.

2.6.3 Allelopathy

The *"unsubstantiated"* effects on native plants through allelopathy and secondary metabolites may enhance "*the ability of buckthorn to rapidly increase in abundance and impact ecosystems"* (Knight et al. 2007).

Plants may release allelopathic chemicals that can inhibit germination, growth, and survival of nearby plants and deter herbivores. Buckthorn has been found to have one of these secondary compounds in particular, anthraquinone emodin, which has been theorized to potentially promote its invasive success by causing "*allelopathic effects on nearby plants, discouraging insects and herbivores from eating its leaves, bark and fruit, as well as affecting the fruit consumption and digestion by birds, effects on soil microorganisms, and protection from pathogens and high light levels*" (Izhaki 2002). Emodin found in the fruit of buckthorn is suggested to affect the growth of native plants beneath buckthorn canopies. More importantly is its presence in unripe immature fruit as protection against seed predation before it is ready to be dispersed due to its unpalatable and laxative effects causing diarrhea or regurgitation/vomiting as birds and small mammals are *"unable to detoxify it, especially when present in high concentrations which can vary seasonally and among individual buckthorn trees"* (Izhaki 2002). When the fruit becomes ripe and ready for dispersal, birds and small mammals are able to consume the fruit without experiencing severe effects except for an *"accelerated rate of passage through the digestive tract to preserve seed viability upon dispersal"* (Izhaki 2002).

Evidence for buckthorn allelopathy, however, has been difficult to establish and reports of buckthorn exudates observations are inconsistent. Archibold et al. (1997) found no reduction in the germination of crop seeds exposed to exudates from buckthorn leaves. In a mesocosm experiment to test if patterns observed in the field could be explained by adding increased dosages of buckthorn to soils containing five plant species, including native and non-native woody and herbaceous species. Warren et al (2017) reported that buckthorn roots at elevated doses "*have an allelopathic effect and that some plant species appear immune".* Buckthorn fruit exudates were found to reduce germination in crop seeds, and buckthorn fruit debris reduced crop seedling growth (Qaderi et al. 2009). Seltzner and Eddy (2003) experimented to observe possible allelopathic effects of buckthorn fruit, leaves, bark and roots on alfalfa seed germination. The exudates from the fruit or drupes proved to exhibit the greatest inhibitory effect on alfalfa seed germination (reduced to <1%) and demonstrated a marked decrease in seed germination corresponding to an increase in exudate concentration (at 100% concentration, 1 seed per 2000 germinated). Exudates from buckthorn leaves demonstrated mild allelopathic effects on germination (reduced to 42%), even with increased exudate concentration. Bark and root exudates demonstrated no significant allelopathic effect on seed germination, even with increased exudate concentrations. Earlier studies reported that allelopathic compounds within buckthorn fruit and leaves might function to inhibit seed germination and growth of other plants (Boudreau and Wilson 1992), and another where only buckthorn fruit may inhibit growth of competing plants (Krebach and Wilson 1996). It was also observed that fruit exudates collected in the summer and fall inhibited ryegrass seed germination, however after frost the fruits no longer had any noticeable effects (Krebach and Wilson 1996).

"Allelopathy can be a very specific process, affecting only certain species, at certain times, with particular concentrations of allelopathic compounds; therefore, laboratory studies often find allelopathic agents in plants that are of no consequence in field" (Jones 2000). *"Evidence for allelopathy in Rhamnus derives from laboratory bioassays* (Archibold et al. 1997; Seltzner and Eddy 2003, Qaderi et al. 2009) *rather than field experiments*" (Knight 2006), and Knight et al. (2007) concluded that buckthorn's allelopathic effects on native plants remain *"unsubstantiated"* (Klionsky et al. 2011).

Consideration of a *"legacy effect"* relating to the potential lingering allelopathic effect on native species revegetation after buckthorn removal remains not definitive and seemingly inconsequential. Recent state and conservation agency literature promoting buckthorn removal, and management and control plans for land managers do not mention allelopathic remediation for encouraging growth and plantings of native species (Mass Audubon 2023; Minnesota DNR 2022; Wisconsin DNR 2023; USDA Forest Service/Northeastern Area State and Private Forestry 2022; Friends of the Mississippi 2019 and 2022). Wragg et al. (2020), Schuster et al. (2022) and Greet et al. (2019) focus on the importance of revegetation of native species in buckthorn removal sites as management and control of buckthorn and report significant success with growth of native seeds, sedges, shrubs and trees with no indication or finding of allelopathy affecting revegetation plant growth or their studies. Larkin et al. (2014) study restoration effects of managed woodland sites after buckthorn removal and find restoration to be successful with native species diversity and growth with no allelopathic indications reported.

3.0 Management and Control

"*Buckthorn aggressively competes with desirable native herbaceous flora, woody shrub and tree species by inhibiting germination and survival with its dense, shady growth, and early leaf-out and late leaf senescence. It can form dense, sharp-thorned thickets that make access difficult*", potentially forming an impenetrable layer of vegetation (USDA Northeastern Area State and Private Forestry 2022). It also has no predators to biologically control its abundance including insects, birds, disease or mammals, except for possibly goats whose effect on buckthorn removal is currently being studied. Therefore, buckthorn is free to cause devastating habitat degradation in the sites it invades, initially altering the plant community composition which in turn alters the structure and performance of the ecosystem. In temperate North American woodlands, Larkin et al. (2014) recognized the buckthorn invasion effects of producing dense thickets with degraded understory native vegetation and increasing rates of litter decomposition and nutrient cycling, and derived methods to measure and document ecosystem changes in managed woodland sites that ranged in age up to 14 years after buckthorn removal compared to unrestored woodland sites to form a better understanding of the extent and value of restoration. With increasing age, restored areas had higher understory plant diversity and cover, higher litter mass, some evidence of reduced soil erosion, and although not as significant and with high variance, increases in total particulate organic matter and mineral-associated soil organic matter fraction. "*Our results suggest that, in addition to better documented biodiversity benefits, beneficial changes to ecosystem properties and processes may also occur with active, long-term restoration of degraded woodlands*" (Larkin et al. 2014).

3.1 Removal of Buckthorn

For large areas of dense buckthorn, the cut stump treatment for buckthorn removal is recommended which involves cutting buckthorn plant stems at or near the soil surface and treating the stump chemically immediately (within 2 hours) with an herbicide to prevent resprouting. Triclopyr amine (Garlon 3A/Vastian) or glyphosate (Roundup, Rodeo) are water soluble herbicides that can be applied by paintbrush, “buckthorn blaster”, or a low volume sprayer on the cut surface when the temperature is above freezing. Triclopyr will kill broadleaf plants and not harm grasses; glyphosate will kill all actively growing vegetation in contact. Triclopyr ester (Garlon 4, Pathfinder II) is an oil based herbicide that can be applied when the temperature is below freezing by treating the cut surface and the remaining bark to the ground. In large areas of cutting, an indicator dye such as Mark-It-Blue is added to the herbicide to mark the cut stumps that have been treated as stumps are easily covered under cut brush. If treatment of buckthorn is near water, an herbicide for aquatic use will be used such as the formulations for Triclopyr (Garlon 3A, Element 3A) and glyphosate (Rodeo, AquaNeat) which are labeled for aquatic use. The most effective time to cut and treat the stumps is in late summer, no earlier than July as the herbicide is less effective when the trees are putting out leaves, and throughout the fall (Zouhar 2011, Minnesota DNR 2022).

Managing buckthorn is an ongoing process as the seeds may remain viable for up to 5 or 6 years in the soil. Removal of mature buckthorn can stimulate seed germination by disturbing the soil and creating open areas for increased light to reach the ground. Follow up monitoring and control of seedlings that emerge or missed sprouts after initial control efforts is necessary or buckthorn is likely to quickly re-establish.

3.2 Revegetation

Buckthorn is one of the most widespread of North American temperate forest understory woody invaders. Buckthorn invaded sites develop abundant buckthorn seedbanks while diminishing growth and abundance of native species and their seedbanks, thereby creating an environment with low resistance to reinvasion of buckthorn with buckthorn removal. Without continued management, buckthorn re-establishes quickly from resprouts and seeds from abundant seedbanks that may remain viable up to 5 or 6 years.

Wragg et al. (2020) hypothesized that revegetation using native herbaceous seed after buckthorn removal would increase herbaceous cover to competitively suppress buckthorn revegetation as a method of buckthorn control. Using a retrospective approach to “*evaluate how management techniques and site characteristics affected re-establishment of buckthorn in* *midwestern North America*", Wragg et al. (2020) surveyed seeded managed sites and unseeded control sites. Compared with unseeded sites, revegetated seeded sites had "*higher herbaceous cover, lower buckthorn cover, and half the ratio of buckthorn:herbaceous cover. Seeding increased herbaceous cover and reduced buckthorn relative abundance more strongly on less acidic, more clayey soils and where follow-up herbicide was not applied*" (Wragg et al. 2020). "*This investigation illustrates how retrospective studies can offer relatively inexpensive first assessments of long-term effects of management techniques; for more rigorous inference, researchers can partner with managers to conduct long-term experiments*" (Wragg et al. 2020).

Schuster et al. (2022 and 2024) studied the potential of native plant revegetation to inhibit buckthorn re-establishment through seeding and planting sedges, shrubs and trees compared to control plots in three forest understories in Minnesota over a 4 year period. Revegetation was observed to continue to decrease forest floor light availability over time, negatively impacting buckthorn growth. Shrubs had the greatest impact in reducing light availability to buckthorn seedlings to <2% total light by the third year, causing 51% lower year over year survival of buckthorn, and 53% shorter buckthorn with 38% fewer leaves by the end of the experiment. "*Planted shrubs, trees, and sedges reduced buckthorn invasion by 89%, 81% and 66% respectively and seeding alone reduced invasion by 51%*." Schuster et al. (2022) concluded that buckthorn invasion can be significantly reduced with the revegetation of forests with native species, particularly shrubs and trees. "*Greater adoption of revegetation by land managers may therefore increase native biodiversity, reduce herbicide applications, and improve the overall health and value of forests*" (Schuster et al. 2022).

Greet et al. (2019) support the conclusions of Schuster et al. (2022) upon surveying and comparing the outcomes of seven riparian revegetation sites. "*Direct seeding tended to result in higher plant densities and similar species richness, but lower rates of species establishment and diversity compared with planting. A median of 67% of target species established via direct seeding compared with 100% for planting, with direct seeded areas often dominated by one or two species*." It was indicated generally that climatic and site factors played more of a role in overall revegetation outcomes than the revegetation method of sowing or planting. Greet et al. (2019) concluded that successful restoration outcomes of diverse plant communities can be achieved, however, to help address factors involved, they emphasized using a combined approach of both sowing and planting as the best strategy.

Gehling (2020) tested the germination resistance of three native species including mustard (*Guillenia flavescens*), big bluestem (*Andropogon gerardi*), and Canada wild rye (*Elymus* *canadensis*) to buckthorn allelopathic metabolites for successful revegetation support in buckthorn management. Petri dishes were used to hold either one unripe drupe collected in mid-August (2019) or one ripe drupe collected in mid-September (2019) in the center with six outward rings of six seeds of one native species around it, and left to germinate for 19 days with continuous light and daily watering. In this lab setting, *E. canadensis* germinated more than the other native species and consistently closer to the drupe for both ripe and unripe drupe tests indicating resistance to buckthorn. Although performed as a lab experiment and the effects of field environment variables were not included in testing such as soil composition, microbiomes and surface substrate, variation in allelopathic resistance between native species of plants was demonstrated as an indication of the better sources for remediation in buckthorn control.

The Wisconsin Department of Natural Resources (DNR) has implemented a project similar to the one proposed for Kirvin Park (Wisconsin DNR 2021). The Wisconsin DNR conducted a "*buckthorn infestation*" removal on a 41 acre area along a stream due to access issues buckthorn created for fishermen, as well as lack of tree regeneration in the understory and bare soils. Immediately following buckthorn removal, treatment methods for control of buckthorn were initiated in 2009 along with tree planting of nearly 9,000 tree seedlings consisting of red pine, white pine, balsam fir, white spruce, black spruce, jack pine, tamarack, burr oak, swamp white oak and quaking aspen. With ongoing yearly monitoring, various buckthorn control treatments and plantings continued to be implemented, and data collection of buckthorn, tree planting and natural native seeding tree growth was recorded each year through 2021 when this report was written. All treatment methods were found to provide effective control of buckthorn, although repeated treatments were necessary for effective reinvasion control. Buckthorn control effectiveness was found to be very similar post treatment despite the buckthorn treatment method, however follow-up herbicide treatments were shown to have a great impact on controlling buckthorn. Natural seeding of a large number of speckled alder regenerated the stream banks, as well as natural seeding across the entire project area from nearby overstories of black ash, red maple and white pine. Natural black cherry seedlings also grew surprisingly well on the site. Of the planted tree species, tamarack stood out as best for survival and growth. "*This data is being used to help determine what control methods are most effective on buckthorn, as well as determining an approximate number of years and follow-up treatments that are necessary to control the species from returning to the landscape*" (Wisconsin DNR 2021). Although time and labor-intensive, "*this project has already created a more ecologically diverse area for not only members of the public, but also the wildlife community*." With the success of this long-term project to achieve a progressive reversal to a native species diverse habitat, it is "*hoped that land managers and the public will begin to understand buckthorn impacts on the ecosystem and possible treatment alternatives*" (Wisconsin DNR 2021).

Other revegetation recommendations for buckthorn control include planting native grass mixes such as red fescue, oats or Virginia wild rye and native shrubs including high-bush cranberry, nannyberry, chokecherry, pagoda dogwood, gray dogwood, elderberry, American hazelnut and black chokeberry (University of Minnesota 2020).

In summary, trees and shrubs have wide ranges of growth conditions and tolerances that may be selected for use in revegetation. Trees and shrubs may compete more strongly with invasive trees and shrubs than grasses and wildflowers due to their similarities in growth requirements and physiology, but it is also more difficult to restore trees and shrubs (Schuster et al 2024.. An important competing trait of trees and shrubs is the ability to hold on to their leaves late into the fall, reducing the seasonal available light for growth and survival of invasive species. To help maintain a dense cover for suppressing invasive plants, inter-seeding with grasses and wildflowers covering the areas between trees and shrubs is recommended. The impacts of deer and other herbivores also require attention, with the use of fencing, cages, or tubing necessary in areas with active herbivores such as deer.

3.3 Chipping

The Minnesota DNR (2022) states that "*with all invasive plants, it is preferred to keep the plant material on site when possible to reduce the chance of spreading seeds to new areas*." They advise that chipping the buckthorn at some sites may be an option, however warn to be aware that chipping by itself does not destroy buckthorn seeds. "*To prevent the spread of buckthorn, wood chips from fruiting plants should be kept on-site where they can be piled, burned, or spread in an area where any seedlings that sprout could be removed.*"

3.4 Composting

Composting has been shown to be successful in the buckthorn removal process of a site by eliminating viable seeds of buckthorn and garlic mustard on site (Van Rossum and Renz 2015):

"*Composting is a common practice for management of herbaceous yard materials and other decomposable materials. Although composting is promoted by state agencies for many materials, a notable exception is invasive plants due to concerns about spreading propagules with the finished product. To address this issue, we measured the viability of garlic mustard and common buckthorn seeds exposed to turned or static composting methods. Piles were built in 2012 and 2013, and seeds from both species were inserted and monitored for viability. Seed* *viability was reduced rapidly regardless of year, composting method, or species. Viability of seeds was zero within 7 and 15 d of composting for garlic mustard and common buckthorn, respectively, in both years. Results indicate that composting facilities are able to render the seeds of these invasive plants nonviable using either composting method because inactivation is within the composting timeframes typically practiced by the industry. This includes the process to further reduce pathogens (PFRP) with thresholds of 55 C for 15 d for the compost management process used for this trial.*

Management Implications: Land managers will continue their efforts to control the spread of invasive plants in natural areas. These efforts will generate a volume of plant material that needs to be managed as a waste. This research demonstrates that the use of landfilling for disposal is not the only option available for garlic mustard and European buckthorn infested material. Well-managed compost facilities are more than capable of achieving the temperatures necessary to render seeds from these species unviable. Placement of the materials within static managed piles with proper moisture and carbon-to-nitrogen ratios create conditions that are favorable for the destruction of seeds from these species in a short time period. An additional practice that could easily be adopted would be to require placement of infested material in the center of the compost piles and leave them unturned for a period of up to 7 d. This would expose any seeds present to maximum pile temperatures, thus reducing seed viability while still allowing facility operators adequate time to meet the process to further reduce pathogens (PFRP) turning requirements. Other options for waste management include composting materials on site to produce a soil amendment, thus eliminating the cost of transporting and disposal of plants materials as currently practiced" (Van Rossum and Renz 2015).

In summary, in the persistent management and control of buckthorn and other invasives "*the primary goals are to prevent… plants from producing seed, prevent new seeds from arriving from nearby populations, and deplete the seed bank" (Michigan DNR, 2018)*. An integrated management approach involving a combination of site-specific control strategies with continued follow-up management is most efficient and effective at reducing established buckthorn populations and increasing native species' establishment and diversity. "*To optimize resources, reduce buckthorn infestation, and increase native species' diversity, an integrated management approach combining knowledge of the biology and ecology of buckthorn is a more ecologically and economically feasible management approach*" (Bisikwa et al. 2020).

4.0 Recommended Floodplain Restoration Management Plan

Based upon the extensive research on common buckthorn biology, control, and management, as described in the previous sections, the following steps are recommended to be incorporated into the Kirvin Park restoration planning to address the objective of reducing the prevalence of this species in this floodplain forest:

1. Cut invasive woody plants (buckthorn, honeysuckle, bittersweet) and immediately apply herbicide to stumps; transport stems to staging area for chipping and stockpile for composting. Season to be determined, but July through late fall is possible.
2. Scrape 1-2" of duff/soil to remove fallen fruit and exposed seeds; stockpile for composting in staging area.
3. Test soils for standard fertility (such as provided the UMass Agricultural Experiment Station; to include standard fertility testing such as pH, acidity, extractable nutrients (P, K, Ca, Mg, Fe, Mn, Zn, Cu, B), lead, and aluminum, cation exchange capacity, percent base saturation, organic matter and soluble salts).
4. Shallow tilling or cultivation of soil surface may be conducted to remove missed invasive seedlings and saplings, followed by seeding with invasive resistant species cover crop to inhibit invasive species growth and erosion control.
5. Either at the end of season or midsummer of following year, do follow-up tilling and/or herbicide treatment and seed with invasive resistant species cover crop.
6. Allow one year with cover crop, if possible, and plant invasive resistant shrub and tree species in spring or (preferably) fall assuming good buckthorn control.

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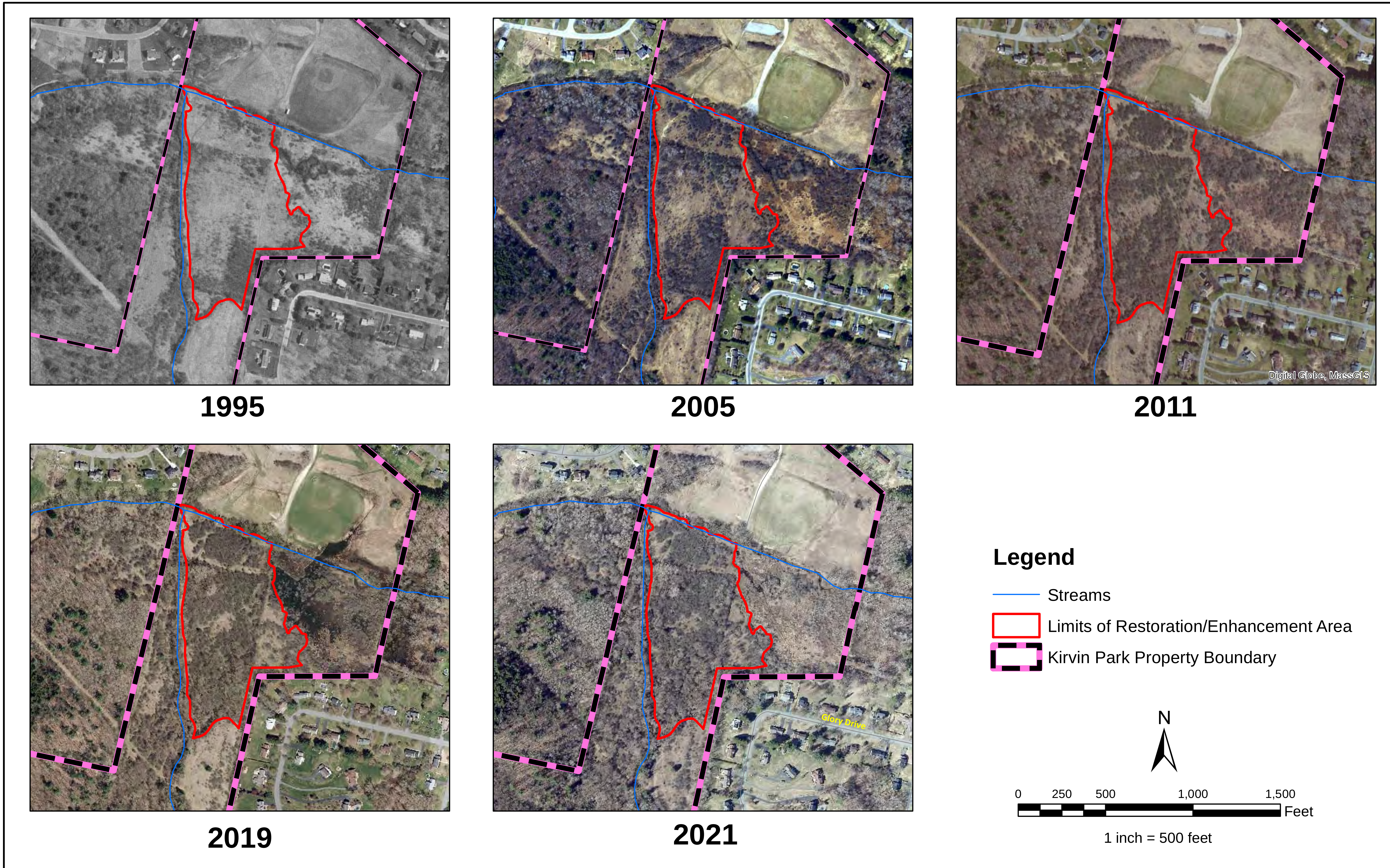
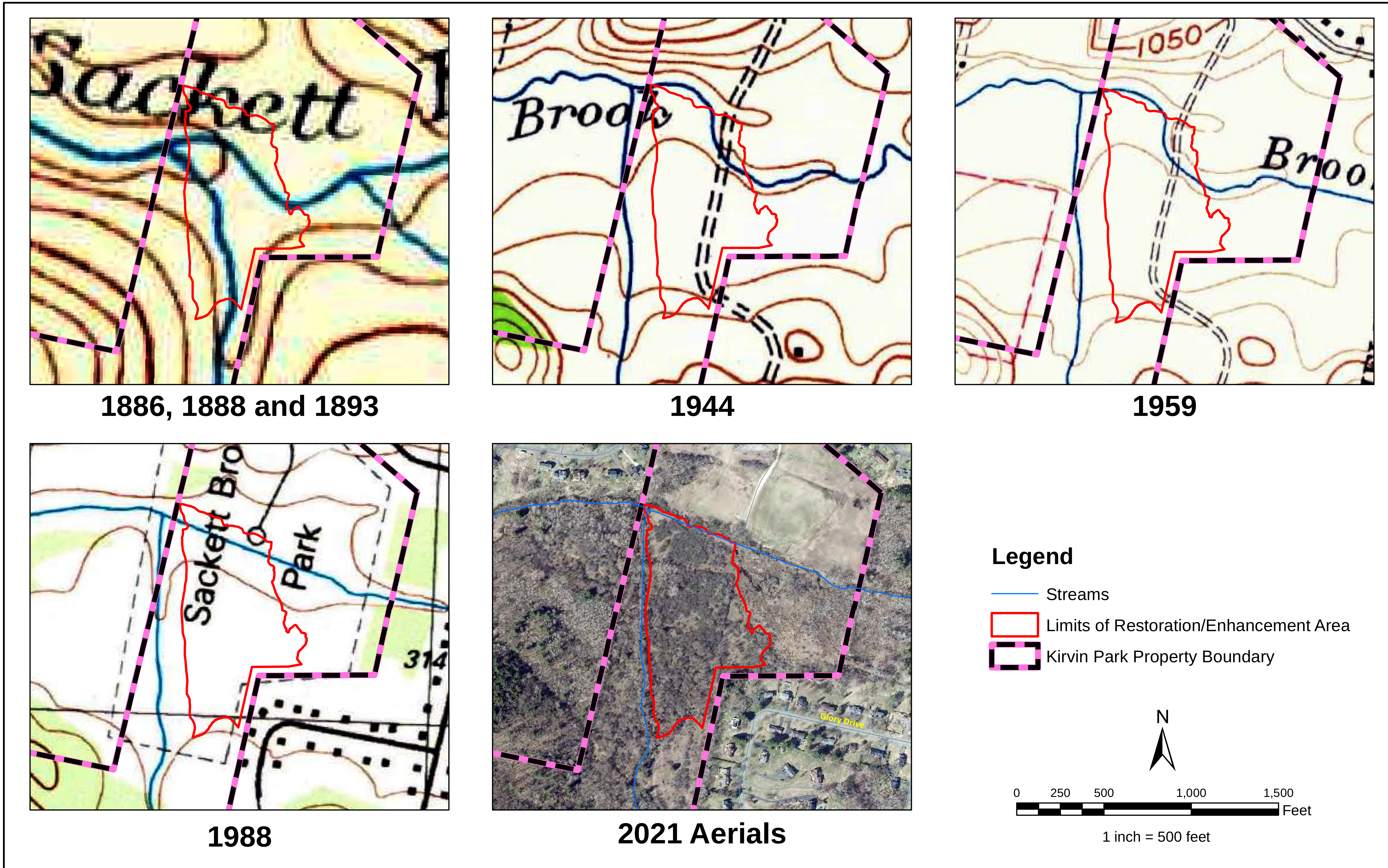
AECOM

Appendix E

Aerial Photographs and Historical USGS Topographic Maps



1995
2005
2011
Digital Globe, MassGIS
2019
2021
Glory Drive
Legend
Streams
Limits of Restoration/Enhancement Area
Kirvin Park Property Boundary
N
0
250
500
1,000
1,500
Feet
1 inch = 500 feet



Sackett
1886, 1888 and 1893
Brook
1944
1050
Brook
1959
Sackett Bro
Park
314
1988
Glory Drive
2021 Aerials
Legend
Streams
Limits of Restoration/Enhancement Area
Kirvin Park Property Boundary
N
0
250
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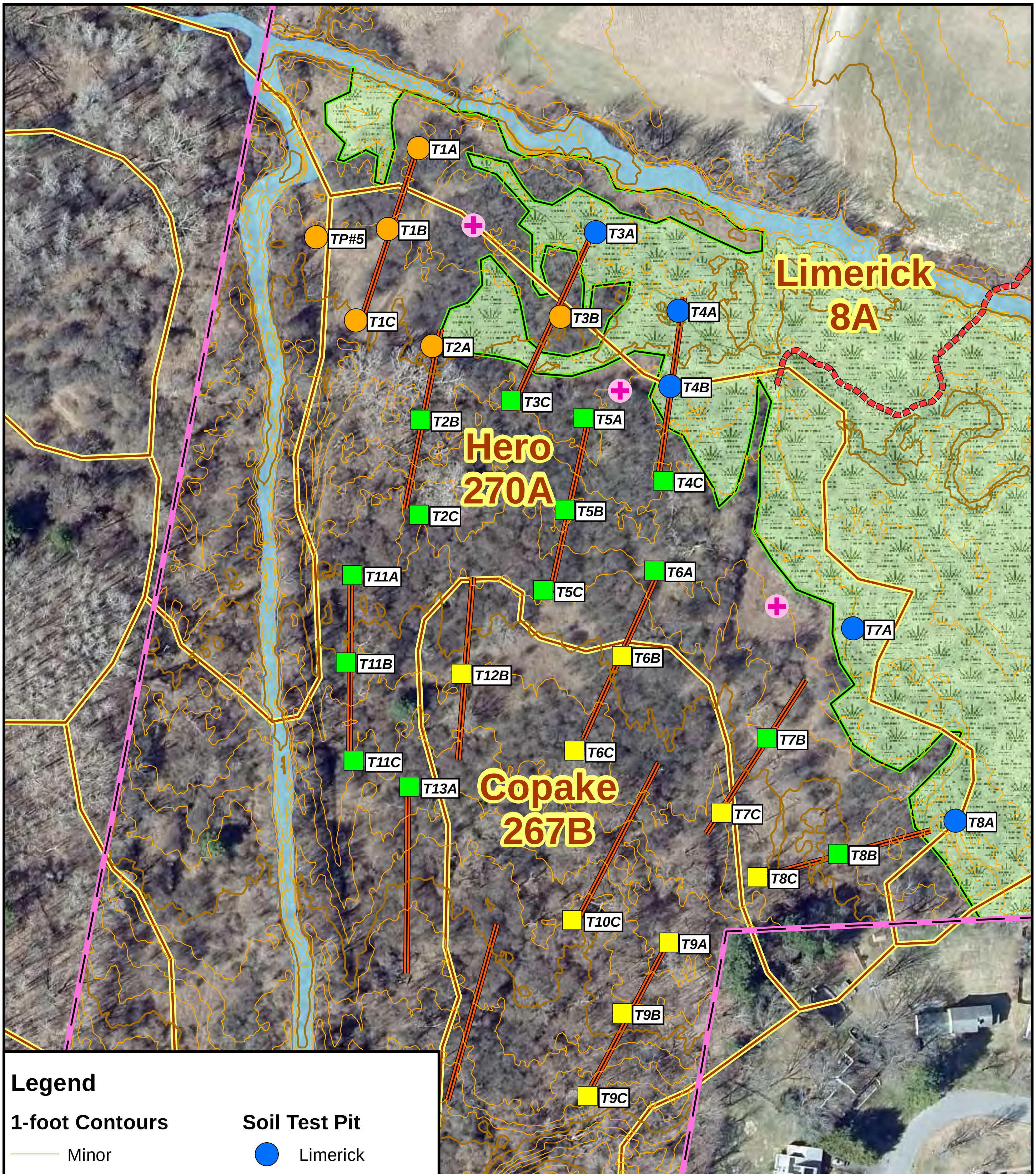
1,000
1,500
Feet
1 inch = 500 feet

AECOM

Appendix F

USDA NRCS Soils Mapping and Descriptions



Legend

1-foot Contours

- Minor
- Major
- Wetland Line
- Transect Locations
- NRCS Soils Mapping
- Kirvin Park
- Historic Beaver Dam

Soil Test Pit

- Limerick
- Winooski
- Copake
- Hero
- Wetlands
- Streams
- Monitoring Wells

NRCS Soil Series Mapping and Site-Specific Soil Survey

Preliminary Wetland Mitigation and Floodplain Restoration Plan
Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
1:24,000	1/16/2023	04191406

AECOM

Figure Number

3

Established Series
Rev. MFF
06/2001

COPAKE SERIES

The Copake series consists of well drained soils formed in loamy mantled stratified drift and glacial outwash. The soils are moderately deep to stratified sand and gravel and are very deep to bedrock. They are nearly level to very steep soils on outwash plains, terraces, kames, eskers, and moraines. Permeability is moderate or moderately rapid in the surface layer and subsoil, and rapid or very rapid in the substratum. The mean annual temperature is about 47 degrees F., and the mean annual precipitation is about 46 inches.

TAXONOMIC CLASS: Coarse-loamy over sandy or sandy-skeletal, mixed, semiactive, mesic Dystric Eutrudepts

TYPICAL PEDON: Copake fine sandy loam, on a 4 percent slope in a cornfield. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 6 inches; dark brown (10YR 3/3) fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; common very fine and fine roots; 10 percent gravel; neutral; gradual wavy boundary. (6 to 10 inches thick)

AB--6 to 13 inches; dark olive brown (2.5Y 3/3) gravelly fine sandy loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; friable; common fine and very fine roots; 15 percent gravel; slightly acid; clear smooth boundary. (0 to 8 inches thick)

Bw1--13 to 21 inches; dark yellowish brown (10YR 4/4) gravelly fine sandy loam; weak medium subangular blocky structure; friable; common very fine and fine roots; 25 percent gravel; slightly acid; gradual smooth boundary.

Bw2--21 to 31 inches; dark yellowish brown (10YR 4/4) gravelly fine sandy loam; weak medium subangular blocky structure; friable; few very fine and fine roots; 20 percent gravel; neutral; abrupt smooth boundary. (Combined thickness of the Bw horizons is 14 to 34 inches.)

2C1--31 to 56 inches; dark brown (10YR 3/3) coarse sand; single grain; loose; 40 percent fine gravel; neutral; abrupt smooth boundary.

2C2--56 to 65 inches; olive brown (2.5Y 4/3) fine sand; single grain; loose; 5 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

2C3--65 to 75 inches; olive brown (2.5Y 4/3) gravelly sand; single grain; loose; 15 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

2C4--75 to 80 inches; olive brown (2.5Y 4/3) gravelly fine sand; single grain; loose; 15 percent gravel; slightly effervescent; moderately alkaline.

TYPE LOCATION: Litchfield County, Connecticut; town of Salisbury, 1.5 miles north along Route 41 from the New York state line at Amenia Union, NY, 500 feet northeast of Bollen District Cemetery, and 150 feet east of Route 41, USGS Ellsworth topographic quadrangle; Latitude 41 degrees 50 minutes 31 seconds N., longitude 73 degrees 29 minutes 27 seconds W. NAD 1927.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 20 to 40 inches and typically corresponds to the depth to sand and gravel. Rock fragments range from 5 to 35 percent by volume in the solum and from 5 to 70 percent in the substratum. The weighted average in the substratum is more than 20 percent. Typically, 75 percent or more of the rock fragments is rounded gravel. Reaction ranges from very strongly acid to neutral in the A horizon, strongly acid to neutral in the B horizon, and slightly acid to moderately alkaline in the 2C horizon. At least one subhorizon of the B ranges from moderately acid to neutral. Depth to carbonates is greater than 40 inches.

The Ap horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 4. Dry value is 6 or more. Undisturbed pedons have a thin A horizon with value of 2 or 3 and chroma of 1 to 3. The Ap or A horizon is silt loam, loam, or fine sandy loam in the fine-earth fraction. It has weak or moderate granular structure and is friable or very friable.

The Bw horizon has hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 3 to 8. It is silt loam, loam, or fine sandy loam in the fine-earth fraction and has less than 50 percent fine or coarser sand. The Bw horizon has weak granular or weak subangular blocky structure, or it is massive. Consistence is friable or very friable.

The 2C horizon has hue of 7.5YR to 5Y, value of 3 to 6, and chroma of 2 to 6. Texture ranges from loamy fine sand to coarse sand in the fine-earth fraction.

COMPETING SERIES: There are no other series currently in the same family.

The Agawam, Alton, Branford, Chenango, Groton, Hartford, Haven, Hero, Hoosic, Merrimac, Riverhead, Tunkhannock, Wappinger, and Warwick series are similar soils in related families. Agawam, Branford, Haven, and Riverhead soils have less than 60 percent base saturation. Alton, Chenango, Tunkhannock, and Warwick soils are loamy-skeletal. Groton and Hoosic soils are sandy-skeletal. Hartford and Merrimac soils have a sandy particle-size control section. Hero soils have redoximorphic depletions within a depth of 24 inches from the surface. Wappinger soils have an irregular decrease in organic carbon with depth.

GEOGRAPHIC SETTING: Copake soils are nearly level to very steep and are on outwash plains, terraces, kames, eskers, and moraines. Slope ranges from 0 to 60 percent. The soils formed in a loamy mantle over sandy and gravelly glaciofluvial materials derived mainly from schist, limestone, gneiss, and dolomite. Mean annual temperature ranges from 46 to 50 degrees F., mean annual precipitation commonly is 40 to 50 inches but the range includes 36 to 50 inches, and the growing season ranges from 120 to 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Agawam, Amenia, Dover, Farmington, Fredon, Georgia, Groton, Hadley, Halsey, Hero, Hoosic, Merrimac, Mudgepond (T), Nellis, Pittsfield, Stockbridge, and Winooski soils on nearby landscapes. The excessively drained Groton, moderately well drained Hero, somewhat poorly and poorly drained Fredon, and very poorly drained Halsey soils are associated in a drainage sequence. Amenia, Dover, Farmington, Georgia, Mudgepond, Nellis, Pittsfield, and Stockbridge soils formed in till derived dominantly from limestone and are on nearby uplands. Hadley and Winooski soils are on flood plains.

DRAINAGE AND PERMEABILITY: Well drained. Surface runoff is negligible to high. Permeability is moderate or moderately rapid in the solum and rapid or very rapid in the substratum.

USE AND VEGETATION: Most areas are in cultivated crops, hay, or pasture. Common crops are silage corn and grass-legume hay. Some areas are wooded or in community development. Common trees are red, white, and black oak, white pine, beech, black birch, sugar maple, and white ash. Gravel commonly is excavated from areas of these soils.

DISTRIBUTION AND EXTENT: Glaciofluvial landforms in western Connecticut, western Massachusetts, eastern and central New York, and western Vermont; dominantly MLRA 144A but includes a small acreage in the eastern part of MLRA 101 in New York. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Columbia County, New York, 1923.

REMARKS: This revision reflects a new typical pedon and general updating. Cation exchange activity class placement was based upon a review of limited data and similar and associated soils.

Diagnostic horizons and features recognized in this pedon are:

1. Ochric epipedon - the zone from 0 to 13 inches (A and AB horizons).
2. Cambic horizon - the zone from 13 to 31 inches (Bw horizons).
3. Strongly contrasting particle-size classes - the weighted average of the control section is coarse-loamy above a depth of 31 inches and is sandy-skeletal below 31 inches with the coarse-loamy part containing less than 50 percent fine sand or coarser (Bw1, Bw2, Bw3, and 2C1 horizons).
4. Dystric Eutrudepts feature - the base saturation is greater than 60 percent in the 10 to 30 inch depth (Bw1 and Bw2 horizons).

National Cooperative Soil Survey
U.S.A.

Established Series
Rev. MFF-SMF
03/2000

HERO SERIES

The Hero series consists of very deep, moderately well drained soils formed in loamy over sandy and gravelly glacial outwash. They are nearly level and gently sloping soils on glaciofluvial landforms, and are typically in slight depressions and broad drainageways. Slope ranges from 0 to 8 percent. Permeability is moderate or moderately rapid in the surface layer and subsoil and rapid or very rapid in the substratum. Mean annual temperature is about 47 degrees F. and mean annual precipitation is about 43 inches.

TAXONOMIC CLASS: Coarse-loamy over sandy or sandy-skeletal, mixed, semiactive, mesic Aquic Eutrudepts

TYPICAL PEDON: Hero gravelly loam - pasture, 2 percent slope. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 9 inches; very dark grayish brown (10YR 3/2) gravelly loam; pale brown (10YR 6/3) dry; weak medium granular structure; very friable; many very fine and fine roots; 15 percent gravel; slightly acid; clear smooth boundary. (6 to 10 inches thick)

Bw1--9 to 18 inches; olive brown (2.5Y 4/4) gravelly silt loam; weak medium subangular blocky structure; friable; few fine and very fine roots; 20 percent gravel; neutral; gradual wavy boundary.

Bw2--18 to 24 inches; olive brown (2.5Y 4/4) gravelly silt loam; weak medium subangular blocky structure; friable; 25 percent gravel; few medium and fine distinct grayish brown (2.5Y 5/2) and olive gray (5Y 5/2) iron depletions and few medium and fine distinct brown (7.5YR 4/4) masses of iron accumulation; neutral; clear wavy boundary. (Combined thickness of the Bw horizons with less than 50 percent fine and coarser sand is 12 to 34 inches)

Bw3--24 to 27 inches; dark grayish brown (2.5Y 4/2) gravelly sandy loam; massive; very friable; 30 percent gravel; slight effervescence; common fine and medium distinct dark yellowish brown (10YR 4/4) masses of iron accumulation and grayish brown (2.5Y 5/2) iron depletions; slightly alkaline; clear smooth boundary. (0 to 5 inches thick)

2C--27 to 60 inches; grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) extremely gravelly sand; few thin lenses of gravelly sandy loam; single grain; loose; 50 percent gravel and 10 percent cobbles; few strong brown (7.5YR 5/6) and gray (N 6/) weathered limestone pebbles; few fine and medium distinct light olive brown (2.5Y 5/6) masses of iron accumulation; slight effervescence; slightly alkaline.

TYPE LOCATION: Litchfield County, Connecticut; town of Sharon, 700 feet due south of the junction of Connecticut Route 361 and Mudge Pond Road; on the USGS Sharon topographic quadrangle, latitude 41 degrees 53 minutes 24 seconds N., longitude 73 degrees 28 minutes 55 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 18 to 36 inches and typically corresponds to the depth of the sandy and gravelly substratum. Rock fragments range from 5 to 35 percent in the solum and from 15 to 65 percent in the substratum. Typically, 75 percent or more of the rock fragments are rounded pebbles. The soil is moderately acid to neutral in the A horizon, moderately acid to slightly alkaline in the B horizon and neutral to moderately alkaline in the 2C horizon. Carbonates are within a depth of 40 inches.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 to 4 and chroma of 1 to 3. Dry value is 6 or more. Undisturbed pedons have a thin A horizon with value of 2 or 3 and chroma of 1 to 3. The A or Ap horizon is silt loam, loam or fine sandy loam in the fine earth. It has weak or moderate granular structure and is friable or very friable.

The Bw horizon has hue of 10YR to 5Y, value of 3 to 6 and chroma of 2 to 6. Subhorizons with chroma of 2 are below a depth of 20 inches. The Bw horizon has iron depletions above a depth of 24 inches. It is silt loam, loam or fine sandy loam with less than 50 percent fine and coarser sand, except some pedons have a sandy loam subhorizon less than 5 inches thick just above the 2C horizon. The Bw horizon has weak or moderate granular or subangular blocky structure or it is massive. Consistence is friable or very friable.

The 2C horizon has hue of 10YR to 5Y, value of 3 to 6 and chroma of 2 to 4. Texture ranges from loamy fine sand to coarse sand in the fine earth. Rock fragments in individual layers range from 5 to 65 percent, but the weighted average is more than 15 percent.

COMPETING SERIES: There are no other series in the same family.

Amenia, Belgrade, Copake, Dover, Ellington, Galway, Georgia, Grenville, Hogansburg, Lenox, Minoa, Nellis, Ninigret, Pawling, Pittsfield and Stockbridge series are similar soils in related families. Amenia, Georgia and Hogansburg soils have a loamy glacial till substratum. Belgrade soils lack carbonates within 40 inches and are coarse-silty. Copake soils lack iron depletions within a 24 inch depth. Dover, Grenville, Lenox, Nellis, Pittsfield and Stockbridge soils lack iron depletions and have a loamy glacial till substratum. Ellington and Ninigret soils lack carbonates. Galway soils lack redoximorphic features and are 20 to 40 inches deep to bedrock. Minoa soils are coarse-loamy and have less than 5 percent rock fragments. Pawling soils are on floodplains and have an irregular decrease in organic carbon with depth.

GEOGRAPHIC SETTING: Hero soils are nearly level and gently sloping soils on glaciofluvial landforms. Slope ranges from 0 to 8 percent. The soils formed in loamy over stratified sandy and gravelly glacial outwash derived mainly from limestone, shale, schist, sandstone and dolomite. Mean annual temperature is 45 to 50 degrees F., mean annual precipitation is 36 to 50 inches and the growing season is 120 to 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Amenia, Copake, Dover, Fredon, Georgia, Groton, Hadley, Halsey, Hazen, Kendaia, Lenox, Massena, Nellis, Palmyra, Pittsfield , Stockbridge, and Winooski soils on nearby landscapes. The excessively drained Groton, well drained Copake, Hazen and Palmyra soils, somewhat poorly drained and poorly drained Fredon and very poorly drained Halsey soils are drainage associates on terraces. Hadley and Winooski soils are on floodplains. Dover, Lenox, Nellis, Pittsfield, and Stockbridge soils are located on nearby glacial till uplands. Amenia, Georgia, Kendaia and Massena soils are wetter associates on nearby glacial till uplands.

DRAINAGE AND PERMEABILITY: Moderately well drained. Surface runoff is slow to medium. Permeability is moderate or moderately rapid in the solum and rapid or very rapid in the substratum. The soil has a seasonal high water table.

USE AND VEGETATION: Cleared areas are in cultivated crops, hay and pasture. Common crops are silage corn and grass-legume hay. Some areas are wooded or in community development. Common trees are red, white, and black oak, white ash, red maple, sugar maple, beech, black birch, black cherry, hemlock and white pine.

DISTRIBUTION AND EXTENT: Glaciofluvial landforms in western Connecticut, western Massachusetts, northern New Jersey, and Vermont; MLRAs 142 and 144A. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Dutchess County, New York, 1941.

REMARKS: This revision reflects general updating.

The horizons and features diagnostic for the typical pedon are:

1. Ochric epipedon from 0 to 9 inches (Ap).
2. Cambic horizon from 9 to 27 inches (Bw1, Bw2, Bw3).
3. Carbonates within a 40 inch depth (Bw3 and 2C horizons).
4. Particle-size control section that is coarse-loamy to 27 inches and contrasting sandy or sandy-skeletal below.
5. Iron depletions within a 24 inch depth (Bw2 horizon).
6. Mesic temperature and udic moisture regimes.

Established Series
Rev. MHS-SHG-DCP
03/2010

LIMERICK SERIES

The Limerick series consists of very deep, poorly drained soils on flood plains. They formed in loamy alluvium. Saturated hydraulic conductivity is moderately high or high. Slope ranges from 0 through 3 percent. Mean annual precipitation is about 44 inches (1118 millimeters) and mean annual temperature is about 45 degrees F. (7 degrees C).

TAXONOMIC CLASS: Coarse-silty, mixed, superactive, nonacid, mesic Fluvaquentic Endoaquepts

TYPICAL PEDON: Limerick silt loam, on a nearly level slope in hay land at an elevation of about 10 feet. (Colors are for moist soil unless otherwise noted.)

Ap-- 0 to 8 inches (0 to 20 centimeters); dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; common very fine and fine and few medium roots; moderately acid; clear smooth boundary. (3 to 10 inches, 8 to 25 centimeters thick.)

BCg1-- 8 to 20 inches (20 to 50 centimeters); olive gray (5Y 4/2) silt loam; massive; friable; few very fine and fine roots; common medium prominent dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4 and 10YR 5/6) soft masses of iron accumulation; moderately acid; clear smooth boundary.

BCg2-- 20 to 36 inches (50 to 91 centimeters); olive gray (5Y 4/2) silt loam; massive; common medium prominent dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4 and 10YR 5/6) soft masses of iron accumulation; moderately acid; clear smooth boundary.

BCg3-- 36 to 54 inches; (91 to 137 centimeters) dark gray (5Y 4/1) silt loam; massive; common medium prominent dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4 and 10YR 5/6) soft masses of iron accumulation; moderately acid; clear smooth boundary. (Combined thickness of the BCg horizons ranges from 6 to more than 60 inches (15 to 152 centimeters.)

Cg-- 54 to 65 inches (137 to 165 centimeters); dark greenish gray (5GY 4/1) silt loam; massive; few, fine prominent dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4 and 10YR 5/6) soft masses of iron accumulation; neutral.

TYPE LOCATION: Hartford County, Connecticut; town of Wethersfield, 1200 feet east on Second Lane Road from Interstate 91 underpass, 50 feet south of Second Lane Road, on the Hartford South. USGS Hartford South topographic quadrangle, Latitude 41 degrees, 41 minutes, 52 seconds N., Longitude 72 degrees, 38 minutes, 22 seconds W., NAD 1983, on the floodplain of the Connecticut River.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 17 through more than 60 inches (43 through 152 centimeters). Depth to bedrock is more than 60 inches (152 centimeters). Reaction ranges from strongly acid through neutral. The weighted average of fine and coarser sands, in the particle-size control section, is less than 15 percent.

The A or Ap horizon has hue of 10YR through 5Y, value of 3 or 4, and chroma of 1 or 2. Texture is commonly silt loam but includes very fine sandy loam. Structure is typically weak or moderate, fine or medium granular. Some A horizons have weak or moderate medium subangular blocky structure. Consistence is friable or very friable. Redoximorphic features, where present, are few through many, fine through coarse and faint through prominent.

Some pedons have one or more Ab horizons with hue of 10YR through 5Y, value of 3 or 4 and chroma of 1 or 2. Texture is commonly silt loam but includes very fine sandy loam. The horizons are massive and friable.

Some pedons have a Bg horizon, 6 through 8 inches (15 through 20 centimeters) thick, with hue of 10YR through 5Y, value of 4 through 6, and chroma of 1 or 2. Texture is commonly silt loam, but includes silt and very fine sandy loam. Structure is weak granular or subangular blocky, or the horizon is massive. Consistence is friable. Redoximorphic features are few through many, fine through coarse and distinct or prominent.

The BCg horizon, where present, has hue of 10YR through 5Y, value of 4 through 6 and chroma of 1 or 2. Texture is commonly silt loam, but includes silt and very fine sandy loam. Strata of loamy very fine sand, very fine sand, or fine sand .2 through .5 inches (.5 through 1.3 centimeters) thick are present in some horizons. The horizon is massive and friable or very friable. Redoximorphic features range from few through many, fine through coarse and faint through prominent.

The Cg horizon, where present, has hue of 10YR through 5GY, or is neutral, value of 4, and chroma of 0 through 2. Texture is commonly silt loam but includes silt and very fine sandy loam. Some pedons have thin strata (less than .2 inches) (.5 centimeters) that vary in color, texture, or reaction. Redoximorphic features, where present, are few through many and fine or medium prominent. The horizon is massive and friable.

Some pedons have a 2Cg horizon below a depth of 40 inches (100 centimeters). It has hue of 10YR through 5Y, value of 3 through 5, and chroma of 1 through 4. Texture is fine sandy loam through sand.

COMPETING SERIES: Oridia and Skokomish soils are currently the only other series in this family. Oridia and Skokomish series are from Land Reasource Region A in the Pacific Northwest.

The Lim, Rippowam, and Rumney series are in related families. They have a weighted average of fine sand or coarser in the particle-size control section of more than 15 percent. Rumney soils have a cooler mean annual soil temperature.

GEOGRAPHIC SETTING: Limerick soils are on the flood plains of major rivers and their larger tributaries. In some places they are on the flood plains of small streams. They may be on broad flat areas or in shallow depressions. The soils formed in recent alluvial deposits that are dominantly silt and very fine sand. Mean annual temperature ranges from about 45 through 52 degrees F. (7 through 11 degrees C.), and mean annual precipitation ranges from 30 through 50 inches (762 through 1270 millimeters). The frost-free season ranges from 105 through 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: Limerick soils are the poorly drained member of the drainage sequence that includes the well drained Hadley, the moderately well drained Winooski, and the very poorly drained Saco soils. Common associated soils on nearby terraces are the Agawam, Enfield, Hinckley, Merrimac, and Windsor series.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained. Saturated hydraulic conductivity is moderately high or high. Most areas are flooded for periods of several days each year, usually in late winter or early spring.

USE AND VEGETATION: Most areas are used for long term hay and pasture. A few areas have been drained, and cultivated crops are grown. Common trees in wooded areas are red maple and eastern white pine. Additional woody species are alders, willows, black ash, green ash, swamp birch, river birch, silky willow, and pussy willow. Common herbaceous species include cinnamon fern, nettle, and skunk cabbage.

DISTRIBUTION AND EXTENT: Connecticut, Massachusetts, New Hampshire, New York, and Vermont; MLRAs 142, 144A, and 145. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Aroostook County, Maine, 1943.

REMARKS: 1. With this revision the classification is changed from Coarse-silty, mixed, active, nonacid, mesic Fluvaquentic Endoaquepts to Coarse-silty, mixed, superactive, nonacid, mesic Fluvaquentic Endoaquepts. This reflects a review of current lab data available for this series, S70MA015004, S70MA015005 and S06CT003-001 were some of the selected lab pedons used to make the determination.

2. The use of the Limerick series in Maine, and in MLRA 143 and 144B, is relict to before temperature classes. These have been removed from the SC file.

3. Diagnostic horizons and features recognized in this pedon include:

a. Ochric epipedon - the zone from 0 to 8 inches (0 to 20 centimeters) (Ap horizon).
b. Cambic horizon - the zone from 8 to 54 inches (20 to 137 centimeters) (BCg horizons).
c. Aquept feature - Within 20 inches (50 centimeters) of the soil surface the matrix has chroma of 2 or less with redox concentrations.
d. Fluvaquentic feature: The organic-carbon content is presumed to decrease irregularly with depth between 10 through 50 inches (25 through 125 centimeters).
e. Nonacid reaction class - the pH is presumed to be 5.0 or more in 0.01m CaCl2 in at least some part of the control section.
f. The material composing the Cg layer is presumed to change color upon exposure to air thereby not meeting the criteria for a Cambic horizon.

National Cooperative Soil Survey
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Appendix G

US Army Corps of Engineers Wetland Determination Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Kirvin Park City/County: Pittsfield / Berkshire Sampling Date: 8/9/22

Applicant/Owner: General Electric Company State: MA Sampling Point: T1-U

Investigator(s): S. Egan & T. Ramborger Section, Township, Range: ____

Landform (hillside, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR or MLRA): LRR R, MLRA 144B Lat: 42.424795 Long: -73.205664 Datum: WGS84

Soil Map Unit Name: Hero Loam NWI classification: ____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation X, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?		X
Wetland Hydrology Present?		X

Is the Sampled Area within a Wetland? **Yes** ____ **No** X

If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Area is dominated by invasive woody shrubs

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?			
Water Table Present?			
Saturation Present? (includes capillary fringe)			

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: T1-U

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1. *Rhamnus cathartica*	98	Yes	FAC
2. *Lonicera morrowii*	15	No	FACU
3.			
4.			
5.			
6.			
7.			
	113	=Total Cover	
Herb Stratum (Plot size:)			
1. *Alliaria petiolata*	20	Yes	FACU
2. *Geum canadense*	3	No	FAC
3. *Solidago rugosa*	3	No	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	26	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	104	x 3 =	312
FACU species	35	x 4 =	140
UPL species	0	x 5 =	0
Column Totals:	139 (A)		452 (B)

Prevalence Index = B/A = 3.25

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: T1-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	2.5Y 3/2	100						
5-16	2.5Y 4/3	100						
16-23	2.5Y 5/2	97	10YR 4/6	3	c	m		Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)

___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** X

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Kirvin Park City/County: Pittsfield / Berkshire Sampling Date: 8/9/22

Applicant/Owner: General Electric Company State: MA Sampling Point: T1-W

Investigator(s): S. Egan & T. Ramborger Section, Township, Range: ____

Landform (hillside, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR or MLRA): LRR R, MLRA 144B Lat: 42.424807 Long: -73.205549 Datum: WGS84

Soil Map Unit Name: Limerick Silt Loam NWI classification: PSS

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___ , Soil ___ , or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation X , Soil ___ , or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	**Is the Sampled Area within a Wetland?**	**Yes** X **No** ___
Hydric Soil Present?	Yes X No ___	If yes, optional Wetland Site ID:	___
Wetland Hydrology Present?	Yes X No ___		

Remarks: (Explain alternative procedures here or in a separate report.)
Vegetation is dominated by invasive plant species

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
X High Water Table (A2)	___ Aquatic Fauna (B13)	
X Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	X Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
X Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
X Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___ No X	Depth (inches):	
Water Table Present?	Yes X No ___	Depth (inches):	12
Saturation Present? (includes capillary fringe)	Yes X No ___	Depth (inches):	6

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: T1-W

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1. *Rhamnus cathartica*	98	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	98	=Total Cover	
Herb Stratum (Plot size:)			
1. *Alliaria petiolata*	15	Yes	FACU
2. *Geum canadense*	20	Yes	FAC
3. *Solidago rugosa*	5	No	FAC
4. *Impatiens capensis*	10	Yes	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	50	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	10	x 2 =	20
FAC species	123	x 3 =	369
FACU species	15	x 4 =	60
UPL species	0	x 5 =	0
Column Totals:	148 (A)		449 (B)

Prevalence Index = B/A = 3.03

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: T1-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 2/1	100						
5-14	10YR 5/1	97	10YR 4/6	3	C	PL		Prominent redox concentrations
14-22	10YR 5/1	94	2.5Y 5/6	6	C	M		Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- X Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ___

Depth (inches): ___

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Kirvin Park City/County: Pittsfield / Berkshire Sampling Date: 8/9/22

Applicant/Owner: General Electric Company State: MA Sampling Point: T2-U

Investigator(s): S. Egan & T. Ramborger Section, Township, Range: ____

Landform (hillside, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR or MLRA): LRR R, MLRA 144B Lat: 42.42450 Long: -73.20520 Datum: WGS84

Soil Map Unit Name: Hero Loam NWI classification: ____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___ , Soil ___ , or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation X , Soil ___ , or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No 0	**Is the Sampled Area within a Wetland?** **Yes** ___ **No** X
Hydric Soil Present?	Yes ___	No X	
Wetland Hydrology Present?	Yes ___	No X	If yes, optional Wetland Site ID: ____

Remarks: (Explain alternative procedures here or in a separate report.)
Area is dominated by invasive woody shrubs

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? **Yes** ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: T2-U

Tree Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer negundo*	10	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	10	=Total Cover	
Sapling/Shrub Stratum (Plot size: ______)			
1. *Rhamnus cathartica*	98	Yes	FAC
2. *Lonicera morrowii*	15	No	FACU
3.			
4.			
5.			
6.			
7.			
	113	=Total Cover	
Herb Stratum (Plot size: ______)			
1. *Alliaria petiolata*	20	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	20	=Total Cover	
Woody Vine Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	108	x 3 =	324
FACU species	35	x 4 =	140
UPL species	0	x 5 =	0
Column Totals:	143 (A)		464 (B)

Prevalence Index = B/A = 3.24

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: T2-U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 3/2	100					Loamy/Clayey	
5-13	10YR 4/2	100					Loamy/Clayey	
13-22	10YR 4/3	100					Sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** X

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Kirvin Park City/County: Pittsfield / Berkshire Sampling Date: 8/9/22

Applicant/Owner: General Electric Company State: MA Sampling Point: T2-W

Investigator(s): S. Egan & T. Ramborger Section, Township, Range: ____

Landform (hillside, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR or MLRA): LRR R, MLRA 144B Lat: 42.424521 Long: -73.205257 Datum: WGS84

Soil Map Unit Name: Limerick Silt Loam NWI classification: PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation X, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?**	**Yes** X **No** ____
Hydric Soil Present?	Yes X	No ____		
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID: ____	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ____ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ____ Water Marks (B1)
- ____ Sediment Deposits (B2)
- ____ Drift Deposits (B3)
- ____ Algal Mat or Crust (B4)
- ____ Iron Deposits (B5)
- ____ Inundation Visible on Aerial Imagery (B7)
- ____ Sparsely Vegetated Concave Surface (B8)
- ____ Water-Stained Leaves (B9)
- ____ Aquatic Fauna (B13)
- ____ Marl Deposits (B15)
- ____ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ____ Presence of Reduced Iron (C4)
- ____ Recent Iron Reduction in Tilled Soils (C6)
- ____ Thin Muck Surface (C7)
- ____ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ____ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ____ Moss Trim Lines (B16)
- ____ Dry-Season Water Table (C2)
- ____ Crayfish Burrows (C8)
- ____ Saturation Visible on Aerial Imagery (C9)
- ____ Stunted or Stressed Plants (D1)
- ____ Geomorphic Position (D2)
- ____ Shallow Aquitard (D3)
- X Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 8
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 0

Wetland Hydrology Present? Yes X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: T2-W

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	
Herb Stratum (Plot size:)			
1. *Alliaria petiolata*	15	No	FACU
2. *Geum canadense*	5	No	FAC
3. *Solidago canadensis*	63	Yes	FACU
4. *Impatiens capensis*	25	Yes	FACW
5. *Onoclea sensibilis*	25	Yes	FACW
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	133	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	50	x 2 =	100
FAC species	5	x 3 =	15
FACU species	78	x 4 =	312
UPL species	0	x 5 =	0
Column Totals:	133 (A)		427 (B)

Prevalence Index = B/A = 3.21

Hydrophytic Vegetation Indicators:

__ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
__ 3 - Prevalence Index is ≤3.0[1]
__ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** __

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: T2-W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/2	100					Loamy/Clayey	
4-14	10YR 4/2	96	10YR 4/6	3	C	M	Loamy/Clayey	Prominent redox concentrations
			7.5YR 4/4	3	C	PL		Distinct redox concentrations
14-22								coarse gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- X Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? **Yes** X **No** ___

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

Appendix H

Rare Species Information

H1: Rare Species Agency and Regulatory Documentation
H2: Summary Assessments of Potential Rare Species for the Site
H3: Wood Turtle Management Plan
H4: Wood Turtle Nesting Plan

Appendix H: Rare Species Information

This appendix consolidates and presents information on rare species habitat for the Kirvin Park Restoration Plan. The appendix consists of four separate appendices, as follows:

H1: Presents rare species agency and regulatory documentation associated with the site and the project, including consultations with the U.S. Fish and Wildlife Service's on-line Information, Planning, and Consultation System and with the Massachusetts Natural Heritage and Endangered Species Program (MNHESP).

H2: Presents summary assessments of potential rare species at the site.

H3: Presents a Wood Turtle Management Plan, which would be implemented before, during, and after construction, in the event that such activities occur outside the wood turtle inactive hibernation period, to minimize potential impacts to this state-listed species.

H4: Presents an updated assessment of creating two wood turtle nesting areas at the Kirvin Park Restoration Site.

Note that implementation of the Wood Turtle Management Plan in Appendix H3 remains subject to MNHESP direction, based upon the timing of the work and the use of machinery. Note also that the wood turtle nesting plan discussed in Appendix H4 is subject to additional review by MNHESP.

Appendix H1: Rare Species Regulatory Documentation

Consistent with standard practices, development of the Kirvin Park Restoration Plan has included consolidation, documentation, and assessment of potential rare species habitats at and in proximity to the project area. An objective of the restoration plan, in the context of improving and enhancing floodplain and wetland habitat conditions, is to support the habitat requirements of both federally listed and state-listed threatened, endangered, or special concern species which are known to occur or could potentially occur in the vicinity of the Park. These federal and state-listed species are referred to collectively as rare species.

The occurrence of any federally listed threatened or endangered species or its habitat at the Kirvin Park site has been identified based on the U.S. Fish and Wildlife Service (USFWS) on-line Information, Planning, and Consultation System (IPaC) (USFWS 2025). Specifically, the IPaC process was most recently conducted for the Kirvin Park restoration area on July 7, 2025. The occurrence of state-listed threatened, endangered, or special concern species and their Priority Habitats is based on established records available from, and communications with, the Massachusetts Natural Heritage Endangered Species Program (MNHESP) of the Massachusetts Division of Fisheries and Wildlife. The Priority Habitat of state-listed rare species (and Estimated Habitat of rare wetlands species) has been designated by MNHESP to run along both Sackett and Ashley Brooks and extend across much of the proposed restoration area. Accordingly, in September 2022, GE prepared and submitted on behalf of the City of Pittsfield (with its review and consent) a formal request for state-listed species information to MNHESP.[1]

As documented in the attached July 7, 2025 response from the USFWS, the 2025 IPaC consultation resulted in the identification of two species that are proposed for federal listing – the tricolored bat (*Perimyotis subflavus*), which has been proposed as endangered, and the monarch butterfly (*Danaus plexippus*), which has been proposed as threatened.[2]

As documented in the attached October 18, 2022 letter from MNHESP in response to GE's inquiry on the City's behalf, MNHESP stated that the project site, or a portion thereof, is located within Priority Habitat 1465 (PH 1465) and Estimated Habitat 1027 (EH 1027) for two state-listed rare species – the dion skipper (*Euphyes dion),* a threatened species of moth, and the wood turtle (*Glyptemys insculpta*), a special concern species of reptile. In a subsequent letter to AECOM, dated October 21, 2022 (also attached), which did not reference the October 18, 2022 response, MNHESP identified those same

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[1] A request was made to MNHESP on July 7, 2025 as to whether an updated request for state-listed species records is needed. A response from MNHESP has not yet been received.

[2] An earlier IPaC consultation, conducted on January 17, 2023, indicated that the Kirvin Park area potentially provided habitat for the northern long-eared bat (*Myotis septentrionalis*), a federally listed endangered species, as well as the monarch butterfly (which was then a candidate species for federal listing). The July 2025 IPaC consultation did not include the northern long-eared bat on the species list for Kirvin Park.

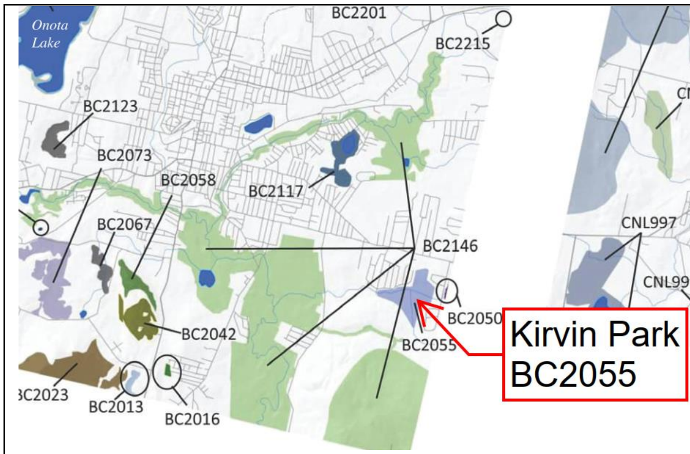
two species plus two others – the bridle shiner (*Notropis bifrenatus*), which is a fish species, and the ocellated darner (*Boyeria grafiana*), which is a dragonfly species (identified by MNHESP as a butterfly) – "in the vicinity of the site." MNHESP subsequently provided clarification on the two responses cited above in the form of an email dated January 27, 2023 (also attached). That email response clarified that the October 21, 2022 letter responded to the request "for species management/conservation purposes, and are not intended for use in MESA Project Review." Accordingly, for a typical MESA project (regulatory) review, only the dion skipper and wood turtle would be subject to MNHESP consideration. However, for completeness, GE has also considered the other two species in the Final Restoration Plan.[3]

The Trustees previously noted, in an email dated May 10, 2024, that, in addition to the species identified by MNHESP, other species may be in the overall vicinity of Kirvin Park, as listed in the Pittsfield BioMap2 report (MNHESP 2011); and they requested that GE conduct monitoring for those species as well. For several reasons, however, as explained in GE's September 13, 2024 Revised Conceptual Restoration Plan, the BioMap input does not warrant the consideration or monitoring of any additional species.

- First, the BioMap2 report lists species that may be present in the overall vicinity, not those that may be present specifically in the Kirvin Park area. In particular, the Kirvin Park area is shown in the 2011 BioMap2 report to be a part of the area designated as BC2055 (see map clip below; BC stands for BioMap Core).[4] The 107 acres of BC2055 that fall within Pittsfield include most of Kirvin Park; in lumping this BC in with several others, BioMap2 indicates they provide habitat for "various state-listed species," but it does not list these species.

[3] As noted above, a request was made to MNHESP on July 7, 2025 as to whether its October 2022 rare species response remains applicable for this project or whether an updated request for state-listed species records is needed. A response from MNHESP has not yet been received. GE will advise the Trustees when that response is received.

[4] In their May 10, 2024 email, the Trustees indicated that Kirvin Park is located in BioMap2 Area BC2146, which is a large area comprising over 7,000 acres, and includes much of the Housatonic River floodplain in Pittsfield (including the East Branch and West Branch of the Housatonic River). However, Kirvin Park is actually located in BC2055, which comprises 107 acres, most of which is part of Kirvin Park. The 2011 BioMap2 does not specifically list the state-listed species documented in BC2055, but indicates that this area, along with other BCs, provides habitat for various state-listed species.

<table>
<tr>
<td>
</td>
<td>Section of map from BioMap2 (2011) showing Kirvin Park locus with Area BC2055. No actual listing of potential state-listed species is provided in BioMap2 associated with BC2055.</td>
</tr>
</table>

- Second, the BioMap2 report referenced by the Trustees is a document generated in 2011, and is now superseded by an on-line version of the BioMap, which was initiated in 2022 (BioMap Hub (arcgis.com)). MassWildlife clarifies on-line that “the BioMap project data, and all associated GIS layers, were completely updated in 2022 and enhanced with a new set of local and regional components. This living project will be called BioMap moving forward and the elements and components are designed to replace the BioMap2 project data.” Accordingly, to follow the updated directive for BioMap consultation, the current on-line BioMap interactive procedure was run to assess the rare species information that may be generated from this updated process. The BioMap Summary Report (dated June 12, 2024) generated from the on-line procedure is also attached. The mapped area submitted for data generation includes 93 acres, covering most of Kirvin Park, and is similar in extent to the BC2055 area defined in BioMap2. As shown in the summary data for this area, only one rare species habitat is indicated to occur within the designated area. The actual species is not listed. However, given the corroborating information (including the MNHESP responses to the latest MESA project review requests), it is likely that the species noted in the updated BioMap summary is the wood turtle.
- Third, MassWildlife clarifies on-line that “BioMap is a non-regulatory conservation planning tool to plan and prioritize conservation actions. In contrast, Priority Habitat is a regulatory screening tool to allow the Natural Heritage and Endangered Species Program (NHESP) to review projects or activities for impacts to state-listed under the Massachusetts Endangered Species Act (MESA).” Thus, the MESA project review list of species (which includes only wood turtle and dion skipper) is the appropriate list of species to consider for assessing the project’s potential impacts on state-listed species.

For these reasons, as approved by the Trustees in their December 10, 2024 conditional approval letter for the Revised Conceptual Restoration Plan, there are no additional species to be considered based upon BioMap output.

Thus, based on the consultations and communications described above, the following rare species have been considered in the Final Restoration Plan:

- Tricolored bat (*Perimyotis subflavus* ;
- Monarch butterfly (*Danaus plexippus)*;
- Dion skipper (*Euphyes dion)*:
- Wood turtle (*Glyptemys insculpta*);
- Ocellated darner (*Boyeria grafiana*); and
- Bridle shiner (*Notropis bifrenatus*).

Brief descriptions of the six species listed above are included in Appendix H2, along with an assessment of whether proposed restoration activities at Kirvin Park would be expected to adversely affect such species, and where warranted, measures to be taken to protect the species.

MASSWILDLIFE

DIVISION OF
FISHERIES & WILDLIFE

1 Rabbit Hill Road, Westborough, MA 01581
p: (508) 389-6300 | f: (508) 389-7890
MASS.GOV/MASSWILDLIFE

October 18, 2022

Robert VanDerKar
City of Pittsfield
70 Allen St
Pittsfield MA 01201

RE: Project Location: Kirvin Park Wetland Restoration
Town: PITTSFIELD
NHESP Tracking No.: 17-37213

To Whom It May Concern:

Thank you for contacting the Natural Heritage and Endangered Species Program of the MA Division of Fisheries & Wildlife (the "Division") for information regarding state-listed rare species in the vicinity of the above referenced site. Based on the information provided, this project site, or a portion thereof, is located **within** *Priority Habitat 1465* (PH 1465) and *Estimated Habitat 1027* (EH 1027) as indicated in the *Massachusetts Natural Heritage Atlas* (15th Edition) for the following state-listed rare species:

Scientific name	Common Name	Taxonomic Group	State Status
Euphyes dion	Dion Skipper	Butterflies and Moths	Threatened
Glyptemys insculpta	Wood Turtle	Reptile	Special Concern

The species listed above are protected under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00). State-listed wildlife are also protected under the state's Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and its implementing regulations (310 CMR 10.00). Fact sheets for most state-listed rare species can be found on our website (www.mass.gov/nhesp).

This evaluation is based on the most recent information available in the Natural Heritage database, which is constantly being expanded and updated through ongoing research and inventory. If the purpose of your inquiry is to generate a species list to fulfill the federal Endangered Species Act (16 U.S.C. 1531 et seq.) information requirements for a permit, proposal, or authorization of any kind from a federal agency, we recommend that you contact the National Marine Fisheries Service at (978)281-9328 and use the U.S. Fish and Wildlife Service's Information for Planning and Conservation website (https://ecos.fws.gov/ipac). If you have any questions regarding this letter please contact Emily Holt, Endangered Species Review Assistant, at (508) 389-6385.

Sincerely,

Everose Schlüter

Everose Schlüter, Ph.D.
Assistant Director

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: 07/07/2025 16:06:50 UTC
Project Code: 2023-0034561
Project Name: Kirvin Park Floodplain and Wetland Restoration

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

Updated 4/12/2023 - Please review this letter each time you request an Official Species List, we will continue to update it with additional information and links to websites may change.

About Official Species Lists

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Federal and non-Federal project proponents have responsibilities under the Act to consider effects on listed species.

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested by returning to an existing project's page in IPaC.

Endangered Species Act Project Review

Please visit the "**New England Field Office Endangered Species Project Review and Consultation**" website for step-by-step instructions on how to consider effects on listed species and prepare and submit a project review package if necessary:

https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review

NOTE Please do not use the **Consultation Package Builder** tool in IPaC except in specific situations following coordination with our office. Please follow the project review guidance on our website instead and reference your **Project Code** in all correspondence.

Northern Long-eared Bat - (Updated 4/12/2023) The Service published a final rule to reclassify the northern long-eared bat (NLEB) as endangered on November 30, 2022. The final rule went into effect on March 31, 2023. You may utilize the **Northern Long-eared Bat Rangewide Determination Key** available in IPaC. More information about this Determination Key and the Interim Consultation Framework are available on the northern long-eared bat species page:

https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis

For projects that previously utilized the 4(d) Determination Key, the change in the species' status may trigger the need to re-initiate consultation for any actions that are not completed and for which the Federal action agency retains discretion once the new listing determination becomes effective. If your project was not completed by March 31, 2023, and may result in incidental take of NLEB, please reach out to our office at newengland@fws.gov to see if reinitiation is necessary.

Additional Info About Section 7 of the Act

Under section 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to determine whether projects may affect threatened and endangered species and/or designated critical habitat. If a Federal agency, or its non-Federal representative, determines that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Federal agency also may need to consider proposed species and proposed critical habitat in the consultation. 50 CFR 402.14(c)(1) specifies the information required for consultation under the Act regardless of the format of the evaluation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/service/section-7-consultations

In addition to consultation requirements under Section 7(a)(2) of the ESA, please note that under sections 7(a)(1) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Please contact NEFO if you would like more information.

Candidate species that appear on the enclosed species list have no current protections under the ESA. The species' occurrence on an official species list does not convey a requirement to consider impacts to this species as you would a proposed, threatened, or endangered species. The ESA does not provide for interagency consultations on candidate species under section 7, however, the Service recommends that all project proponents incorporate measures into projects to benefit candidate species and their habitats wherever possible.

Migratory Birds

In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see:

https://www.fws.gov/program/migratory-bird-permit

https://www.fws.gov/library/collections/bald-and-golden-eagle-management

Please feel free to contact us at **newengland@fws.gov** with your **Project Code** in the subject line if you need more information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat.

Attachment(s): Official Species List

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

PROJECT SUMMARY

Project Code: 2023-0034561
Project Name: Kirvin Park Floodplain and Wetland Restoration
Project Type: Restoration / Enhancement - Wetland
Project Description: Natural resources restoration/enhancement to include floodplain restoration via invasive species removal and native plantings.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@42.421807099999995,-73.20587119802474,14z

Counties: Berkshire County, Massachusetts

ENDANGERED SPECIES ACT SPECIES

There is a total of 2 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9743	Proposed Threatened

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

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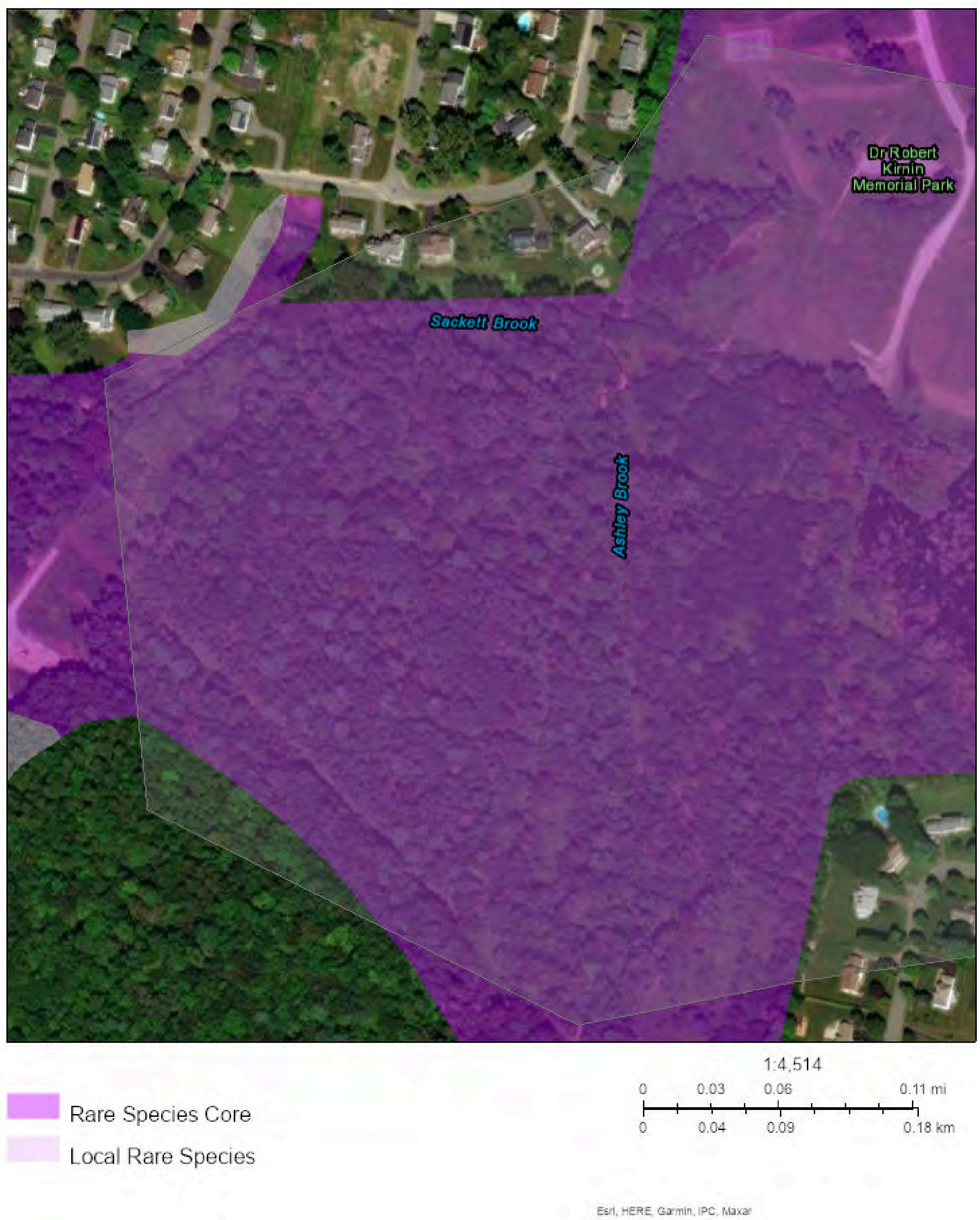
BioMap Summary Report

Area of Interest (AOI) Information

Area : 93.07 acres

Jun 12 2024 17:14:06 Eastern Daylight Time



Summary

Name	Count	Area(acres)	Length(ft)
Core Habitat	1	80.65	N/A
Critical Natural Landscape	1	66.85	N/A
Aquatic Core	2	44.11	N/A
Aquatic Core Buffer	1	21.60	N/A
Wetland Core	3	13.07	N/A
Wetland Core Buffer	2	21.25	N/A
Priority Natural Communities Core	0	0	N/A
Vernal Pool Core	0	0	N/A
Forest Core	0	0	N/A
Rare Species Core	1	80.51	N/A
Tern Foraging Habitat	0	0	N/A
Coastal Adaptation Areas	0	0	N/A
Landscape Blocks	0	0	N/A
Local Aquatic Habitats	0	0	N/A
Local Aquatic Habitats Buffer	0	0	N/A
Local Wetlands	1	1.88	N/A
Local Wetlands Buffer	0	0	N/A
Local Landscapes	0	0	N/A
Local Rare Species	1	0.06	N/A
Local Vernal Pools	0	0	N/A
Regional Rare Species	0	0	N/A
Regional Connectivity	0	0	N/A

Appendix H2: Assessment of Federal and State-Listed Rare Species

As described in Section 2.9.2 of the Final Restoration Design/Restoration Action Plan for Kirvin Park (Final Restoration Plan) and in Appendix H1, two species that have been proposed for federal listing (one of which is also state-listed) and two other state-listed species have been identified as potentially occurring at the Kirvin Park restoration/enhancement area. The two species that have been proposed for federal listing are the tricolored bat (*Perimyotis subflavus*), which has been proposed as endangered (and is also a state-listed endangered species), and the monarch butterfly (*Danaus plexippus*), which has been proposed as threatened. The two other state-listed species are the dion skipper (*Euphyes dion*), a state-listed threatened species of moth, the wood turtle (*Glyptemys insculpta*), a state-listed special concern species of reptile. In addition, two additional state-listed species have been indicated by the Massachusetts Natural Heritage and Endangered Species Program (MNHESP) to be considered for conservation management purposes within the project area. These are the ocellated darner (*Boyeria grafiana*) dragonfly, and the bridle shiner (*Notropis bifrenatus*) minnow.

The following text provides a brief description of each of these species and their habitat requirements in relation to the habitats in and around Kirvin Park, and an assessment of whether proposed restoration activities at Kirvin Park would be expected to adversely affect such species, and where warranted, measures to be taken to protect the species. The results of the latter assessment are summarized in Section 2.9.3 of the Final Restoration Plan. These assessments include the results of surveys conducted by AECOM in 2024 for each species (except for the tricolored bat, which was not identified until July 2025) in accordance with requests by the natural resource trustees (Trustees) for such surveys.

Tricolored Bat

The tricolored bat is a wide-ranging bat species that is state-listed as endangered and proposed for federal listing. This species typically overwinters in caves or mines and spends the remainder of the year in forested habitats (MNHESP 2025). This species has been severely impacted by white-nose syndrome, a disease which has spread rapidly throughout the species' range in the United States, causing declines in populations sizes by 97 to 100% across the species' range. During the warmer months, tricolored bats occupy day and night roosts in forest vegetation in the canopy, most typically in dead leaves on mature live or recently dead deciduous trees. Maternity colonies, where females rear young, are commonly found among the dead needles of living pines. Colonies and roost sites are also occasionally situated in barns, out buildings, and other man-made structures, as well as in caves. Tricolored bats forage at the treetop level, in partly open country with large trees, over water courses, and at forest-field edges. They avoid deep woods and open fields. In winter, tricolored bats hibernate in limestone caves and abandoned mines. Winter hibernacula (hibernation sites) have been reported in Berkshire, Franklin, and Hampden counties (MNHESP 2025).

A common approach to addressing potential effects to tricolored bats is to implement time-of-year restrictions on tree cutting in order to avoid the adult roosting and pup-rearing time periods of this species (June and July). However, the present restoration plan for Kirvin Park does not propose to cut any mature native trees which might provide habitat for the tricolored bat. In fact, any large-diameter live trees with cavities or loose bark or standing dead trees that are found within the limits of the restoration area and may provide summer roosting habitats for this species will be specifically targeted and marked in the field for preservation as wildlife habitat. The buckthorn/honeysuckle-dominated thickets that are proposed for removal under the restoration plan do not provide desirable habitat for tricolored bats. In the unlikely event that that any tree removals would need to occur under the restoration plan, such cutting would not be conducted in June or July.

Monarch Butterfly

The monarch butterfly inhabits a variety of terrestrial and wetland habitats but is most known for the long-range migrations to overwintering sites in Mexico conducted by populations east of the Rocky Mountains. They can live for an extended period of time (six to nine months) and can travel distances of over 3,000 kilometers (USFWS 2023a).

During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily *Asclepias spp.*), and larvae emerge after two to five days feeding on milkweed leaves. Monarchs can bread throughout the season, with adults emerging late in the season making the migrations south to Mexico (USFWS 2023a).

The primary driver affecting migratory populations in the Northeast are changes in breeding, migratory, and overwintering habitat due to conversion of grasslands to agriculture, urban development, and widespread use of herbicides (USFWS 2023b).

At the Kirvin Park restoration/enhancement area, old field/grassland habitats are not present within the limits of work and the plant used for egg deposition and larval feeding by monarch butterflies (milkweed) was not observed. However, for seeding at the Kirvin Park site, particularly at the planned pollinator habitat area, GE has selected native seed mixtures that include both common milkweed and swamp milkweed, which should benefit potential breeding populations of monarchs in the regions. A complete list of species included in the seed mixes is provided on Figure 6-4 in the Final Restoration Plan. It is anticipated that conditions in the restoration area, particularly the pollinator meadow area, will be substantially improved as potential habitat for monarch butterflies after construction.

Dion Skipper

The dion skipper is a small butterfly that inhabits sedge wetlands, including calcareous fens, riparian marshes, wet meadows and shrub swamps. Adult butterflies collect nectar in infrequently mowed fields near wetlands (MNHESP 2015a). Adults feed in July and collect nectar on flowers such as swamp and common milkweed (*Asclepias incarnata* and *A. syriaca*) and blue flag iris (*Iris versicolor*). Larvae feed on sedges (*Carex spp.*) in wetlands, overwintering and pupating the following June.

As requested by the Trustees, GE conducted additional field reviews in the proposed restoration area (and adjacent open habitats) during the adult feeding period (July into August) in 2024. Based upon field inventories conducted to date, no areas within the currently proposed limits of restoration/enhancement activities at Kirvin Park provide preferred habitats for the dion skipper (either feeding or collecting nectar by adult butterflies or larvae feeding). While potential habitat (i.e., open sedge meadows) may occur to the east of the restoration area (within the beaver-impounded wetland where sedge growth has developed), the invasive species that dominate the restoration area have little potential to support activities of the dion skipper, Wetland scientist monitoring before and during construction will include surveys for dion skipper presence, especially along the eastern side of the construction area, and construction activities will be directed to avoid any area where this species is observed.

Further, GE has selected seed mixes for site restoration within wetland creation areas and restored floodplains that include flowering plants and sedges that will benefit both the larval and flight periods of this species. A complete list of species included in the seed mixes is provided on Figure 6-4 in the Final Restoration Plan. It is anticipated that conditions in the restoration area, particularly the wetland portion, will be substantially improved as potential habitat for dion skipper after construction.

Wood Turtle

The wood turtle is a medium-sized turtle that inhabits a variety of streams, wetland, floodplains, and other terrestrial habitats during the course of its annual life cycle (MNHESP 2015b). Slower moving mid-sized streams with sandy bottoms and heavily vegetated stream banks are preferred by this species for overwintering, where they hibernate in muddy banks, in-stream log jams/woody debris piles, or sitting on the bottom. Full-time submersion in the water typically begins in early November and continues through spring. In Massachusetts, the active period for the wood turtle is generally considered to be April 1 through October 31 of each year. During this period, they can be found in terrestrial habitats, including open fields, forested uplands, and floodplains, usually within a few hundred meters of the stream banks.

Both Sackett and Ashley Brooks provide excellent habitat for wood turtles, and this species has been documented to occur along Sackett Brook just downstream of the Kirvin Restoration Plan area. During a prior wetland creation project in 2018, AECOM observed wood turtles along the northern side of Sackett Brook across from the northwestern corner of the currently proposed restoration area. A wood turtle was also observed in the wetland creation area on August 8, 2024, roughly 200 feet north of the brook in a wet meadow area. However, field surveys on May 22 and June 24, 2024 did not encounter any wood turtles. These surveys encompassed the entire proposed restoration area, and also extended upstream in Sackett Brook to the eastern limit of Kirvin Park, and also downstream in Sackett Brook to the transmission line right-of-way (roughly 1,000 feet downstream of the proposed restoration area). These surveys were also intended to assess the potential for suitable nesting sites along the brook and within a few hundred feet of the brook. No such nesting sites were confirmed, although some suitable locations for nesting were noted.

GE has prepared a Wood Turtle Management Plan (included as Appendix H3) designed to protect wood turtles during construction activities at Kirvin Park in the event that such activities occur outside of the wood turtles' non-active period of November through March. The plan outlines responsibilities of participating parties, pre-construction activities to minimize the potential for wood turtles to be present in construction areas, requirements for work in active and inactive wood turtle seasons, monitoring for wood turtles during construction, qualification requirements for overseeing herpetologists and biologists, training guidance for construction personnel, and reporting and documentation requirements. This plan has been submitted to MNHESP, and was discussed with the MNHESP's State Herpetologist (Michael Jones) on March 11, 2025. On March 13, 2025, Mr. Jones indicated that "the timing of all machine work (mowers, tractors, brushhog, backhoe, trucks, etc) must be conducted during the off-season (Nov to Mar) in order to result in some benefit to wood turtle, rather than harm." Consistent with that recommendation, the current schedule for on-site construction work is set to occur between November 1, 2025 and April 1, 2026. However, in case such work extends into the wood turtle's active period, GE has asked NHESP for further discussion of whether the management plan is sufficient to protect wood turtles during potential construction during that period. Further discussion with MNHESP is anticipated to confirm an acceptable schedule and approach.

In addition, on March 11, 2025, GE reviewed with Mr. Jones the potential for adding the creation of wood turtle nesting habitat to the restoration plan, as requested by the Trustees and outlined in the 2024 Revised Conceptual Restoration Plan. On March 13, 2025, Mr, Jones noted that MNHESP "did not see any significant concerns with the proposal for wood turtle nesting habitat creation at Kirvin Park," but that more review would be necessary. Mr. Jones added that MNHESP "sees value in the general concept," but "that replicated (multiple) nesting features are more likely to provide habitat value than a single feature at the confluence." Based on this input, the Final Restoration Plan includes plans to create two wood turtle nesting areas at the Kirvin Park restoration/enhancement site. These wood turtle nesting areas are discussed further in Appendix H4.

Ocellated Darner

The large ocellated darner is an insect member of the dragonflies (Order Odonata, Suborder Anisoptera) in the Aeshnidae family known as the darners. The ocellated darner is a species of special concern under MESA (MNHESP 2015c). The darners are characterized by being one of the largest dragonflies, 2.4 to 2.6 inches long with an average wingspan approximately 3.4 inches, and by its unusually large eyes positioned to wrap around the head to meet along a seam on top of the head. The ocellated darner has an overall dull brown coloration with distinguishing markings of yellow or greenish spots on the sides of the thorax, green or greenish-yellow stripes on the top of the thorax, and small dull green to yellow lateral markings on the abdomen. Brighter markings that are more distinct are typical of the male, otherwise appearance is similar to the female. The ocellated darner is one of two spotted darner species in North America, both distinguished by the two pale spots on the sides of the thorax from the other groups of darners.

Limited information exists on the life history of the ocellated darner; however, published information of the closely related fawn darner species is presumed representative of a similar life history and relied on to supplement the knowledge of the ocellated darner.

Two distinct stages complete the life cycle of the dragonfly after the egg hatches known as the larval or nymph aquatic and adult flying stages. It is known to inhabit clear, shallow, swift-flowing streams and large, rocky, poorly vegetated lakes. In Massachusetts, it has been observed only in shaded, clear, cold, rocky streams and rivers. Most of the ocellated darner nymph cycle is spent hanging upsidedown, clinging under rocks and sunken sticks. The nymphs are voracious and typically dominant predators of their aquatic habitats.

Although the time required for the ocellated darner nymph to fully develop to the final step of emergence or eclosion from the nymphal exoskeleton (excuviae) to become a free-flying adult is unknown, other species in the family comparatively are known to take one to four years to develop. In preparation for the eclosion, the nymph of the ocellated darner crawls out of the water onto exposed rocks, emergent vegetation or onto bank vegetation to find a secure perch where the new adult emerges from the exuviae in a very soft form (teneral dragonfly), vulnerable to damage by rain showers, falling debris, or predators. As soon as its wings are dry and strong enough, the ocellated darner adult flies to nearby upland areas to find shelter where it can continue to mature. It often inhabits upland woodland with mixed coniferous and deciduous trees. During maturation, ocellated darner adults feed on aerial insects captured in flight with the grasping aid of spines on their legs. When resting in the adjacent woodland, the adults hang vertically from the woodland vegetation. Being crepuscular, ocellated darner activity peaks late in the day, often flying well after sunset, unlike most Odonates. Unlike many darners, they rarely leave their water habitat, and also do not partake in feeding swarms characteristic of most species in the family. ocellated darners prefer shady areas and are often observed active on overcast days. With completion of the maturation process, the males return to the stream to breed.

The ocellated darner has a late flight season from mid-July to mid-October with most records occurring from August to mid-September. The flight of the male ocellated darner is swift and very erratic as it patrols the irregular shoreline, circling emerged rocks and vegetation to search for potential mates. In Massachusetts, males have been observed patrolling early in the morning. Females return to the stream only briefly when they are ready to mate and lay eggs. After mating, females in Massachusetts have been observed flying along rivers, dipping their abdomens into the water and into the mud along riverbanks, presumably releasing eggs from the long, thin ovipositor characteristic of darners. ocellated darner females further use the ovipositor to slice into emergent vegetation and rotting, submerged logs where they also lay eggs. Once the eggs develop over an unknown length of time, the eggs hatch, and the nymphs re-initiate the life cycle.

Based upon the habitat characteristics and life cycle of the ocellated darner described above, both Ashley and Sackett Brooks appear to offer suitable habitat for aquatic stages of this species. However, the current schedule for on-site construction work would not involve such work during this species' flight season. Moreover, even if it did, the nearby woodland habitats which ocellated darner requires for maturation appear marginal at best and even incompatible with the described preferred habitats. The dominance of common buckthorn over much of the woodland habitat of the restoration area is a particularly negative feature in this respect. However, the woodland along the southern side of Sackett Brook downstream of the restoration area contains more mature deciduous trees with some mixed conifers in the near-shore buffer zone along the brook, and this may provide better habitat for ocellated darner maturation. GE conducted additional habitat surveys for this species in 2024 during the primary flight season (mid-July to September) to assess the potential presence of this species and did not observe any such darners. In any case, given the current schedule for on-site construction work, as well as the facts that the project will not entail any direct alteration of the in-stream habitats which provide suitable aquatic conditions for the ocellated darner and that the floodplain habitats where restoration activities will occur are not preferred habitat for the adults of this species, the project is not expected to affect this species and may even offer some long-term benefit due to the removal of buckthorn and replacement by native floodplain tree species.

Bridle Shiner

The bridle shiner is a small minnow (< 50 millimeters) that is straw-colored with a distinct dark lateral band that starts at the tip of the snout and ends in a spot at the base of the caudal fin. This minnow is found in clear water in slack areas of streams and rivers and is also found in lakes and ponds. Bridle shiners are associated with moderate levels of submerged aquatic vegetation (SAV) with open areas where they can school. They seem to prefer sites with high coverage of SAV along the bottom 25 centimeters. In addition, sites with bridle shiners tend to have more aquatic vegetation with feather-like leaves such as *Ceratophyllum* (MNHESP 2015d).

The bridle shiner matures at a year and lives for only about two years. Spawning occurs during the day from late May to the end of July but may occur as late as August. Spawning sites are generally located in water depths of 0.6 meter in clearings surrounded by dense submerged vegetation, such as *Myriophyllum* or *Chara*. Eggs sink and adhere to vegetation. Young-of-the-year remain in vegetation until late July when they begin to school with other young-of-the-year bridle shiners, and by August they join adult schools. Bridle shiners are visual predators and feed only during the day. They feed in the water column or around aquatic vegetation, although before aquatic vegetation has started growing in the spring, they feed at the bottom. Their diet mainly consists of invertebrates, such as Chironomidae, Cladocera and Copepoda. Bridle shiners are not good swimmers and are ideal prey for pickerel, bass, and perch species.

Habitat alterations due to turbidity, flow alterations, draining of ponds, and exotic species are major threats to bridle shiners. Bridle shiners are visual feeders and turbidity will decrease their feeding efficiency. Bridle shiners are also poor swimmers and as such changes in flows can negatively impact their habitats. When exotic plants dominate plants dominate and form monocultures, this changes the bridle shiner's preferred habitat to vegetation with open areas.

Given the habitat considerations described above, while some elements of the aquatic habitat in Sackett Brook are consistent with bridle shiner requirements, the key element that is lacking is the presence of appreciable amounts of SAV. Very little SAV is present in either Sackett Brook or Ashley Brook. Further, the high flashy flows that both of these brooks experience appears to be a constraint to the use of these streams by bridle shiner. Further, no in-stream work directly within potential bridle shiner habitat will be conducted, and erosion/sediment control measures will be implemented to minimize indirect impacts. Thus, the Kirvin Park restoration project is very unlikely to adversely affect bridle shiners.

References

MNHESP (Massachusetts Natural Heritage and Endangered Species Program), 2015a. Dion Skipper (*Euphyes dion*) Fact Sheet.

MNHESP, 2015b. Wood Turtle (*Glyptemys insculpta*) Fact Sheet.

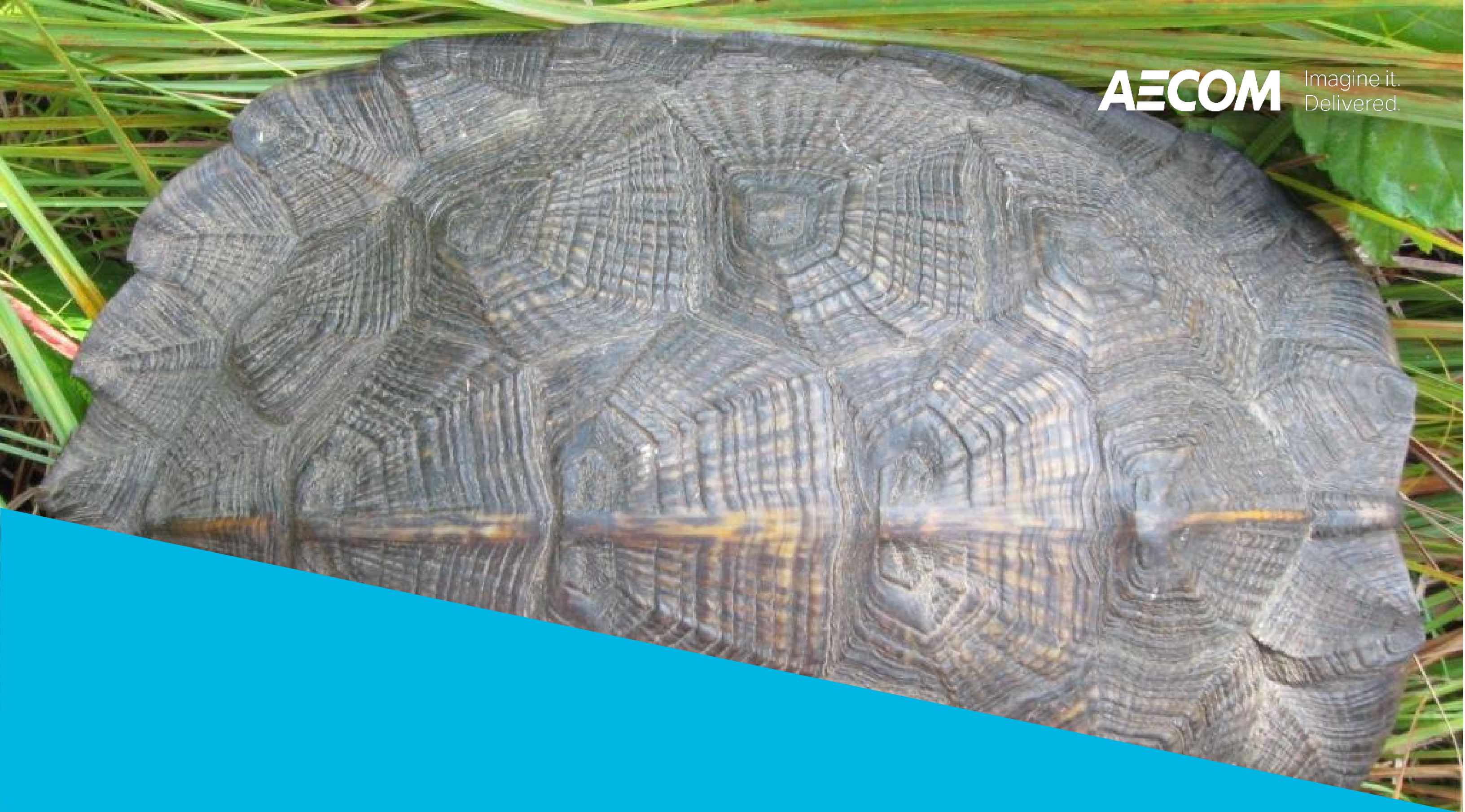
MNHESP, 2015c. Ocellated Darner (*Boyeria grafiana*) Fact Sheet.

MNHESP, 2015d. Bridle Shiner (*Notropis bifrenatus*) Fact Sheet.

MNHESP, 2025. Tricolored Bat. https://www.mass.gov/info-details/tricolored-bat. [Accessed 7/10/2025].

USFWS. 2023a. Monarch butterfly. Available URL: https://ecos.fws.gov/ecp/species/9743. [Accessed 1/30/23).

USFWS. 2023b. Monarch butterfly species status assessment (SSA) report. Available URL: https://www.fws.gov/initiative/pollinators/monarchs. [Accessed 1/30/23).



Appendix H3

Wood Turtle Management Plan

Kirvin Park Floodplain and Wetland Restoration Project

General Electric Company
Pittsfield, MA

Revised July 2025

Prepared for:

General Electric Company

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1. Introduction

On behalf of the General Electric Company (GE), AECOM has prepared this Wood Turtle Management Plan in support of the floodplain and wetland restoration/enhancement project that is planned to be implemented at the Kirvin Memorial Park in Pittsfield, MA (**Figure 1**). Specifically, the project site is located south of Sackett Brook and between Ashley Brook to the west and residential neighborhoods along Mountain Drive and Glory Drive to the east. The total project area consists of approximately 13 acres of wetland creation/enhancement and floodplain/riparian zone restoration/enhancement, supplemented by a smaller (two-acre) supplemental tree planting area north of Sackett Brook and further east of Ashley Brook and a two-acre staging area, to be converted into a pollinator meadow habitat, south of the main floodplain restoration area.

According to correspondence dated October 18, 2022 from the Massachusetts Natural Heritage and Endangered Species Program (MNHESP), the site is located within mapped priority habitat for the wood turtle (*Glyptemys insculpta*), which is a state-listed species of special concern. For any work occurring within the habitat of this species during the active season (i.e., between April 1 and October 31), a turtle protection plan needs to be developed and implemented by a qualified biologist. The current schedule for on-site construction work for this project is set to occur between November 1, 2025 and April 1, 2026, during the wood turtles' inactive period. However, given the potential for such work to occur after April 1, AECOM has developed this management plan.

This plan focuses specifically on measures designed to protect state-listed wood turtles during implementation of the project (if conducted during the wood turtles' active period) and includes the following elements:

- Responsibilities of participating parties including the project general contractor, on-site professional project engineers, and construction field personnel, and required qualifications and training for staff performing wood turtle oversight monitoring and surveys.
- Scope of work and schedule for wood turtle monitoring and protection during pre-construction and construction phases, including methods for clearing construction zones and capturing and handling wood turtles, if necessary.
- Guidelines for training field and construction personnel to recognize and relocate (as needed) wood turtles that may be at immediate risk of harm (e.g., within construction zones).
- Reporting and documentation requirements.

The goal of this plan is to clearly outline and effectively communicate the protection measures necessary to avoid and/or minimize the potential for direct impacts to individual wood turtles and their habitats during project implementation. This plan is subject to additional review by MNHESP.

2. Methods and Responsibilities

For implementation of this management plan, a person will be identified as the "Designated Herpetologist" (DH). The DH will develop Standard Operating Procedures (SOPs) for the handling of wood turtles during implementation of this project. In addition, the DH will confer and coordinate with MNHESP to reach concurrence on this management plan and the SOPs for any handling of wood turtles that may be necessary before or during construction.

During implementation of the project, the DH will maintain regular contact with project general contractor, construction representative, and/or other person(s) responsible for construction oversight (e.g., site supervisor) to ensure that this management plan is being implemented appropriately.

3. Pre-Construction Activities

The pre-construction activities outlined in this section are designed to minimize the potential for wood turtles to be present in the construction areas. Pre-construction tasks include installation of turtle exclusion barriers around the limits-of-work, surveys within the designated project area and along the access route, and active re-location of wood turtles from the construction site, as needed.

Installation of Turtle Exclusion Barriers

If construction work is planned for times outside of the wood turtle inactive period of November 1 through March 31, and if consistent with final direction from MNHESP, turtle exclusion barriers will be installed around the restoration/enhancement area in Kirvin Park (including the south staging area) to isolate areas of concentrated activity and machinery operation from surrounding habitats.[1] **Figure 2** shows the potential layout of exclusion barriers for the site (again, depending on the project schedule and direction from MNHESP). The layout of the exclusion barriers is expected to be the same as the erosion control/limit of work barrier established around the project area (except for the access route, north staging area, and the supplementary tree planting area). The turtle exclusion barriers will consist of a continuous silt fence or a similar barrier. In order to accommodate variability in site-specific conditions, two options for a properly installed turtle exclusion barrier are provided below.

Option 1 (depicted on **Figure 3**) involves the removal of vegetation and woody debris from the ground surface in a 4- to 6-foot wide path around the entire limits-of-work and excavation of a narrow trench at least six inches deep, into which several inches of fencing will placed in the trench bottom followed by backfilling, with support stakes driven 1-2 feet into the ground.

Option 2 (also depicted on **Figure 3**) may be implemented as an alternative to trenching when conditions such as frozen ground, presence of bedrock, or other obstacles make trenching

[1] MNHESP has indicated that limiting machine-based construction work to the period between November 1 and April 1 (the wood turtle non-active or hibernation period) is preferable to using exclusion barriers during the wood turtle active period (April 1 through October). Discussions are continuing with MNHESP regarding whether the management measures described in this plan could allow for certain construction work to occur during the active period.

difficult, or if avoiding ground disturbance in sensitive areas is deemed necessary. With this option, the tail of the silt fence can be pinched/weighted to the ground using coir fiber rolls or silt-socks full of chips or other organic debris (e.g., some vendors use inert materials such as ground up construction debris that are free of weeds, seeds and disease). A minimum six-inch tail of silt fence will be left on the ground surface and weighted down with a minimum eight-inch diameter sock, and wooden stakes will be installed every 10-20 feet as needed, according to the contractor's discretion.

It is imperative that the exclusion fence be either toed into the ground at least six inches or sufficiently pinched to the ground surface with weighted coir fiber rolls so that wood turtles cannot pass beneath the fencing.

With either option, mowing machinery will be used to clear a path along the proposed limits-of-work. Should the need arise to install straw bales as an additional erosion control measure, they will be placed on the work-side of the exclusion barrier to prevent turtles from climbing the bales and potentially entering the work area.

A movable gate will be placed at the project area entrance and will serve as the exclusion fencing for the entrance. This gate will be closed every night in order to prevent turtles from entering the work zone during the active season. The exact design of the moveable gate is at the discretion of the contractor but must be approved by the DH.

Immediately following exclusion barrier installation, and prior to commencement of pre-construction turtle surveys, a full-length perimeter check of the exclusion barrier will be conducted by the DH or approved delegate to ensure there are no gaps or other potential sources of wood turtle access into the construction zone. No construction-related activities (other than travel along the approved access route) will occur outside of these established work limits without direct oversight by the DH and/or approved delegate.

Requirements for Active Season (April 1 through October 31) Site Preparation

Vegetation removal (mowing) and exclusion barrier installation, as described above, will be performed under direct oversight of the DH or approved delegate. Surveys will be conducted in advance of the exclusion barrier to clear the work area of any wood turtles.

After the installation of the exclusion barrier and prior to commencement of construction-related activities within the confines of the exclusion barrier, wood turtle surveys will be conducted by biologists with demonstrated experience in finding turtles. If available, a canine assistant will be deployed to increase the effectiveness of surveys and better ensure the species' conservation. Canine-assisted surveys have been shown to greatly increase capture rates of turtles. Canines specially trained in the detection and capture of wood turtles have been demonstrated to be 5-10 times more efficient at finding turtles than their human counterparts.

The DH and/or approved delegate will work directly with the site contractor to schedule vegetation clearing and exclusion fence installation activities and will authorize the commencement of work within the construction zones once these activities are complete.

Any wood turtles captured during the pre-construction survey period will be photo-documented, measured and weighed, and then released into appropriate habitats away from active work areas at the discretion of the DH or approved delegate.

Requirements for Inactive Season (November 1 through March 31) Site Preparation

Wood turtles typically spend the winter within flowing rivers and perennial streams. Full-time submersion in the water typically begins in early November and continues through spring (NHESP, 2015, Wood Turtle [*Glyptemys insculpta*] fact sheet). This means that chance encounters with this species during the inactive season in terrestrial habitats, including open fields, forested uplands, and floodplains, is extremely unlikely to occur. Therefore, if installation of the turtle exclusion barriers can be completed during this period and prior to April 1, then oversight by the DH or approved delegate as described above will not be required. Likewise, the search effort for turtles within the confines of the exclusion barrier will be minimized.

In such a case, however, the DH or approved delegate will conduct an inspection of the stream bank and substrates at the stream crossing location to ensure that no turtles or habitat conditions suitable for overwintering turtles (e.g., undercut banks, root wads, log jams, or deep muddy substrates) are present.

4. Construction Period Monitoring

For any machine-based construction work during the turtles' active season, the DH and/or approved delegate will conduct weekly inspections of the turtle exclusion fencing from the start to end of construction.. Such weekly inspections will be conducted until the project construction is complete.

During that construction period:

- Exclusion barriers will be maintained in good condition by the contractor and repaired as necessary. A surplus of materials needed to repair the exclusion barriers (i.e., additional siltation fencing and stakes, coir fiber rolls, or silt socks, etc.) will be maintained on-site and be accessible to all persons.
- A full-length check of the exclusion barrier will be conducted by the DH or approved delegate once per week between April 1 and October 31, as well as following any large storm events which could potentially damage the barrier (e.g., by causing wind-thrown trees or branches to be deposited onto the barrier). If a wood turtle encounter occurs within the work limits, a full-length perimeter evaluation of the barrier will be conducted by the DH within 24 hours. Any observed damage to the exclusion barrier will be immediately repaired.
- If project work continues after October 31 in any year, the DH and/or approved delegate will conduct a review of the barrier prior to April 1 in the following year.
- Any wood turtles encountered during barrier inspection procedures will be handled and cared for in accordance with project SOPs and this management plan.
- Wood turtles encountered along the fence line will be relocated away from the work limits and placed within nearby, appropriate habitat.
- Any harmed or killed wood observed by the DH, approved delegate, site contractor, or other on-site personnel will be reported to the MNHESP within 24 hours of the observation. The

DH will identify the cause (if possible) and work with the site contractor and MNHESP to develop additional protection measures, if warranted.

- Injured turtles will be brought to Tufts Wildlife Clinic at 50 Willard Street, in North Grafton, MA (Phone: 508-839-7918) or other MAHESP-approved wildlife rehabilitation facility.
- All exclusion barriers will be removed as soon as construction is complete and/or site stabilization has occurred. The site contractor will be responsible for barrier-fence removal.

5. Contractor Education

To further ensure the protection of wood turtles, field and construction personnel (including the project general contractor, on-site professional project engineers, and construction field personnel) will be trained to recognize and capture wood turtles (if necessary) and will be informed of conservation practices to avoid or minimize the potential for the loss of individual wood turtles. This will include discussion of protective measures to be followed during access to and from the project area (e.g., driving slowly, scanning for turtles from the vehicle and if necessary, by foot in advance of the vehicle) by the contractors.

Training will be provided prior to installation of the barrier fence, and prior to commencement of construction activities within the project work limits. Additional training for each new individual construction contractor or crew that will be performing work within turtle habitat will also be provided by the DH or approved delegate.

A document with detailed procedures on what to do in the event of a turtle observation by the contractor, and representative photographs of turtles for identification purposes is included in **Exhibit A** and will be provided to the contractor/site supervisor. (The names and contact information for three qualified biologists will be added to this document before it is distributed.)

6. Qualifications and Training

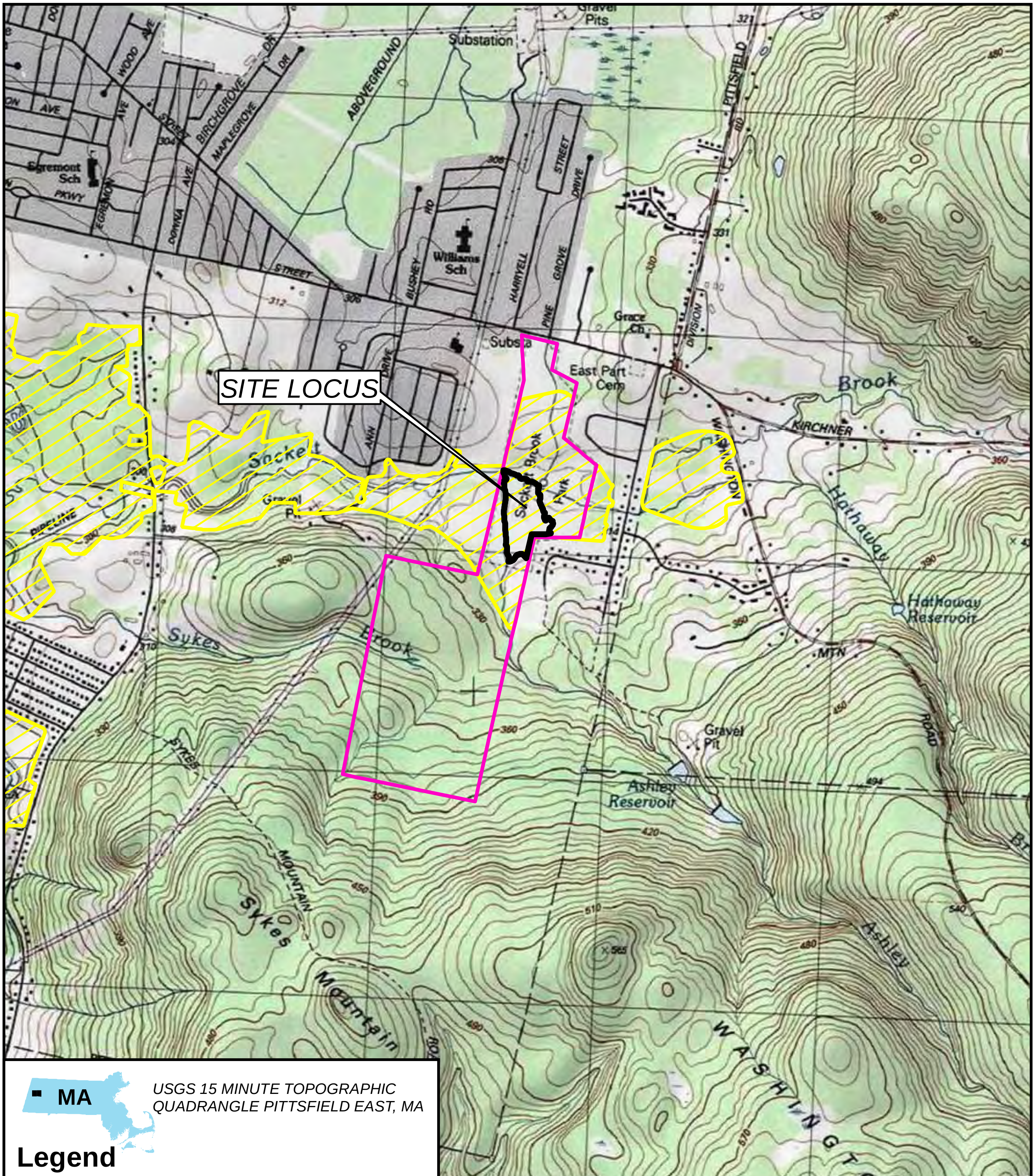
The DH must have, at a minimum, a master's degree in biology or similar natural resources science degree, and five years of experience working with state-listed turtle species. If applicable, the canine handler must have a minimum of five years of experience surveying for state-listed turtles and working with a canine assistant.

Staff biologists conducting barrier fence inspections and relocation of wood turtles outside of the turtle exclusion barrier during the construction period will have a minimum of a bachelor's degree in biology or similar natural resources science degree and/or will receive adequate training from the DH.

7. Reporting

Within 24 hours of the completion of each barrier inspection (i.e., at least once per week), a construction oversight report (**Figure 4**) will be completed by the DH or approved delegate. Any matters requiring immediate attention (e.g., activities outside of designated work zones, breaches in turtle barrier, etc.) will be immediately addressed with the site contractor.

Within 30 days of the completion of the project, a summary report will be prepared by the DH specifying the date of the pre-work search, the number of hours searched, and results of the survey effort (i.e., how many turtles were found and where) and containing post-construction photographs. This report will be included as part of a final report on the overall Kirvin Park restoration/enhancement project.



MA

USGS 15 MINUTE TOPOGRAPHIC QUADRANGLE PITTSFIELD EAST, MA

Legend

- Kirvin Park Property Boundary
- Limits of Restoration/Enhancement Areas
- NHESP Priority Habitats (2021)

0 1,000 2,000 4,000 *Feet*

N

SITE LOCUS and NHESP PRIORITY HABITATS

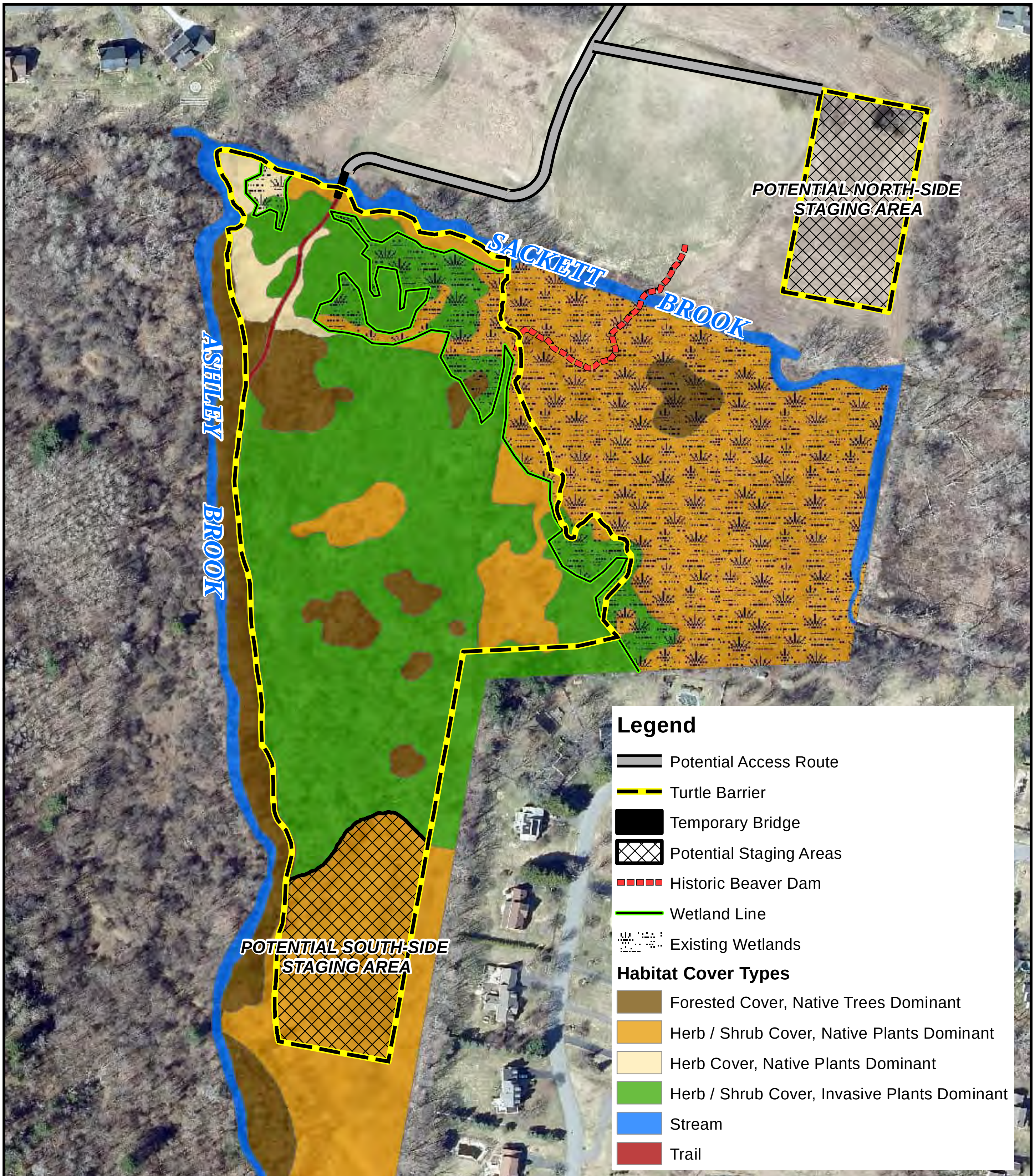
Construction Period Monitoring and Protection Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
1:24,000	1/26/2023	04191406

AECOM

Figure Number

1



Note: The need for wood turtle protection measures and the exclusion barrier locations/layout for the access routes and staging areas will be determined during final plan development; layout shown here is only to show the intent of coverage.

0 100 200 400 Feet

N

Turtle Exclusion Barrier

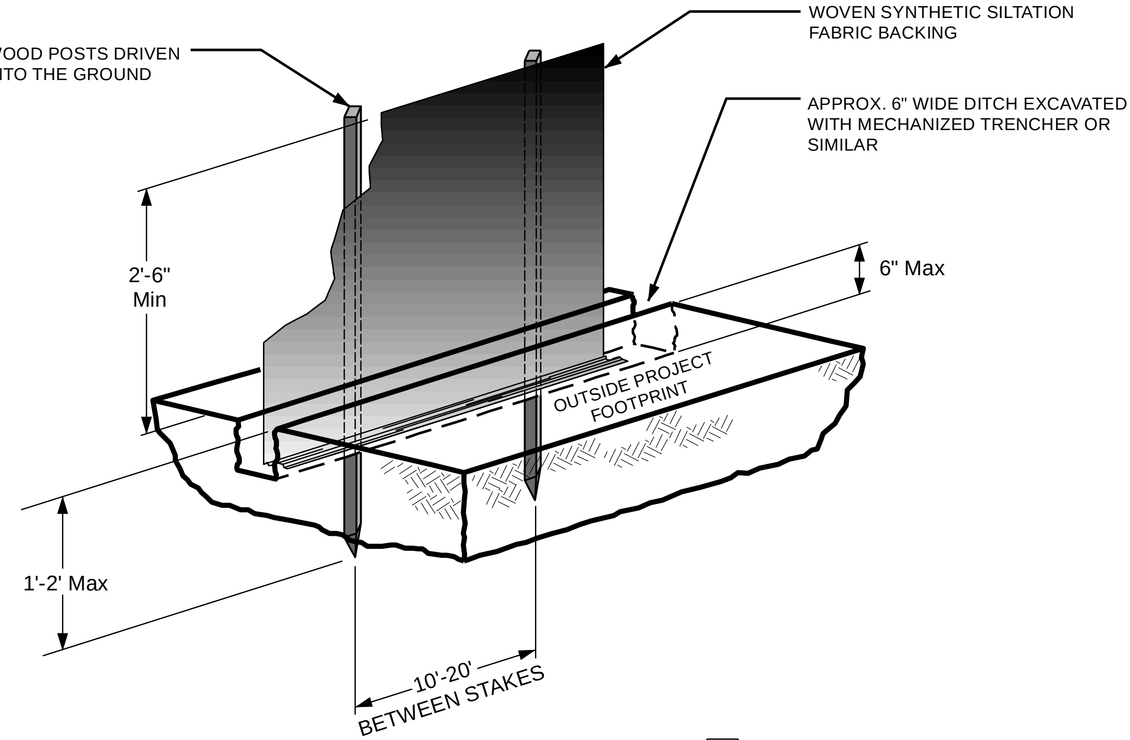
Construction Period Monitoring and Protection Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
1:2,400	1/30/2023	04191406

AECOM

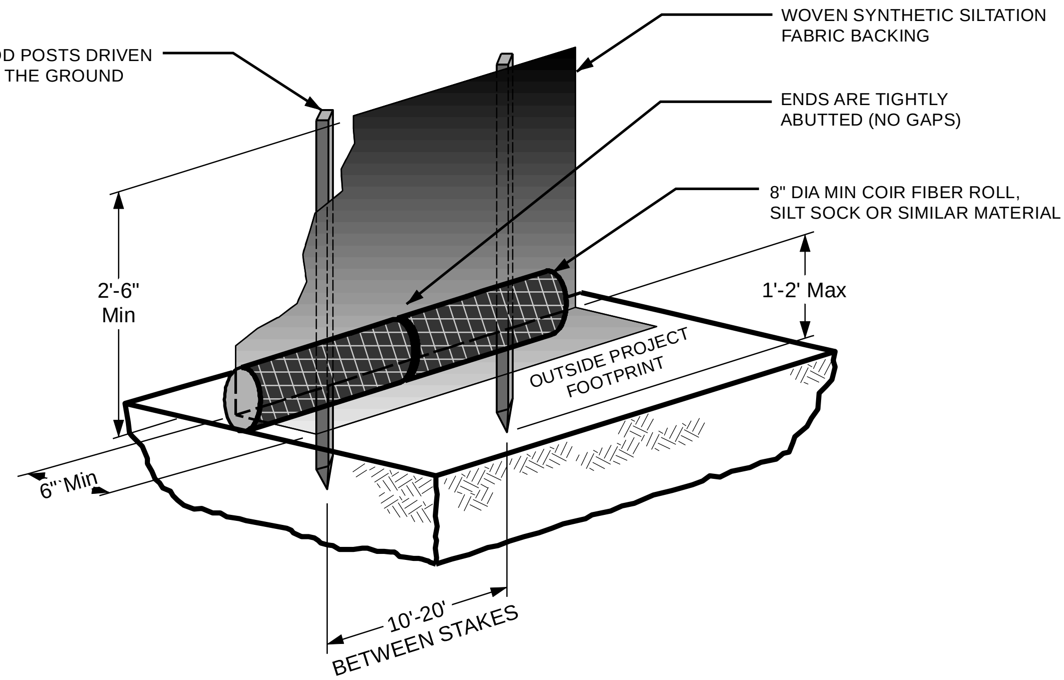
Figure Number

2



WILDLIFE EXCLUSION BARRIER (OPT 1) 1

NOT TO SCALE



WILDLIFE EXCLUSION BARRIER (OPT 2) 2

NOT TO SCALE

WILDLIFE EXCLUSION BARRIER DETAILS (Option 1 and Option 2)
Construction Period Monitoring and Protection Plan
Kirvin Park, Pittsfield, Massachusetts

SCALE	DATE	PROJECT NO.
NA	1/26/2023	04191406

AECOM

Figure Number
3

Figure 4. Example of Barrier Inspection Report

BARRIER INSPECTION REPORT

Site Name: Kirvin Park

Project Number: 04191406

Project Manager:

Date:

On-Site personnel:

WEATHER CONDITIONS:

WORK COMPLETED:

OBSERVATIONS / RECCOMENDATIONS:

SAFETY ISSUES:

OTHER COMMENTS:

AECOM

Exhibit A – Contractor and Construction Phase Education

Purpose

The wood turtle (*Glyptemys insculpta*) is a Massachusetts state-listed species of Special Concern, and is therefore protected against direct harm to the individual, and protected against destruction or disturbance of its habitat. The purpose of this document is to provide construction personnel with important information that will help reduce the potential for direct harm to individual wood turtles should they be encountered during construction activities. This includes a basic understanding of wood turtle habitat use, instructions on proper turtle handling and temporary detainment and relocation techniques, contact information of at least three (3) qualified biologists, and representative photographs of the wood turtle to assist in proper identification.

General Overview of Wood Turtle Activity and Habitat Use

Wood turtles in the northeast use a variety of habitats over the course of the year based on life cycle requirements (e.g., nesting and hibernating) and body temperature regulation. A generalized breakdown of this seasonal habitat use is provided below to give contractors an idea of where chance encounters are most likely to occur given the time of year construction activities are occurring;

- *June through September*. Wood turtles are typically observed feeding in successional fields, hayfields and forests. They can also be seen in riparian wetlands such as wet meadows, bogs, and beaver ponds. The majority of wood turtle nesting activity occurs in June in areas which provide sandy and/or gravelly substrate.
- *October through March*. Wood turtles typically spend winters hibernating in flowing rivers and perennial streams. In October, the turtles start to make their way back to the rivers and streams with full-time submersion in the water starting in November. Winter bedding can be in muddy banks, stream bottoms, deep pools, in-stream woody debris, and abandoned muskrat burrows.

Methods

Below is a step-by-step process that shall be followed in the event of a rare turtle observation.

1) If a turtle is observed, first determine if the individual is within harm's way. If the individual is observed outside of exclusion zones (i.e., outside of the work area and access roads), then the turtles should not be handled to minimize disturbance and prevent altering their behavior.
2) When a turtle is determined to be within harm's way it should be captured and temporarily detained until the lead biologist has been notified and can perform standard data collection and turtle relocation.
3) When handling a turtle grasp it firmly by the sides of the carapace (top shell). Wood turtles are very shy and will typically close up tight into their shell. If the turtle does not retreat into its shell, be cautious of the turtle's head, mouth and feet. Although wood Turtles typically do not bite, they certainly are capable of doing so. In addition, they have very sharp claws and powerful legs for digging, which can scratch the skin.
4) Captured turtles may be placed into a small tub or cooler if necessary. Turtles can easily die from overheating. Therefore, this tub **MUST** be placed in a cool shaded area out of direct sunlight, indoors or out. Outdoor shaded areas must be persistent, that is, make sure that the tub is not in an area that will BECOME sunny later in the day. In addition, fresh vegetation (e.g., leaves, tall grass cuttings) and water **SHALL** be placed into the tub for cover and hydration.
5) Within one (1) hour of capturing a wood turtle, one of the three qualified biologists listed below **SHALL** be notified.

Contact Information of Qualified Biologists

Name:________________	Name:________________	Name:________________
Work No:________________	Work No:________________	Work No:________________
Cell No:________________	Cell No: ________________	Cell No:________________
Email:________________	Email:________________	Email:________________

AECOM

Wood turtle top shell (Carapace)

Wood turtle bottom shell (Plastron)

aecom.com

Appendix H4: Updated Assessment of Creating a Wood Turtle Nesting Areas at the Kirvin Park Restoration Site

Introduction and Overview

The Kirvin Park area is mapped by the Massachusetts Natural Heritage and Endangered Species Program (MNHESP) as Priority Habitat and Estimated Habitat for the wood turtle (*Glyptemys insculpta*). Although wood turtles were not observed in the restoration area during the extensive field surveys conducted for this project (in 2022-2024), AECOM has observed wood turtles in the past (~2018) in Sackett Brook just downstream of the restoration area, and both Sackett and Ashley Brooks are considered to provide suitable habitat for wood turtles.

The natural resource trustees suggested that GE consider the creation of wood turtle nesting habitat as part of the Kirvin Park restoration/enhancement project. Accordingly , GE conducted a preliminary assessment of this concept, as described its September 2024 Revised Conceptual Restoration Plan. In addition, on March 11, 2025, GE reviewed this concept with MNHESP's State Herpetologist (Michael Jones). On March 13, 2025, Mr. Jones noted that MNHESP "did not see any significant concerns with the proposal for wood turtle nesting habitat creation at Kirvin Park," but that more review would be necessary. Mr. Jones added that MNHESP "sees value in the general concept," but "that replicated (multiple) nesting features are more likely to provide habitat value than a single feature at the confluence." Based on this input, GE has included in the Final Restoration Plan plans to create two wood turtle nesting areas at the Kirvin Park restoration/enhancement site.

This appendix presents an updated assessment of the creation of such wood turtle nesting habitat, with some additional details about GE's current plans to create such nesting areas at Kirvin Park.

The primary sources for the information in this document are the following:

A Guide to Habitat Management For Wood Turtles (*Glyptemys insculpta*), prepared by the Northeast Wood Turtle Working Group, with support from the U.S. Fish And Wildlife Service Competitive State Wildlife Grants (Technical_Assistance_Booklet_62617 (northeastturtles.org));

and

Jones, M.T., H.P. Roberts, and L.L. Willey. 2018. Conservation Plan for the Wood Turtle in the Northeastern United States. Report to the Massachusetts Division of Fisheries & Wildlife and the U.S. Fish & Wildlife Service. 259 pp. WoodTurtlePlan_Final_2018_v2 (northeastturtles.org).

Wood Turtle Habitat Summary

Wood turtles depend on aquatic and terrestrial habitats to sustain their populations. They are typically found in slow-moving sections of clear, cold, woodland streams (10-65 feet wide) that have a sand, gravel, or rock substrate (although they also may be found in dominant areas of organics and muck, clay, silt, cobble, boulders, and bedrock). Large root masses, woody debris, and logs, along with areas of deep pools, are important in-stream features that provide cover, basking and overwintering sites, as well as stability during times of high flow. Wood turtles overwinter and mate in streams. The rest of the year, from late spring to fall, they are found mostly in floodplains and upland habitats that include mature forest and early successional cover types where edge habitats are particularly important in balancing their requirements for both thermoregulation and food. Other habitats that provide value during the wood turtle's active period include springs, vernal pools, seeps, and temporary wetlands.

Wood turtles may also be found in freshwater tidal wetlands and estuarine creeks, although those are not common habitats.

Wood Turtle Nesting Habitat Requirements

Wood turtle nesting areas are generally well-drained, elevated, and exposed areas of sand and/or gravel. The turtles use natural and anthropogenic sites in coarse alluvium, poorly graded sand, or fine to medium gravel, and sandy loam. Attachment H4-1 provides photographs of wood turtle nesting habitats as provided by the previously cited source documents.

Natural nesting features include:

- Sandy point bars on the inside of river bends;
- Cutbanks on the outside of river bends;
- Sand and gravel bar deposits in the stream channel associated with stream obstructions, constrictions, or directional changes in flow, and areas of overwashed sand in open floodplains; and
- Dry stream beds.

A variety of anthropogenic features can serve as nesting habitats as well. Examples include:

- Sand and gravel pits;
- Gravel boat ramps;
- Powerlines;
- Roadsides;
- Unpaved farm roads near streams;
- Railroad beds;
- Gravel piles; and
- Golf course sand traps.

Wood turtles have also been known to make use of anthropogenic nesting areas created specifically for turtles. Attachment H4-2 provides photographs of anthropogenic nesting sites, again provided by the previously cited source materials.

Key facts relating to wood turtles are provided below, as presented in the two sources listed above.

Home Range Size
Male - 44.9 acres
Female – 28.7 acres

Distance Traveled Along Streams
Males spend more time in streams than females and have greater stream ranges, documented in Massachusetts up to 3.9 miles.

Distance Traveled Away from the River
Most movement is within 100 feet with a high-activity zone within 300 feet. Females move further distances and may travel over one-half mile.

Nesting Distance
Wood turtles have been documented in Massachusetts to travel a median distance of 84 feet from streams for nesting.

Annual Activity Periods
The period of the year when wood turtles are found in streams and upland areas may vary with latitude, but runs generally from early April to late October.
Emergence and pre-nesting may be determined by ice-out, when wood turtles become active and are found within 35 feet of streams.
Nesting typically begins in June.
The post-nesting period when nesting has concluded runs from July through late September.
Pre-hibernation typically begins in early October when temperatures drop and the turtles retreat to streams to overwinter.
Overwintering occurs from November/December to March/April, when wood turtles hibernate.

Nesting Habitat Management Considerations
The following presents considerations relating to the establishment of wood turtle nesting habitat. After the description of each item, the text in italics presents how each item has been addressed in connection with the plans for Kirvin Park.

Surveying and Mapping Nesting Habitat:
First, it is necessary to consider the abundance and availability of existing nesting areas to determine whether the creation of nesting habitat is appropriate. Wood turtle streams and surrounding terrestrial habitat should first be surveyed to assess the need for nesting areas through ground surveys and aerial imagery mapping that identify all existing and potential nesting habitat. *As described below, surveys for potential existing nesting areas were conducted during the summer of 2024. While some potential areas were observed, sandier/gravel areas outside of the higher flow zones in the rivers (vs larger cobble habitat along the stream flow) would have merit for nesting areas.*

Nesting creation/enhancement efforts should occur between November 1 and March 31 during the overwintering, inactive period. *The work to establish the nesting areas would occur during this "non-active period" while the wood turtles would be hibernating in the streams.*

Upon completion of the mapping of existing and potential nesting sites, the management focus should include the following:

1. Maintaining/restoring existing nesting sites.
This would involve clearing overgrown vegetation that deters females, while leaving a vegetation density that provides cover for nesting. Clearing should occur only when nesting is not active (October – April) and sections of nesting habitat should be disturbed only on a multi-year rotational basis. *The two created nesting sites would be subject to a five-year management plan which would manage vegetative cover on the nesting area accordingly.*

2. Expanding and augmenting existing sites and/or creating new nesting areas, as appropriate.
This may be achieved by clearing land to expose mixed poorly graded sand and gravel or by depositing soil in a pile (60' L x 25' W x 5' H) in an open, sunny area with an open, unfragmented path (no roads, structure or difficult terrain) next to a stream or within 200 ft. Multiple nesting habitat sites are optimal to meet environmental preferences and disperse nesting to reduce predation. *The two planned nesting areas are sized in accordance with these dimensions, and would consist of poorly graded sand and gravel.*

Avoiding Ecological Traps:
Nesting areas need to be carefully placed so that females are not attracted to an ecological trap (such as a road between the nesting area and the stream), where decreased adult survival rates, decreased nest success, or decreased hatchling survivorship may occur. *No such anthropogenic features occur in the vicinity of the two nesting areas. A woodland trail extends through the site between the two nesting areas; however, it is anticipated that signs will be part of the restoration work to alert park visitors to the wood turtle presence and the need to avoid disturbances.*

Monitoring Artificial Nest Sites:
Habitat quality and effectiveness of the created nesting area in attracting nesting females should be monitored and assessed. A newly created nesting area is susceptible to erosion, drainage, and invasive species colonization and also needs monitoring through field observation monthly for the first year, and annually for five years thereafter. Visual foot surveys conducted during the typical nesting period between May 29 and July 8 for signs of nesting activity in a defined survey area is one method to evaluate the relative use and success of nesting sites. Another method is the use of camera surveys with the installation of one or more cameras on trees (vertical structures) facing north into the nesting area. *The two created nesting sites would be subject to a five-year management plan which would manage conditions accordingly.*

Monitoring Vegetation:
Monitoring to assess nesting areas is necessary to prevent vegetation from becoming too dense or creating shading of exposed soil and to also prevent colonization and establishment of invasive plant species. *The two created nesting sites would be subject to a five-year management plan which would manage vegetative cover on the nesting area accordingly.*

Kirvin Park Area Wood Turtle Habitat Survey Findings

AECOM biologists conducted surveys for wood turtle habitats on May 22, June 18, and August 8 2024. These investigations focused on the habitat conditions within Sackett and Ashley Brooks, along their banks, and within 200-300 feet of the brooks. Photographs of the conditions observed are provided in Attachment H4-3. As documented in the photographs, both brooks offer excellent habitats for wood turtles, including both in-stream and along the banks. The banks of both streams offer potential nesting areas for wood turtles, such as at point (and mid) bars and at the confluence of the brooks, where open cobble-gravel deposits occur and are maintained by the flashy flows from these upper perennial streams. However, as noted in many of the photographs, most of these deposits appear to have more larger stone and cobble size material than may be ideal for wood turtles. Further, most of these deposits are maintained by higher flows within the bankfull zone (i.e., within the 1-2 year flow zone), which may be a constraint for successful nesting.

Creation of Wood Turtle Nesting Areas at Kirvin Park

As noted above, the field surveys to date have noted that wood turtles have been documented in the Kirvin Park area in the past, and that both Sackett and Ashley Brooks offer excellent habitats for this species. While potential nesting habitats are available near these brooks, those observed to date appear to have limitations due primarily to the dominance of larger stones and cobbles as opposed to more sand and gravel composition. The location of these potential nesting deposits within annual high flow events may also be a constraint to successful nesting.

Accordingly, the creation of nesting sites elsewhere in the floodplain with sandier/gravel substrate is preferable. Considering the nesting site selection characteristics presented above, as well as the conditions at the proposed restoration site, two suitable locations for the creation of wood turtle nesting areas have been selected. One is located in the northwestern corner of the restoration area (see photo below). This area is adjacent to both Sackett and Ashley Brooks, is currently in open upland meadow cover (primarily goldenrod growth), and is just above the bankfull level of both brooks, such that high flows during flooding would not be as much of a factor. A suitable size area within this meadow (e.g., 60' L x 25' W) is available, following the guidance presented above for creating a wood turtle nesting area. It would involve clearing land to add mixed poorly graded sand and gravel in a pile (~ 5' high) in an open, sunny area with an open, unfragmented path (no roads, structure or difficult terrain) next to or within 200 feet of a stream. A second nesting area will be located in the main floodplain restoration area along the southern edge of the created wetland area, roughly 300 feet south of Sackett Brook. The locations of both turtle nesting areas are shown on the map below.

Any loss of flood storage associated with depositing the sand and gravel in these portions of the floodplain would be more than compensated by the excavation proposed for the creation of the expanded wetland area just adjacent to these locations.

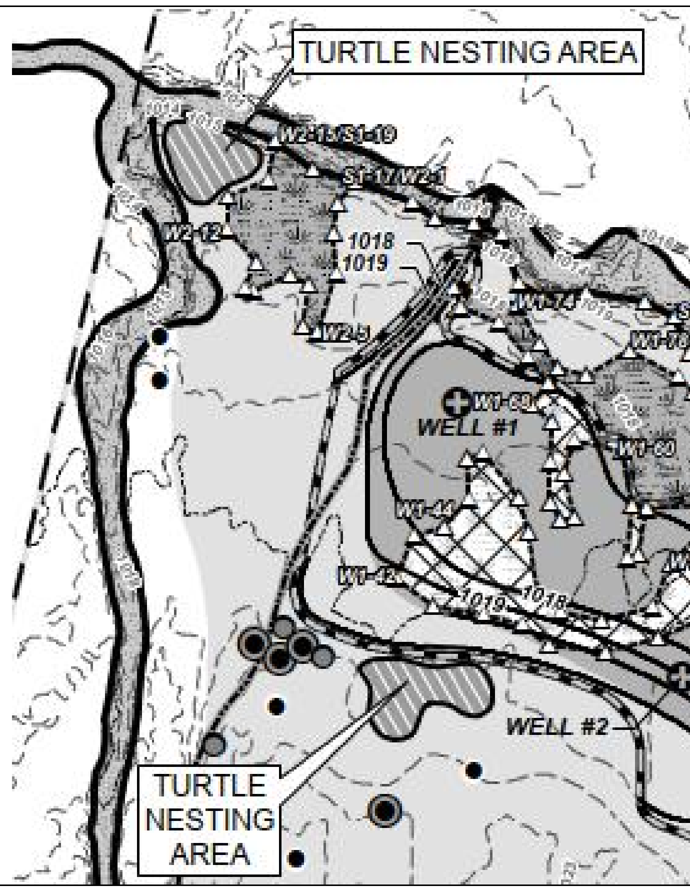


Photo of current meadow habitat in the northern nesting area, and the buckthorn habitat in the southern nesting area.

Plan view of proposed nesting areas. Ashley Brook is along the left (west) side, and Sackett Brook is along the north side.

Photograph and Plan View of Potential Created Wood Turtle Nesting Areas within Restoration Plan Area

The creation of these wood turtle nesting areas within the Kirvin Park restoration area will be further discussed with MNHESP. If MNHESP provides final concurrence with the creation of these areas these features will be included in the final design/construction plans for this project.

Figure H4-1: Examples of Wood Turtle Nesting Habitats

From: A Guide to Habitat Management For Wood Turtles (*Glyptemys insculpta*), prepared by the Northeast Wood Turtle Working Group, with support from the U.S. Fish And Wildlife Service Competitive State Wildlife Grants (Technical_Assistance_Booklet_62617 (northeastturtles.org)).

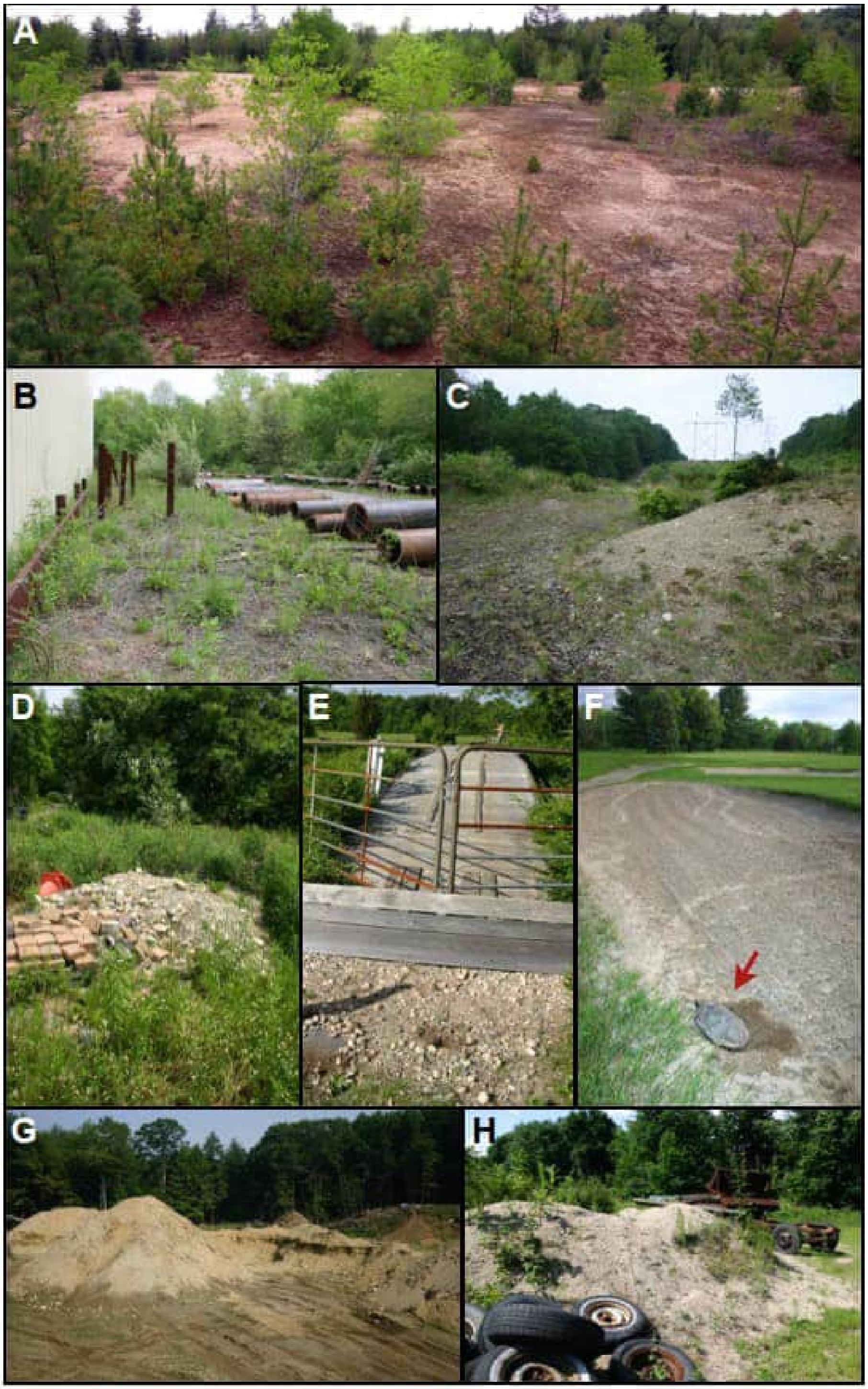


Figure H4-2 Anthropogenic nesting areas ranging from disturbed soil (A, B, E), to powerline corridors (C), piles of soil (D, G, H), and golf course sand traps (F). Arrow indicates nesting Wood Turtle. Photos © Mike Jones / MassWildlife

Figure H4-2: Examples of Anthropogenic Wood Turtle Nesting Habitats

From: A Guide to Habitat Management For Wood Turtles (*Glyptemys insculpta*), prepared by the Northeast Wood Turtle Working Group, with support from the U.S. Fish And Wildlife Service Competitive State Wildlife Grants ([Technical_Assistance_Booklet_62617 (northeastturtles.org)]).

Attachment H4-3: Photographs of Wood Turtle Habitat along Sackett and Ashley Brooks

	
Ashley Brook near confluence with Sackett	Ashley Brook 100 ft upstream of confluence with Sackett
	
Ashley Brook 100 ft upstream of confluence with Sackett	Ashley Brook 100 ft upstream of confluence with Sackett
	
Ashley Brook (left) at confluence with Sackett (in distance)	Sackett Brook looking south at Ashley Brook confluence
	
Sackett Brook just downstream of Restoration Area	Sackett Brook at upstream end of Restoration Area

Appendix I

Pollinator Habitat Information

Appendix I: Pollinator Habitat Information

The Kirvin Park habitat restoration plan will include the creation of a pollinator meadow habitat in the south staging area as a further habitat enhancement measure on the site. This appendix provides further background information on the recent experience of pollinator habitat creation in general and in the Berkshires in particular, as well as additional technical information on such habitats that have been drawn from to develop the Kirvin Park pollinator habitat plan.

Overview and Objectives

The south staging area consists of a previously disturbed, roughly two-acre area composed of open field with scattered shrubs and trees (see Attachment 1 for photographs). Aerial photographs indicate that this area was entirely an open field until around the year 2000, and that it has grown in with mostly invasive plant species over the past 25 years and especially the last 10 years. Many of the shrubs and trees growing there currently are invasive species, including common buckthorn, multi-flora rose, bittersweet, and Morrow's honeysuckle. Much of the open meadow consists of dense goldenrod growth, a plant cover which provides pollinator habitat but precludes the growth of other native species and thereby limits habitat value.

In short, the current habitat value of the south staging area is very low. Accordingly, enhancing the habitat value of this area by establishing a high-quality diverse pollinator habitat there will contribute significantly to the biodiversity of Kirvin Park and the surrounding landscape. Pollinators are critical foundational components of ecosystems, facilitating plant reproduction and supporting wildlife (Xerces 2025). Research indicates that many pollinator species, such as native bees and monarch butterflies, are declining due to habitat loss, pesticide exposure, and agricultural intensification. In Massachusetts, for example, populations of three bumblebee species have declined by over 90% in the past 30 years, highlighting the urgency of conservation efforts (Mass Audubon 2025; MAPN 2025).

Creating a pollinator habitat at Kirvin Park is consistent with other efforts along the Housatonic River Valley from the Connecticut border to Pittsfield. Establishing a network of pollinator habitats through the valley is crucial for supporting local ecosystems and biodiversity. Pollinators, such as bees, butterflies, and moths, are essential for the reproduction of many plants, which in turn support food production and wildlife. Given the above-mentioned decline in many pollinator species due to habitat loss, pesticide use, and agricultural intensification, conservation efforts are vital. The pollinator habitat to be established in the south staging area will consist of a diverse assemblage of native wildflowers (e.g., milkweeds, asters, coneflowers) with scattered shrubs and small trees (e.g., viburnums, chokeberries, crabapples, red maple), creating landscapes as shown in Attachment 1. This pollinator habitat will be integrated with the main floodplain restoration area. Informational signs may be included to educate visitors about the importance of pollinators, listing species like monarch butterflies and native bees and providing tips for supporting them. This aligns with community engagement efforts, such as those by the 1001 Pollinator Gardens initiative (https://1001pollinatorgardens.wordpress.com/home/), which includes members of the local community in and around Pittsfield. While this project will establish a pollinator habitat at Kirvin Park, it is also intended to serve as a catalyst to encourage community stewardship to collectively contribute to the long-term sustaining of this habitat feature in Kirvin Park.

The following sections summarize the ecology of pollinator habitat and provide further detail on the creation and maintenance of this pollinator habitat.

What is Pollinator Habitat and Why is it Important?

Creating pollinator habitats such as that proposed in Kirvin Park is an ecological and community-driven objective that will provide food, shelter, and breeding grounds in support of vital pollinators, such as bees, butterflies, and birds, that enrich local biodiversity and ecosystems and counteract the recent pollinator decline. Native pollinator populations are experiencing significant declines, with some species, like certain bumblebees in the eastern United States, dropping by over 90% in the past 30 years, as noted by Mass Audubon (2025). These declines are attributed to habitat loss, broad use pesticide exposure, and agricultural intensification, and highlight the urgent need for conservation efforts.

Pollinator habitat includes a partial to full sun area with abundant native grasses and wildflowers and scattered native shrubs and trees, such as in fields, meadows, and woodland edges with accessible water. Pollinator habitat provides pollinators with food including nectar, pollen and host plants, shelter such as trees, shrubs, sticks, thatch, bare sandy, loamy soil, and breeding areas such as leaves, trees and shrubs, and sandy, loamy soil. Butterflies and moths, for example, lay eggs on or near the vegetation they eat as caterpillars known as "host plants." As adults, they consume nectar from flowers and sugar from sap and fruit. Most butterflies and moths pollinate flowers that produce nectar, such as native milkweed and columbine. A truly “pollinator-friendly” landscape is highly diverse in both plant and animal species composition and includes a wide range of native plant types, ensuring that pollen and nectar are available throughout the growing season and that nesting habitat and host plants are available throughout the year (Abramson 2021).

Native pollinators play a vital role in creating and sustaining a variety of habitats and ecosystems that offer food and shelter crucial to the survival and diversity of animals, as well as human survival. Massachusetts’ native pollinators include 400 species of bees, 3000 species of moths, and 120 species of butterflies as well as hover flies, beetles, and hummingbirds (MAPN 2025). Pollinators, each with their specific needs, also rely on plentiful nutrient-rich food, protective sheltering sources, and breeding areas for reproductive success where they can thrive and create flourishing habitats and ecosystems. Beyond these elements of survival, there also exists a delicate balance of a complex relationship between specific pollinators and native plants that coevolved over millions of years to optimally ensure pollination. A pollination syndrome, or association between plants and pollinators over millions of years, coevolves traits of a flower such as its color, shape, or scent to specifically attract and benefit the pollinator so as to ensure its successful pollination. Consequently, there are pollinators that have become pollen specialists for specific native plants, and this dependency better ensures successful pollination, but may also create risk of pollinators being unable to reproduce when their coevolved native plant species dies out or disappears from their habitat causing them to become extirpated, endangered as a species, and eventually extinct. Approximately 15% of Northeastern native bees are considered pollen specialists (Fowler 2016).

Creating pollinator habitat in Kirvin Park is a conservation effort that supports biodiversity, enhances ecosystem health, and contributes to food security. Pollinators are crucial for ecosystems and agriculture. Many crops rely on pollinators for yield, making them vital for food security. Improved pollinator presence can support local agriculture by increasing crop pollination. Their role in transferring pollen is critical for producing fruits, vegetables, and nuts, which supports both natural ecosystems and agricultural systems. Although some plants obtain pollination by cross pollination (98% wind, and 2% water) or by self-pollination, the majority of plant species, over 70%, rely on pollinators to transfer the pollen from the flowers male anther to the female stigma of the same or another flower of the same species so the plant can produce fruit and seed (Lavengood 2025). Pollinators (e.g., bees, butterflies, moths, hummingbirds) are essential for over 75% of flowering plants and 35% of global food crops, including Massachusetts agricultural staples like apples, cranberries, and blueberries (MassDCR 2021). Pollinators ensure healthy crops, supporting local farms and food security in Berkshire County. Without them, many crops would struggle, affecting food supplies. Massachusetts agriculture, including Berkshire County's farms, relies on pollinators for crops like apples, berries, and squash. Supporting pollinators in Pittsfield help to ensure that local food production thrives, especially commercial honeybees, which aren't as effective as diverse native pollinators. Native bees are two to three times better pollinators than commercial honeybees, according to Cornell University entomology professor Bryan Danforth (cited in Gashler 2011), noting that commercial honeybees are more interested in the nectar and actually avoid the pollen if possible, while wild native bees are mostly pollen collectors, collecting the pollen to take back to their nests (Gashler 2011). Many pollinator species like native bees (over 365 species in Massachusetts) and monarch butterflies are declining due to habitat loss and broad pesticide use (Mass Audubon 2025). Pittsfield's urban and suburban growth has reduced natural habitat landscapes, making backyard and community pollinator gardens critical for supporting pollinator populations.

Tracked observations of bees, butterflies and moths over the last 150+ years reveal a drop in bumblebee species from 11 species to nine species, with danger of three additional species being extirpated within the next decade (Abramson 2021). Five bee species and 44 butterfly and moth species are listed by the Massachusetts Division of Fisheries and Wildlife as Massachusetts Species of Greatest Conservation Need (MassDFW 2015). MassWildlife's Natural Heritage and Endangered Species Program (MNHESP) lists five bee species under the Massachusetts Endangered Species Act (MESA) (of which three species are Threatened and two species are Endangered), and 45 butterfly and moth species (of which 21 species are of Special Concern, 17 species are Threatened, and eight species are Endangered) (MNHESP 2024). A major misconception about pollinator decline is that all species are declining at the same rate. In fact, many species are actually increasing in abundance and geographic distribution as a direct result of human disturbance. "Seeing lots of bees" does not necessarily mean that the landscape is pollinator-friendly. Unfortunately, most efforts to restore pollination systems to date have resulted in increasing the numbers of a few common bee, butterfly, and moth species, rather than on the range of wild pollinator species needed for ecosystem health and resiliency (Abramson 2021).

Creating pollinator habitat at Kirvin Park can mitigate deficient habitat issues by providing native food sources (nectar and pollen), shelter, and breeding grounds. This not only supports local biodiversity but also contributes to regional ecosystem health, ensuring that pollinators can thrive and continue their essential services. Native pollinator plants that attract pollinators and enhance their populations locally include columbine (*Aquilegia canadensis*), wild lupine (*Lupinus perennis*), smooth swamp-milkweed (*Asclepias incarnatal*), birds foot violet (*Viola pedata*), wild geranium (*Geranium maculatum*) and goldenrods (*Solidago* spp). Community efforts can enhance this effect, creating connected habitats that facilitate pollinator movement and survival, especially in urban and suburban areas where natural habitats are fragmented (Xerces 2025).

Summary of Pollinator Habitat Initiatives in the Berkshires

The content and composition of the proposed pollinator habitat at Kirvin Park have drawn from other recent pollinator habitat initiatives in the Berkshires. In particular, recent efforts in Egremont and Great Barrington, Massachusetts, have been consulted and many details from these initiatives have been incorporated into the Kirvin Park pollinator habitat plan (Abramson 2021; Abramson et al 2018).[1] In addition, the Berkshire Conservation District established the Berkshire County Pollinator and Native Plant Initiative as a dedicated endeavor to protect and enhance pollinator habitats in Berkshire County.

Great Barrington Pollinator Action Plan

A comprehensive plan to support pollinators for their vital role in maintaining biodiversity and food production was prepared for Great Barrington, MA in 2018 (Abramson et al. 2018). The Great Barrington Pollinator Action Plan was produced in collaboration with the Town of Great Barrington Department of Public Works, The Great Barrington Agricultural Commission, the Conway School, and key stakeholders across the region in response to the global decline in pollinator species, including bees, butterflies, hummingbirds, and moths. It envisioned an interconnected pollinator habitat network through Great Barrington, with scalable models applicable to other towns and properties with different uses, to guarantee a healthy pollinator population in Great Barrington and across the Berkshire region (Abramson et al. 2018). One contributor to pollinator decline is use of pesticides (insecticides in particular) given their direct exposure effect on the health of the pollinators from spray drift or contaminated dust from coated seeds, and their indirect effect responsible for loss of plant diversity and variety of flowering plants available to pollinators. Neonicotinoids (a class of insecticides), in particular, negatively affect pollinators as their chemicals move through plants into the pollen and nectar. Neonicotinoids are not only extensively used on farms, but also found in home garden products for general use at homes, schools, nurseries, and in other landscapes. They are long-lived, persisting months to years after an application in the environment. Neonicotinoids are about 6,000 times more toxic to bees than DDT (Environment Massachusetts 2018). Habitat decline through the loss, degradation, and fragmentation of habitat and human disruption of some migratory pathways has greatly contributed to pollinator decline, with 23% of native plant species in decline due to their specialist pollinators declining (Abramson et al. 2018). An increase in bee colony trade and transportation of bees has promoted the spread of parasites and pathogens beyond the normal range to new areas where they are detrimental to host plants that lack resistance causing their increasing decline. Also, in some areas, air pollution may collect in river valleys in warmer months that disrupts the scent tails necessary for pollinators to find flowers. Pollinator habitat potential maps were developed for the diverse properties of Great Barrington, including farmland, residential land, schools, cemeteries, golf courses, streetscapes, and parking lots, along with consideration of green roof establishment in the urban town center and related habitat potential.

This initiative follows the Town of Great Barrington's prior commitment to pollinator support, becoming the first municipality in New England to approve to pass a Pollinator-Friendly Community Resolution on May 19, 2016. Great Barrington's resolution encourages the commitment of property owners, including residents, businesses, and institutions, to adopt pollinator support policies, the most important being

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[1] See https://www.egremont-ma.gov/DocumentCenter/View/234/Pollinator-Pathway-PDF?bidId= greatbarringtonpollinatoractionplan2018.pdf

the commitment to avoid using insecticides, as well as to avoid planting flowering plants treated with systemic insecticides and to plant more pollinator-supporting forage on their property and adopt organic or chemical-free lawns and landscaping practices (cited in the *Resolution Declaring The Town Of Great Barrington To Be A Pollinator-Friendly Community*, 2016).[2]

Egremont Pollinator Pathway

The Egremont Pollinator Pathway, as with the Great Barrington Action Plan, was developed as a toolkit (Abramson et al 2021), providing recommendations for the creation of habitat supportive of threatened and declining pollinator species, with the result of ultimately promoting habitat connectivity within Egremont and the Berkshires. This toolkit focuses on the planting of diverse native plants using landscape management strategies to produce a highly diverse landscape where flourishing pollinator habitat provides pollen and nectar throughout the growing season and essential nesting habitat and host plant availability throughout the year (Abramson 2021). Among the resources in the toolkit are a recommended native plant list for the Berkshire Region, convenient plant seed mix suggestions used on the different site-types in a local park (French Park), a diagram key to the design areas of different site-types illustrating the native plantings and their placement in French Park, use and placement of bee nesting strips, the recommended mowing regime for the first three years to promote optimal plant growth and flowering for pollen and nectar, and a map showing the land areas suitable throughout Egremont for pollinator habitat replication to form a pollinator corridor. This toolkit educates the user of various ecological conditions and sites, and provides recommendations of the best suited native plants and landscape planting design that supports thriving pollinator habitat. In following the guidelines provided, citizens of Egremont as well as in other towns of the Berkshires attract threatened pollinator species to specifically designed pollinator habitats on their properties where flourishing pollinator-plant interaction strengthens the biodiversity and health of ecosystems and develops pollinator networks and habitat connectivity.

In a public meeting in October 2019, Egremont's French Park was selected to exhibit the creation of a pollinator pathway through visual demonstration of pollinator habitat landscape design. This highly visible public site belonging to the town offered a landscape of various representative ecological conditions to exemplify beneficial pollinator habitat creation specific to each ecological site, which then could be easily replicated on other properties throughout the town. In October 2020, Egremont citizens planted almost 10,000 sq ft of upland meadow, woodland edges, and wet meadow habitats of French Park with selected site-specific native shrubs, forbs, graminoids, and trees based on landscape conditions that support at-risk bees and butterflies native to high elevation Western Massachusetts (Abramson 2021).

1001 Pollinator Gardens (https://1001pollinatorgardens.wordpress.com/home/)

1001 Pollinator Gardens is a project initiated by local advocates in western Massachusetts in response to the urgent need for pollinator conservation due to habitat loss, broad pesticide use, and agricultural intensification that have caused a decline in pollinator populations. This project's goal is to encourage and support the creation and maintenance of 1001 pollinator-friendly gardens across western Massachusetts through the registration of 1001 committed individuals, groups, or organizations,

[2] https://townofgbma.gov/DocumentCenter/View/158/Town-of-Gb-Pollinator-Friendly-Community-Resolution-PDF

ultimately forming an interconnected habitat network offering food and shelter to benefit and sustain pollinators. The focus in the creation of pollinator gardens emphasizes the use of native plants which are best suited to the local area and optimally beneficial for associated native pollinators (https://1001pollinatorgardens.wordpress.com/home/). As noted on the project's website: "Native flowers support three to four times more pollinator species than non-natives and many caterpillars of butterfly and moth pollinators depend on specific native host plants for food." The website offers easy access to comprehensive resources to guide in the creation of a pollinator garden such as plant lists of native pollinator plants and local nursery recommendations, shelter for nesting sites and overwintering, water needs, (and garden maintenance), displays of various pollinator garden designs for backyard gardens to large meadows, and a pollinator garden registration form and platform for pollinator advocates to share information and experiences. It is the vision of this initiative to bring an ecologically beneficial change in the typical garden by enhancing gardening practices through the planting of native flowering plants for the creation of interconnected pollinator gardens throughout the landscape along with connected communities of pollinator advocates.

Berkshire County Pollinator and Native Plant Initiative

In 2020, the Berkshire Conservation District received grant money to promote healthy soil and pollinator habitat creation. The Berkshire County Pollinator and Native Plant Initiative (Initiative) was developed as a dedicated endeavor to protect and enhance pollinator habitats in Berkshire County through habitat creation, community support, and educational resources in response to the decline of pollinators and their host plants with the expanding loss of habitat, use of pesticides, and introduction of non-native plant species (https://berkshireconservation.org/berkshire-county-pollinator-and-native-plant-initiative/). The Initiative works primarily to educate residents through webinars and local resources, and focuses on planting native pollinator plants throughout the various Berkshire County public, residential, and farm landscapes. Through these efforts, the Initiative works toward the goal of Berkshire communities' adoption of the Pollinator-Friendly Community resolution to support pollinators. The resolution requirement involves committed action to be taken by the community such as creating favorable pollinator native plant habitats, reducing the use of pesticides, educating communities about the ecological role of pollinators and gardening practices that support healthy soils and native pollinator plantings, and assisting farmers to include large-scale pollinator habitat and conservation practices on agricultural land.

The Initiative was developed after the success of a pilot program conducted in Hinsdale with the establishment of a pollinator garden, which encouraged creation of small-scale pollinator gardens, leading Hinsdale to become a Pollinator-Friendly Community with its approval of the resolution commitment in 2019. Hinsdale set a precedent for the pollinator conservation guideline for the Initiative. Following the lead of Hinsdale, nearby towns of Monterey in 2022 and Lee in 2023 also approved and committed to the resolution to become Pollinator-Friendly Communities. Through its grant with the Initiative program, the Berkshire Conservation District was able to offer the towns of Monterey and Lee matching grants for design, plant materials, and educational outreach for public pollinator gardens, after which the funding ended. The District continues to hold an annual native plant sale in September that focuses on plants that benefit pollinators. The Berkshire Conservation District website and its Initiative program page offer resources such as the Gardening to Support Pollinators (Bayer 2015) fact sheet, and links that include, among many others, the Massachusetts Pollinator Network (Mass Pollinator Network) which offers additional resources and networks and is an official program of Grow Native Massachusetts (2025), another organization with abundant informational resources (MAPN 2025).

Kirvin Park: An Ideal Location to Establish Pollinator Habitat

Kirvin Park is a large public park in Pittsfield with diverse natural features, making it a promising location for a pollinator habitat. Kirvin Park's size, natural ecological features, proximity to water, community engagement opportunities, and alignment with broader conservation goals make it an ideal location for a pollinator habitat, fostering biodiversity and supporting vital pollinator populations. Kirvin Park offers a large, diverse landscape with ample space for creating and supporting a diverse pollinator habitat. The park's varied terrain, including floodplain areas along Sackett and Ashley Brooks, open fields, and wooded sections, provides solid foundation for pollinator-friendly plants and nesting sites. This diversity can accommodate species like bees, butterflies, and hummingbirds with different habitat needs.

Located along the transition of urban-suburban-rural areas, Kirvin Park serves as a vital green space where pollinator habitats can counteract habitat loss from development. Its accessibility, with amenities like trails, parking, and a playground, makes it a desirable hub for community engagement and education access about pollinators. Kirvin Park's existing features of natural floodplain and wetland areas near Sackett and Ashley Brooks provide moist soils ideal for native plants like swamp milkweed, common boneset, butterfly weed and joe-pye weed which are highly attractive to pollinators. Planting these can provide additional nectar and pollen throughout the growing season.

The creation of pollinator habitat in Kirvin Park aligns with regional Massachusetts pollinator conservation initiatives such as Growing Wild Massachusetts (a state-wide program that encourages planting native plants to support local pollinators: https://www.mass.gov/guides/growing-wild-massachusetts). In combination, these local initiatives demonstrate the regional support for such a collective effort. The creation of a pollinator habitat for Kirvin Park draws from these successful pollinator habitat efforts in the Berkshire County area, including the Great Barrington Pollinator Action Plan, Egremont Pollinator Pathway, Berkshire County Pollinator and Native Plant Initiative and the 1001 Pollinator Gardens Initiative; and it builds on the success of nearby towns like Hinsdale, Monterey, and Lee, which have adopted 'Pollinator-Friendly Community' resolutions, all to promote connectivity through the Housatonic River Valley. Kirvin Park's pollinator area aims to support a diverse range of pollinators, including bees, butterflies, moths, hummingbirds, and other insects, by providing food, shelter, and nesting sites, and enhancing ecological connectivity for their movement across the region. Educational signage could inform visitors about pollinators, and a designated path would allow observation without disturbance, enhancing community engagement and biodiversity.

In summary, Kirvin Park's large size, diverse natural features, proximity to rare habitats, and alignment with regional conservation efforts make it an excellent candidate for establishing a pollinator habitat. Its urban accessibility further enhances its value as a community-focused ecological project.

Key Components of Pollinator Habitat at Kirvin Park

The pollinator area in Kirvin Park would feature a natural landscape with diverse flowering plants, grasses, and scattered trees and shrubs, creating a visually appealing and ecologically functional space. The pollinator habitat is intended to blend with the park's natural and recreational landscape, enhancing its ecological and aesthetic value. It would feature a mix of flowering plants, native grasses, and scattered trees and shrubs, creating a visually appealing natural landscape of meadows and woodland edges. Pollinators require habitat with plentiful food, water and shelter. Planting native, pollinator-friendly plants is essential in supporting healthy, successful pollinator habitat. Native plants, adapted to ecological conditions of Pittsfield, are low-maintenance and resilient to local weather extremes, and they provide optimal nectar, pollen, and larval host resources.

The selection of plant species to establish in the pollinator habitat is based on a variety of factors, including the following (Bayer 2015):

- Selecting a diversity of plant materials including grasses, annuals, perennials, fruit-bearing trees and shrubs, with the objective of sequencing showy flowers from spring to fall with varying shapes and sizes;
- Emphasizing native species (not cultivars) to maximize pollen and nectar production;
- Ensuring that perennials are chosen to expand over the first few years, since they usually produce more nectar than annuals;
- For bees, selection of bright white, yellow, or blue flowers with a mild scent and flowers with a landing platform and plentiful nectar;
- For butterflies, selection of bright-colored flowers with landing platforms, nectar guides, hidden nectar, and narrow, tubular flowers; and
- For hummingbirds, selection of plants with funnel/tubular or cup shaped flowers, generally orange and red with strong perch supports and abundant nectar.

After final grading of the topsoil on the south staging area, an initial cover of a meadow seed crop will be sown to include fast-germinating grasses such as Canada rye or annual rye (e.g., New England Conservation Wildlife Mix[3]); these will assist in soil stabilization as well as minimizing weed invasion. The seeding will also include both annual and perennial native wildflower species selected to include a variety of sizes, colors, flowering times, and growth forms, as well clump-forming grasses such as little bluestem and Indian grass. Plantings of selected shrub and tree species will also be conducted. Figure 6-7 in the main text of the Final Restoration Plan provides lists of acceptable seed mixes and of the tree and shrub species anticipated to be installed at the pollinator area. However, the final selection will reflect input from the selected contractor based on availability, timing, and other factors. Attachment 2 provides more comprehensive lists of acceptable plant species that may be considered in establishing the pollinator habitat.

Following the Egremont pollinator plan, which fits with the setting of the Kirvin Park pollinator habitat area, three pollinator zones will be created, as summarized in the text of the Final Restoration Plan:

- Upland Meadow: This pollinator habitat will comprise the major portion of the Kirvin Park pollinator habitat area, extending from the western edge across the higher elevation portion of the area up towards the northern end. This area will emphasize upland wildflowers with less than 25% grass cover and patches of flowering shrubs such as meadowsweet, dogwoods, and

[3] Available from New England Wetland Plants, Amherst, MA.

steeplebush. A mowed trail will extend in a circuitous route through this area, connecting to the existing trail near to Ashley Brook along the western side of the site. A bench will be situated at the northern end of the trail for visitors to rest and observe the meadow. A number of bee nesting strips will be included within this planting zone. Seventy percent of native bee species are ground nesting (UMass Amherst 2025).

- Wet Meadow: This habitat zone will extend along the existing swale in the eastern part of the area. While this swale is not technically a wetland, it receives sufficient runoff from the surrounding landscape that species adapted to periodic wet soils will be established here. Some willow shrubs will be included with the wildflower and grass seed mix used for this zone.
- Woodland Edge: This planting zone will wrap around the northern and eastern edges of the area where existing tree cover occurs and will accommodate a transition between open meadow and woodland conditions. Small trees, such as shrub willows, crabapple, and shadbush, will be planted in this zone along with shrubs and wildflower species adapted to more shaded conditions.

Management and Maintenance of the Pollinator Habitat

While establishing a meadow of wildflowers is a fairly basic objective and may appear to be a straightforward proposition, the experience of creating larger areas of such habitat is relatively limited, and invasive plant species present an increasingly significant factor to be considered in the composition of the vegetation to be installed as well as the implementation, management, and maintenance of the habitat plan. Careful planning of establishing meadow plant cover from the seeding stage to full mature meadow growth is necessary to effectively design and manage the progress of plant growth. In addition to managing the desired pollinator plant species as they develop on the site, control of invasive plant colonization in the pollinator habitat is essential, especially in the early stages of establishing the meadow habitat. Schuster et al (2024) have shown that establishing desirable plant coverage early on is critical to controlling invasive plant species colonization, as the resources used by desirable plant species inhibit the colonization and growth of invasive species. Revegetation with desirable species also helps to reduce the need for herbicides and additional management strategies. Effective revegetation also acts to reduce soil erosion and improve runoff water quality.

Establishing Vegetative Cover to Inhibit Invasive Species Growth

Management of invasive species should occur during the initial planting and seeding of native species for revegetation. Invasive species removal during the grow-in period of the first seeding with graminoids (grasses, sedges, rushes) and wildflowers and plantings of shrubs and trees will aid in establishing an early dense vegetative cover that can more effectively compete with and suppress invasive species seedlings, whether they come from the seed bank in the soils used for the site or attempt to colonize the site from outside (via wind-blown seed, wildlife, humans, or vegetative expansion from surrounding areas). Sown graminoids and wildflowers can establish and densely revegetate large areas quickly and cost-effectively. Generally, grasses (particularly cool-season grasses) establish and revegetate more quickly than wildflowers, and they better suppress underlying invasive species' seedlings than most wildflowers by forming a thatch that inhibits the seedling's light availability (Shuster et al 2024), especially later into the fall. Wildflowers may need more time to establish (several years) but are aided by their shade-tolerance and ability to self-perpetuate for many years. Therefore, wildflowers may grow too slowly to become densely enough established to help suppress the early colonization of invasive species, but wildflowers grown in dense and diverse patches in the long run will aid in impeding invasive colonization. Therefore, having graminoids in the initial seeding mix along with wildflowers is warranted, using both cool-season and warm-season grass species. Warm-season grasses take more time to establish than cool-season grasses, but may remain persistent for long-term suppression of invasive species.

Even with effective seeding and initial revegetation success, invasive species control efforts are warranted for three to five years as the meadow growth develops. For areas as large as the Kirvin Park pollinator meadow, there is no practicable substitute for trained, licensed herbicide applicators to arduously traverse through the meadow area with back-pack units to directly apply herbicide to invasive species during the growing season. This practice, along with the mowing regime described below, will be implemented for the Kirvin Park pollinator meadow for a five-year period after construction.

Mowing Regime

Critical to pollinator habitat is to mow less frequently and raise mower height to allow flower growth. Plant damage is natural as some life stages of pollinators eat vegetation such as larval host plants and caterpillars chew on leaves. The following mowing and management program for the pollinator habitat is based on that established for the Egremont experience (Abramson 2021) and by MassDCR/MDAR (2025).

For the first growing season following seeding, all seeded areas should be closely monitored for growth. When the average height of vegetation in a seeded area is approximately 12 inches, the area should be weed whacked or brush hogged to a height of no less than eight inches. This schedule should continue throughout the first growing season and possibly the second, as noted below.

In the second growing season, the seeded areas should be periodically assessed by a botanist or other individual with plant identification skills. If the majority of vegetation in a given area is native species from the seed mixes, then the mowing schedule for that area should transition to a once-a-year mowing. This should always occur during the dormant season (preferably as late after November 15 as possible but before April 1), after plants have gone to seed or before they begin next season's growth. Ideally, the site would be broken up into two or three mowed sections, with each section mowed once a year on a rotational basis. During this annual mowing, vegetation should be cut to a height of 6-8 inches. If, during the second growing season, the majority of vegetation in a given area appears to remain non-native grasses and/or weeds, then mowing should be continued to keep the overall height of plants between eight and 12 inches. This regime should be followed until the third growing season.

By the third growing season, the site should be ready for transition to an annual mowing of all or portions of the area on a rotational basis, as described above, in late winter or early spring.

Invasive species and early successional trees should be closely monitored throughout the 3-5 year establishment period, and either manually grubbed using a weed wrench, mechanically grubbed using a brush grubber, or applied with herbicides in a cut stump treatment (by a licensed pesticide applicator).

Fall "clean-ups" are not warranted for the pollinator habitat. Allowing dead stems, leaves and seed heads to stand over winter and into the next spring and growing season are beneficial. Some "weeds" act as host plants for caterpillars, such as lambsquarters (*Chenopodium album*) for common sootywing (*Pholisora catullus*) and Queen Anne's lace (*Daucus carota*) for black swallowtail (*Papilio polyxenes*).

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Attachment 1:

Photographs of the South Staging Area and Prospective Pollinator Habitat Conditions

AECOM

PHOTOGRAPHIC LOG

Client Name: GE	**Site Location:** Kirvin Park south staging area	**Project No.**

Photo No. 1	**Date:** 5/1/25	**Photo No. 2**	**Date:** 5/1/25

Description: View of buckthorn and Morrow's honeysuckle growth in south staging area.

Description: Buckthorn and garlic mustard growth in south staging area.

Photo No. 3	**Date:** 11/20/24	**Photo No. 4**	**Date:** 5/1/25

Description: View of south staging area habitat in the fall of 2024. Buckthorn and multiflora rose thicket on the right.

Description: Low-lying swale in east side of south staging area. Scattered buckthorn growth.

AECOM

PHOTOGRAPHIC LOG

Client Name: GE	**Site Location:** Kirvin Park Pollinator Habitat	**Project No.**

Photo No. 5	**Date:**	**Photo No. 6**	**Date:**
Description: View of intended pollinator habitat conditions.		**Description:** View of intended pollinator habitat conditions.	

Photo No. 7	**Date:**	**Photo No. 8**	**Date:**
Description: View of intended pollinator habitat conditions.		**Description:** View of intended pollinator habitat conditions.	

Attachment 2:

Pollinator Habitat Plant Species Lists

Note: Figure 6-7 in the main text of the Final Restoration Plan provides listings of acceptable seed mixes for establishing the pollinator habitat at Kirvin Park, as well as the tree and shrub species anticipated to be installed at the pollinator area. However, the final selection of seed mixes and plant species will reflect the input from the selected contractor based on availability, timing, and other factors. The attached lists are intended to include additional lists of acceptable plant species that may be considered for establishing the Kirvin Park pollinator habitat.

CREATING POLLINATOR-FRIENDLY GARDENS WITH NATIVE PLANTS: LOCALLY-AVAILABLE OPTIONS

Interested in improving pollinator resources on your property? The Massachusetts Department of Agricultural Resources has developed this list of native plant species commonly available at local nurseries. It includes basic information about flower color, light and soil moisture requirements, and flowering time, so that you can create habitat that supports a wide variety of insects.

Tips:

- Each section is organized by flowering season - choose a suite of species that provide pollinator resources in spring, summer, and fall
- Place plants in sweeps (several of the same species planted along a curve) to make it easier for pollinators to find the plants they prefer
- Support the greatest diversity of pollinator insects by selecting a variety of flower colors, shapes, and sizes
- If you are looking for true native species, stick with the plants that have a checkmark in the "Native to New England" column
- Need help determining the species that will grow best on your property, or have other questions? Consult with your local nursery or landscaper

PERENNIALS

Name	Flower Color	Light	Moisture	Flowering Time	Native to New England	Native to Northeast
Allegheny spurge *(Pachysandra procumbens)*	white	◐ ●	◑ ◉	spring	✓	✓
bloodroot (*Sanguinaria canadensis*)	white, pink	◐ ●	◑ ◉	spring	✓	✓
Canada wild ginger (*Asarum canadense*)	brown	◐ ●	◑ ◉	spring	✓	✓
golden star (*Chrysogonum virginianum*)	yellow	☼ ◐ ●	○ ◑	spring		✓
marsh marigold (*Caltha palustris*)	yellow	☼ ◐ ●	◉ ◉	spring	✓	✓
moss pink (*Phlox subulata*)	white, blue, pink, red	☼ ◐	○ ◑	spring		✓
red columbine (*Aquilegia canadensis*)	red, yellow, pink	☼ ◐	○ ◑	spring	✓	✓
wild blue phlox (*Phlox divaricata*)	pink, lavender	◐ ●	◑ ◉	spring	✓	✓
creeping phlox (*Phlox stolonifera*)	purple, blue, pink	◐ ●	◑ ◉	spring, summer		✓
Culver's root (*Veronicastrum virginicum*)	white	☼ ◐	◑ ◉	spring, summer	✓	✓
Eastern bluestar (*Amsonia tabernaemontana*)	blue/purple	☼ ◐	◑ ◉	spring, summer	✓	✓
foam flower (*Tiarella cordifolia*)	white, pink	◐ ●	◑	spring, summer	✓	✓
sundrops (*Oenothera fruticosa*)	yellow	☼ ◐	○ ◑	spring, summer	✓	✓
black cohosh (*Actaea racemosa*)	white, light pink	☼ ◐ ●	○ ◑ ◉	spring, summer, fall	✓	✓
fringed bleeding-heart (*Dicentra eximia*)	pink to red	☼ ◐ ●	○ ◑ ◉	spring, summer, fall		✓

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PERENNIALS, CONT.

Name	Flower Color	Light	Moisture	Flowering Time	Native to New England	Native to Northeast
bee balm (*Monarda didyma*)	violet, red, pink	☼ ◐	◔ ◕	summer		✓
big blue Lobelia (*Lobelia siphilitica*)	blue	☼ ◐	◔ ◕ ●	summer	✓	✓
blue wild indigo (*Baptisia australis*)	blue	☼ ◐	○ ◔	summer	✓	✓
butterfly weed (*Asclepias tuberosa*)	orange	☼	○	summer	✓	✓
cardinal flower (*Lobelia cardinalis*)	red	☼ ◐ ●	◕ ●	summer	✓	✓
dwarf crested iris (*Iris cristata*)	blue, white	◐ ●	○ ◔	summer		✓
fall phlox (*Phlox paniculata*)	pink/white, blue, etc.	☼ ◐	◔ ◕	summer	✓	✓
foxglove beardtounge (*Penstemon digitalis*)	pink, purple, white, red	☼ ◐	○ ◔	summer	✓	✓
Joe pye weed (*Eupatorium maculatum*)	lavender/pink	☼ ◐	◔ ◕ ●	summer	✓	✓
New York ironweed (*Vernonia noveboracensis*)	purple	☼ ◐	◕ ●	summer	✓	✓
northern blue flag iris (*Iris versicolor*)	purple	☼ ◐	◔ ◕	summer	✓	✓
obedient plant (*Physostegia virginiana*)	white	☼ ◐	◔	summer	✓	✓
swamp milkweed (*Asclepias incarnata*)	pink	☼ ◐	◔ ◕ ●	summer	✓	✓
turtlehead (*Chelone lyonii*)	pink	☼ ◐	◕ ●	summer	✓	✓
wrinkle-leaved goldenrod (*Solidago rugosa*)	yellow	☼ ◐	○ ◔ ◕ ●	summer	✓	✓
blazing star (*Liatris spicata*)	purple, white	☼ ◐	◔ ◕	summer, fall	✓	✓
Bolton's aster (*Boltonia asteroides*)	white, lavender, pink	☼ ◐	◔	summer, fall	✓	✓
false sunflower (*Heliopsis helianthoides*)	yellow	☼ ◐	○ ◔	summer, fall	✓	✓
thread-leaved tickseed (*Coreopsis verticillata*)	yellow, pink	☼ ◐	○ ◔	summer, fall		✓
New England aster (*Aster novae-angliae*)	pink, purple	☼ ◐	◕ ●	fall	✓	✓
smooth aster (*Aster laevis*)	purple	☼ ◐	○ ◔	fall	✓	✓
white snakeroot (*Ageratina altissima* var. *altissima*)	white	☼ ◐	○ ◔ ◕	fall	✓	✓

SHRUBS

Name	Flower Color	Light	Moisture	Flowering Time	Native to New England	Native to Northeast
American cranberry (*Vaccinium macrocarpon*)	white, pinkish	☼ ◐	◔ ◕ ●	spring	✓	✓
arrowwood Viburnum (*Viburnum dentatum*)	white	☼ ◐	◔ ◕ ●	spring	✓	✓
beach plum (*Prunus maritima*)	white	☼	○	spring	✓	✓
bearberry (*Arctostaphylos uva-ursi*)	white	☼	○ ◔	spring	✓	✓
clammy azalea (*Rhododendron viscosum*)	white, pink	☼ ◐	◔ ◕ ●	spring	✓	✓
fragrant sumac (*Rhus aromatica*)	greenish yellow	☼ ◐	○ ◔	spring	✓	✓
gray twig dogwood (*Cornus racemosa*)	white	☼ ◐ ●	◔ ◕ ●	spring	✓	✓
highbush blueberry (*Vaccinium corymbosum*)	white, pinkish	☼ ◐	◔ ◕ ●	spring	✓	✓
lowbush blueberry (*Vaccinium angustifolium*)	white, pinkish	☼ ◐ ●	○ ◔	spring	✓	✓
red chokeberry (*Aronia arbutifolia*)	white	☼ ◐	◔ ◕ ●	spring	✓	✓
red twig dogwood (*Cornus sericea*)	white	☼ ◐	◔ ◕ ●	spring	✓	✓
Rhodora (*Rhododendron canadense*)	purple, white	☼ ◐	◔ ◕ ●	spring	✓	✓
silky dogwood (*Cornus amomum*)	yellowish white	☼ ◐	◔ ◕ ●	spring	✓	✓
spicebush (*Lindera benzoin*)	greenish yellow	☼ ◐ ●	◔ ◕ ●	spring	✓	✓
sweet azalea (*Rhododendron arborescens*)	white	☼ ◐	◔ ◕	spring		✓
sweetfern (*Comptonia peregrina*)	yellowish-green	☼ ◐	○ ◔	spring	✓	✓
American cranberry bush (*Viburnum opulus* var. *americanum*)	white	☼ ◐	◔ ◕ ●	summer	✓	✓
American hydrangea (*Hydrangea arborescens*)	white	☼ ◐ ●	○ ◔	summer		✓
American wintergreen (*Gaultheria procumbens*)	white with pink tinge	☼ ◐ ●	○ ◔ ◕	summer	✓	✓
buttonbush (*Cephalanthus occidentalis*)	white	☼ ◐	◕ ●	summer	✓	✓
inkberry (*Ilex glabra*)	white	☼ ◐	◔ ◕ ●	summer	✓	✓
mountain laurel (*Kalmia latifolia*)	pinkish white	☼ ◐ ●	○ ◔ ◕	summer	✓	✓
ninebark (*Physocarpus opulifolius*)	white	☼ ◐	○ ◔ ◕	summer	✓	✓
rosebay rhododendron (*Rhododendron maximum*)	white, pink, purple	☼ ◐ ●	○ ◔ ◕ ●	summer	✓	✓

SHRUBS, CONT.

Name	Flower Color	Light	Moisture	Flowering Time	Native to New England	Native to Northeast
shrubby cinquefoil (*Dasiphora floribunda*)	yellow	☼ ◐	○ ◑	summer	✓	✓
sweet pepperbush (*Clethra alnifolia*)	white, pink	☼ ◐ ●	◑ ◕ ●	summer	✓	✓
Virginia sweetspire (*Itea virginica*)	white	☼ ◐ ●	○ ◑ ◕	summer		✓
winged sumac (*Rhus copallinum*)	green	☼ ◐	○ ◑	summer	✓	✓
winterberry (*Ilex verticillata*)	white	☼ ◐	◑ ◕ ●	summer	✓	✓

TREES

Name	Flower Color	Light	Moisture	Flowering Time	Native to New England	Native to Northeast
Allegheny serviceberry (*Amelanchier laevis*)	white	☼ ◐	○ ◑	spring	✓	✓
American hornbeam (*Carpinus caroliniana* ssp. *virginiana*)	greenish, reddish-green	☼ ◐ ●	◑ ◕ ●	spring	✓	✓
Canadian serviceberry (*Amelanchier canadensis*)	white	☼ ◐	○ ◑ ◕	spring	✓	✓
Eastern redbud (*Cercis canadensis*)	pink	☼ ◐	◑ ◕	spring	✓	✓
flowering dogwood (*Cornus florida*)	white	☼ ◐	◑ ◕	spring	✓	✓
paper birch (*Betula papyrifera*)	brown, green	☼	◑ ◕	spring	✓	✓
red maple (*Acer rubrum*)	red	☼ ◐	◑ ◕ ●	spring	✓	✓
sugar maple (*Acer saccharum*)	red, green	☼ ◐	○ ◑	spring	✓	✓
sweetbay magnolia (*Magnolia virginiana*)	white	☼ ◐	◑ ◕ ●	spring	✓	✓
tulip tree (*Liriodendron tulipifera*)	yellow	☼ ◐	◑ ◕	spring	✓	✓
black gum (*Nyssa sylvatica*)	greenish-white	☼ ◐	◑ ◕ ●	spring, summer	✓	✓
sourwood (*Oxydendrum aboreum*)	white	☼ ◐ ●	◑ ◕	summer		✓
staghorn sumac (*Rhus typhina*)	greenish yellow	☼ ◐	○ ◑	summer	✓	✓
witchhazel (*Hamamelis virginiana*)	yellow	☼ ◐ ●	◑ ◕ ●	fall	✓	✓

GRASSES/RUSHES/SEDGES (provide habitat for pollinators)

Name	Flower Color	Light	Moisture	Flowering Time	Native to New England	Native to Northeast
Pennsylvania sedge (*Carex pensylvanica*)	green	full sun, part shade, shade	dry, average, moist	spring, summer	✓	✓
purple love grass (*Eragrostis spectabilis*)	reddish purple	full sun, part shade	dry, average	summer	✓	✓
switch grass (*Panicum virgatum*)	pinkish	full sun, part shade	dry, average	summer, fall, winter	✓	✓

KEY

Light

full sun   part shade   shade

Soil Moisture

dry   average   moist   wet

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Recommended Plants
for the Berkshire Region*

Latin Name	Common Name
Agastache scrophulariaefolia	Purple giant hyssop
Andropogon gerardii	Big bluestem
Asclepias incarnata	Swamp milkweed
Asclepias syriaca	Common milkweed
Cardamine concatenata	Toothwort
Cardamine diphylla	Two-leaved toothwort
Carex brevior	Plains oval sedge
Carex stricta	Tussock sedge
Cephalanthus occidentalis	Buttonbush
Cercis canadensis	Redbud
Chasmanthium latifolium	River oats
Cirsium muticum	Swamp thistle
Doellingeria umbellata	Tall white aster
Eragrostis spectabilis	Purple Lovegrass
Eutrochium fistulosum	Hollow Joe-Pye weed
Geranium maculatum	Spotted crane's-bill
Hypericum kalmianum	Kalm's St. John's-wort
Lobelia siphilitica	Blue lobelia
Lupinus perennis	Wild lupine
Mimulus ringens	Allegheny monkeyflower
Monarda didyma	Scarlet beebalm
Monarda fistulosa	Wild bergamot
Monarda punctata	Spotted beebalm
Panicum virgatum	Switchgrass
Pedicularis canadensis	Canadian wood betony
Penstemon digitalis	Foxglove beardtongue
Penstemon hirsutus	Northeastern beardtongue
Physostegia virginiana	Obedient false dragonhead

Latin Name	Common Name
Prunella vulgaris ssp. lanceolata	Common selfheal
Ribes rubrum	Red currant
Rosa nitida	Shining rose
Rosa palustris	Swamp rose
Rosa virginiana	Virginia rose
Rubus odoratus	Purple-flowering raspberry
Rumex orbiculatus	Great water dock
Salix bebbiana	Bebb's willow
Salix discolor	Pussy willow
Salix petiolaris	Meadow willow
Salix sericea	Silky willow
Sambucus nigra	Black elderberry
Schizachyrium scoparium	Little bluestem
Solidago altissima	Tall goldenrod
Solidago arguta	Forest goldenrod
Solidago caesia	Axillary goldenrod
Solidago juncea	Early goldenrod
Solidago odora	Sweet goldenrod
Solidago speciosa	Showy Goldenrod
Spiraea alba	White meadowsweet
Spiraea tomentosa	Steeplebush
Symphyotrichum lateriflorum	Calico aster
Symphyotrichum novi-belgii	New York American-aster
Symphyotrichum puniceum	Purple-stemmed American-aster
Vaccinium angustifolium	Lowbush blueberry
Vaccinium corymbosum	Highbush blueberry
Vaccinium macrocarpon	Large cranberry
Zizia aurea	Golden Alexanders

**Plant recommendations are site-specific and based on landscape conditions at French Park.*

NEW ENGLAND WETLAND PLANTS, INC

14 Pearl Lane South Hadley, MA 01075
PHONE: 413-548-8000 FAX 413-549-4000
EMAIL: INFO@NEWP.COM WEB ADDRESS: WWW.NEWP.COM

New England Showy Wildflower Mix

Botanical Name	Common Name	Indicator
Schizachyrium scoparium	Little Bluestem	FACU
Chamaecrista fasciculata	Partridge Pea	FACU
Sorghastrum nutans	Indian Grass	UPL
Festuca rubra	Red Fescue	FACU
Elymus canadensis	Canada Wild Rye	FACU+
Elymus riparius	Riverbank Wild Rye	FACW
Heliopsis helianthoides	Ox Eye Sunflower	UPL
Coreopsis lanceolata	Lance Leaved Coreopsis	FACU
Rudbeckia hirta	Black Eyed Susan	FACU-
Liatris spicata	Spiked Gayfeather/Marsh Blazing Star	FAC+
Asclepias syriaca	Common Milkweed	FACU-
Vernonia noveboracensis	New York Ironweed	FACW+
Aster novae-angliae (Symphyotrichum novae-anglia	New England Aster	FACW-
Eupatorium purpureum (Eutrochium maculatum)	Purple Joe Pye Weed	FAC
Asclepias tuberosa	Butterfly Milkweed	NI
Solidago juncea	Early Goldenrod	
Eupatorium perfoliatum	Boneset	FACW

APPLY: 23 LBS/ACRE :1900 sq ft/lb

The New England Showy Wildflower mix includes a selection of native wildflowers and grasses that will mature into a colorful and vibrant native meadow. It is appropriate seed mix for roadsides, commercial landscaping, parks, golf courses, and industrial sites. Always apply on clean bare soil. The mix may be applied by mechanical spreader, or on small sites it can be spread by hand. Lightly rake, or roll to ensure proper seed to soil contact. Best results are obtained with a Spring or late Fall dormant seeding. Late Spring and early Summer seeding will benefit with a light mulching of weed-free straw to conserve moisture. If conditions are drier than usual, watering may be required. Late Fall and Winter dormant seeding require an increase in the seeding rate. Fertilization is not required unless the soils are particularly infertile. Preparation of a clean weed free seed bed is necessary for optimal results.

New England Wetland Plants, Inc. may modify seed mixes at any time depending upon seed availability. The design criteria and ecological function of the mix will remain unchanged. Price is $/bulk pound, FOB warehouse, Plus SH and applicable taxes.

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New England Wildflower Mix

Botanical Name	Common Name	Indicator
Schizachyrium scoparium	Little Bluestem	FACU
Sorghastrum nutans	Indian Grass	UPL
Chamaecrista fasciculata	Partridge Pea	FACU
Elymus virginicus	Virginia Wild Rye	FACW-
Elymus canadensis	Canada Wild Rye	FACU+
Festuca rubra	Red Fescue	FACU
Asclepias tuberosa	Butterfly Milkweed	NI
Vernonia noveboracensis	New York Ironweed	FACW+
Oenothera biennis	Evening Primrose	FACU-
Aster novae-angliae (Symphyotrichum novae-anglia	New England Aster	FACW-
Rudbeckia hirta	Black Eyed Susan	FACU-
Solidago juncea	Early Goldenrod	
Eupatorium fistulosum (Eutrochium fistulosum)	Hollow-Stem Joe Pye Weed	FACW
Aster lateriflorus (Symphyotrichum lateriflorum)	Starved/Calico Aster	FACW

APPLY: 23 LBS/ACRE :1900 sq ft/lb

New England Wetland Plants, Inc. may modify seed mixes at any time depending upon seed availability. The design criteria and ecological function of the mix will remain unchanged. Price is $/bulk pound, FOB warehouse, Plus SH and applicable taxes.

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14 Pearl Lane South Hadley, MA 01075

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EMAIL: INFO@NEWP.COM WEB ADDRESS: WWW.NEWP.COM

New England Conservation/Wildlife Mix

Botanical Name	Common Name	Indicator
Elymus virginicus	Virginia Wild Rye	FACW-
Schizachyrium scoparium	Little Bluestem	FACU
Andropogon gerardii	Big Bluestem	FAC
Festuca rubra	Red Fescue	FACU
Sorghastrum nutans	Indian Grass	UPL
Panicum virgatum	Switch Grass	FAC
Chamaecrista fasciculata	Partridge Pea	FACU
Desmodium canadense	Showy Tick Trefoil	FAC
Asclepias tuberosa	Butterfly Milkweed	NI
Bidens frondosa	Beggar Ticks	FACW
Eupatorium purpureum (Eutrochium maculatum)	Purple Joe Pye Weed	FAC
Rudbeckia hirta	Black Eyed Susan	FACU-
Aster pilosus (Symphyotrichum pilosum)	Heath (or Hairy) Aster	UPL
Solidago juncea	Early Goldenrod	

APPLY: 25 LBS/ACRE :1750 sq ft/lb

The New England Conservation/Wildlife Mix provides a permanent cover of grasses, wildflowers, and legumes For both good erosion control and wildlife habitat value. The mix is designed to be a no maintenance seeding, and is appropriate for cut and fill slopes, detention basin side slopes, and disturbed areas adjacent to commercial and residential projects.

New England Wetland Plants, Inc. may modify seed mixes at any time depending upon seed availability. The design criteria and ecological function of the mix will remain unchanged. Price is $/bulk pound, FOB warehouse, Plus SH and applicable taxes.