NETC 21-3: Initiating Seed Production for Effective Establishment of Native Plants on Roadsides in New England

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Definition of ecotypic plants and why they are important for use in ecological restoration

- Native plant species that have adapted to the climatic conditions of a region and share the genetic markers of local plant species.
- Commercially sold ecotypic seeds are harvested from and regrown in their region of origin.
- More likely to establish and persist more successfully when planted in their region of origin.
- Local pollinators and wildlife depend upon native plant communities for food, nesting, and shelter. Non-local ecotypes frequently have different biological cycles, such as bloom time, which may result in the misalignment of floral resources with native pollinator populations.
- A 2018 survey of Eastern U.S. states indicated that seed buyers source seeds from vendors located an average of 418 miles away from their restoration sites (Tangren, et al., 2022). Since roadsides occupy a significant amount of land, revegetation using non-local ecotypes could compromise existing New England native plant genetics, further contributing to their decline.

Project Tasks

1. Develop ecologically sound Seed Mixes that provide increased ecosystem services.
2. Familiarize DOTs with protocols for establishing biodiverse native plant communities and Identify Potential Impediments they might encounter when establishing such communities.
3. Provide guidelines for effective Conservation Mowing of roadside native plant communities.
4. Catalyze and accelerate the Production of Regional Ecotypic Seed

Why New England DOTs are adopting new roadside revegetation protocols

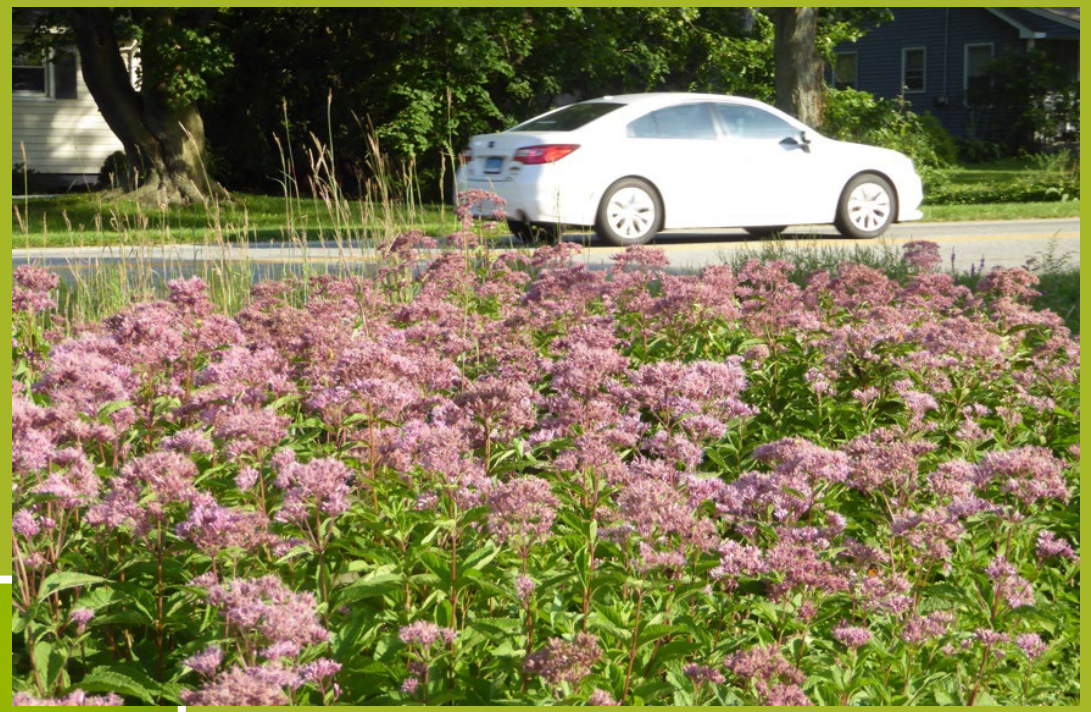
For decades DOTs have used turfgrass to revegetate roadsides for several practical reasons

Their rapid establishment provides effective erosion control for the bare soil roadsides following construction projects

Their ability to withstand frequent mowing during any part of the growing season allowed for simple, risk-free management practices

Turfgrass is relatively inexpensive to establish

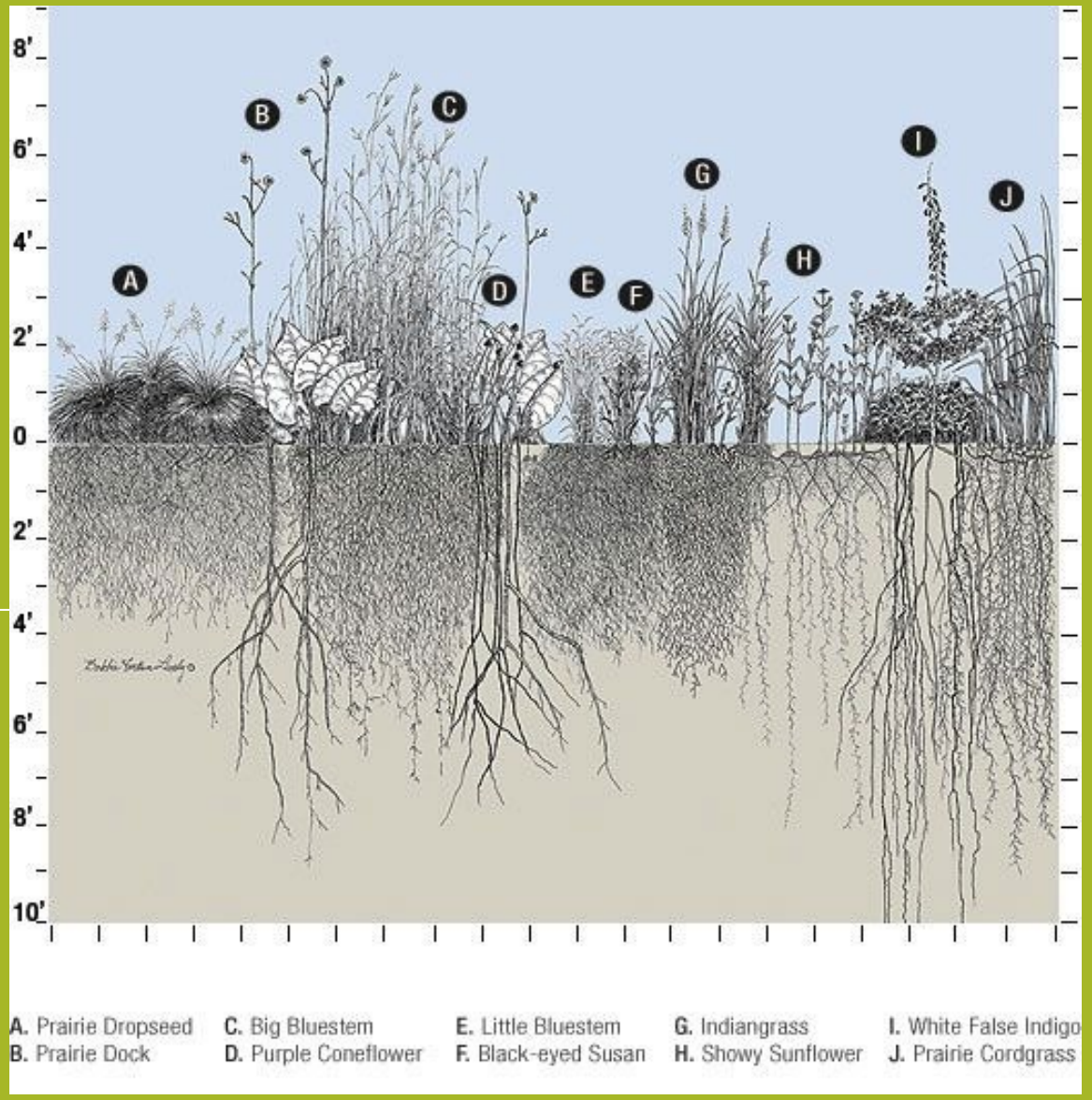
Contribute to pollinator health by providing corridors of habitats with nesting, shelter, and foraging resources.



Greater erosion control provided by the deep, extensive root systems of native warm-season grasses

Warm-season grasses help combat climate change because they need to absorb more CO_2 than cool-season grasses to produce the additional biomass of their root systems

Several DOTs have explored participation in carbon credit markets to supplement their dwindling budgets and finance the higher initial establishment costs for native plants.



Task 1: Seed Mixes

Species selection followed seven criteria, including:

- Plants of shorter stature to ensure clear lines of sight for drivers
- "Workhorse" species, which perform reliably, establish quickly with minimal water and fertilizer, and thrive in various climates and soil conditions.
- High Wildlife Value, providing forage, nesting, and shelter resources
- Aesthetically pleasing species that provide more pleasurable travel experiences.
- Species that are widely available and relatively affordable.

Ecologically Appropriate Plant Combinations

Roadsides are frequently disturbed ecosystems. The combinations of grasses, grass-like species, and wildflowers need to work in harmony under stressful environments while playing important ecological roles.

Sedge

Warm-season grasses, which provide soil stabilization, constitute the largest portion of most mixes. They also provide ground-nesting wild bees, such as bumblebees, shelter.

For wetter soils, grass-like species such as sedges and rushes, which can survive inundation, constitute the majority of mixes

Rush

Ecologically Appropriate Plant Combinations

Year-Long Sequential Flowering

Mixes include wildflowers that provide year-long sequential flowering. This provides pollinators with continuous sources of nutrition. In addition, it provides travelers color and texture throughout the year.

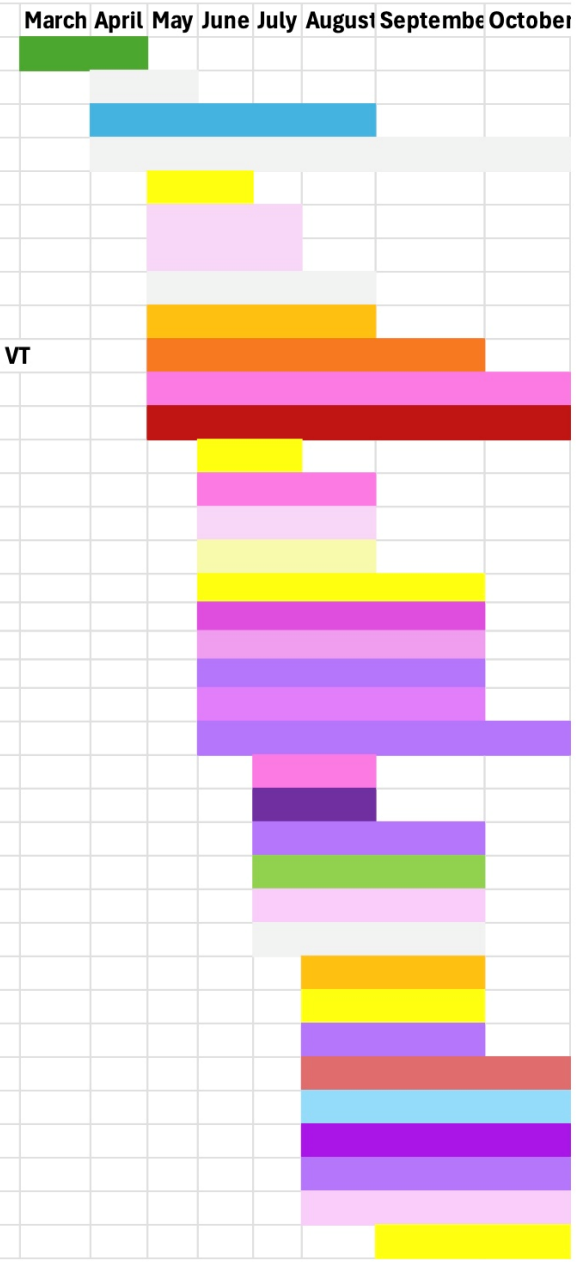
Examples of seed mixes were developed for four common roadside soil types:

Mesic, dry, wet, and coastal

Each example included:

- Appropriate proportions for each grass and wildflower
- Bloom range
- States where species should not be included because of conservation concerns.
- Less common species that cater to specialist bees, highlighted in blue font.

Botanical Name	Common Name	% of mix	Exclusions
Elymus virginicus	Virginia wildrye	30.8	
Anemone virginiana	tall windflower	0.7	
Viola sororia	woolly blue violet	0.4	
Fragaria virginiana	wild strawberry	0.4	
Zizia aurea	Golden Alexanders	2.3	
Penstemon digitalis	Foxglove beardtongue	1.5	RI
Asclepias exaltata	poke milkweed	0.4	RI, VT
Eupatorium perfoliatum	boneset thoroughwort	0.8	
Rudbeckia hirta	Black-eye Susan	4.6	
Asclepias tuberosa	butterfly milkweed	0.9	ME, NH, RI, VT
Eutrochium dubium	coastal plain Joe-Pye wee	0.8	ME
Schizachyrium scoparium	Little bluestem	28.7	
Solidago juncea	early goldenrod	0.4	
Asclepias incarnata	Swamp milkweed	1.1	
Asclepias syriaca	Common milkweed	0.5	
Solidago flexicaulis	zig-zag goldenrod	0.4	RI
Achillea millefolium	Common yarrow	0.2	
Chamerion angustifolium	fireweed	0.6	
Cirsium discolor	field thistle	0.4	VT
Cirsium pumilum	field thistle	0.4	
Monarda fistulosa	Wild bergamot	0.5	
Vernonia noveboracensis	New York Ironweed	0.8	
Desmodium canadense	showy tick-trefoil	0.8	
Symphyotrichum novae-angliae	New England Aster	0.8	
Eutrochium purpureum	purple Joe-Pye weed	0.8	ME
Panicum virgatum	switch panicgrass	4.6	VT
Pycnanthemum muticum	Broad-leaved mountain m	0.2	ME, VT
Pycnanthemum tenuifolium	Narrowleaf mountain min	0.5	
Lespedeza capitata	round-headed bush-clov	1.5	VT
Solidago nemoralis	Gray goldenrod	0.5	
Symphyotrichum cordifolium	heart-leaved American-as	0.6	
Eragrostis spectabilis	purple lovegrass	1.5	
Solidago puberula	downy goldenrod	0.2	
Tridens flavus	purple top	8.8	
Symphyotrichum lateriflorum	calico American-aster	0.8	
Symphyotrichum novi-belgii	New York American-aster	0.6	
Solidago caesia	Blue-stem goldenrod	0.2	



Sortable seed mix spreadsheets

Since the availability of species changes each year, we developed sortable Excel programs for each soil type that allows DOTs to select 3-5 species for four bloom periods:

- **Late Spring**
- **Early Summer**
- **Mid-Summer**
- **Late Summer**

Wildflowers (Forbs)	
Late spring blooming species	
Achillea millefolium	Common yarrow
Aquilegia canadensis	Columbine
Penstemon digitalis	Foxglove beardtongue
Penstemon hirsutus	northeastern beardtongue
Zizia aurea	Golden Alexanders
Early summer blooming species	
Achillea millefolium	Common yarrow
Asclepias syriaca	Common milkweed
Asclepias tuberosa	butterfly milkweed
Baptisia tinctoria	yellow wild indigo
Chamaecrista fasciculata	Partridge Pea
Chamerion angustifolium	fireweed
Cirsium discolor	field thistle
Cirsium pumilum	pasture thistle
Monarda fistulosa	Wild bergamot
Solidago flexicaulis	zig-zag goldenrod
Solidago juncea	early goldenrod
Mid-summer blooming species	
Desmodium canadense	showy tick-trefoil
Desmodium paniculatum	panicled tick-trefoil
Lespedeza capitata	round-headed bush-clover
Pycnanthemum muticum	Broad-leaved mountain mint
Pycnanthemum tenuifolium	Narrowleaf mountain mint
Pycnanthemum virginianum	Virginia mountain-mint
Symphyotrichum novae-angliae	New England Aster
Late summer blooming species	
Eupatorium perfoliatum	boneset thoroughwort
Eurybia divaricata	white wood-aster
Euthamia graminifolia	flat-top goldentop
Lespedeza capitata	round-headed bush-clover
Solidago bicolor	white goldenrod
Solidago caesia	Blue-stem goldenrod
Solidago nemoralis	Gray goldenrod
Solidago patula	rough-leaved goldenrod
Solidago puberula	downy goldenrod
Solidago rugosa	common wrinkle-leaved goldenrod
Solidago speciosa	showy goldenrod
Symphyotrichum cordifolium	heart-leaved American-aster
Symphyotrichum lateriflorum	calico American-aster
Symphyotrichum laeve	smooth blue aster
Symphyotrichum novi-belgii	New York American-aster

Location of demonstration sites along Rte. 91.

Task 2: Protocols for Establishment Identifying Potential Impediments:

- By selecting sites interconnected by one roadway, the demonstration sites provide an example of how DOTs could focus on corridor development.
- Rte. 91 was chosen because it runs south-north, like the two-way migratory pattern of monarch butterflies.
- Each site was located in three different states: CT , MA, and VT.

By locating each site in a different state, we wanted to compare the challenges created by each state's regulations. In addition, by locating each site at different latitudes, we could compare how seed mixes respond to their relative positions from south to north.

No-till drill used in CT and MA

Broadcast seeding with straw matting to prevent erosion on VT's sloped site.

Identifying Potential Impediments: Demonstration Sites As Case Studies

Each site had a different seeding method.

- Both CT and MA sites were converted from existing vegetation. requiring the application of Round-Up.
- Each state received a different no-till drill regime. Both grass and wildflower seeds were drilled together in MA in mid-October while CT was split-seeded with grasses in early June and wildflowers in mid-October.

The VT site was hand seeded on bare soil following new construction, the most common circumstance when native seeding occurs. Because the site was sloped, straw matting was used to prevent soil erosion and seeds from washing downslope following rain or snow melting.

Black-eye Susan blooming the spring after summer seeding in VT.

Virginia wild rye interspersed with common milkweed in CT

Highlights of Lessons Learned at Each Site

The seeding of grass seed in late spring in CT resulted in cool-season Virginia wild rye fully emerging the next spring.

MA had the most onerous regulatory regime involving the application of herbicides.

VT had two important lessons involving its site's soil pH and the timing of its seeding at the end of summer.

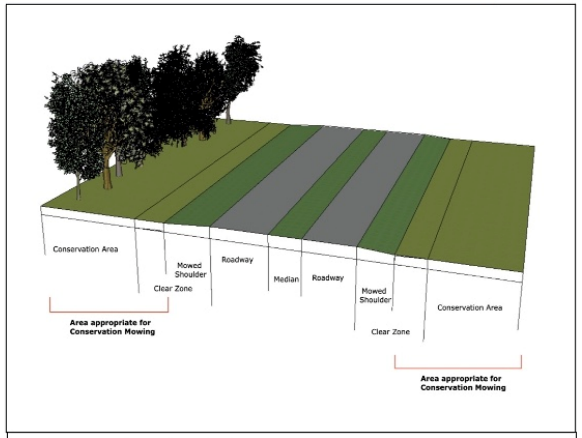
One of the most important lessons emerging from all three sites is the importance of doing site analysis as far in advance as possible. This includes surveying for potential weed and invasive infestations, testing soil pH, and exploring potential regulatory hurdles.

Task 3: Conservation Mowing:
Linking Reduced Mowing with Timing

- Too often Conservation Mowing is considered merely another term for Reduced Mowing.
- In practice, Conservation Mowing involves mowing only within windows that do not hinder native plant community life cycles.
- In New England, the windows for Conservation Mowing are March through mid-May and October 15 to the end of November.
- Which window is chosen for mowing depends upon the portion of the roadside.
- To provide overwintering resources to pollinators, prioritize spring mowing window for existing native plant communities, whether intentionally planted or resulting from existing banks of seed and propagules.
- For remaining portions, mow in the fall window.

Recommendations for Conservation Mowing

Conservation Mowing involves reduction of mowing frequency and alteration of mowing schedules to encourage the growth and establishment of native plants and their seed banks currently existing along roadsides. Native plants provide pollinators and other beneficial insects habitats rich with pollen, nectar, and shelter and nesting opportunities. Compared to turfgrass, native grasses and wildflowers have deeper roots, which improve soil structure and provide greater erosion control. In addition, reduced mowing results in decreased equipment emissions and likely lower labor and operational costs.



ROADWAY CROSS-SECTION – light green areas are appropriate for conservation mowing; dark green zones receive repeat mowing

Conservation Mowing Calendar for New England

Windows for Annual Mowing	March	April	May	June	July	August	Sept	Oct	Nov
	Yes	Yes	Until May 15	June 1-20 Mow only milkweed	No	No	No	After Oct 15	Yes

Conservation Mowing Best Practices

The goal of Conservation Mowing is to ensure that roadside maintenance does not restrict driver safety or interfere with native plant growth and flowering periods. The window for Conservation Mowing in New England is **late fall after October 15th and early spring before May 15th**. Spring mowing is the optimal time to allow seeds to ripen and disperse in the fall and to provide wildlife sheltering opportunities in the dormant vegetation during winter months. For this fact sheet, the section of roadside beyond the 30 foot of the Clear Zone will be referred to as the **Conservation Area**. The **Area appropriate for Conservation Mowing** encompasses the Conservation Area and the portion of the Clear Zone beyond the Mowed Shoulder, which will receive repeated mowing to prevent potential hazards for errant drivers. Medians and ramp sections wider than 60 feet would also be areas appropriate for Conservation Mowing.

The **Conservation Mowing height** should vary depending upon the season. Clippings from fall mowing will disperse and decompose over the course of the winter, so **fall mowing should be at minimum 4 inches.** With spring mowing, however, clippings could smother spring emerging plants. Therefore, it is advised that **spring mowing heights should be higher, between 6-8 inches**.

Reduced mowing may also help to limit the proliferation of invasive species by decreasing the potential for mowing equipment to spread invasive plant stems and seeds and by fostering more widespread and better-established native plant communities with deeper, more extensive root systems. Therefore, **Conservation Areas should be mowed no more than once a year or once every other year.** For zones populated with woody saplings, it is recommended to mow once a year to prevent woody plants from establishing.

The Need for Planning Conservation Mowing

- For those native plant communities consisting mainly of common milkweed, fall mowing can be prioritized.
- However, if the milkweed grows within a native plant community where warm-season grasses like little bluestem predominate, mow in the spring.
- If confining mowing to the early spring and late fall windows is not enough time to conduct mowing for your state's entire roadside network, consider staggering mowing to provide continuous, connected swaths of habitat.

However, staggered mowing does require planning.

Mowing the Shoulder

Roadways require a 30-foot **Clear Zone** for vehicle recovery. Within the Clear Zone, the **Mowed Shoulder** next to the roadway pavement is mowed frequently to prevent possible vegetation fire hazards from errant drivers leaving the road and to prevent obstruction of signs and object markers. The width of the Mowed Shoulder is determined by each DOT and is often dictated by the width of the flail mowers used. Since spring and summer are the growth periods for most plants, mowing of the Shoulders is recommended during these seasons.

While functional, Mowed Shoulders also create the impression of intentional, active management. In addition, the mowed edges minimize vehicle-insect conflict because insects will tend to remain within the habitats of taller, unmowed vegetation.

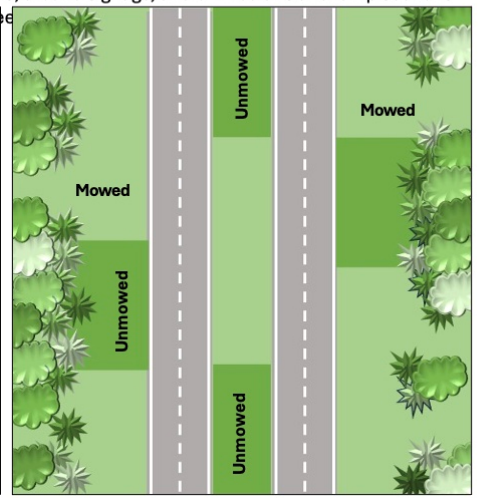
Maintaining Sight Lines

To maintain clear sight lines, vegetation should be routinely mowed at intersections, around signage, and on medians and ramp sections

Staggered or Mosaic Mowing

Staggered Mowing helps preserve corridors of habitat often eliminated when long stretches of roadsides are mowed, requiring pollinators to expend precious energy reserves searching for resources, which research shows threatens their lives and has contributed to declines in their populations. Staggered mowing involves mowing roadsides into segments near one another on alternate sides of roadways, leaving continuous, easily accessible patches of nutrient rich refuge areas for insect migration. **It is recommended to leave about 30% of an area uncut during annual cycles of staggered mowing.**

Rotating sides: Long portions of roadsides on alternate sides of roadways may be mowed at different times of the year to ensure that habitat always exists for pollinator to forage, shelter, and nest. Each side can be mowed entirely every 2 or 3 years.



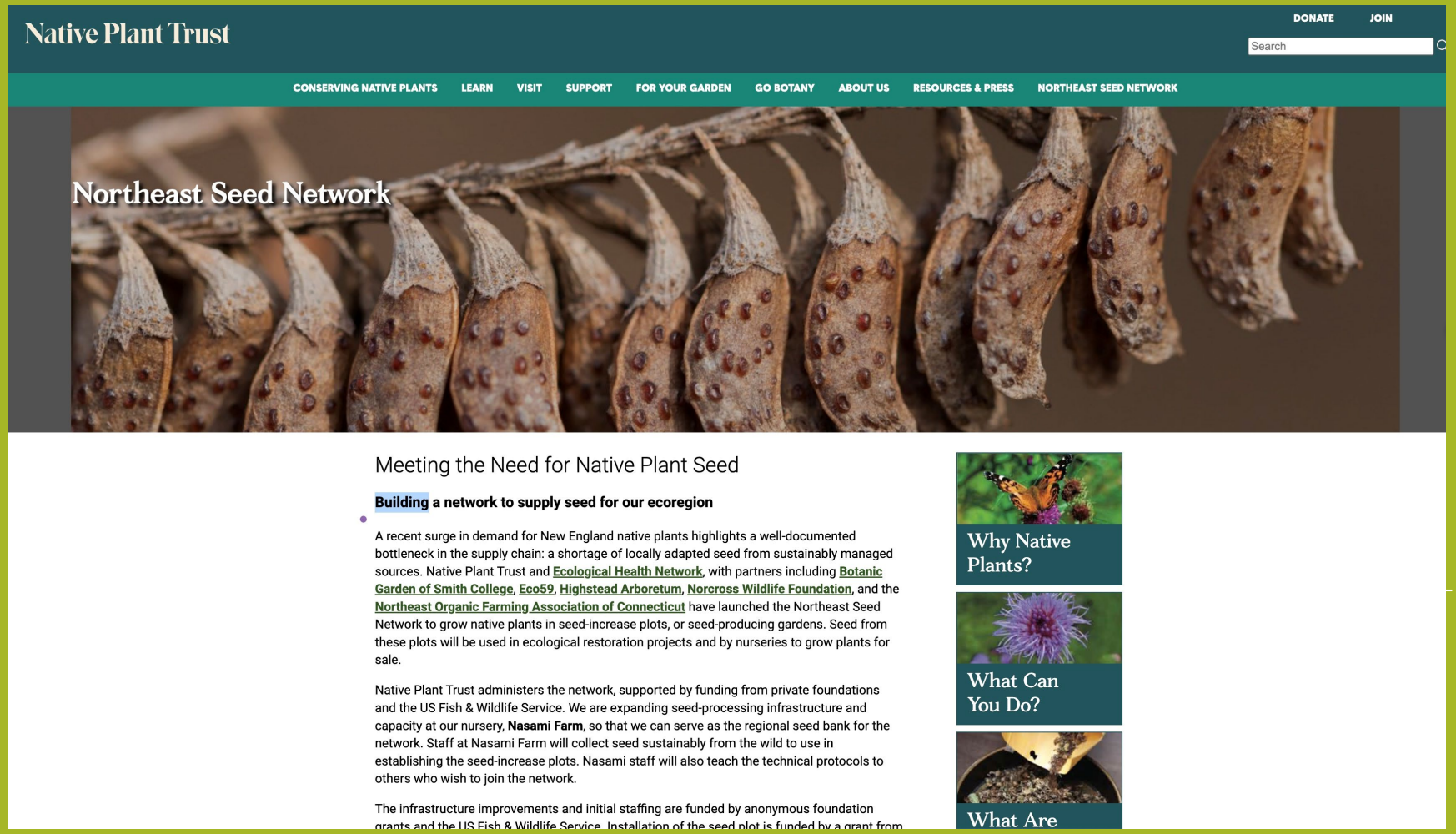
Mowing to Benefit Monarch Butterflies

Milkweed (*Asclepias* spp.) is a critical resource for monarch butterflies, which lay their eggs exclusively on its leaves to allow their caterpillars to feed upon its leaves and ingest the plant's milky sap, making them toxic for ingestion by birds. The milkweed leaves need to be fresh to produce sap. **By mowing milkweed at a height of 6 - 8" between June 1-20**, milkweed delays flowering, puts out new growth, and produces fresh sap, which benefits monarch butterflies migrating back to Mexico in the fall. However, best practices recommend leaving a third of a site's population unmowed during this June window to allow butterflies to lay eggs while the mowed milkweed regenerates. **For further information about monarchs, see fact sheet *"How Roadsides Can Support the Eastern Monarch Butterfly".***

Campanelli, J., Urban, L., and Kuzovkina, Y.A. (2024). New England Transportation Consortium. University of Connecticut. Department of Plant Science and Landscape Architecture.

Task 4: Production of Regional Ecotypic Seed

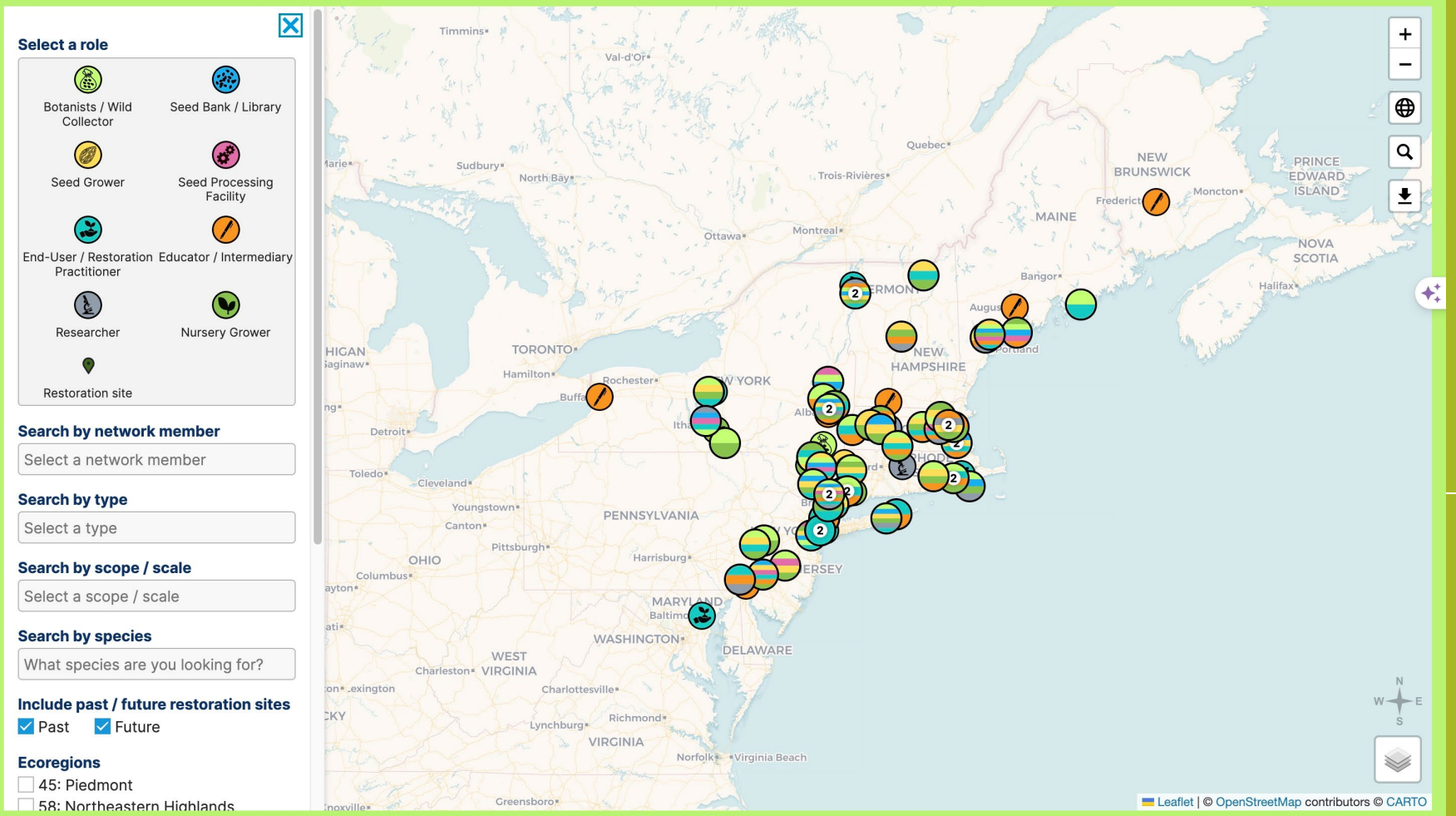
March 2022	Virtual roundtables with opinion leaders and stakeholders provided useful feedback
October 2022	A follow-up in-person meeting at Highstead Arboretum in West Reading, CT
November 2022	Need for Seed Symposium organized by Native Plant Trust
March 2023	The formation of the NSN was announced at The Native Seed Conference. The website was launched.
2023-2024	NSN developed a five-year vision of values, priorities, and goals, and formed committees.
Spring 2024	NSN Map was launched.



The Native Plant Trust currently hosts the webpage for the NSN on their website and pays for the person coordinating the development of the network.

Northeast Seed Network Map

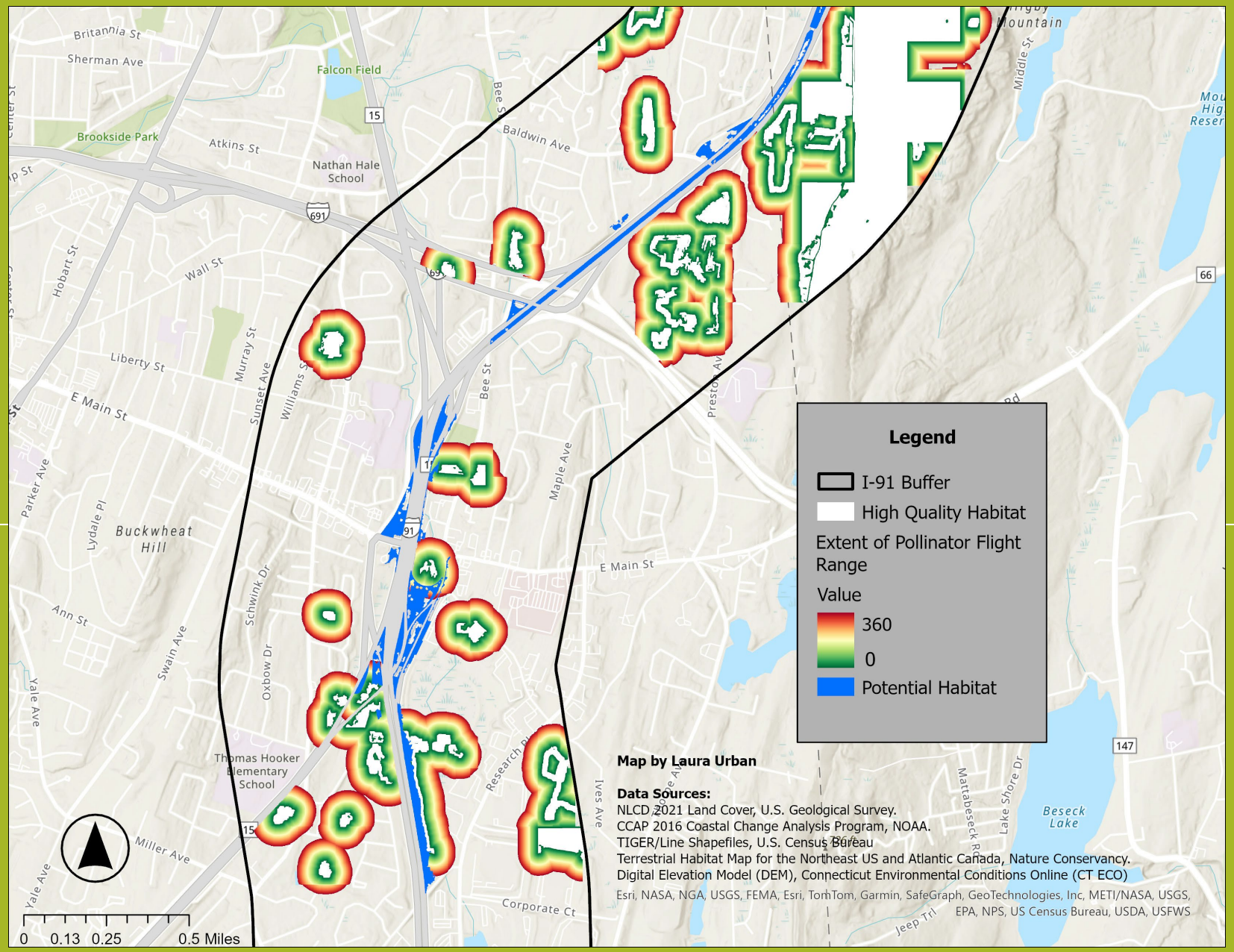
• Catalyze new connections by exploring the filters and map layers in the legend



The NSN Map is housed on the Ecotype Project portion of CT NOFA.

Next Step Recommendations

- Approach plantings and conservation mowing systematically
- Take small, realistic steps to use available ecotypic seed and plant material.
- Establish communication between DOTs and ecotypic seed producers, as we are trying to arrange
- Establish more effective communication between DOT departments, especially with the Maintenance Dept.
- Designate a native plant specialist to oversee the implementation of new practices.


Legend
I-91 Buffer
High Quality Habitat
Extent of Pollinator Flight Range
Value
360
0
Potential Habitat
Map by Laura Urban
Data Sources:
NLCD 2021 Land Cover, U.S. Geological Survey.
CCAP 2016 Coastal Change Analysis Program, NOAA.
TIGER/Line Shapefiles, U.S. Census Bureau
Terrestrial Habitat Map for the Northeast US and Atlantic Canada, Nature Conservancy.
Digital Elevation Model (DEM), Connecticut Environmental Conditions Online (CT ECO)
Esri, NASA, NGA, USGS, FEMA, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, USFWS
0 0.13 0.25 0.5 Miles
Britannia St
Sherman Ave
Falcon Field
Brookside Park
Atkins St
Nathan Hale School
Baldwin Ave
Middle St
Wall St
Hobart St
Liberty St
Murray St
Sunset Ave
Williams St
Bee St
Preston Ave
E Main St
Parker Ave
Lydale Pl
Buckwheat Hill
Maple Ave
Schwink Dr
Oxbow Dr
Ann St
Swain Ave
Yale Ave
Thomas Hooker Elementary School
Research Pl
Ives Ave
Miller Ave
Corporate Ct
Mattabesseck Rd
Lake Shore Dr
Beseck Lake
Jeep Trl
691
15
66
147
91