Challenge Grant Implementing the Commonwealth's Healthy Soils Action Plan
COMMBUYS Bid #BD-24-1042-ENV-ENV01-96064
RFR ID: ENV 24 DCS 08
Offeror: Evan Abramson, Managing Member, LandscapeInteractions LLC
Solicitation Title: Healthy Soil through Maximum Biodiversity: Farmscape Models for Resilient Design and Land Management Using Pollinator Habitat

February 1, 2024

To Whom It May Concern,

On behalf of Landscape Interactions LLC as its Owner and Managing Member, I submit the attached proposal to the Challenge Grant Implementing the Commonwealth's Healthy Soils Action Plan RFR, entitled **Healthy Soil through Maximum Biodiversity: Farmscape Models for Resilient Design and Land Management Using Pollinator Habitat**. The submission of this proposal binds Landscape Interactions LLC to enter into a professional services contract with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Division of Conservation Services for the contract period, should the proposal be accepted. This proposal is firm for ninety (90) days.

Landscape Interactions is an interdisciplinary landscape planning and design firm based in Western Massachusetts, with a demonstrated track record of public education and high quality, original designs and publications in the form of scalable, replicable habitat designs, farmscape land management guidelines, site-specific landscape designs, watershed-based regional plans and pollinator action plans. What makes our design and planning services unique is that they are scientifically-based, and backed by research. We improve ecosystems, document the results and teach others how to do it themselves.

Landscape Interactions has ample prior experience creating resilient, biodiverse designs for farms and landscapes across the region, conducting scientific research as well as organizing successful community workshops and educational events. We pride ourselves on our numerous, diverse collaborations with municipal governments, conservation organizations, regional planning organizations, farms, schools, private landowners, Native American tribes, federal land management agencies, non-profit organizations and solar companies. To date, we have been responsible for designing and planning over 300 acres of installed, biodiverse habitat to support native pollinators and wildlife across the Northeast.

We offer the attached proposal with the intent of collaborating closely with the EEA and our project partners — NOFA/Mass, Nuestras Raíces, Indian Line Farm, Red Fire Farm and Stonebridge Farm —

to demonstrate a series of new practices to improve soil health across Western Massachusetts. Through the integration of biodiverse, native pollinator-supporting vegetation, we will implement 11 scalable, replicable design models for healthy soils land management across the five participating farms. These models will serve as case study sites and an applicable reference for a broad range of properties and landscapes across the Commonwealth. Our comprehensive public outreach and engagement strategy will culminate in the publication of a fully illustrated PDF manual documenting the project, detailing the implemented healthy soils practices, providing user-friendly guidelines and BMPs, and featuring baseline data for each site on soil health, soil organic carbon and pollinator species diversity.

As you will see, our proposed project meets **all four objectives** of the Healthy Soils Challenge Grant as outlined in the RFR. We thank you for this unique opportunity to build a more resilient landscape across the Commonwealth on the foundation of healthy soils, and look forward to your review of our proposal.

Sincerely,

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LANDSCAPE | NTERACTIONS

designing biodiversity through pollination science

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Project Description

Healthy soil makes biodiversity happen. In turn biodiversity, including all its component parts, from microbes and fungal threads to pollinator plants and mast producing trees to top predators, is nature's engine that keeps soils healthy and drives carbon, water, nutrient and energy cycling.

Healthy Soils Action Plan

Land use and land cover play outsized roles in determining the health of soils and ecosystems. Natural, undisturbed landscapes consisting of a wide diversity of native perennial vegetation contribute directly to not only soil health but also soil carbon sequestration (Yang et al., 2019). While landscape development and habitat loss are inevitable, insofar as human populations continue to grow and require new resources, well-informed landscape design and management decisions can have an outsized role in buffering the impacts to soils and ecosystems by restoring biodiversity in the form of plant-pollinator communities and the terrestrial food webs they support. That is the purpose of this project.

The 2023 Massachusetts Healthy Soils Action Plan (HSAP) makes recommendations for improving soil health across the five major land covers of the Commonwealth: Forests, Wetlands and Agriculture (Natural and Working Lands), as well as Recreational/Ornamental and Impervious/Urbanized Lands (Developed Landscapes) (HSAP, p. 5). Within those five categories, forests represent the largest land cover in the State, as well as the second largest carbon pool after wetlands. The per-acre soil organic carbon (SOC) stocks of wetlands in Massachusetts are on average six times as high as those of forests (HSAP, p. 57). Protecting and enhancing the carbon sequestration capabilities of both forested and wetland landscapes in the Commonwealth is crucial, as soil organic carbon is one of the few universally agreed-upon indicators of soil health (HSAP, p. 21).

Farms Matter

Farms represent a unique opportunity for improving soil health across large swaths of the State. Freshwater wetlands comprise 82% of the acreage of all wetland resources in Massachusetts (Rhodes et al., 2019), and many farms in Massachusetts contain freshwater wetland ecosystems on or adjacent to their properties, in the form of such features as wet meadows, shrub swamps, wooded swamps, marshes, bogs and riparian habitat. Significantly, farmers as a group are the single largest forest holders in the State (HSAP, p. 67), and land management in upland areas surrounding a wetland exert a strong influence on that habitat. In order to maintain healthy wetland soils, healthy upland soils must also be maintained (HSAP, p. 49).

Any project that is successful in 1) educating farmers regarding the manifold benefits of resilient design and landscape management and 2) providing them with the necessary technical assistance and resources for improving the functional diversity of their landscapes through biodiverse combinations of woody and herbaceous perennial vegetation is a triple, if not quadruple win for soil health. First, the health of agricultural, wetland and forested soils across the Commonwealth will be improved, including their SOC stocks. Second, this will occur at a scale that is not only formidable, but scalable and replicable across other working landscapes, as many farms grow the same crops and share similar land uses and landscape management practices. Third, urban farms and soils will also benefit, representing a rapidly growing sector of the agricultural community, and an important intervention for Massachusetts' developed landscapes. Fourth, improving the soils and landscape biodiversity of urban farms also provides the added benefit of directly contributing to quality of life improvements for communities who are the most in need of green space, food security, stormwater management, carbon sequestration, air purification and mitigation of climate change impacts, such as the urban heat island effect.

Higher Biodiversity, Healthier Soils

Plant diversity enhances SOC storage in many ecosystems, likely by positively influencing plant productivity and thereby increasing organic carbon input to soil (Spohn et al., 2023 and citations within). Diverse plant communities are not only primary drivers for healthy soils but highly productive and functional ecosystems as well, including agricultural systems. A one percent rise in soil organic matter can boost water retention by up to 20,000 gallons per acre (Bryant, 2015; HSAP, p. 21), providing tremendous benefits to farmers, particularly during hot, dry summer months when most food crops are actively growing. According to a white paper published by NOFA/Mass (Kittredge, 2015), perennial growing systems can restore more carbon than most other agricultural methods. Encouraging diversity is one of the keys to supporting soil microbial life: the more biodiversity there is in a system, the healthier and more resilient it is. This is also true when building soil carbon (Lal, 2004). Below ground, biodiversity enables every microbe to fill a niche in the food web — fungi, algae, bacteria, earthworms, termites, ants, nematodes, dung beetles. Above ground, crop diversity keeps [pest and disease] infestations from growing and spreading (Kittredge, 2015). Diverse perennial vegetation on the farmscape — in the form of native trees, shrubs, flowers, grasses, sedges and vines — goes even further by attracting and sustaining important pest predators such as wasps, flies, beetles, spiders and ladybugs, many of whom are also pollinators.

Why Pollinators?

Native pollinators are vital to creating and maintaining the habitats and ecosystems that most animals — including humans — rely on for food and shelter. What happens at the pollination scale has repercussions all the way through the food web. Over 80% of the Earth's flowering plants, including trees, depend upon insect-mediated pollination; bees alone pollinate one-third of the food grown in the United States, and 45% of the food grown in Massachusetts (Massachusetts Department of Agricultural Resources). A global study of 41 crops in 600 fields across every populated continent revealed that wild pollinators were twice as effective as honeybees in seed and fruit production (Garibaldi et al., 2013). In the United States, wild bee pollination services were valued at $3.07 billion in 2006 (Losey & Vaughan, 2006), a conservative estimate of wild bee pollination's contemporary value given the increase in pollinator-dependent crop plants over the past decade (Russo et al., 2013; Mathiasson & Rehan, 2020).

As ***keystone species***, wild pollinators provide food, shelter and nest sites to wildlife at other trophic levels through their interactions with native flowering plants (Gegear, personal communication, 2019). Protecting a diversity of native pollinator-plant interactions, or "pollination systems" (Gegear, 2018) is therefore critical for maintaining healthy ecosystems, including wetlands, forests and fields. Pollination systems include bees, butterflies, moths, birds, beetles and flies, and represent over 80% of plant species worldwide (Gegear, 2018).

Just like humans, pollinators need nutrient-dense food, shelter, and successful reproduction to thrive. But not all species require the same thing. Plant diversity is key. A delicate balance exists between native plants and their pollinators, relationships that evolved over millions of years. Some plants rely on a small guild of coevolved species to ensure their pollination. Similarly, approximately 15% of northeastern native bees are considered pollen specialists (Fowler, 2016). For many specialists, once their "partner" is missing from the landscape, they cannot reproduce, and are therefore at risk of extirpation, endangerment and eventual extinction.

Goals and Objectives

The objective of this project is to demonstrate and implement a series of new practices to improve soil health at five Western Massachusetts farms, through the incorporation of biodiverse, native pollinator-supporting vegetation. Each farm will represent a unique form of resilient design or landscape management, with two to three practices implemented at each farm across seven locations. Located in Berkshire, Franklin, Hampden and Hampshire Counties, these farms represent the diverse range of landscapes found across the Commonwealth. As such they will serve as appropriate demonstration sites for farmers, landowners and land managers across the State to learn from. **What is perhaps most valuable about this project's selected farms and landscape practices is that they represent all of the Commonwealth's dominant land covers, including wetlands, forest, cropland, pasture and developed landscapes (recreational/ornamental as well as impervious/urbanized).**

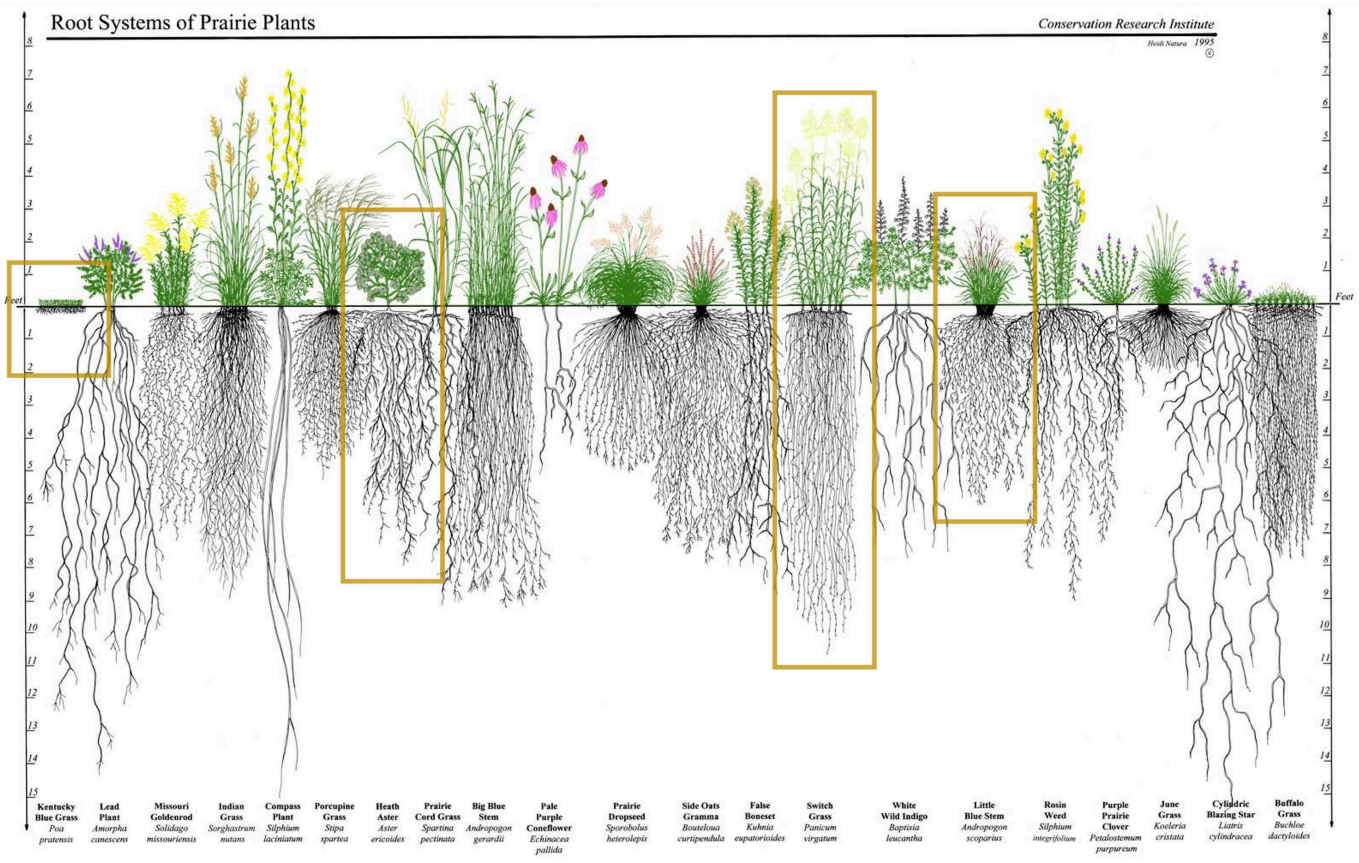
Beginning at the start of the 2024 growing season, a range of data will be collected from each site including comprehensive soil analyses, soil organic carbon levels and pollinator species surveys. This data will establish baseline conditions at each farm for future comparison, demonstrating this project's impact on soil health, SOC and pollinator diversity. Findings will be published and shared widely through a robust community education and engagement strategy that includes hands-on

demonstrations at each farm, youth leadership development, college and faith-based community service networks, social media, podcasts, press releases, as well as state-wide and regional conferences geared specifically to farmers, conservation commission members, regional planners, land managers, gardeners and environmental professionals.

All work completed through this grant will be a collaboration between Landscape Interactions, NOFA/Mass and the farmers and community organizers responsible for the day-to-day operations at each site. EEA grant funds will be used completely within FY24, with all work occurring after June 30, 2024 to be offered as in-kind match by Landscape Interactions, NOFA/Mass and the participating farms.

This project meets **all four objectives** of the Healthy Soils Challenge Grant as outlined in the RFR:

1. **Promote Soil Health.** We will create and implement 11 scalable and replicable designs across the five participating farms on seven sites (Red Fire Farm and NOFA/Mass each have two locations). These projects will document, prioritize and execute practices aimed at improving soil health through various science-based techniques, all of which will emphasize the incorporation of deep-rooted native perennial plantings to boost biodiversity. A list of literature that supports this approach may be found here.



Root Systems of Prairie Plants, copyright 1995 Heidi Natura, annotated by Landscape Interactions

2. **Sustainable Land Management.** The projects will take innovative approaches to sustainable land management, enhance biodiversity, improve climate resilience, increase drought resilience,

reverse environmental degradation and restore soil health. These strategies will include but are not limited to:

- Increasing carbon sequestration and ecosystem function of wetlands through restoration planting design and land management changes
- Creating riparian buffers using native vegetation and nature-based stormwater solutions
- Minimizing soil disturbance and reducing tillage through regenerative practices such as rotational livestock grazing and perennial agriculture
- Establishing agroforestry practices in both urban and rural agricultural settings
- Incorporating deep-rooted, perennial vegetation alongside annual food crops
- Converting non-native pastures to biodiverse native plant communities
- Restoring forest edges for early and mid-successional habitat
- Prioritizing the use of native plants that directly support the pollen, nectar and host plant requirements of at-risk native pollinator species
- Encouraging wild pollination of food crops and mixed native/productive plantings, increasing local food security
- Managing and removing invasive species without the use of herbicides

A list of literature that supports this approach may be found here.

Livestock grazing on native grasses in Franklin County, courtesy of Landscape Interactions

3. **Community Engagement.** Our project will educate farmers, gardeners, landowners, land managers, youth leaders and community leaders in practical, actionable practices for soil health improvement and sustainable land management, both during and after the grant period (see

Sustainability Plan). Community engagement will be centered around hands-on workshops at the participating farms and urban gardens, urban youth leadership trainings, and the publication of a comprehensive, easily accessible, fully illustrated PDF manual available for free download online (see Prior Work). We will also present on this project at statewide and regional conferences as well as through online webinars available on platforms like Youtube. All on-site educational events, publications and presentations will be actively promoted through press releases, podcasts and email blasts; NOFA/Mass, Landscape Interactions, and the participating farms will share to each of their own subscriber lists, many of which number in the thousands. See Methodology, Public Education + Outreach for a full description of our community engagement plan.

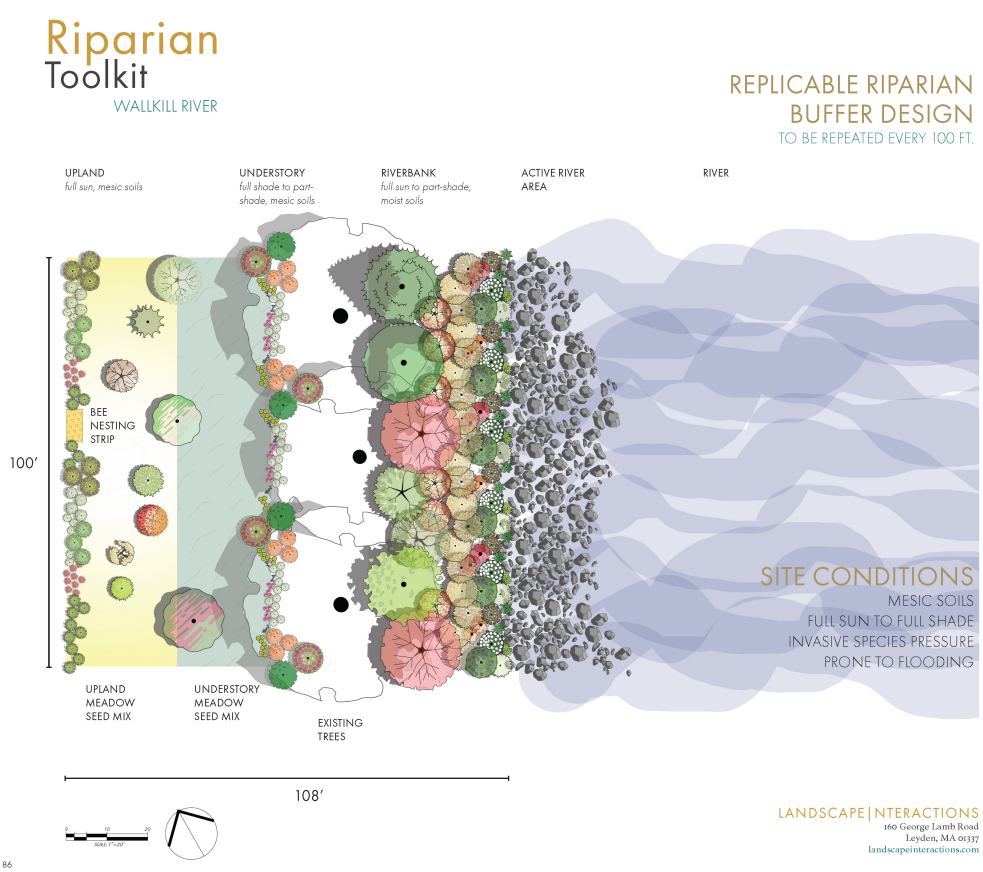
Community engagement event at a public park in Wellesley led by Landscape Interactions

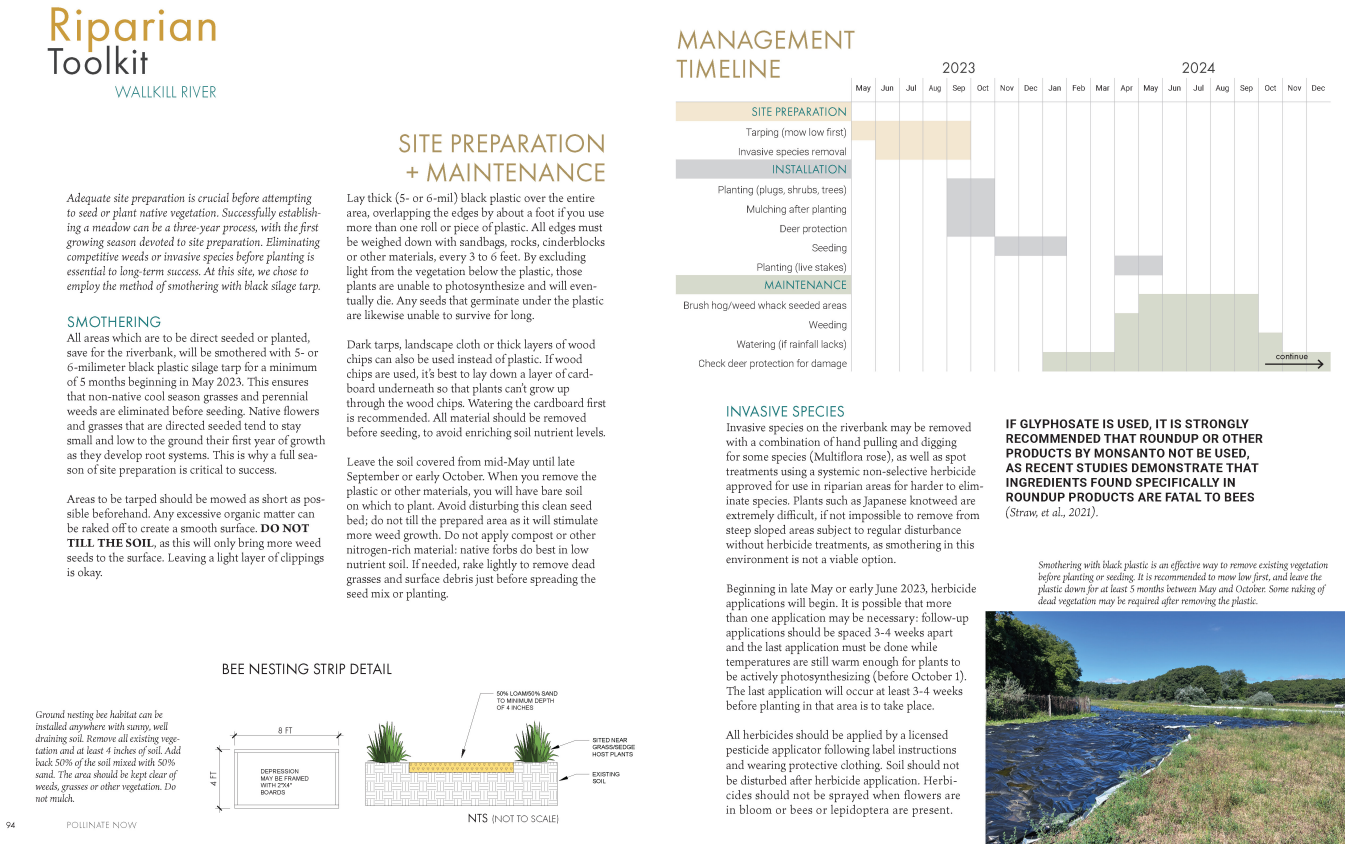
4. **Improving Tools for Assessment/Planning.** The final deliverable for this project is an illustrated PDF manual that describes step-by-step the process by which each of the 11 sustainable land management and design practices were created for the participating farms and urban gardens. Each practice will be scalable and replicable on similar landscapes across the Commonwealth. The manual will equip readers with the necessary tools to site, plan and implement resilient healthy soils practices into their existing workflows. Its distribution will extend beyond farmers, gardeners, and land managers to include municipalities, regional planning districts, conservation organizations and the general public.

   In addition to Geographic Information System (GIS) workflows for mapping the existing conditions of properties and selecting appropriate management strategies for particular site

conditions, the manual will also provide detailed diagrams and instructions regarding plant layout, site preparation, installation and maintenance. It will address meadow establishment, mowing regimes, plant selection based on site conditions, and will feature a list of target at-risk native pollinator species, the plants that support their varied pollen, nectar and host plant requirements, and a list of local and regional nurseries and seed suppliers specializing in native plants. See Prior Work for examples of past projects by Landscape Interactions that are similar in scope.

The final PDF manual will present the baseline data collected on each participating farm, including soil health assessments, soil organic carbon (SOC) levels, and a list of all the bee and butterfly species observed throughout the 2024 growing season. These baseline measurements can be compared to future data collected at each site to demonstrate the project's impact on soil health, soil carbon and pollinator species diversity. This protocol for assessing soil health and site biodiversity will be published in the final PDF manual so that municipalities, regional planning districts, conservation organizations, farmers and members of the public can replicate the same data collection for their own projects.





Riparian Toolkit
WALLKILL RIVER

SITE PREPARATION + MAINTENANCE

Adequate site preparation is crucial before attempting to seed or plant native vegetation. Successfully establishing a meadow can be a three-year process, with the first growing season devoted to site preparation. Eliminating competitive weeds or invasive species before planting is essential to long-term success. At this site, we chose to employ the method of smothering with black silage tarp.

SMOTHERING

All areas which are to be direct seeded or planted, save for the riverbank, will be smothered with 5- or 6-milimeter black plastic silage tarp for a minimum of 5 months beginning in May 2023. This ensures that non-native cool season grasses and perennial weeds are eliminated before seeding. Native flowers and grasses that are directed seeded tend to stay small and low to the ground their first year of growth as they develop root systems. This is why a full season of site preparation is critical to success.

Areas to be tarped should be mowed as short as possible beforehand. Any excessive organic matter can be raked off to create a smooth surface. **DO NOT TILL THE SOIL**, as this will only bring more weed seeds to the surface. Leaving a light layer of clippings is okay.

Lay thick (5- or 6-mil) black plastic over the entire area, overlapping the edges by about a foot if you use more than one roll or piece of plastic. All edges must be weighed down with sandbags, rocks, cinderblocks or other materials, every 3 to 6 feet. By excluding light from the vegetation below the plastic, those plants are unable to photosynthesize and will eventually die. Any seeds that germinate under the plastic are likewise unable to survive for long.

Dark tarps, landscape cloth or thick layers of wood chips can also be used instead of plastic. If wood chips are used, it's best to lay down a layer of cardboard underneath so that plants can't grow up through the wood chips. Watering the cardboard first is recommended. All material should be removed before seeding, to avoid enriching soil nutrient levels.

Leave the soil covered from mid-May until late September or early October. When you remove the plastic or other materials, you will have bare soil on which to plant. Avoid disturbing this clean seed bed; do not till the prepared area as it will stimulate more weed growth. Do not apply compost or other nitrogen-rich material: native forbs do best in low nutrient soil. If needed, rake lightly to remove dead grasses and surface debris just before spreading the seed mix or planting.

BEE NESTING STRIP DETAIL

Ground nesting bee habitat can be installed anywhere with sunny, well draining soil. Remove all existing vegetation and at least 4 inches of soil. Add back 50% of the soil mixed with 50% sand. The area should be kept clear of weeds, grasses or other vegetation. Do not mulch.

NTS (NOT TO SCALE)

MANAGEMENT TIMELINE

INVASIVE SPECIES

Invasive species on the riverbank may be removed with a combination of hand pulling and digging for some species (Multiflora rose), as well as spot treatments using a systemic non-selective herbicide approved for use in riparian areas for harder to eliminate species. Plants such as Japanese knotweed are extremely difficult, if not impossible to remove from steep sloped areas subject to regular disturbance without herbicide treatments, as smothering in this environment is not a viable option.

Beginning in late May or early June 2023, herbicide applications will begin. It is possible that more than one application may be necessary: follow-up applications should be spaced 3-4 weeks apart and the last application must be done while temperatures are still warm enough for plants to be actively photosynthesizing (before October 1). The last application will occur at least 3-4 weeks before planting in that area is to take place.

All herbicides should be applied by a licensed pesticide applicator following label instructions and wearing protective clothing. Soil should not be disturbed after herbicide application. Herbicides should not be sprayed when flowers are in bloom or bees or lepidoptera are present.

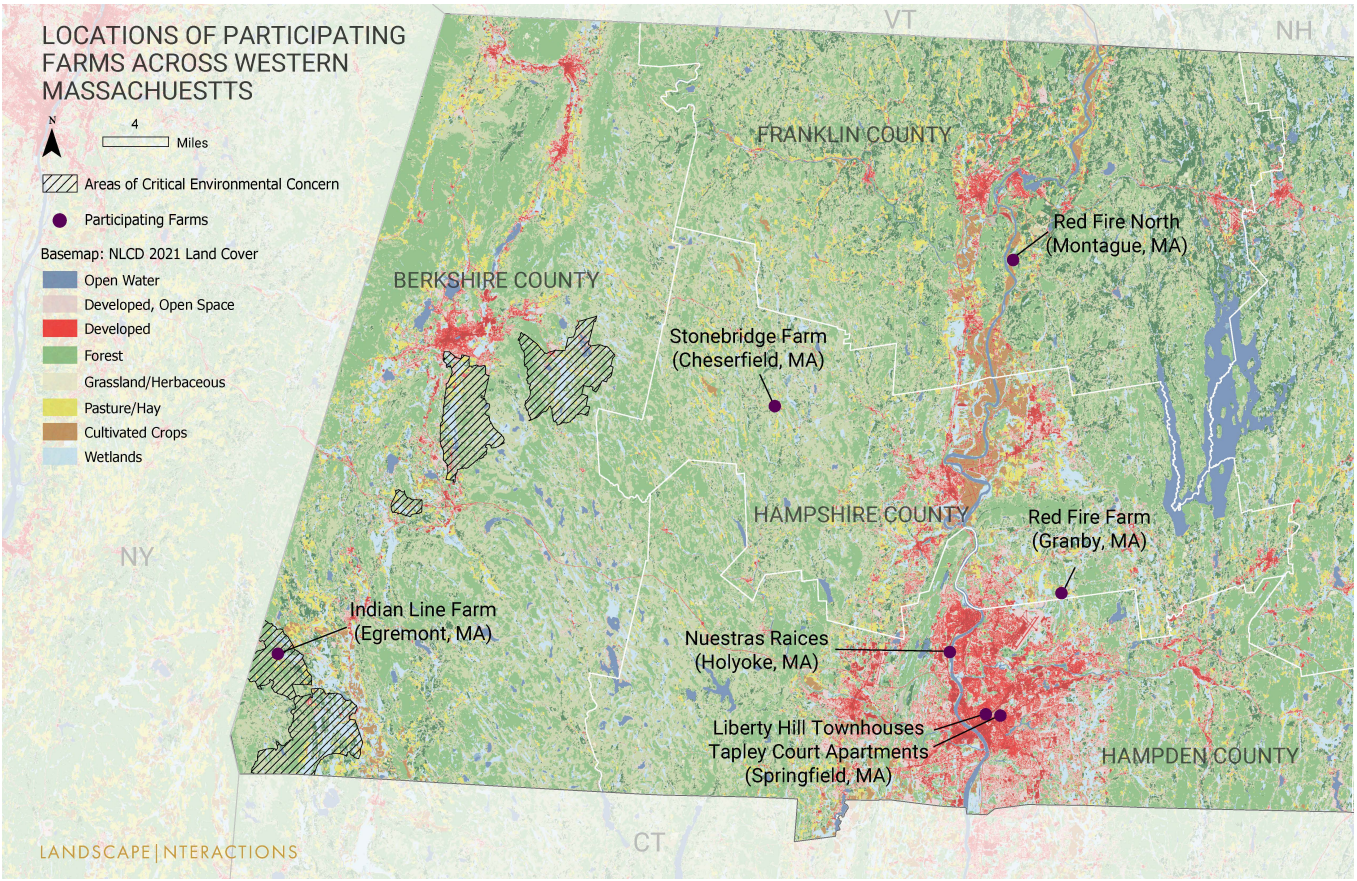
IF GLYPHOSATE IS USED, IT IS STRONGLY RECOMMENDED THAT ROUNDUP OR OTHER PRODUCTS BY MONSANTO NOT BE USED, AS RECENT STUDIES DEMONSTRATE THAT INGREDIENTS FOUND SPECIFICALLY IN ROUNDUP PRODUCTS ARE FATAL TO BEES *(Straw, et al., 2021).*

Smothering with black plastic is an effective way to remove existing vegetation before planting or seeding. It is recommended to mow low first, and leave the plastic down for at least 5 months between May and October. Some raking of dead vegetation may be required after removing the plastic.

Example of PDF manual with step-by-step instructions, courtesy of Landscape Interactions

Participating Farms

Landscape Interactions will realize 11 projects on five participating farms across seven locations: Indian Line Farm (Egremont), Red Fire Farm (Granby and Montague), Nuestras Raíces (Holyoke), NOFA/Mass Food Access (Community gardens at Tapley Court Apartments and Liberty Hill Townhouses, Springfield) and Stonebridge Farm (Chesterfield).



Locations of Participating Farms across Western Massachusetts, courtesy of Landscape Interactions

The projects at each location will serve as case studies for other farmers, landowners, land managers and members of the public to observe and learn from. The following goals will be accomplished through this grant, all of which were articulated by the participating farmers and community organizers at the case study sites:

1. Create a model for other farms to utilize native and pollinator-friendly species to increase biodiversity and improve soil health.
2. Mitigate the effects of climate change by improving soil health, increasing organic matter and native species, and enhancing the soil's ability to sequester carbon in both upland and riparian zones.
3. Install native plants to protect sensitive riparian areas from spillover/leaching in heavy rainfall, improve their water retention during drought, and in some cases, to prevent livestock from accessing and contaminating waterways.
4. Create an emergent wetland of pollinator habitat to slow the flow of runoff, safeguard vulnerable infrastructure, and filter out environmental contaminants before reaching the [Connecticut] River.
5. Improve biodiversity and native habitat by removing invasive species — which tend to crowd out native plants and reduce landscape diversity and resilience — and replacing them with native species, including productive native plants.
6. Establish land management BMPs to turn current pasture and fields to native planted areas, including pollinator-supportive and productive native trees and woody perennials, and a biodiverse native forage mix for livestock grazing.

7. Incorporate edible fruit trees and shrubs into hedgerows that attract wild pollinators, increasing local food access while improving pollination of adjacent vegetables.
8. Create pollinator habitat in container plantings suitable for an impervious urban space.
9. Establish windbreaks to protect crops that consist of native pollinator habitat.
10. Create an enhanced aesthetic and educational opportunity in public farm spaces for employees, farm members and guests who visit the farms and farm stands.
11. Engage students in our community in project activities, and build youth leadership capabilities.

Specific Areas where this Project will Align With and Advance the Objectives of the HSAP

The Healthy Soils Action Plan outlines several principles for sustainable land management and soil health improvement on the primary land covers in Massachusetts (HSAP, p. 27). The table below identifies the land cover types represented by the five participating farms, the project design areas at each, and how these design areas align with the objectives of the HSAP.

Farm Name **Location**	**Land Cover Applicability (HSAP Category)**	**Project Design Areas**	**Corresponding HSAP Objectives (See Table 1.3, HSAP, p. 27)**
Indian Line Farm Egremont (Berkshire County)	Agriculture (rural) Wetland Forest	1. Convert moist, marginal crop field in wetland buffer area to perennial native shrubs that can be sold as cuttings 2. Reforestation with pollinator-supporting trees in area with high invasive species pressure	+Restore former/degraded wetlands +Encourage endemic plant communities in restoration +Incorporate perennials +Reduce tillage +Plant trees, shrubs, grasslands and pollinator habitat +Restore degraded forests +Manage for early successional forest habitat +Manage against invasives

Farm Name Location	Land Cover Applicability (HSAP Category)	Project Design Areas	Corresponding HSAP Objectives (See Table 1.3, HSAP, p. 27)
Red Fire Farm Granby (Hampshire County) Montague (Franklin County)	Agriculture (rural and suburban) Recreational + Ornamental	1. Establish demonstration pollinator garden on an ornamental landscape for public education and recreation (Granby) 2. Convert crop field perimeter to agroforestry (Montague) 3. Transform a poorly draining former crop field into a diverse, productive wet shrubland (Granby)	+Restore degraded soils +Incorporate mulches, compost and perennials +Plant mixed species grasses +Plant pollinator habitat +Plant shrub + tree layers +Reduce tillage +Restore degraded farmlands +Plant cover crops
Nuestras Raíces Holyoke (Hampden County)	Agriculture (peri-urban) Wetland Forest	1. Create windbreak of pollinator-supporting trees, shrubs, flowers and grasses 2. Restore native emergent wetland understory in forest and mitigate stormwater impacts on riparian area 3. Educate and engage local students in soil health, pollinator habitat design and project tasks	+Establish riparian buffers +Restore degraded farmlands +Reduce tillage +Incorporate perennials +Restore former/degraded wetlands +Incorporate green stormwater infrastructure +Restore degraded forests +Manage for early successional habitat +Restore degraded soils +Plant pollinator habitat +Plant tree + shrub layers
NOFA/Mass Food Access (Tapley Court Apartments +	Agriculture (urban) Recreational + Ornamental	1. Create hedgerow of edible fruit trees and shrubs and pollinator-supporting plants in urban community garden	+Restore degraded soils +Plant mixed species grasses +Plant shrub + tree layers

Farm Name Location	Land Cover Applicability (HSAP Category)	Project Design Areas	Corresponding HSAP Objectives (See Table 1.3, HSAP, p. 27)
Liberty Hill Townhouses) Springfield (Hampden County)	Impervious	2. Attract pollinators, increase biodiversity and improve soil health in raised bed and container gardens on an impervious community garden space 3. Empower youth leaders and educate local students in soil health, pollinator habitat design and project tasks	+Incorporate mulches, compost and perennials +Plant trees, shrubs, grasslands and pollinator habitat +Remove pavement to restore soil where feasible
Stonebridge Farm Chesterfield (Hampshire County)	Agriculture (rural) Wetland	1. Create riparian buffer of biodiverse native plantings to support pollinators and prevent livestock from eroding stream banks and polluting waterways 2. Convert unproductive pasture into native grassland for livestock grazing and establish BMPs for rotational grazing on native plants	+Establish riparian buffers +Restore former/degraded wetlands +Restore degraded farmlands +Incorporate animals +Incorporate perennials +Encourage endemic plant communities in restorations +Plant trees, shrubs, grasslands and pollinator habitat

Methodology

See Project Timeline for specific events and milestones

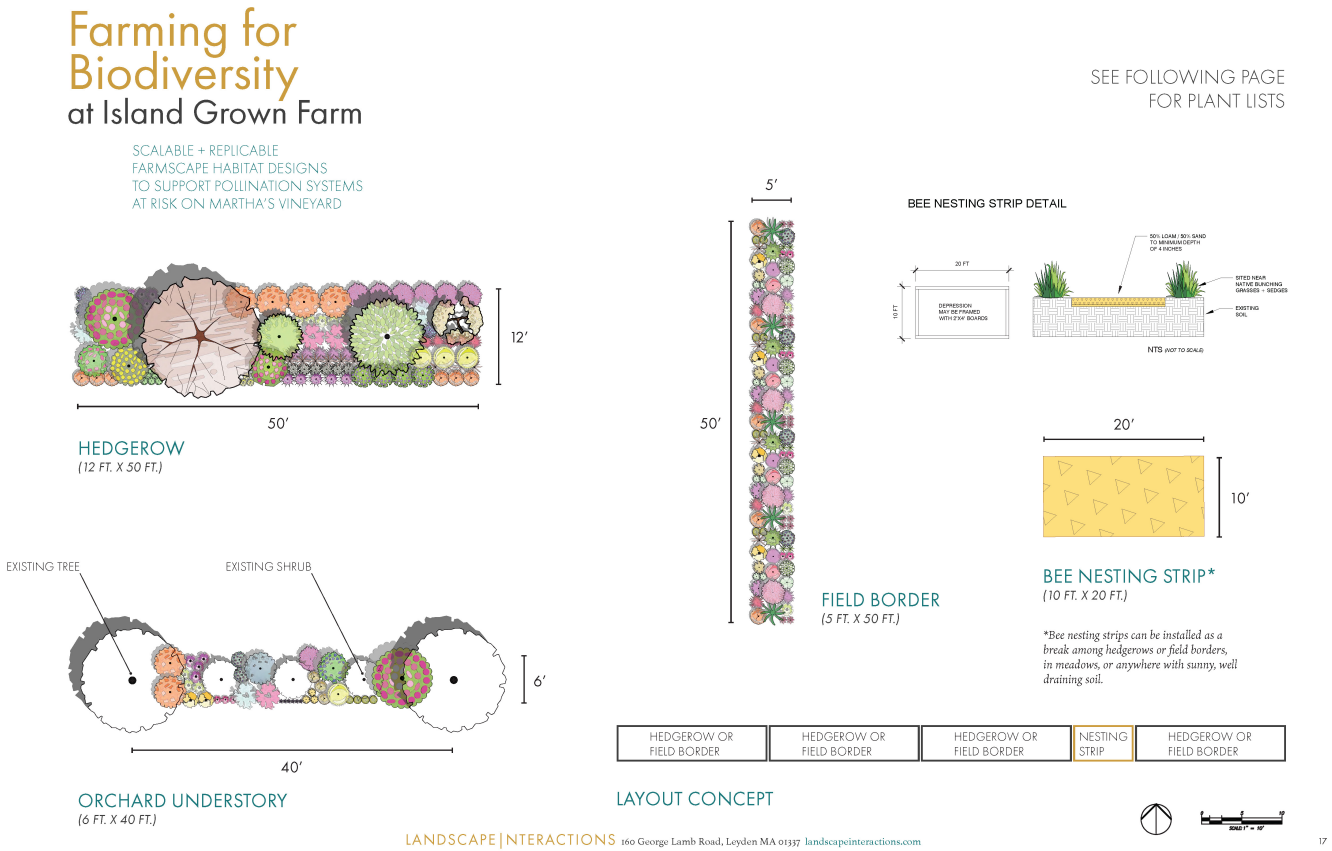
Case Study Site Selection

In preparation for this proposal, farms across Western Massachusetts were selected to represent the five major land covers assessed by the Healthy Soils Action Plan: Natural and Working Lands (Forests, Wetlands, Agriculture) and Developed Landscapes (Recreational/Ornamental, Impervious/Urbanized) (HSAP, p. 5). Each selected farm incorporates one or more land covers, forming the basis for 11 scalable, replicable design models for healthy soils land management. This will allow the five farms to serve as case study sites for a broad range of properties and landscapes across the Commonwealth.

Selection of Project Design Areas

Farmers and project managers at each site (listed under Organizational Capacity and Appendix II. Participating Organizations and Key Personnel) were interviewed by Landscape Interactions over the

phone and provided with a series of follow up questions over email, in order to identify their top priority design/land management goals and recognize opportunities and constraints with regards to improving soil health practices on each participating property. After an internal review process to eliminate redundancies and adhere to the constraints of the Healthy Soils Action Grant budget and timeline, 11 scalable, replicable design areas were selected for the grant, to be implemented across seven sites in 2024 (NOFA/Mass and Red Fire Farm each represent two participating sites).



Example of scalable, replicable design area courtesy of Landscape Interactions

Example of design area replication strategy courtesy of Landscape Interactions

Farm Site Visits

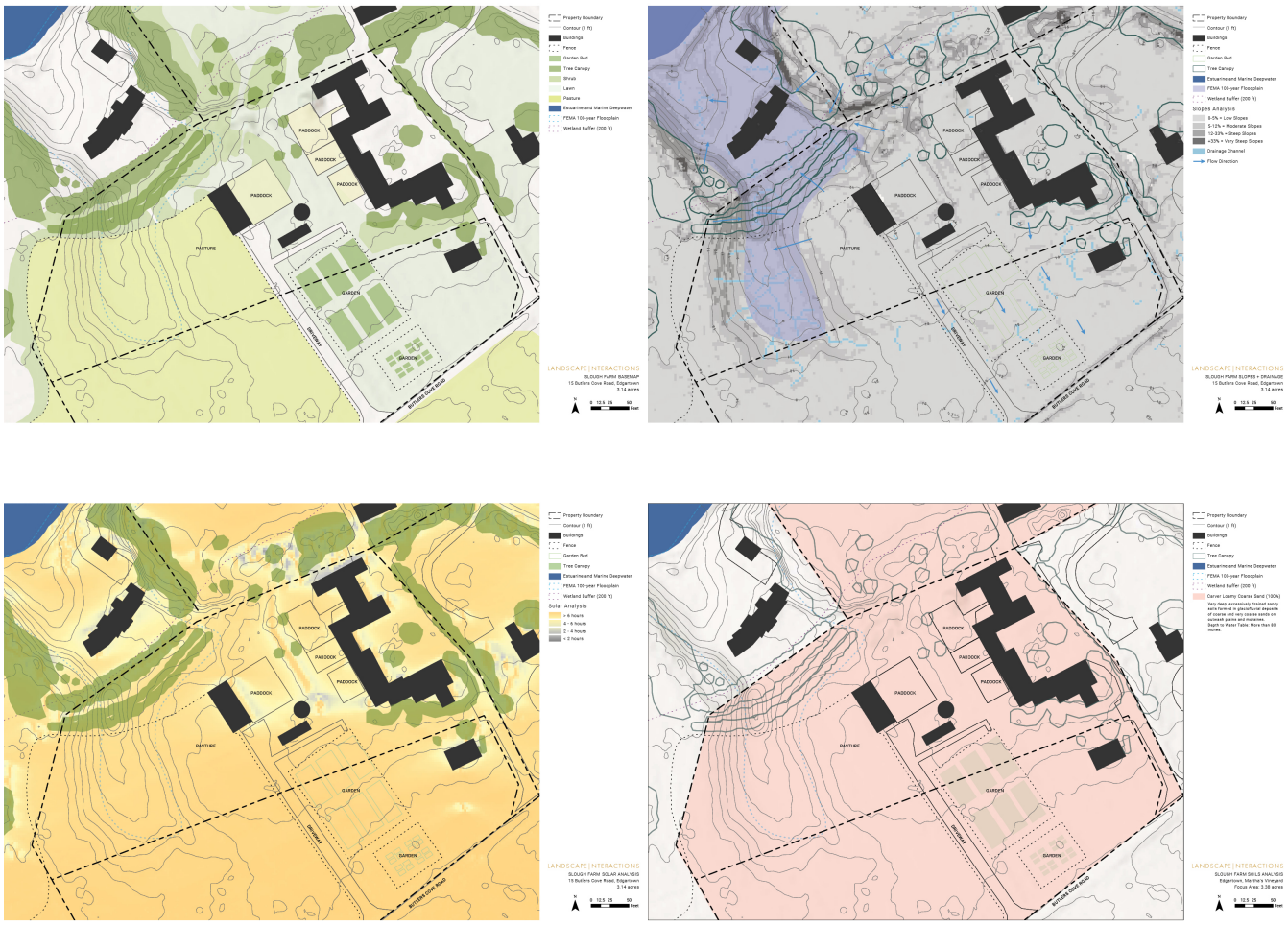
Landscape Interactions will meet with each farmer/community garden manager on site to review project goals, make field observations of existing conditions (using photography, notes, GPS points), ground truth GIS basemaps and spatial analyses for each property (see below), develop site sketches and further refine the project design areas for the grant.

Site and Regional Spatial Analyses (GIS, Field Surveys)

Landscape Interactions will complete a comprehensive suite of spatial analyses using ArcGIS and field observations for all seven project sites, which will inform the design process, plant selection and BMPs recommended in the final plan. This will allow our team to comprehend the ecological, environmental and social factors relevant to each site and its immediate surroundings (see Prior Work, Spatial Analysis). Examples of spatial analyses that may be conducted include:

- Existing conditions: land use and vegetative cover, including wetlands, buffer areas, roads and paths, buildings and impervious surfaces
- Soil type, depth, and sampling locations
- Topography and drainage areas, including surface flow analysis and FEMA 100-year flood zones (not available for Franklin County)
- Solar exposure over the course of the growing season (average number of hours per day)
- Critical habitat and NHESP areas (priority habitat, estimated habitat of rare species)
- Environmental Justice Populations and relevant social factors such as urban heat islands, food access and tree canopy

Spatial analyses will be presented as a series of maps for each farm, with workflows included for each analysis to promote public education and replication by municipalities, regional planning districts and conservation organizations. They will also be used for promotion and education around the projects in workshops, presentations, newsletters, social media and included in the final PDF manual.



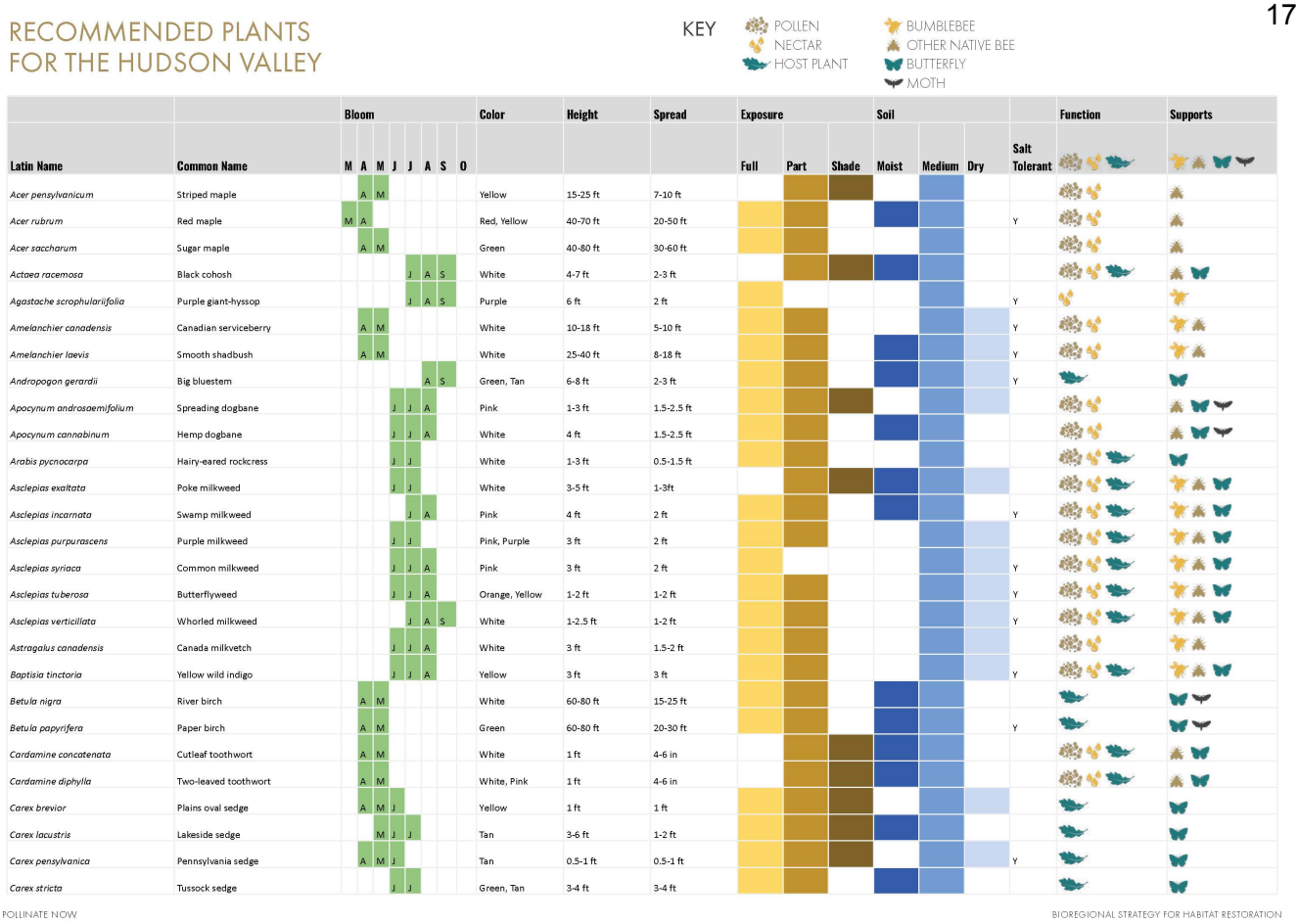
Example of GIS site analyses, courtesy of Landscape Interactions

Target Pollinator + Plant List Development

Landscape Interactions will conduct research to determine which bee and butterfly species are at the greatest risk of local extinction in the four counties of Western Massachusetts; this will become the target pollinator list for the project, and will inform the final selection of plant species to be used on the project design sites. The plant list will prioritize native plant species that satisfy the varied life cycle requirements of the target pollinators (preferred pollen, nectar, and host plants, and nesting substrates). The plant list will also highlight species that can be used by farmers for their productive value, either as livestock forage, for fruit production, medicinal use or as floral cuttings. All species selected will be well suited to the range of landscape conditions present on the participating farms and throughout Massachusetts. This includes salt-tolerant, drought-tolerant and flood-tolerant species, those suitable for present, near-future and long-term climate change projections (including rising temperatures, increased rainfall and invasive species pressure), and species suitable for growing in containers. Target

pollinator research will involve the assessment of both historical (1800s-1999) and contemporary (2000-2024) observation data, including online databases and museum collections, and a review of scientific literature.

Example of a target pollinator species list courtesy of Landscape Interactions



RECOMMENDED PLANTS
FOR THE HUDSON VALLEY

KEY
POLLEN
NECTAR
HOST PLANT
BUMBLEBEE
OTHER NATIVE BEE
BUTTERFLY
MOTH

Latin Name	Common Name	Bloom	Color	Height	Spread	Exposure			Soil			Salt Tolerant	Function	Supports
		M A M J J A S O				Full	Part	Shade	Moist	Medium	Dry			
Acer pensylvanicum	Striped maple	A M	Yellow	15-25 ft	7-10 ft		●	●		●				
Acer rubrum	Red maple	M A	Red, Yellow	40-70 ft	20-50 ft	●	●		●	●		Y		
Acer saccharum	Sugar maple	A M	Green	40-80 ft	30-60 ft	●	●			●				
Actaea racemosa	Black cohosh	J A S	White	4-7 ft	2-3 ft		●	●	●	●				
Agastache scrophulariifolia	Purple giant-hyssop	J A S	Purple	6 ft	2 ft	●				●		Y		
Amelanchier canadensis	Canadian serviceberry	A M	White	10-18 ft	5-10 ft	●	●			●	●	Y		
Amelanchier laevis	Smooth shadbush	A M	White	25-40 ft	8-18 ft	●	●		●	●	●	Y		
Andropogon gerardii	Big bluestem	A S	Green, Tan	6-8 ft	2-3 ft	●	●		●	●	●	Y		
Apocynum androsaemifolium	Spreading dogbane	J J A	Pink	1-3 ft	1.5-2.5 ft	●	●	●		●	●			
Apocynum cannabinum	Hemp dogbane	J J A	White	4 ft	1.5-2.5 ft	●	●		●	●	●			
Arabis pycnocarpa	Hairy-eared rockcress	J J	White	1-3 ft	0.5-1.5 ft	●	●			●				
Asclepias exaltata	Poke milkweed	J J	White	3-5 ft	1-3ft		●	●	●	●	●			
Asclepias incarnata	Swamp milkweed	J A	Pink	4 ft	2 ft	●	●		●	●		Y		
Asclepias purpurascens	Purple milkweed	J J	Pink, Purple	3 ft	2 ft	●	●			●	●			
Asclepias syriaca	Common milkweed	J J A	Pink	3 ft	2 ft	●				●	●	Y		
Asclepias tuberosa	Butterflyweed	J J A	Orange, Yellow	1-2 ft	1-2 ft	●	●			●	●	Y		
Asclepias verticillata	Whorled milkweed	J A S	White	1-2.5 ft	1-2 ft	●	●			●	●	Y		
Astragalus canadensis	Canada milkvetch	J J A	White	3 ft	1.5-2 ft	●	●			●	●			
Baptisia tinctoria	Yellow wild indigo	J J A	Yellow	3 ft	3 ft	●	●			●	●	Y		
Betula nigra	River birch	A M	White	60-80 ft	15-25 ft	●	●		●	●				
Betula papyrifera	Paper birch	A M	Green	60-80 ft	20-30 ft	●	●		●	●		Y		
Cardamine concatenata	Cutleaf toothwort	A M	White	1 ft	4-6 in		●	●	●	●				
Cardamine diphylla	Two-leaved toothwort	A M	White, Pink	1 ft	4-6 in		●	●	●	●				
Carex brevior	Plains oval sedge	A M J	Yellow	1 ft	1 ft	●	●	●		●	●			
Carex lacustris	Lakeside sedge	M J J	Tan	3-6 ft	1-2 ft	●	●	●	●	●				
Carex pensylvanica	Pennsylvania sedge	A M J	Tan	0.5-1 ft	0.5-1 ft	●	●	●		●	●	Y		
Carex stricta	Tussock sedge	J J	Green, Tan	3-4 ft	3-4 ft	●	●		●	●				

POLLINATE NOW

BIOREGIONAL STRATEGY FOR HABITAT RESTORATION

Excerpt of a project plant list courtesy of Landscape Interactions

Soil Health Assessments

As stated in the HSAP, the best available approaches for assessing soil health fit into two categories: field assessments and laboratory assessments. Our methodology will integrate both field and laboratory assessments following the protocols outlined in the HSAP by OpenTEAM (HSAP, p. 71-72). In-field evaluations based on physical soil properties, soil surface and crop characteristics, and ecological indicators will be conducted by Rubén Parilla of NOFA/Mass. The NOFA/Mass soil health assessment consists of 8 testing components: soil surface biology, soil texture and aggregation, bulk density, water infiltration, aggregate stability, earthworm count, soil hardness and active carbon. Following each test, NOFA/Mass will develop a summary of the carbon measured through the test to help evaluate changes in active soil carbon levels and soil health over time.

Because soil organic carbon (SOC) is a universally agreed-upon and important indicator of soil health, we will also obtain baseline SOC measurements for each farm through testing at Cornell University's Soil Health Laboratory. Although changes in SOC generally occur over 10 years or more, current SOC can be used with bulk density measurements to report on soil carbon stocks under existing conditions and in future comparison studies. In the interim, active carbon (POXC) – which is included in the NOFA/Mass field assessment, and is more sensitive to changes in land management and closely correlated with SOC – can be tested more frequently to track shorter term changes in soil carbon and predict long term changes in SOC.

Soil sampling will be GPS-located and conducted in the designated locations on each farm site where project design areas are planned. This ensures that future soil sampling will accurately

reflect changes in soil health resulting from the varied healthy soils practices implemented through this grant.

Soil health measurements taken during the grant period will serve as a baseline for comparison with future testing following design implementations and shifts to sustainable practices. Field assessments can be retested every 3-5 years, and SOC measurements can be repeated in 10-12 years to show differences (Yang et al., 2019).

Site Planning + Design

All designs and land management practices established and implemented through this grant will be suited to the goals and landscape conditions of each participating farm, but also easily scaled and replicated by other farmers, landowners and land managers. Site sketches and concepts generated from site visits with farmers will be combined with data from GIS basemaps to create site-specific full color planting designs in AutoCAD (see Prior Work). The CAD designs will serve as a guide for ordering and laying out plants and seeds at each site, and as models that can be scaled up or down to fit other sites with similar landscape conditions. The design documents will be included in the final PDF manual, along with detailed site establishment, installation and maintenance guidelines for other farmers, landowners and land managers to use independently. See Prior Work, Designs + Design Packets for examples of past projects by Landscape Interactions featuring scalable, replicable design models.

Healthy Soils Practices to be Installed at Participating Farms:

Indian Line Farm Design Areas:

1. **Convert moist cropland to perennial, productive native shrubs**
   Plant productive native shrub species, including dogwoods, winterberry, blueberry, elderberry and willows, in a seasonally moist crop field that was recently in vegetables and rhubarb. New plantings will be used for products (cuttings for floral arrangements, fruit) while also serving as valuable resources for native pollinators, increasing biodiversity, stabilizing soils, minimizing erosion and runoff in wetland buffer zones directly adjacent to the fragile Jug End Fen, an Area of Critical Environmental Concern in Massachusetts.

2. **Native reforestation in area with high invasive species pressure**
   Plant native pollinator-supporting trees along the southern edge of the farm where dying ash trees were removed and now invasives (primarily bittersweet) are taking over. This project will serve as a model for climate-resilient early successional forest habitat and invasive species management.

Red Fire Farm Design Areas:

3. **Establish demonstration pollinator garden on an ornamental landscape for public education and recreation (Granby)**
   This 10,000 ft^2 area is adjacent to the Red Fire Farm store in Granby, a full service market serving seasonal produce, dry goods and prepared food. A demonstration garden of native pollinator-supporting shrubs, flowers and grasses will be established at the perimeter of the parking lot, a high visibility location that divides the parking area from the crop field. An excellent location to showcase desirable, attractive ecosystem-enhancing plants.

4. **Convert crop field perimeter to agroforestry (Montague)**
   Rows of pollinator-supporting trees, shrubs and perennials will be established on the periphery of annual crop fields along with productive American-Chinese hybrid chestnut trees. Because this area will be transformed from a mix of invasive and weedy species to a diversity of perennial native vegetation, it will provide an important opportunity to measure the soil health impacts derived from this change in land cover.

5. **Transform a poorly draining former crop field into a diverse, productive wet shrubland (Granby)**
   A marginal, poorly draining former crop field that is currently reverting to wet meadow and located adjacent to productive fruit orchards will be transformed into a diverse polyculture of native shrubs, forbs and graminoids to better support beneficial insects, provide cuttings that can be used in floral arrangements and require minimal mowing.

Nuestras Raíces Design Areas:

6. **Create windbreak of pollinator-supporting trees, shrubs, flowers and grasses**
   A hedgerow of native pollinator-supporting plants will be established on the edge of a field that was previously in vegetables and subject to annual tillage. The hedgerow will block prevailing winds that damage crops, improve soil health by reducing tillage and establishing diverse, perennial native vegetation with increased above- and below-ground biomass, and create habitat for at-risk pollinators and other wildlife. Youth leaders will receive training on installing the windbreak and identifying supported pollinators, and they will lead public planting workshops.

7. **Restore emergent wetland understory and mitigate stormwater impacts to the Connecticut River**
   There is a strip of forest between the two sides of Nuestras Raíces' La Finca farm that features a pathway and bridge under which runoff drains to the Connecticut River. Extreme flooding over the past year damaged the bridge and increased runoff is now carrying contaminants from nearby streets and shopping centers directly into the river. This degraded wetland will be restored with diverse, densely planted native vegetation to support pollinators while storing, spreading, and slowing water, minimizing erosion, filtering environmental contaminants and protecting farm infrastructure from unmitigated runoff. Youth leaders will receive training on installing the wetland and identifying supported pollinators, and they will lead public planting workshops.

NOFA/Mass Food Access Design Areas:

8. **Create edible, pollinator-supporting hedgerow (Tapley Court Apartments)**
   This edible hedgerow at Tapley Court Apartments will be suitable for replication in urban environments. The hedgerow will improve soil health, block noise and air pollution, and include edible native pollinator-supporting trees and shrubs (plums, nuts, berries) as well as non-native dwarf fruit trees to serve the garden in its mission to improve local food access and food security. Youth leaders will receive training on installing the windbreak and identifying supported pollinators, and they will lead a public planting workshop.

9. **Increase biodiversity and improve soil health in container habitat gardens (Liberty Hill Townhouses)**

We will create pollinator habitat designs for container plantings suitable for impervious urban environments. These will be implemented at Liberty Hill Townhouses, where all vegetables are grown in raised beds, and can be replicated on other impervious sites. The designs will consist of a wide range of native perennials and warm season grasses. Youth leaders will receive training on installing the container gardens and identifying supported pollinators, and they will lead a public planting workshop.

Stonebridge Farm Design Areas:

10. **Create biodiverse riparian buffer to protect stream banks and waterways**
    Native riparian plantings will be established to reduce erosion, slow drainage, improve water retention and expand habitat over a large stream bank that is presently accessed by livestock. This will limit spill-over and leaching during seasons of heavy rainfall, improve water retention during drought, prevent livestock from contaminating the waterway, and restore a critical wetland ecosystem.

11. **Convert marginal pasture into native foraging grassland for livestock**
    A portion of a marginal, poorly drained field will be converted to an entirely native flowering grassland consisting of palatable warm season grasses and flowers suitable for livestock grazing. BMPs will include a customized livestock-friendly native seed mix, a grazing plan with recommended stocking and rotation, and detailed site establishment, installation and mowing guidelines. Soil health testing will demonstrate the value of diverse native perennial vegetation in comparison to weedy, non-native cool season grass-dominated old field vegetation. As with all deliverables created through this grant, the native grazing seed mix will be included in the final PDF manual for public distribution.

Plant Sourcing

Landscape Interactions will work with native plant nurseries (local to Western Massachusetts whenever possible) to source all plants and seeds for the designs at each farm. Landscape Interactions will handle all plant sourcing and ordering. The final list of nurseries used will be included in the final PDF manual as a public resource. Nurseries that Landscape Interactions has routinely worked with in the past, which will likely supply plants for this project include: Wing and a Prayer Nursery (Cummington, MA), New England Wetland Plants (South Hadley, MA), Native Plant Trust/Nasami Farm (Whately, MA) and Earth Tones Native Plants (Woodbury, CT), as well as Prairie Moon Nursery (Winona, MN) for seed mixes.

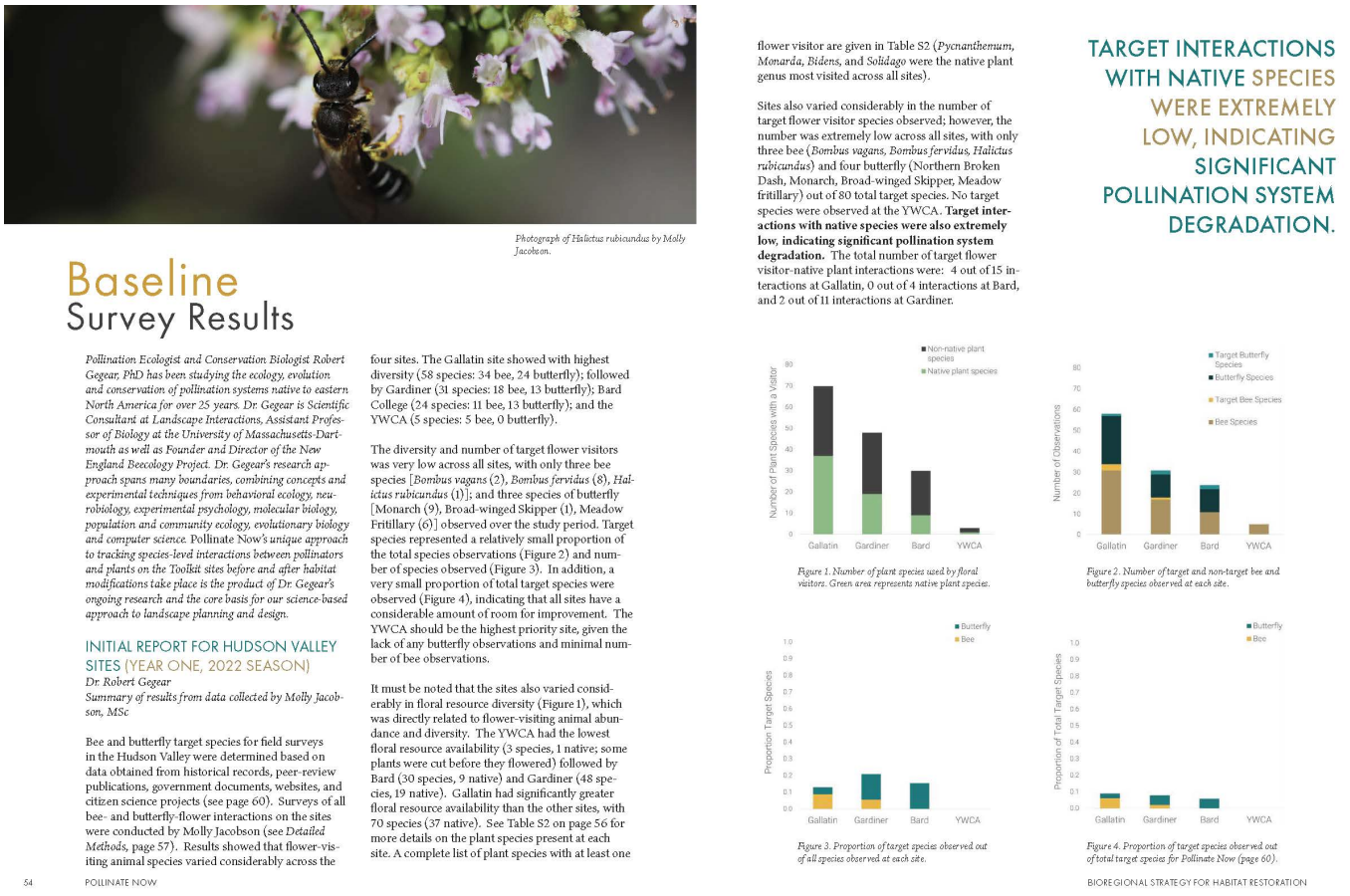
Pollinator Surveys

This project will take a unique approach to demonstrating the relationship between healthy soils practices and pollinator species diversity. Data on species-level interactions between pollinators and plants will be collected from all participating farms throughout the 2024 growing season, before any designs are implemented. This will allow for future phases of the project to compare the differences in pollinator diversity on each site, after the healthy soils practices have been established.

Pollinator surveys will be conducted by native pollinator ecologist Molly Jacobson. Surveys on each farm will occur once per month for four months, May to August 2024. Surveys will be conducted in fair weather (i.e., sunny, no precipitation, winds <10 mph) and will be performed between the hours of 09:00 and 16:00 (most pollinators' peak activity is between 10:00-15:00). The goal of the surveys will be to document plant-pollinator interactions on the sites, to draw a benchmark between the sites

before and after design installation, and to demonstrate the extent to which the plants installed support at-risk pollinator species. The surveys are not intended to be an exhaustive documentation of pollinator diversity, which would require lethal standardized sampling and a much longer timeline for data collection. Rather, bees and butterflies will be identified visually through observation, or captured via netting for handheld inspection and/or photographing for later examination, and lethal collection will be avoided. Focal areas for surveys will be identified during initial site visits, and will center on the areas of each farm where design interventions will occur. Surveys will seek to describe pollinator-plant interactions and presence of floral resources at each property. Bees and butterflies will be identified to the species level, as well as any plant species with which they are interacting (collecting pollen, collecting nectar, laying eggs, resting).

Complete results and interpretations will be written into a report by Molly Jacobson, expressed in data visualizations (e.g. bar graphs) from Landscape Interactions and published in the final PDF manual. Thorough data collection and documentation will allow for repeating surveys in 2-3 years to accurately compare species diversity before and after healthy soils design installation.



Photograph of Halictus rubicundus by Molly Jacobson.

Baseline Survey Results

Pollination Ecologist and Conservation Biologist Robert Gegear, PhD has been studying the ecology, evolution and conservation of pollination systems native to eastern North America for over 25 years. Dr. Gegear is Scientific Consultant at Landscape Interactions, Assistant Professor of Biology at the University of Massachusetts-Dartmouth as well as Founder and Director of the New England Beecology Project. Dr. Gegear's research approach spans many boundaries, combining concepts and experimental techniques from behavioral ecology, neurobiology, experimental psychology, molecular biology, population and community ecology, evolutionary biology and computer science. Pollinate Now's *unique approach to tracking species-level interactions between pollinators and plants on the Toolkit sites before and after habitat modifications take place is the product of Dr. Gegear's ongoing research and the core basis for our science-based approach to landscape planning and design.*

INITIAL REPORT FOR HUDSON VALLEY SITES (YEAR ONE, 2022 SEASON)

Dr. Robert Gegear
Summary of results from data collected by Molly Jacobson, MSc

Bee and butterfly target species for field surveys in the Hudson Valley were determined based on data obtained from historical records, peer-review publications, government documents, websites, and citizen science projects (see page 60). Surveys of all bee- and butterfly-flower interactions on the sites were conducted by Molly Jacobson (see *Detailed Methods*, page 57). Results showed that flower-visiting animal species varied considerably across the four sites. The Gallatin site showed with highest diversity (58 species: 34 bee, 24 butterfly); followed by Gardiner (31 species: 18 bee, 13 butterfly); Bard College (24 species: 11 bee, 13 butterfly); and the YWCA (5 species: 5 bee, 0 butterfly).

The diversity and number of target flower visitors was very low across all sites, with only three bee species [*Bombus vagans* (2), *Bombus fervidus* (8), *Halictus rubicundus* (1)]; and three species of butterfly [Monarch (9), Broad-winged Skipper (1), Meadow Fritillary (6)] observed over the study period. Target species represented a relatively small proportion of the total species observations (Figure 2) and number of species observed (Figure 3). In addition, a very small proportion of total target species were observed (Figure 4), indicating that all sites have a considerable amount of room for improvement. The YWCA should be the highest priority site, given the lack of any butterfly observations and minimal number of bee observations.

It must be noted that the sites also varied considerably in floral resource diversity (Figure 1), which was directly related to flower-visiting animal abundance and diversity. The YWCA had the lowest floral resource availability (3 species, 1 native; some plants were cut before they flowered) followed by Bard (30 species, 9 native) and Gardiner (48 species, 19 native). Gallatin had significantly greater floral resource availability than the other sites, with 70 species (37 native). See Table S2 on page 56 for more details on the plant species present at each site. A complete list of plant species with at least one flower visitor are given in Table S2 (*Pycnanthemum, Monarda, Bidens,* and *Solidago* were the native plant genus most visited across all sites).

Sites also varied considerably in the number of target flower visitor species observed; however, the number was extremely low across all sites, with only three bee (*Bombus vagans, Bombus fervidus, Halictus rubicundus*) and four butterfly (Northern Broken Dash, Monarch, Broad-winged Skipper, Meadow fritillary) out of 80 total target species. No target species were observed at the YWCA. **Target interactions with native species were also extremely low, indicating significant pollination system degradation.** The total number of target flower visitor-native plant interactions were: 4 out of 15 interactions at Gallatin, 0 out of 4 interactions at Bard, and 2 out of 11 interactions at Gardiner.

TARGET INTERACTIONS WITH NATIVE SPECIES WERE EXTREMELY LOW, INDICATING SIGNIFICANT POLLINATION SYSTEM DEGRADATION.

Figure 1. Number of plant species used by floral visitors. Green area represents native plant species.

Figure 2. Number of target and non-target bee and butterfly species observed at each site.

Figure 3. Proportion of target species observed out of all species observed at each site.

Figure 4. Proportion of target species observed out of total target species for Pollinate Now (page 60).

54 POLLINATE NOW

BIOREGIONAL STRATEGY FOR HABITAT RESTORATION

Example of baseline pollinator survey report courtesy of Landscape Interactions

Implementation

As an in-kind contribution after June 30, Landscape Interactions will be present on the participating farms to lead all site preparation and installation days. Farmers, community organizers and volunteers will provide all physical labor and equipment required for plant pick up from area nurseries, site preparation and installation, also as in-kind contributions. Site preparation will include methods aimed at minimizing soil disturbance, such as solarization using landscape tarp and manual removal of

invasive plants. Site preparation and installation will be well documented (photo, video) and shared in the final PDF manual as well as on social media and in email newsletters alongside maintenance guidelines/BMPs for farmers, landowners and land managers throughout Massachusetts to use as a reference.

Public Education + Outreach

Throughout the spring and summer of 2024, public outreach will be centered around increasing awareness of the projects at each farm, promoting hands-on public learning events (educational workshops and demonstrations, volunteer days for site preparation and planning), and organizing volunteers to assist with implementation at each site. A public launch of the final PDF manual will begin in July 2024, in concert with promotion and organization of ongoing hands-on public learning events, conference presentations and press releases/podcasts on the part of Landscape Interactions, NOFA/Mass and participating farms (see Project Timeline).

NOFA/Mass' Education Team will provide advertising and promotions for all on-site education events, as well as the final project launch, through the typical NOFA advertisement channels, including email blasts, social media and the NOFA annual Summer and Winter Conferences. NOFA/Mass will also lead four on-site soil health assessment workshops from April toJune 2024, at Indian Line Farm, Nuestras Raíces, Red Fire Farm and Tapley Court Apartments.

Promotion for all on-site events and the public launch of the final PDF manual will also occur via email blasts and social media on the part of Landscape Interactions and participating farms. On-site demonstrations at the farms will be open to the public, and will be promoted through UMass Agricultural Extension and Franklin, Hampshire, Hampden and Berkshire Conservation Districts. On-site events will additionally be promoted with flyers displayed at local businesses, community centers, libraries and farmers markets. Community service organizations at local colleges, universities and through faith-based networks will be contacted to promote volunteer opportunities at each farm's public planting day. We will collaborate within existing volunteer networks at each farm, including CSA membership. Events at Nuestras Raíces, Tapley Court Apartments and Liberty Hill Townhouses co-led by NOFA/Mass Food Access will have strong focuses on youth leadership development, involving students from Springfield and Holyoke in tasks such as soil health assessments, site preparation, planting and pollinator identification. Additionally, the NOFA/Mass Food Access Team will provide smaller community training sessions in partnership with Landscape Interactions for youth leaders, community members and families that live at Tapley Court Apartments and Liberty Street Townhouses.

Throughout FY25, all work will be in-kind. Community outreach will center on promoting the final project plan to a wide audience across the State, including farmers, land managers, municipalities, regional planning districts, conservation organizations, gardeners, landscapers and students. The project will be presented at a series of conferences and webinars, including the following:

- NOFA/Mass Summer Conference (August 2024)
- Massachusetts Association of Conservation Commissions (MACC) Conference (October 2024)
- Grow Native webinar (October 2024)
- Massachusetts Pollinator Network (MAPN) webinar (November 2024)
- Massachusetts Fruit Growers Association webinar (November 2024)
- New Entry Sustainable Farming Project webinar (December 2024)
- New England Vegetable & Fruit Conference (December 2024)

- New Entry Sustainable Farming Project webinar (December 2024)
- NOFA/Mass Winter Conference - panel with Landscape Interactions and participating farms (January 2025)
- Gathering of Good Graziers Conference (January 2025)
- UMass Amherst Center for Food, Agriculture and the Environment webinar (February 2025)
- MassLand Conference (March 2025)
- Southern New England Planning Association (SNEAPA) Conference (Fall 2025)

Press releases will be distributed to local and state-wide media outlets (Greenfield Recorder, Daily Hampshire Gazette, Valley Advocate, La Pueblo Latino, Berkshire Eagle, Berkshire Edge, MassLive, Western Mass News, NEPM, WWLP, The Republican, The Boston Globe, etc.), as well as podcasts and radio shows focused on themes such as sustainable land management, soil health, pollinators, regenerative agriculture, conservation and environmental science:

- NEPM (New England Public Media)
  Fabulous 413
- NOFA Podcast
- The Poor Prole's Almanac
- Cultivating Place
- The Soil Health Hub Podcast
- Regenerative Agriculture Podcast
- The No-Till Growers Network Podcast
- The Native Plant Podcast
- Our Farms, Our Future
- PolliNation Podcast (OSU Extension)
- Farm Small Farm Smart
- Sustainable World Radio - Permaculture and Ecology Podcast
- AGRICULTURE
- Grazing Grass Podcast
- The Urban Permaculture Podcast
- Conservation Connection

Outcomes + Deliverables

In addition to Design Areas implemented at each farm (see Healthy Soils Practices to be Installed at Participating Farms) and various on-site public workshops and educational events (see Project Timeline), a comprehensive, illustrated PDF manual will be published which documents the project and the various healthy soils practices implemented, provides easy-to-follow guidelines and BMPs, and includes baseline data for each site on soil health, SOC and pollinator species diversity.

A general outline for the final PDF manual:

- Executive Summary articulating the varied collaborations between the diverse organizations involved in the project, and the project's funding sources.
- Introduction of the local, regional and global issues addressed by this work, including soil health, soil carbon sequestration, climate change, land use change, pollinator species decline, food access, environmental justice and human health.
- Brief discussion of why pollinator and plant species diversity is relevant to the topic of soil health.
- Presentation of the spatial analyses conducted for each farm site and for the region of Western Massachusetts, including maps, photographs of existing conditions and data visualizations of baseline soil sampling and pollinator survey results.
- Visual tools and workflows pertaining to the creation and interpretation of the various spatial analyses (mapping of existing conditions; soil mapping; slopes and drainage mapping; sun and

shade mapping, etc.). This will serve as a tool for future decision-making and assist readers in learning how to run similar analyses on their own projects and properties.
- Data and interpretations of baseline soil health assessments and soil organic carbon (SOC) levels for each farm by Rubén Parilla (NOFA/Mass).
- Data and interpretations of baseline pollinator survey results for each farm by Molly Jacobson (Landscape Interactions).
- Visualizations of soil health and pollinator survey data.
- A list of the target pollinator species for the Western Massachusetts region and a brief discussion of how the list was created (comparison of historical to contemporary observations to determine species in decline). See Prior Work, At-Risk Pollinator Species in the Hudson Valley.
- A master plant list for Western Massachusetts healthy soils practices. The list will span the full range of native plant types (tree, shrub, forb, graminoid, vine) required to support the pollen, nectar and host plant requirements of the target pollinator species. Plant list will include cultural information for each plant species (sun/shade requirements, soil moisture requirements, height/spread, bloom time/color, salt tolerance) as well as the function of each plant in relation to pollinators (pollen, nectar, host) and the pollinator taxa each plant supports (bumblebees, solitary bees, butterflies). See Prior Work, Recommended Plants for the Hudson Valley.
- The 11 project design areas will be presented as a series of scalable, replicable Toolkits for healthy soils land management across a variety of landscape types (forest, wetland, agriculture, developed) and locations in Western Massachusetts. See Prior Work, Designs + Design Packets.
- Plant lists and seed mixes specific to each Toolkit.
- Detailed site preparation, installation and maintenance guidelines, including BMPs and mowing schedules, and instructional photographs. See Prior Work, Best Management Practices.
- Strategies and recommendations for continued monitoring of soil health and pollinator species on participating sites after project period ends, and ways to compare to baseline data
- Bibliography of relevant scientific literature and educational materials.
- List of nurseries and seed suppliers both local to Western Massachusetts and regional, who supply the plant species recommended in the plan. See Prior Work, Recommended Nurseries for Martha's Vineyard.

Budget

A complete budget aligning with the Project Timeline, including in-kind contributions and matching funds, can be found here as a PDF or a Google Sheet:

- Budget as PDF
- Budget as spreadsheet

Organizational Capacity

Full descriptions of the participating organizations and their key personnel are available in Appendix II. Letters of support from participating organizations can be found here.

Organization	Roles & Responsibilities	Key Personnel
Landscape Interactions	• Site assessments at all participating sites using GIS and field observations • Design and planning for all participating sites (project design areas) • Writing BMPs for all sites (including site preparation, installation, maintenance guidelines, mowing regimes) • Sourcing and purchasing all plants + seeds • Pollinator surveys, reporting and interpretation of baseline results • Design and layout of final report • Project lead for site preparation and installation at all participating sites	• Evan Abramson, Principal • Casey Armanetti, Landscape Designer & GIS Specialist • Molly Jacobson, Native Pollinator Ecologist
NOFA/Mass	• Soil testing and soil health assessments at all participating sites • Soil health-related education and outreach • Marketing and promotion of public events and workshops at participating sites (newsletter, social media) • Participation in site visits at Tapley Court Apartments and Liberty Hill Townhouses • Coordination of youth leadership events at Tapley Court Apartments and Liberty Hill Townhouses • Labor and equipment required for site preparation, installation and maintenance of project design areas • Plant + seed pick up, coordination of delivery • Co-presentation with Landscape Interactions at NOFA/Mass Conference, specific podcasts/media	• Anna Gilbert-Muhammad, Food Access Director • Rubén Parrilla, Education & Technical Assistance Director • Christine Manuck, Development Director
Nuestras Raíces	• Participation in site visits at their farm • Labor and equipment required for site preparation, installation and maintenance of project design areas • Plant + seed pick up, coordination of delivery • Coordination of youth leadership events at their farm • Assistance in coordination of public events at their farm • Marketing and promotion of public events at their farm (newsletter, social media) • Co-presentation with Landscape Interactions at NOFA/Mass Conference, specific podcasts/media • Administration and project management	• Jason Comcowich, Development Director • Kendy Capois, Assistant Executive Director
Red Fire Farm	• Participation in site visits at their farm • Labor and equipment required for site preparation, installation and maintenance of project design areas • Plant + seed pick up, coordination of delivery • Assistance in coordination of public events at their farm • Marketing and promotion of public events at their farm (newsletter, social media)	• Ryan Voiland, Owner/Farmer • Sarah Voiland, Owner/Farmer

Organization	Roles & Responsibilities	Key Personnel
	• Co-presentation with Landscape Interactions at NOFA/Mass Conference	
Stonebridge Farm	• Participation in site visits at their farm • Labor and equipment required for site preparation, installation and maintenance of project design areas • Plant + seed pick up, coordination of delivery • Assistance in coordination of public events at their farm • Marketing and promotion of public events at their farm (newsletter, social media) • Co-presentation with Landscape Interactions at NOFA/Mass Conference	• Brooke Bullock, Owner/Farmer • John Collector, Owner/Farmer
Indian Line Farm	• Participation in site visits at their farm • Labor and equipment required for site preparation, installation and maintenance of project design areas • Plant + seed pick up, coordination of delivery • Assistance in coordination of public events at their farm • Marketing and promotion of public events at their farm (newsletter, social media) • Co-presentation with Landscape Interactions at NOFA/Mass Conference	• Elizabeth Keen, Owner/Farmer • Alex Thorp, Owner/Farmer

Prior Work by Landscape Interactions

Designs + Design Packets:

- Farming for Biodiversity
- Farmland Toolkit - excerpt from Pollinate Now
- Riparian Toolkit - excerpt from Pollinate Now
- Urban & Residential Toolkit - excerpt from Pollinate Now
- Pollinate Northampton
- Building Resilience through Biodiversity - MVP Action Grant for Hampden + East Longmeadow
- Biodiversity in the First Light - Stormwater basin design for the Mashpee Wampanoag Tribe (draft)
- Best Management Practices - excerpt from Pollinate Now

Regional Planning:

- Pollinate Now
- Lincoln Pollinator Action Plan

Spatial Analysis:

- Slough Farm site analyses
- Mashpee site analyses - flooding and natural communities
- Regional analyses of Martha's Vineyard - excerpt from Farming for Biodiversity

Target Species Lists + Plant Lists

- At-Risk Pollinator Species in the Hudson Valley - excerpt from Pollinate Now
- Recommended Plants for the Hudson Valley - excerpt from Pollinate Now
- Recommended Nurseries for Martha's Vineyard - excerpt from Farming for Biodiversity

Community Workshops:

- Design charette at Berkshire Botanical Garden
- Design workshop in Great Barrington

Outreach:

- Social Media (visit our Instagram account to view more content)
    - Installation with volunteers and DPW in Wellesley
    - Riparian Buffer design on the Wallkill River
    - Medicinal plants in a stormwater basin, collaboration with Mashpee Wampanoag Tribe
    - Reel: seeding a native meadow
    - Sharing research: bumblebee diversity loss in the Hudson Valley
    - Natives vs Cultivars
- Signage
    - Habit to Habitat in Wellesley
    - Egremont Pollinator Pathway
- Planting Day with Students at the Birches School

Past Awards:

$5,000 for Egremont Pollinator Pathway
Town of Egremont, MA (2019)

$21,760 for Lincoln Pollinator Action Plan: Planting for Biodiversity and Climate Resilience
Lincoln Land Conservation Trust (2019)

$5,000 for Green Corridor Toolkit
Aspetuck Land Trust (2020)

$6,000 for McKeon Farm Meadows & Hedgerows
Norwalk River Watershed Alliance (2020)

$10,080 for Farming for Biodiversity at Island Grown Farm
Island Grown Initiative/Fink Family Foundation (2021)

$21,420 for MVP Action Grant, Building Resilience through Biodiversity: Stormwater Management Designs in Hampden & East Longmeadow
Massachusetts Municipal Vulnerability Preparedness Program (2021)

$16,995 for Designing Multifunctional Buffers to Improve Farm Viability in the Berkshire-Taconic Region of MA, NY and CT
Northeast SARE Professional Development Program (2021)

$30,150 for Habit to Habitat: Community Strategy for Pollinator Habitat Restoration in the Town of Wellesley
Wellesley Natural Resources Commission (2022)

$73,170 for Pollinate Now: Bioregional Strategy for Habitat Restoration in the Hudson River Estuary Watershed
Partners for Climate Action (2022)

$19,800 for Designing Biodiversity at Slough Farm
Slough Farm Foundation (2023)

$13,760 for A Living Laboratory on the Land
Robert D. Wray Charitable Trust (2023)

$17,200 for Biodiversity in the First Light: Pollination Systems Design and Education at Mashpee Wampanoag Tribal Headquarters
United States Environmental Protection Agency (EPA) (2023)

Presentations:
Evan Abramson has offered dozens of public presentations to audiences both large and small, and is highly regarded as a messenger on the subjects of pollinator decline, climate resiliency, community engagement and landscape strategies for ecological restoration.

Select Presentations by Evan Abramson:

- Native Pollinator-Plant Interactions
- Designing Biodiversity in the Age of the Anthropocene

Project Timeline

Timeline	Key Tasks + Milestones	Budget Summary
February 2024	• Meeting with farmers on sites, finalizing project design areas • Site and regional spatial analyses using GIS • Develop plant list for the project based on target pollinator species for Western Massachusetts (species at risk) **• Milestone: Plant list for all project sites complete**	Grant monies: $11,004.21 In-kind: $525.00
March 2024	• Site planning and draft designs for each farm • Begin sourcing plants from area nurseries • Process updates and outreach/marketing for upcoming public events at farms via social media, newsletters, flyers, press release **• Milestone: Final designs approved by farmers/community gardeners for all locations**	Grant monies: $17,860.00 In-kind: $1,300.00

Timeline	Key Tasks + Milestones	Budget Summary
April 2024	• **Milestone: Soil organic carbon testing and soil health assessments at all participating sites (Cornell + NOFA/Mass)** • Process updates and outreach/marketing for upcoming public events at farms via social media, newsletters, flyers, press release • **Milestone: Public workshops at Indian Line Farm, Tapley Court Apartments, Nuestras Raíces and Red Fire Farm (Montague) on testing and measuring soil health** • **Milestone: Plant orders placed with nurseries + seed suppliers, site prep materials ordered.** • **Milestone: Baseline soil health and SOC results for all sites**	Grant monies: $28,299.84 In-kind: $1,200.00
May 2024	• **Milestone: Public workshops at Red Fire Farm (Granby) and Stonebridge Farm demonstrating sustainable site preparation** • **Milestone: Pollinator surveys begin at each site** • Process updates and outreach/marketing for upcoming public events at farms via social media, newsletters, flyers, press release • **Milestone: Site preparation occurs at all farm/garden sites** • **Milestone: Draft illustrated PDF manual submitted to project partners for review**	Grant monies: $25,471.21 In-kind: $2,150.00
June 2024	• **Milestone: Youth leadership workshops at Nuestras Raíces and Tapley Court Apartments on soil health and pollinators** • Second pollinator survey at each site • Process updates and outreach/marketing for upcoming public events at farms via social media, newsletters, flyers, press release • **Milestone: Final deliverable complete (illustrated PDF manual describing the project step-by-step for public education and replication)**	Grant monies: $17,359.77 In-kind: $1,300.00
FY 24 Summary	• All project deliverables completed and materials purchased before June 30, 2024	Grant monies: $99,995.03 In-kind: $6,475.00 Matching Funds: $444,000.00
July 2024	• Third pollinator survey at each site • Site visit at all participating farms to ensure site preparation is adequate for planting • **Milestone: Public launch of project manual through social media, newsletters, press releases, radio + podcasts** • **Milestone: plant + seed orders arrive at all participating sites**	In-kind: $6,966.48
August 2024	• **Milestone: Youth leadership trainings and public planting workshops at Nuestras Raíces, Tapley Court Apartments + Liberty Hill Townhouses** • **Milestone: NOFA/Mass Summer Conference presentation about the project** • Project promotion and outreach/marketing for upcoming public events at farms via social media, newsletters, flyers, press release	In-kind: $6,219.65

Timeline	Key Tasks + Milestones	Budget Summary
	• Final pollinator survey at each site	
September 2024	• **Milestone: Public planting workshops at Indian Line Farm, Stonebridge Farm, Red Fire Farm (Granby + Montague)** • Radio + podcast interviews about the project	In-kind: $5,214.95
October 2024	• Massachusetts Association of Conservation Commissions Fall Conference presentation about the project • Grow Native webinar about the project • Radio + podcast interviews about the project **•Milestone: Appendix to final project manual published with last two months of pollinator surveys**	In-kind: $1,387.19
November 2024	• **Milestone: Meadow seeding at Stonebridge Farm and Red Fire Farm (Granby)** • Massachusetts Pollinator Network webinar about the project • Massachusetts Fruit Growers Association webinar about the project • Radio + podcast interviews about the project	In-kind: $1,203.40
December 2024	• New Entry Sustainable Farming Project webinar about the project • 2024 New England Vegetable & Fruit Conference presentation about the project	In-kind: $325.07
January 2025	• NOFA/Mass Winter Conference roundtable about the project with Landscape Interactions and all participating farms/community gardens • Gathering of Good Graziers Conference presentation about the project	In-kind: $1,455.63
February 2025	• UMass Amherst Center for Food, Agriculture and the Environment webinar about the project	In-kind: $50.00
March 2025	• MassLand Conference presentation about the project	In-kind: $122.54
June 2025	• Site visit at all participating farms to check on plant establishment/maintenance needs for project design areas	In-kind: $1,959.21
Fall 2025	• Southern New England Planning Association (SNEAPA) Conference presentation about the project	In-kind: $299.41
FY 25 Summary	• All work in FY 2025 is in-kind match by Landscape Interactions, NOFA/Mass and participating farms/community gardens	Grant monies: $0 In-kind: $25,608.53

Project Evaluation and Monitoring

Performance Metrics

In order to evaluate and monitor the success of this project, the following criteria will be documented through visual and written media and/or measured through data collection:

1. Project site preparation prior to plant and seed installation (11 design areas on seven sites)
2. Project site installation
3. Soil health assessments for all project sites
4. Soil organic carbon (SOC) results for all project sites
5. Pollinator survey results for all project sites
6. On-site public educational events, press releases, press coverage, conference presentations and webinars
7. Final deliverable (final illustrated PDF manual)

Reporting

Project site preparation will be guided by Landscape Interactions staff Evan Abramson and Casey Armanetti, who will be on-site working in collaboration with the farmers preparing each of the 11 design areas in May 2024 prior to planting. Site preparation will be documented through photography and video, and shared on social media, in email newsletter updates, and at future conference/webinar presentations. In July 2024, a follow-up site visit will occur by Landscape Interactions staff in coordination with all farmers to check on the project sites, ensure that site preparation is adequate or that any necessary improvements or modifications occur. This follow-up visit will also be documented in photography/video and shared. Site preparation guidelines/BMPs will also be published in the final project PDF manual.

Project site installation will similarly be guided by Landscape Interactions staff, who will be on-site working in collaboration with the farmers to ensure all 11 project design areas are installed correctly according to the final plan. Installations on all sites will occur between August and September 2024, with meadow seeding occuring in November 2024 at Stonebridge Farm and Red Fire Farm, Granby. Site installation will be documented through photography and video, and shared on social media, in email newsletter updates, and at conference/webinar presentations. The final designs, plant lists, seed mixes and site installation guidelines/BMPs will also be published in the final project PDF manual.

Baseline data collection will be essential to show improvements in soil health, soil organic carbon and pollinator diversity on the participating farm sites, made possible through the implementation of our 11 project designs and recommended BMPs. As detailed under Methodology, soil health assessments, SOC tests and pollinator surveys conducted in 2024 on all participating farms will be the primary quantitative metrics used to establish baseline conditions prior to implementation and demonstrate future success of the BMPs. We will have extremely detailed data for each farm on all of the above metrics.

Soil health assessments for all project sites will be undertaken by Rubén Parilla of NOFA/Mass. They will occur in April for all 11 project design areas (11 tests total) and the data collected from the eight testing components of these comprehensive soil health assessments (see Methodology, Soil Health

Assessments) will be published in the final PDF manual. This baseline soil health data for each project site will be valuable to compare to future testing results after project installations have taken place.

Similarly, *soil organic carbon (SOC) levels for all project sites* will be collected in April, with the results analyzed by Cornell University's Soil Health Laboratory. This valuable data for all 11 project design areas (11 SOC tests total) will be published in the final PDF manual, and serve as a baseline for SOC data at each project site before landscape changes take place, for comparison in future phases of the project after design installations are well established (see Methodology, Soil Health Assessments). All soil sampling will be GPS-located and occur in the same locations on each farm site where project design areas are to be implemented. This will ensure that future soil sampling accurately reflects any changes in soil health and SOC following the healthy soils practices which are implemented through this grant.

Pollinator survey results for all project sites will be published in the final project PDF manual in June 2024, with an appendix released in October 2024 to reflect the last two rounds of surveys, which will occur in July and August. Data from survey results will be represented in bar graphs and other visual formats, and summarized by Molly Jacobson to describe the landscape conditions at each site, the diversity and type of vegetation present, and the diversity/types of bees and butterflies present at each project site — including a comprehensive list of all bee and butterfly species observed at each project site, the number of observations of each species, the month they were observed, and pollinator-plant interaction data (which species of bees and butterflies were observed on which species of plants, and whether they were collecting pollen, nectar, laying eggs, nesting or simply resting). This baseline pollinator-plant diversity data for each site will be incredibly valuable to compare to data collected from future surveys, after design areas have been installed and plants are established and blooming.

On-site public educational events, press releases, press coverage, conference presentations and webinars will occur throughout the project time period, from FY24 through FY25 (all FY25 work will be in-kind). Public educational events will span the range of the project's areas of focus, from workshops on soil health testing to site preparation, pollinator identification, pollinator habitat design, BIPOC youth leadership trainings and planting workshops. All on-site educational events will be free and open to the public, and promoted broadly through NOFA/Mass' extensive email list, Landscape Interactions' email list and those of the participating farms. Additionally, on-site workshops will be advertised in press releases, on flyers posted in public spaces, and through interviews given to podcasts and the press (See Methodology, Public Education + Outreach for a full description of our community engagement plan). All public workshops and on-site events will be documented through photography and video and shared on social media, in email newsletter updates, and at conference/webinar presentations.

Throughout the project timeline, we will measure the success of public participatory and youth training events, as well as site preparation and installation at all sites, through the use of online surveys to participating farmers, gardeners, project partners and youth leaders. Feedback from these surveys will be continuously incorporated into our approach for facilitating project implementation and community engagement.

Conference presentations and webinars about the project will span statewide and regional audiences, targeted specifically to farmers, municipalities, regional planning districts and conservation organizations — but also gardeners, land managers, students and members of the general public. These public presentations will highlight the various learnings gleaned through the project and

emphasize its unique methodologies for improving soil health, sequestering SOC and enhancing farmscape biodiversity and climate resilience through pollinator habitat restoration. The final project manual will be advertised widely through these engagements. Project photographs and videos will be shared, and baseline data results on soil health, SOC and pollinator diversity shared and discussed. See past presentations by Evan Abramson.

The most comprehensive representation of project reporting will be the *final illustrated PDF manual.* It will include all of the above-mentioned data, visual media, and a clear, in-depth discussion covering the importance of soil health, the links between soil health, SOC and pollinator-plant diversity, the significant role farms play, and the rationale behind project site selections. The PDF manual will also present the baseline data results from each farm (on soil health, SOC and pollinator diversity), the list of target pollinator species, the complete plant list, the designs for each project site, user-friendly guidelines for site preparation, installation and maintenance, and a list of local and regional nurseries and seed suppliers. The final illustrated PDF manual will also contain strategies for monitoring habitat implementation and soil health assessments, as well as continued observation of pollinator species post-implementation. Essentially, **the final PDF manual will be the go-to source for learning about and taking action on the project's goals of improving soil health through maximum farmscape biodiversity.**

Sustainability Plan

Post-grant Project Sustainability Assessment, Partners Involved
Sustainability of this project after the grant period depends primarily upon five factors:

1. Successful maintenance of the project design areas by participating farmers, according to the final project plan's maintenance guidelines/BMPs.
2. Successful marketing and promotion of the final project plan (PDF manual).
3. Adoption of the project's scalable/replicable designs and BMPs on other farms and landscapes across the Commonwealth.
4. Knowledge gained by youth leaders and members of the public through on-site workshops and events.
5. Improvements in soil health, SOC and pollinator diversity on the project sites.

Successful maintenance of the project design areas depends largely upon the work of our project partners, the farmers that steward the seven project sites. As affirmed in our letters of support for the project, all participating farmers are committed not only to installing, but also to maintaining the project sites in accordance with our guidelines and BMPs, which will be published and easily accessed in the final PDF manual. Additionally, we will actively seek follow-up funding beyond the grant period, to sustain engagement with project partners through ongoing site visits, assessing vegetation establishment on the project sites, and maintaining our role as consultants to guarantee the project's long-term success.

Successful marketing and promotion of the final project plan is something that we consider to be of utmost importance to the sustainability of the project. As outlined in the FY25 portion of the Project Timeline, the majority of our work in FY25 will be focused on promoting the project through conferences, webinars, podcasts and public events. Public outreach and education will lay the

foundation for future funding acquisition while prompting farmers, municipalities, regional planning districts, gardeners, landowners and land managers toward *adoption of the project's scalable/replicable designs and BMPs on other farms and landscapes across the Commonwealth*.

Knowledge gained by youth leaders and members of the public through on-site workshops and events will be dependent upon the quality of our educational programming. For this reason, we are partnering with NOFA/Mass and Nuestras Raíces on all youth leadership trainings, as both organizations have ample experience in that field and have already acquired substantial matching funds (see Budget) toward that objective. Further, NOFA/Mass will be promoting all on-site events through their expansive email list, online marketing campaigns and social media. With their pre-existing platforms and communities, NOFA/Mass and the participating farms will play a vital role in sharing this work and distributing the project's final resources. As described in our Methodology, Public Education + Outreach section, physical flyers will also be posted in key public locations, and events will be shared through both university and faith-based volunteer service networks to further the project's reach.

Improvements in soil health, SOC and pollinator diversity on the project sites is similarly dependent upon successful maintenance of the project design areas by project partners, the farmers that steward the seven project sites. After completion of the Healthy Soil Challenge Grant, we will seek additional funding for the following pursuits:

- Maintenance of the design areas implemented on participating farms through semiannual site visits by Landscape Interactions staff
- Continued monitoring at the participating farms: follow-up pollinator surveys and soil health assessments three years after implementation, with repeat SOC testing to take place 10 years after implementation
- Expansion of the design areas on larger portions of the participating farms
- Replication of the 11 scalable, replicable design areas at other farms and landscapes across the Commonwealth
- Translation of the final PDF manual into Spanish, Portuguese, Nepali and other languages

Community Engagement

In addition to wide promotion through conferences, webinars and the press, the final project plan will be posted as a resource for free download on the Landscape Interactions website. **The manual is intended to be an evergreen resource for future soil health projects on Massachusetts lands.** As described in Methodology, Outcomes + Deliverables, the manual will contain clear and detailed documentation of site preparation, establishment and maintenance for maximum soil health, as well as scalable, replicable design models applicable to a range of landscapes and sites.

As the manual will describe step-by-step the workflow for creating each of the 11 sustainable land management practices at the participating sites, it will provide readers with all the tools they need to site, plan and implement resilient healthy soils practices in their current and future projects. This will be particularly valuable for municipalities, regional planning districts and conservation organizations looking to improve their tools for assessment and planning. Follow up funding will enable us to further promote the project's workflows specifically for municipal and regional planners, through targeted webinars, workshops and presentations in future phases of the project.

Risk Assessment for Project, Partners, Timeline

Through our past work on various local and regional projects, we understand the possibility for various challenges to arise over the grant period. We anticipate the following challenges and propose the following solutions:

Risk Considerations	Mitigation Strategies
Managing weed pressure and deer browse after implementation of designs.	Ensure farmer's approve site designs and maintenance requirements before they are finalized; select areas on each farm site that will require low maintenance, or a level of maintenance appropriate for the available resources of each farmer (staff, labor, equipment). In the case of deer browse, woody plants, shrubs and trees will be caged if they are not already protected by fencing.
Ensuring project partners can follow through with site maintenance guidelines on a limited timeline and/or budget.	Planning with project partners at length before committing to a particular design format or methodology; ensuring scale of proposed projects is within the farmers' scope and means.
Ensuring success in establishment of habitat and BMPs on project sites.	Landscape Interactions will conduct site visits in July 2024 to ensure site preparation is adequate, and will return again in the summer of 2025 to check in with farmers, observe the establishment of vegetation on the project sites and provide guidance if required.
Timelines required to show differences in soil health and pollinator diversity on the project sites are beyond the scope of this grant.	We will seek follow up funding to return to all project sites in three years for soil health assessments and pollinator surveys, and 10-12 years for SOC measurements.
Making design areas specific to the particular pilot project sites, while at the same time generic enough to be scaled and replicated on other properties.	We will create designs that are as close to generic and replicable on similar landscapes as possible (see Prior Work, Pollinate Northampton and Farming for Biodiversity).
Ensuring farmers are willing to implement and follow the final plan's recommendations.	We will sign a Memo of Understanding with all participating farmers at the onset of the project, outlining the expectations and requirements for participation. As demonstrated in our letters of support for the project, all participating farmers are committed to not only installing, but maintaining the project sites according to our guidelines and BMPs.
Sufficient plant and seed availability from local and regional nurseries.	We maintain relationships and regularly source plants and seeds from a number of local and regional nurseries and are familiar with their current and future availability of all species to be used in this project. We will not include plants that are not able to be sourced.
Language barriers and accessibility of final PDF resources; some users of	Pursue funding to translate the final PDF manual into Spanish, Portuguese, Nepali and possibly other languages.

Risk Considerations	Mitigation Strategies
the final PDF manual may prefer to read it in languages other than English.	
Land changing hands.	We have ensured that the participating farmers either own their land or have long term (20+ year) leases.

Appendix I. Support from Scientific Literature

Goals and Objectives: 1. Promote Soil Health

a. "Plant diversity is positively correlated with soil carbon content and soil carbon-to-nitrogen ratio across 84 grasslands on six continents that span wide climate gradients." (Spohn et al., 2023).
b. "Restoration of late-successional grassland plant diversity leads to accelerating annual carbon storage rates that, by the second period (years 13–22), are 200% greater in our highest diversity treatment than during succession at this site, and 70% greater than in monocultures." (Yang et al., 2019).
c. "A transition from an annual to a perennial crop generally resulted in an average gain of a 20% (±10) in SOC (6.07 Mg/ha) 20 years or more after conversion in the upper layers." (Ledo et al., 2020).
d. "Overall, an increase in SOC stocks over time after conversion to perennial crops in the upper soil layers was observed…This trend was consistent for all crop types, although woody plants tended to accumulate progressively more SOC." (Ledo et al., 2020).
e. "Deep roots are a common trait among a wide range of plant species and biomes, and are pivotal to the very existence of ecosystem services such as pedogenesis, groundwater and streamflow regulation, soil carbon sequestration and moisture content in the lower troposphere." (Pierret et al., 2016).
f. "Root biomass is likely to be one of the main components of the terrestrial carbon budget, and storing more carbon in soils, particularly at depth, could be an effective and readily available means to mitigate climate change." (Pierret et al., 2016).

Goals and Objectives: 2. Sustainable Land Management

a. "There is a body of evidence suggesting that deep roots could play a role of utmost importance as a 'safety net' against surface stress such as drought and soil loss and that, at the landscape scale, they could contribute to prevent water and nutrient losses by deep drainage." (Bergeron, 2011; Laclau et al., 2013; Pierret et al., 2016).
b. "Compared to annual cropping systems, perennial forages, and grasslands as well as woody perennials like fruit trees have enhanced potential for increasing soil carbon. Perennial crops are more deeply rooted, pumping carbon deeper into soil; creating more biomass which itself acts as a carbon store; and photosynthesize for a longer portion of the year, drawing more CO2 from the atmosphere." (Fulwider et al.).
c. "The Natural Resources Conservation Service outlines four general management principles [Minimize Disturbance; Maximize Soil Cover; Encourage Biodiversity; Maximize Living Roots] that, by protecting soil habitat and feeding soil biota, support soil health. Although developed

and primarily applied within the context of agriculture, these principles have relevance for other land covers as well, even if management differs widely." (HSAP, p. 27)

d. "Riparian buffers can manage stormwater by mitigating surface runoff processes, such as decreasing flow velocity and increasing residence time. It is critical to mitigate surface runoff for efficient infiltration, absorption, evaporation, and interception in riparian buffer zones, which can affect the capacity to control floods, trap sediments, and filter out pollutants and nutrient loading. In addition, riparian zones provide several ecological functions, such as enhancing biodiversity, microclimate regulation, and increasing recreational opportunities." (Park et al., 2021).
e. "The crops that were most attractive to flower-visiting insects were flowering trees (apple, pear, cherries and plums) and shrubs (raspberries, loganberries and blackberries). These crops had the lowest specialisation, meaning they were visited by a broad range of insect visitors and therefore are likely the most important in providing resources for a diverse range of insects in urban growing spaces in temperate regions…Collectively they provide food resources to pollinators over a long flowering period, with some fruit trees flowering as early as April, and raspberries flowering into early to mid-September. From the grower's perspective, these perennial crops offer another advantage, given they do not need to be purchased and planted again each year, meaning they require less financial and labour inputs compared with annual crops such as beans, squash and tomatoes. Because they do not need to be dug up annually, they also limit soil erosion and may contribute to carbon storage in urban areas." (Ledo et al., 2020; Nicholls et al., 2023).
f. "Urban, peri-urban, and suburban farms are multi-benefit agricultural entities providing enhanced food security, agricultural and soils education, and greenspace." (HSAP, p. 89)

Appendix II. Participating Organizations and Key Personnel

Landscape Interactions

Landscape Interactions is an interdisciplinary landscape planning and design firm based in Western Massachusetts and working throughout the Northeast, with a demonstrated track record of public education and high quality, original designs and publications in the form of scalable, replicable habitat designs, farmscape land management guidelines, site-specific landscape designs, watershed-based regional plans and pollinator action plans. What makes our design and planning services unique is that they are scientifically-based, and backed by research. We improve ecosystems, document the results and teach others how to do it themselves.

Landscape Interactions Project Team

Our interdisciplinary team will be led by Evan Abramson, MSc, Founder and Principal of Landscape Interactions. Evan is a results-driven designer and planner who works closely with project partners along every step of the process, from conception through design, implementation and maintenance. A former Land Use and Natural Resources Planner at the Franklin Regional Council of Governments, Evan designed a climate resiliency plan for the Deerfield River Watershed, the first of its kind in the Commonwealth. Prior to earning a Master of Science in Ecological Design from the Conway School of Landscape Design, Evan worked as a community organizer, farmer, environmental filmmaker and photojournalist. A native New Yorker who is bilingual in Spanish, Evan lived and worked in indigenous communities of the Bolivian Andes between 2003 and 2008. He has extensive experience collaborating with community stakeholders to conceptualize, plan and design projects both large and small in

geographic scope, having served as the author and lead designer of Pollinate Now: Bioregional Strategy for Habitat Restoration in the Hudson River Estuary Watershed, Lincoln Pollinator Action Plan, Farming for Biodiversity, A Framework for Resilience: Responding to Climate Change in the Deerfield River Watershed, Great Barrington Pollinator Action Plan: Connecting Habitat and Community, among other publications (see Prior Work).

Casey Armanetti is an Associate Landscape Designer and GIS Specialist at Landscape Interactions whose interest in the environment stems from her coastal Massachusetts upbringing. Casey worked internationally as a geoscientist for six years in a variety of research positions prior to joining Landscape Interactions. She holds a B.A. in Geosciences with distinction from Smith College and studied Landscape Architecture at Harvard University's Graduate School of Design. Her work is driven by an imperative to restore fragmented ecosystems and build resilience in the face of the biodiversity and climate crises. Casey's past work includes designs for increasing recreational access and food security in Allston, MA; studies of shade inequity and urban heat island effect in downtown Boston; and investigations of erasure of indigenous history through land use and ownership in highly developed urban settings. Casey most enjoys design projects rooted in site-specific analysis of physical, cultural and historical contexts, and is inspired by work that weaves climate resilience into the existing social fabric through creative public engagement.

Molly Jacobson is the pollinator ecologist at the SUNY College of Environmental Science and Forestry (ESF) Restoration Science Center. She received her Bachelor of Science in Wildlife & Conservation Biology from the University of New Hampshire and her Master of Science in Conservation Biology from ESF. In her current position, Molly performs a variety of roles related to native pollinator conservation, including research on plant-pollinator interactions, surveys, habitat creation and native plant propagation, and public outreach in many forms from webinars to outdoor workshops and popular articles. She also spends a good deal of time in the lab identifying bees and other pollinators under the microscope, and photographing them in the field. Molly is greatly interested in the trophic interactions between plants, insects, and birds, habitat gardening, citizen science, and documenting rare and specialized pollinators in the northeast.

NOFA/Mass (Massachusetts Chapter of the Northeast Organic Farming Association)

NOFA/Mass is regionally recognized as a leader and innovator in the areas of soil health and education for farmers and gardeners. Through advocacy, hands-on learning events and conferences, NOFA/Mass promotes organic agriculture to expand the production and availability of nutritious food from living soil for the health of individuals, communities and the planet. We envision a commonwealth of people working together to create healthy landscapes that feed our communities and restore the environment. NOFA/Mass is committed to a racially just and equitable food and farming system, and our ongoing work around racial and cultural equity is a core tenet of our organization's outlook.

In 2016, NOFA/Mass began our own soil carbon proxy testing program which provides on-farm soil health assessments using a range of soil health indicators as proxies for a relative level of soil carbon sequestration capacity. The purpose of the tests is to track change over time to help farmers understand the impact of management practices on soil health, and to identify barriers to increasing soil carbon accumulation. NOFA/Mass is currently the only institution offering this particular technical

support program. We have seen immediate actionable change taken by the Massachusetts growers who have participated in our on-farm carbon proxy testing and farmer soil health learning groups.

NOFA/Mass Food Access in partnership with Home City Development, Inc. (HCDI) has established community gardens to address food insecurity in the Mason Square neighborhood of Springfield, MA, an Environmental Justice community with a majority BIPOC population (Buchanan, et al., 2003). With no supermarkets in the area, Mason Square is an urban food desert. Landscape Interactions will be working on two community garden sites as part of the project, located at Tapley Court Apartments and Liberty Hill Townhouses.

A large component of the work at Tapley Court Apartments and Liberty Hill Townhouses centers around youth leadership and education. Through the Carbon Gardening Youth Leader Program, NOFA/Mass works with local youth ages 14 to 21 to manage the community gardens, monitor soil health, teach organic gardening techniques, and promote cooking and food preservation. The project also focuses on creating citizen scientists to observe changes and improvements in soil health — using traditional knowledge from elders, community members and youth participants.

NOFA/Mass Project Team

Rubén Parrilla is Education Department and Technical Services Director for NOFA/Mass and trained in microscopic soil microbial identification through the Soil Food Web School. He is a Certified Lab Tech and studied Environmental Design at the University of Puerto Rico. Rubén has 15 years experience working at different capacities in the environmental laboratory industry. He has been performing soil carbon proxy testing, soil health assessments, soil chemical analysis and soil microbiological evaluations for NOFA/Mass in recent years and has extensive experience farming and working with farmers, including beginning and socially disadvantaged farmers. Rubén performs soil health related outreach and education events for NOFA/Mass by leading monthly farmer learning calls, providing hands-on workshops and instruction at soil health education events, and networking with farmers and individuals in the agricultural industry. He is a native Spanish speaker and fully English/Spanish bilingual.

Anna Gilbert-Muhammad began working with NOFA/Mass after completing their Beginner Farmer Program in 2015. She currently serves as the NOFA/Mass Food Access Director and oversees the Youth Agricultural Scientist Program, The Open Pantry Community Garden Project and smaller projects in the Boston and Springfield areas. Anna and her husband Keith live in Springfield and are market gardeners in the Mason Square area. Anna will assist in coordinating project implementation and youth leadership events at Tapley Court Apartments and Liberty Hill Townhouses, as well as oversee long term maintenance of the project design areas in Springfield.

Christine Manuck is Development Director of NOFA/Mass. She has a background in sustainability, agriculture and environmental science, and has been performing project management, grant writing and program development at NOFA/Mass since joining the organization in 2021. Christine works to support and expand NOFA/Mass' programming and strengthen the services the organization provides to communities and constituencies across Massachusetts and the Northeast. In previous roles she developed land treatment plans for farmers, improved sustainable water use on vineyards and integrated urban planning with sustainable land use to reduce urban heat islands.

Nuestras Raíces

Nuestras Raíces is a grassroots urban agriculture organization supporting BIPOC farmers and gardeners with 7 community gardens and a 30-acre farm La Finca that hosts 11 small farming and food businesses in Holyoke. They run several programs including a mobile produce market for food insecure neighborhoods, a prescription food box education program for Type 2 Diabetes funded by the National Institute of Food and Agriculture, a yearly community entrepreneurs business development workshop series, biannual ServSafe Manager Certification courses, and a wide range of youth-focused agricultural skills and leadership development programs. Through all of their work, Nuestras Raíces promotes food security and the development of small businesses in a majority Latinx community, providing opportunities for cascading mentorship between elders and youth to pass down agricultural skills and other cultural knowledge.

This collaboration with Landscape Interactions will be implemented at La Finca, Nuestras Raíces' 30-acre farm. La Finca includes ten acres of annual field crops with a focus on Latinx cultural produce, a half-acre apple orchard, a quarter-acre diversified forest garden, four greenhouses of varying sizes, a farm store, an historically preserved barn, a stage and festival area, and various forest-scrub features including a riparian buffer with the neighboring Connecticut River. The farm hosts seasonal festivals, farm tours, agricultural classes and numerous other events throughout the growing season. As much as possible, opportunities will be created for students in Nuestras Raíces' partner schools to participate in project activities, such as assisting with site preparation, planting and maintenance.

Nuestras Raíces Project Team

Jason Comcowich is Development Director of Nuestras Raíces. He began his food journey when he was big enough to hold a hoe on his grandfather's farm. Growing up with a deep connection to agriculture, he spent his early career as a chef in community retreat centers, teaching hundreds of students, volunteers and guests a variety of food skills from growing and harvesting to preparing and cooking. During that time, he attained his Permaculture Design Certification and participated in a variety of projects, from establishing urban community gardens to designing pollinator gardens and developing community seed hubs. Jason believes in practicing deep ecology throughout his life, observing the inter-relation and connection of all things. This especially applies to agricultural systems because living soils produce more nutrient dense food, replenishing our environment and leading to better health.

Kendy Capois has been the Assistant Executive Director of Nuestras Raíces for six years. She has a bachelor's degree in business administration from the University of Massachusetts, Amherst, with additional training in Accounting, Human Resources, Food Safety, and Real Estate. She has been with Nuestras Raíces in various capacities for over 11 years, including leading business trainings, ServSafe Manager Certification Courses and collaborating with contractors in farmer trainings. Kendy also has over 20 years of experience with family-owned businesses, and has been working with Holyoke nonprofit agencies since 2009. She has a love of agriculture stemming from her childhood spending time on her family's cacao, coffee and rice farms. During her childhood, she would spend parts of her summers visiting her grandparents and learning how to grow root crops and other fresh vegetables, as well as how to make chocolate from scratch. She strongly believes that we are what we eat and that we need to protect our natural resources for our own health and the benefit of future generations.

Indian Line Farm

Indian Line Farm is home to the oldest CSA in the nation, started in 1986 by Robyn Van En. Farmers Elizabeth Keen and Alex Thorp have been producing vegetables, herbs, fruit and cut flowers there for 26 years. They have a 250-member CSA feeding over 600 people and attend the Great Barrington Farmers Market every Saturday from May through November. They also supply two local grocers and several restaurants with weekly produce. They grow year-round using high tunnels for greens production during the winter months. Their produce is Certified Naturally Grown (CNG) without the use of any synthetic herbicides, pesticides or fertilizers; although they are not certified organic, Indian Line Farm is fully committed to the current National Organics Program.

The farm is currently owned by the Berkshire Community Land Trust (BCLT) and the farmers have a 99-year lease to steward the land, keeping the property affordable for future generations. The Nature Conservancy (TNC) holds a Conservation Restriction on the property. TNC and BCLT worked to preserve Indian Line as a working farm at the same time maintaining farmland affordability, watershed and wildlife habitat conservation and community involvement in sustainable food production. Together, the farmers and the two organizations have worked to prevent future development and to continue protecting the adjacent fragile Jug End Fen Marsh which has been designated by the Natural Heritage Endangered Species Program (NHESP) for having estimated habitats of rare wildlife and home of one of the largest sites in the U. S. of the endangered bog turtle. The farm is part of the larger Karner Brook Watershed Area of Critical Ecological Concern.

Indian Line Farm Project Team
Elizabeth Keen came to farming via social justice work in Guatemala, a 1000 mile bike tour through New England and an unexpected stop in Great Barrington, where she found her now husband Alex Thorp and a community dedicated to saving small farms. Over the past 26 years, she and Al have transformed Indian Line Farm into a thriving community resource for local food. Elizabeth and Al are committed to the productivity and fertility of their land, nourishing themselves, their soil and their community.

For over 20 years, Elizabeth has been an active member of the Collaborative Regional Alliance for Farmer Training (CRAFT) program, which trains future farmers. She is in her 5th year on the Massachusetts Board of Agriculture under Commissioner Ashley Randle, which serves to provide input on policy development and budgetary decisions to the Department of Agricultural Resources (MDAR). Elizabeth is committed to the Berkshire agricultural community and co-founded a group called Famers Gather which meets monthly for farm tours and camaraderie. In addition, Elizabeth is President of the Egremont Agricultural Commission, and after encouraging the Town of Egremont to become the third Pollinator Friendly Community in Massachusetts, she worked with volunteers to install a 10,000 square foot pollinator garden at French Park with Landscape Interactions as the designer and planner.

Red Fire Farm

Red Fire Farm is a diversified produce farm that grows over 50 different vegetable and fruit crops, with a 200-acre farm yard in Montague that is half forested, and a farm yard in Granby consisting of 100 acres of farmland, 30 acres of rough former pasture, and some associated swamp and forest land. The two properties allow more effective soil building and crop rotation than could be achieved on either piece individually. Red Fire Farm uses certified organic farming practices on all of their vegetable and

berry crops with goals of maintaining soil health, improving the overall farm ecosystem, and producing food that is safe and nutritious to eat. Their tree fruit orchards use a low spray IPM approach for managing insect and fungal pests, but are herbicide-free and use only organic approved fertilizers. Many of the crops they grow are heavily reliant on insects for successful pollination. This includes cucumbers, melons, squashes, apples, peaches, pears, strawberries and blueberries, which, due to their long tubular blossoms, need the long tongues of bumblebees in particular. With this in mind, Red Fire Farm is interested in projects that will help enhance the success of pollinators and beneficial insects in and around their crop fields.

Red Fire Farm Project Team

Ryan Voiland began his farming career when he was a middle school student in Montague. With the encouragement and support of his father and mother, he opened a small stand where he sold wild berries that he picked. Over the course of high school Ryan took over and expanded the family garden with plans to grow more vegetables for his farm stand. By the time he reached college, Ryan was renting additional farm land and selling his produce at farmer's markets and to wholesale customers in addition to the Montague farm stand. After graduating from Cornell University with a degree in Fruit and Vegetable horticulture in 2000, Ryan pursued his goal of securing a permanent property for his farm business. With financing assistance from the Farm Service Agency (a department of the U.S. government) and Farm Credit East, Ryan purchased the Granby farmstead. Ryan has now been farming in Granby for 15 years, and it has been over 30 years since he took over his parent's garden and became an organic farmer. Ryan is delighted that his passion for growing organic food continues to make a positive impact on the local food supply.

Sarah Voiland grew up in rural Stafford Springs, Connecticut and has a background in environmental studies from Vassar College. She first learned about Community Supported Agriculture when she joined the Poughkeepsie Farm Project CSA. Inspired by all of the positive environmental and social change that CSAs encourage, Sarah started a small community supported agriculture farm called Down to Earth in her home town of Stafford. After meeting Ryan, Sarah decided to transfer Down to Earth's management to other CSA members, and began working at Red Fire Farm in 2007. Sarah now manages communications at the farm, including their newsletter.

Stonebridge Farm

Located in Chesterfield, , Stonebridge Farm has been using regenerative practices to produce orchard fruit and eggs, as well as grass fed beef, lamb and rabbit since their establishment in 2021. They wholesale their products locally to distributors such as The Chesterfield General Store, Oliver's Farm Stand and the Hilltown Mobile Market. The farm sits on 22 acres, and is comprised of 18 acres of pasture, two acres of fruit production (apples, blueberries, peaches, pears, raspberries), a quarter-acre seed production plot leased to Keshtyar Seed, with the remaining acreage featuring vegetable gardens, woodlands, a farmhouse and farm structures.

Stonebridge uses regenerative and organic practices to improve soil health and promote biodiversity. They rotationally graze their livestock throughout their pastures to allow for mob grazing, pasture resting, manure deposit control and selective grazing of poor forage areas to encourage higher quality grasses. Even with their extant soil health practices, their fields struggle with heavy compaction, invasive species, drainage and erosion issues, poor forage, and lack the ability to sequester large

amounts of carbon. In addition, their cattle and sheep currently have access to a large riparian zone (full of invasives) that they would like to restore by installing native species and excluding livestock from entering. The installation of native habitat in a number of areas of Stonebridge farm will help to reach their soil health and biodiversity goals.

Stonebridge Farm Project Team
Brooke Bullock is a co-owner of Stonebridge Farm and Keshtyar Seed. Brooke's background in entomology sparked her enthusiasm for agroecological growing practices, and specifically, the implementation of native pollinator habitat in farms and gardens. Brooke is the former Executive Director of Sugar Roots Farm, a 501(c)(3) regenerative teaching farm located in New Orleans, Louisiana. She currently works part time with Just Roots, a food access organization based in Greenfield.

John Collector is a co-owner of Stonebridge Farm and a carpenter by trade. John has worked on a variety of farms on the West Coast, East Coast and in the Gulf South. He's passionate about grass farming and building soil through grazing management.

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