EFFECTIVE ESTABLISHMENT OF NATIVE PLANT COMMUNITIES ALONG NEW ENGLAND ROADSIDES

Laura Urban & John Campanelli

November 2023

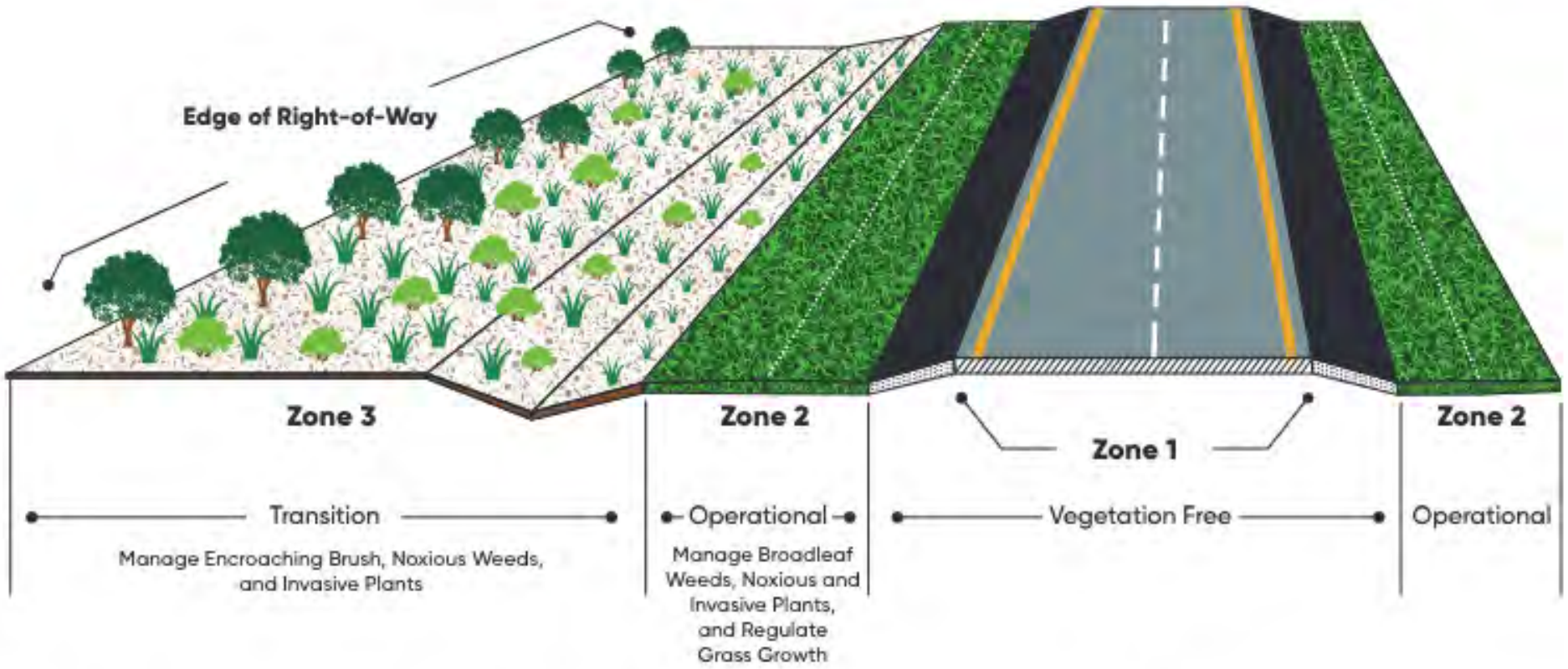
Native Plant Community Established in 2015 at Rte 6, Roundabout near Willimantic

In 2014 and 2021, the New England Transportation Consortium (NETC) - a research cooperative funded by all six New England state Departments of Transportation (DOTs) - commissioned two studies to find the most affordable, reliable, and expeditious methods for establishing and maintaining native plant communities of warm-season grasses and forbs along New England roadsides and to document these findings in manuals for use by all six New England DOTs.

2014 Study: Methodology

- The Role Roadsides & Roadside Vegetation Play in Transportation Infrastructure.
- Why DOTs have begun Transitioning to the use of Native Warm-Season Grasses and Forbs for Roadside Vegetation.
- Methods for Establishing Bio-diverse Native Plant Communities.
- Selection of Native Plant Species Appropriate for Use along New England Roadsides.
- Barriers that Exist for New England DOTs to Successfully Transition to New Roadside Vegetation Protocols.
- Creating a Roadmap for DOTs to Transition to New Protocols (DOT manual).

The Role of Roadsides & Roadside Vegetation in Transportation Infrastructure



Zone 1
Vegetation Free Zone
(Width as Necessary to Meet Operational Needs)

- Provide for Surface Drainage
- Prevent Pavement Breakup by Plants
- Provide for Visibility and Maintenance of Roadside Hardware

Zone 2
Operational Zone
(From Zone 1 to Meet Operational Needs)

- Maintain a Hazard Free Vehicle Recovery Area
- Provide Sight Distance for Passing and Stopping
- Provide Sight Distance at Intersections
- Maintain Hydraulic Capacity of Ditches

Zone 3
Transition Zone
(From Zone 2 to R/W Line)

- Blend and/or Screen Adjacent Surroundings
- Control Incompatible Vegetation
- Remove Danger Trees
- Manage trees to Reduce Shading in Areas Prone to Roadway Icing
- Establish or Maintain Pollinator Habitat

Agriscience, C. (2022, May 4). Herbicide use for roadside vegetation management. https://www.corteva.us/products-and-solutions/land-management/articles/herbicide-use-for-roadside-vegetation-management.html

Operational Zone

Also called the "Clear Zone"

The first 10 ft of adjacent to the pavement.

Must be managed for safety.

Eck, Ronald W, and Hugh W. McGee. *Vegetation Control for Safety: A Guide for Local Highway and Street Maintenance Personnel.* Washington, DC: U.S. Dept. of Transportation, Federal Highway Administration, Office of Safety, 2008. Internet resource.

- Ensure that vegetation does not obscure street signs.

- Excessive vegetation can make it difficult for drivers to see traffic approaching.

- Clear zones have to provide a clear line of site and free of obstructions that may cause accidents. .

Eck, Ronald W, and Hugh W. McGee. *Vegetation Control for Safety: A Guide for Local Highway and Street Maintenance Personnel.* Washington, DC: U.S. Dept. of Transportation, Federal Highway Administration, Office of Safety, 2008. Internet resource.

- Ponding due to clogged overflow ditch can cause:
  - Drivers to leave their lane and reduce braking ability.
  - In the winter, can turn to ice, and with the freeze/thaw cycle can contribute to pavement deterioration.

- Deterioration of pavement edge and shoulder due to poor drainage.

McGee, Hugh W., Daniel Nabors, and Timothy Baughman. *Maintenance of Drainage Features for Safety, A Guide for Local Street and Highway Maintenance Personnel*. Washington, D.C: Office of Safety Federal Highway Administration U.S. Department of Transportation, 2009. Print.

Why Departments of Transportation (DOTs) use Introduced Cool-Season Turf Grass to Vegetate Roadsides

- Low growing habit is appropriate for Safe clear zones.

Cavanaugh, Matt. "Salt-Tolerant Roadside Grasses: Does Anything Actually Survive?" *Turfgrass Science.* University of Minnesota, 19 Jan. 2015. Web. 10 Apr. 2016. <http://turf.umn.edu/2015/01/salt-tolerant-roadside-grasses-anything-actually-survive/>.

DustOut™

Fast Erosion Control

- Cool-season grass seed can be laid down efficiently.
  - Establish quickly, producing roots that bind the soil in place.

Phil Busey Agronomy Consulting Inc.

- Can withstand frequent mowing.

- Provides a simple management regime.

In 1988, the Iowa Legislature established the Living Roadway Trust Fund (LRTF) within Iowa Code 314.21.

- This program is designed to support the establishment and maintenance of native vegetation along Iowa's roadways.

- Promotes environmental stewardship and enhances the beauty and biodiversity of the state's transportation corridors.
- Utilizes Integrated Roadside Vegetation Management (IRVM) which focuses on sustainability and the use of native species for various ecological benefits.
- Iowa's origins as a prairie state make its native vegetation ideal for roadside use.
- Supporting Iowa's agricultural economy with soil conservation and pollinator habitats.

WHY DOTS BEGAN TRANSITIONING TO THE USE OF NATIVE WARM-SEASON GRASSES & FORBS FOR ROADSIDE VEGETATION

Clinton Memorandum on Environmentally Beneficial Landscaping - April 26, 1994

- "These landscaping practices should benefit the environment, as well as generate long-term costs savings for the Federal Government. For example, the use of native plants not only protects our natural heritage and provides wildlife habitat, but also can reduce fertilizer, pesticide, and irrigation demands and their associated costs because native plants are suited to the local environment and climate."

Plymouth, MA roadside

- **On Feb 3, 1999, President Clinton signed Executive Order 13112 establishing the National Invasive Species Council (NISC).**

- **Federal Highway Administration Guidance on Invasive Species August 10, 1999**
- State DOT Activities and Funded Facilities:
  - "The FHWA encourages the State DOTs to implement the Executive Memorandum on Beneficial Landscaping at every opportunity. This includes applying it to highway landscaping projects, rest area construction, scenic overlooks, State entrances, and Transportation Enhancement activities. In addition, FHWA recommends that roadside maintenance programs be given the necessary support to control and prevent invasive species."

- **Presidential Memorandum – A Federal Strategy to Promote the Health of Honeybees and Other Pollinators**
  June 20th, 2014
  President Obama

- "Pollinators contribute substantially to the economy of the United States and are vital to keeping fruits, nuts, and vegetables in our diets. Honeybee pollination alone adds more than $15 billion in value to agricultural crops each year in the United States. Over the past few decades, there has been a significant loss of pollinators, including honeybees, native bees, birds, bats, and butterflies, from the environment… "
- "Given the breadth, severity, and persistence of pollinator losses, it is critical to expand Federal efforts and take new steps to reverse pollinator losses and help restore populations to healthy levels. These steps should include the development of new public-private partnerships and increased citizen engagement."

Presidential Memorandum -- Creating a Federal Strategy to Promote the. (2015, July 20). whitehouse.gov. https://obamawhitehouse.archives.gov/the-press-office/2014/06/20/presidential-memorandum-creating-federal-strategy-promote-health-honey-b

1 Cause of Pollinator Decline: Land Use Change causing Habitat Fragmentation

- Land use change results in a decrease in habitat for feeding and breeding.
- Habitat fragmentation disrupts ecosystems, isolating species and diminishing biodiversity, which can contribute to the decline of pollinators.
- As pollinator populations decrease, due in part to these fragmented habitats, the pollination services vital for agriculture and natural plant reproduction are significantly reduced.

- Government pressure, combined with a growing awareness of the benefits and ecosystem services provided by native plants, has spurred state transportation departments to adopt more sustainable and environmentally conscious roadside management practices.

Roadside Right of Way Ecosystem Services

NATIVE WARM SEASON MEADOWS VS. INTRODUCED COOL SEASON TURF

- Warm-season (native) grass roots can reach 6-10 feet deep.
- Cool-season (introduced) grasses only go about 2-6 inches deep.

- Deeper warm season grass roots provide low-maintenance weed and invasive species control.
- Also excellent for erosion control, soil health, and drought resistance, as they can access water and nutrients from deeper soil layers.
- Reduces surface runoff by improving infiltration.
  - This also benefits ground nesting insects, like many of our native bees.

Erosion & Runoff Prevention

- Cool-season grass roots only hold the top 2-6 inches of soil in place, causing the soil to wash away from the underside during larger rain events.

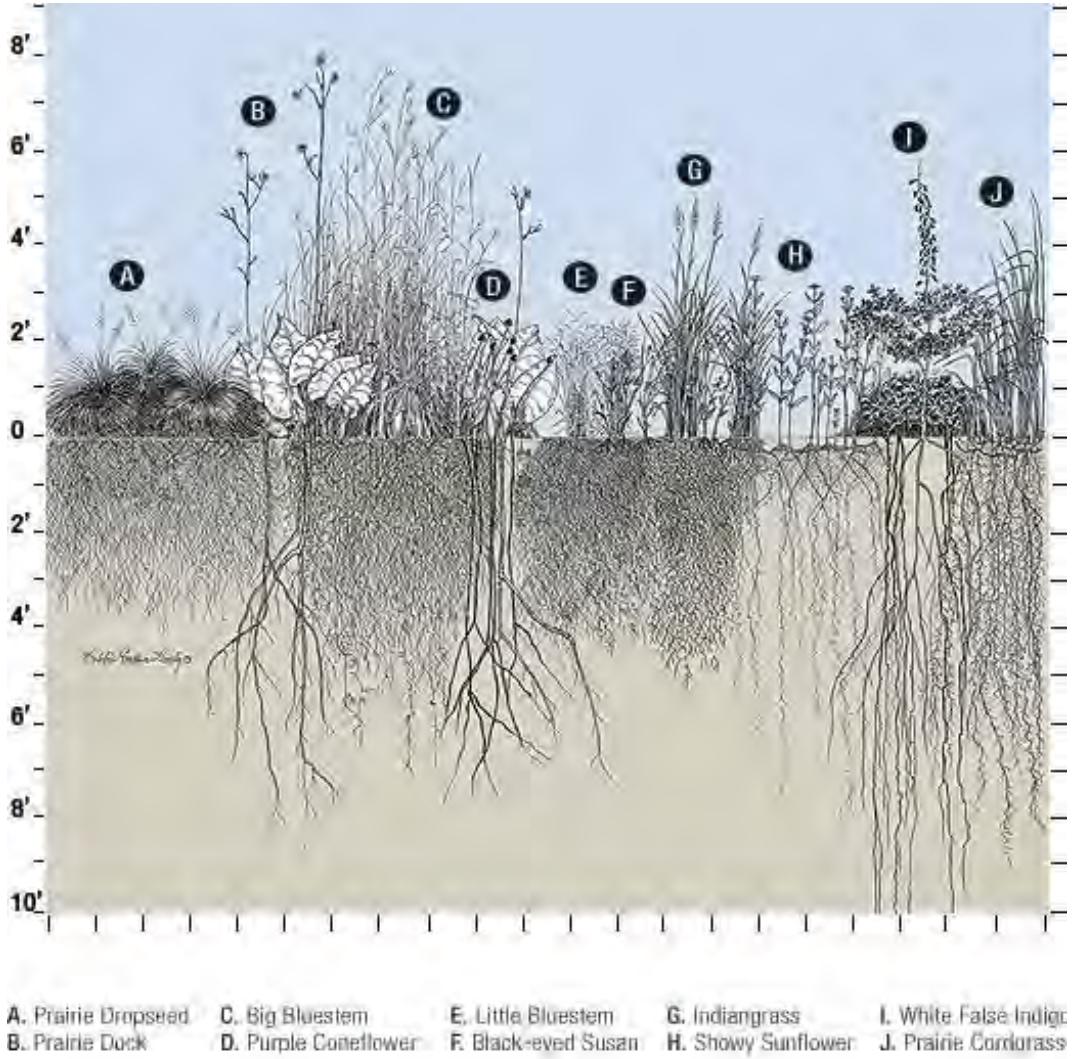
After the Storm: How Green Infrastructure Can Effectively Manage Stormwater Runoff from Roads and Highways. (2011, September). www.nrdc.org. https://www.nrdc.org/sites/default/files/afterthestorm.pdf

- Warm-season grass roots, because they penetrate feet into the soil, anchor the vegetation in place. Therefore, large rain events do not cause erosion.

"Potential solutions to New England roadside erosion" Dr. Rebecca Brown, URI
American Society for Horticultural Science December 30, 2010
Credit: Photo by Rebecca Nelson Brown

Resistant to Colonization by Invasive Species

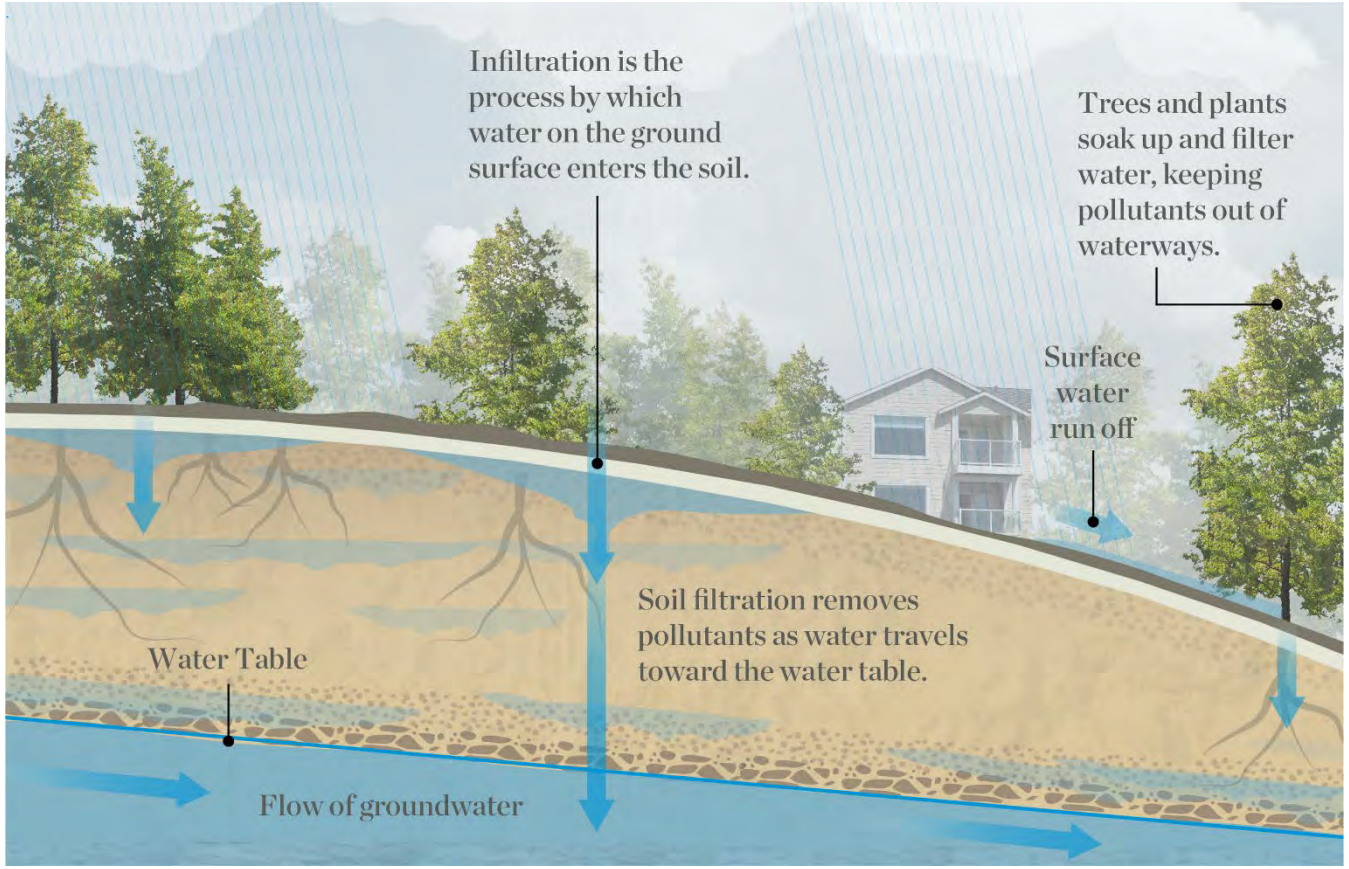
- Many invasive species like Japanese knotweed, burning bush, and Phragmites are opportunistic.
- They will colonize any available space.
- The dense root systems are warm season grasses inhibit this colonization.



Carbon Sequestration

- Plants can absorb carbon from atmospheric CO_2 and, using sunlight and water, convert it into sugars for energy.
- They can store those sugars deep in the ground, in their roots.

Pollution



- One of the biggest sources of pollution is called "Nonpoint Source Pollution" and it occurs because of runoff.
- When rain or melted snow moves over and through the ground, the water absorbs pollutants as it passes over.
- This runoff then enters a storm drain, which empties into a local water body.
- The plants along roadsides can mitigate stormwater runoff, helping to prevent the spread of pollutants into waterways.
- Roadside vegetation and the soil acts as a natural filter, trapping pollutants before the water reaches our groundwater.
- By absorbing noise and airborne particles, roadside vegetation contributes to a cleaner and quieter urban environment as well.

Animal Habitats

- Iowa experienced a resurgence of fowl populations as a result of their program to revegetate roadsides with native plants.
- In CT, ground-nesting birds like American Woodcocks, Juncos, and Song Sparrows will benefit form the native vegetation and reduced mowing.
- Aswell as, the Eastern Box Turtle which is listed as a "Species of Concern".

Quail

Pollination

- Roadsides provide corridors for pollinators to migrate.
- Corridors of connected habitat are critical to population health.
- These habitats provide all that is necessary for a pollinators' life cycle.
  - A place for foraging, nesting, breeding, and overwintering
- The presence of pollinators helps increase the yield of surrounding crops, thus increasing crops sales and bringing in added taxes.

Cultural Services

- Increases tourism
    - Texas, North Carolina, Virginia
- Added texture stimulates driver attention and increases driver safety
- Research shows decreases road rage

Table 3-1. Economic benefits in 2011-12 of using sustainable right-of-way (ROW) vegetation management practices on Florida's State Highway System. Values were estimated using the benefits transfer method[1] (King & Mazzotta, 2000), and based on 93,060 vegetated acres of state-maintained ROW) [Caster (2006); (J. Caster, personal communication, June 6, 2013)].

		Additional Value if Including Sustainable ROW Vegetation Mgt. Practices	
Ecosystem Service	Value	Plus Wildflower Area[2]	Minus Wildflower Area[3]
Aesthetics	$2,233,452	$3,200,498	$967,073
Pollination and other insect services	$34,246,264	$49,074,896	$14,828,632
Carbon sequestration	$39,457,650	$56,542,810	$17,085,160
Invasive species resistance[1]	$388,380	$1,011,082	$622,696
Runoff reduction[4]	$465,300,000	$939,636,000	$702,468,000
Air quality	$5,955,872	$11,113,657	$8,534,765
Total	$547,581,618	$1,060,578,943	$744,506,326

[1] There was no pertinent data in the literature about the value of the ecosystem services provided by invasive species resistance so these values were estimated using cost accounting methods based on FY 2011-12 data provided by FDOT. Also, these values assume that the future of invasive plants will mirror the past and no new species are introduced. In reality, the likelihood of new problem species being introduced is high, rendering these values low. Without knowing the invasive species or its problematic qualities, it is speculation to assign values.

[2] Based on 1000 acres of Wildflower Areas, which is about 1% of the total vegetated State Highway System ROW.

[3] Same sustainable management regime as shown in Table 1-5.

Economic Impact of Ecosystem Services Provided by Ecologically Sustainable Roadside Right of Way Vegetation Management Practices

- Research showed that there are economic benefits to revegetating roadsides using native plants rather than turfgrass.
- A 2014 report concluded that FDOT could reduce right-of-way (ROW) vegetation management costs by 30% simply by implementing sustainable management practices such as reduced mowing.

- University of Florida/IFAS, Wakulla County Extension Service George L. (Les) Harrison FDOT Contract Number: BDK75-977-74

Inventory of Existing Vegetation

- We wanted to see what was already growing on the roadsides.
  - Was it all invasives?
  - Natives?
  - Any plants that are ecologically significant.
  - Any listed species or species of concern.
  - Soil samples
    - pH and Nutrient analysis.

Pennsylvania sedge (*Carex pensylvanica)*

Poverty oatgrass (Danthonia spicata)

Little bluestem (*Schizachyrium scoparium*)

- Inventories of roadside vegetation revealed that colonies of native grasses and forbs already existed along roadsides.
  - They usually emerged when a roadside was not mowed for a season or two.
- This revealed that seedbanks and root propagules of native plants already existed along roadsides and mowing practices needed to be changed to foster the development of these native plant communities.

Native Plant Communities Emerging along Rte. 6 as a result of Reduced Mowing

Foxglove beardtongue (*Penstemon digitalis*)

Common milkweed (*Asclepias syriaca*)

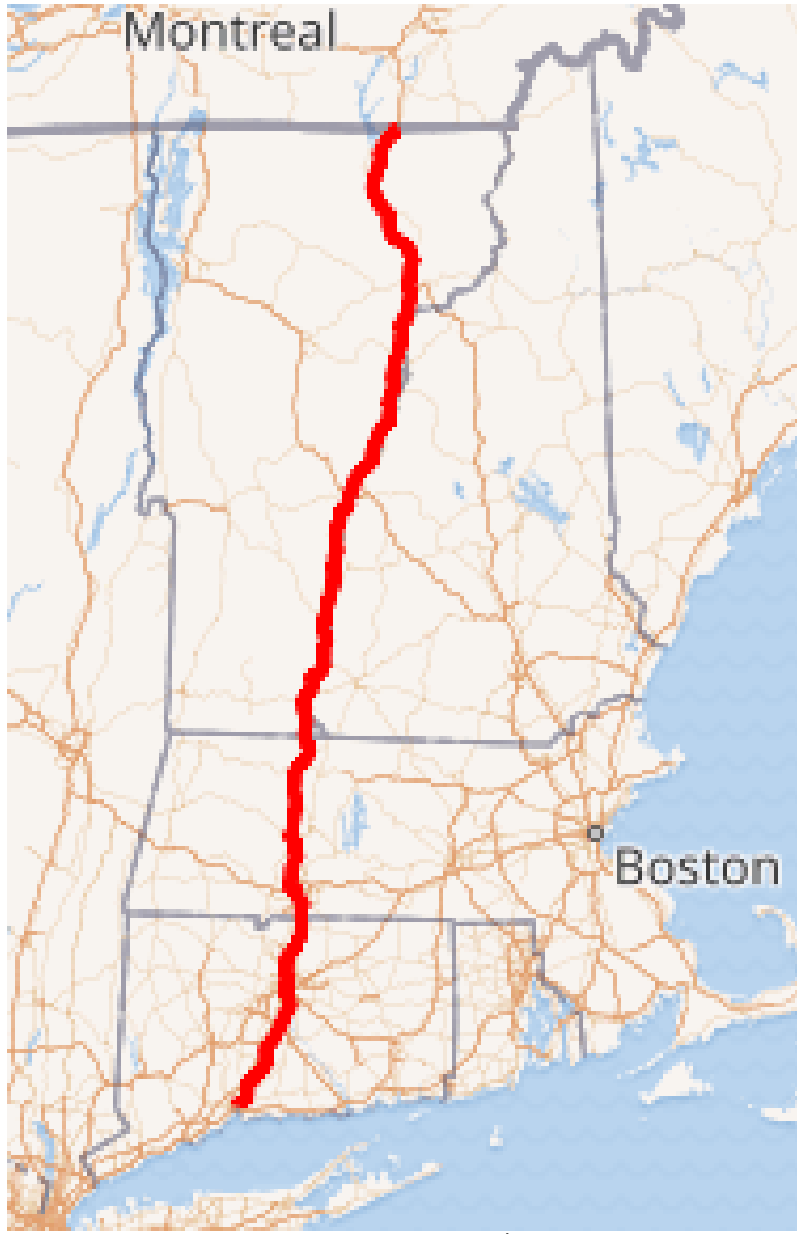

Rt 6 in Windham, CT

Rt 6 in Mansfield, CT

Developing a model for a *Pollinator Conservation Corridor* in New England

I-91 Corridor

- **I-91 was chosen due to its South to North route.**
  - Which follows the blooming cycle of flowers in response to increasing temperatures and extended daylight hours
  - As well as following the Monarch butterfly's migration route.
- **Demonstration plots will serve as case studies.**
  - Windham, Connecticut
  - Holyoke, Massachusetts
  - Lyndon, Vermont



Interstate 91 (I-91). (n.d.). https://www.exitexplorer.com/ee/hwy/us/I-91/MA/

Windsor, Connecticut Site

I-91 Exit 38

- Transition from mostly turf grass using herbicide.
  - Early Spring
- Experimenting with a concept called "Split Seeding"
  - Seed grasses in the spring will allow them to take root before winter comes.
  - Seed forbs in the fall will allow them to go through a cycle of winter stratification while decreasing the amount of animal predation.
- Cover crop was added to the grass seed.
  - Cover crops are annuals, that are used to protect the soil.
  - In this case, they provide protection for the grass seed while it germinates.
  - While also, preventing erosion.

- Since CT DOT has reduced mowing, several native species have emerged.

Spreading dogbane (*Apocynum androsaemifolium*)

Blue vervain (*Verbena hastata*)

Black-Eyed Susan (*Rudbeckia hirta)*

Common milkweed
(*Asclepias syriaca*)

Common evening-primrose
(Oenothera biennis)

Steeplebush
(*Spirea tomentosa*)

Challenges: Connecticut Site

- Yellow foxtail grass (*Setaria glauca*) and nutsedge (*Cyperus rotundus*) emerged in some large areas of the field following seeding.
  - Rather than spray with herbicide, which could inhibit or kill the native seedlings, we decided to mow the grass since it is an annual.
  - Yellow foxtail's life cycle allows it to regenerate foliage and seeds rapidly, we had to monitor it and have mowed it twice so far.

Holyoke, Massachusetts Site
I-91 Exit 14

Encountered several challenges:

MA regulations concerning herbicide applications are quite complex.

- We needed to choose a second site after we realized that a site in Northampton would encounter community resistance.
- Visited the site several times with state and local officials and needed to present before the Holyoke Conservation commission for approval.
- Needed to place an advertisement of a particular size in a local newspaper to allow citizens to express concerns.

Lyndon, Vermont Site (Near Canadian border)

- Only site that followed new construction.
  - Would not need to kill existing vegetation.
- There was thin layer of asphalt because it had been used as staging area for construction.
  - The asphalt raised the pH level to 7.7, which was not the optimal range for native plants to establish.
- We needed to find a fast-acting solution for the elevated pH.
- Usual techniques of amending the soil with sulfur or aluminum sulfate would take too long, be too costly, and not a common practice of New England DOTs.

Lyndon, Vermont Site near Canadian Border

- We consulted with Mark Fiely, the head botanist at Ernst Seed.
- Since the pH of the surrounding soil was lower than that of the site, he believed the site pH would eventually lower to that of the surrounding soil.
- Therefore, he recommended that we increase the rate of the native seed by 50%.
  - So that enough seed will survive while the soil pH lowers.

Vermont Site

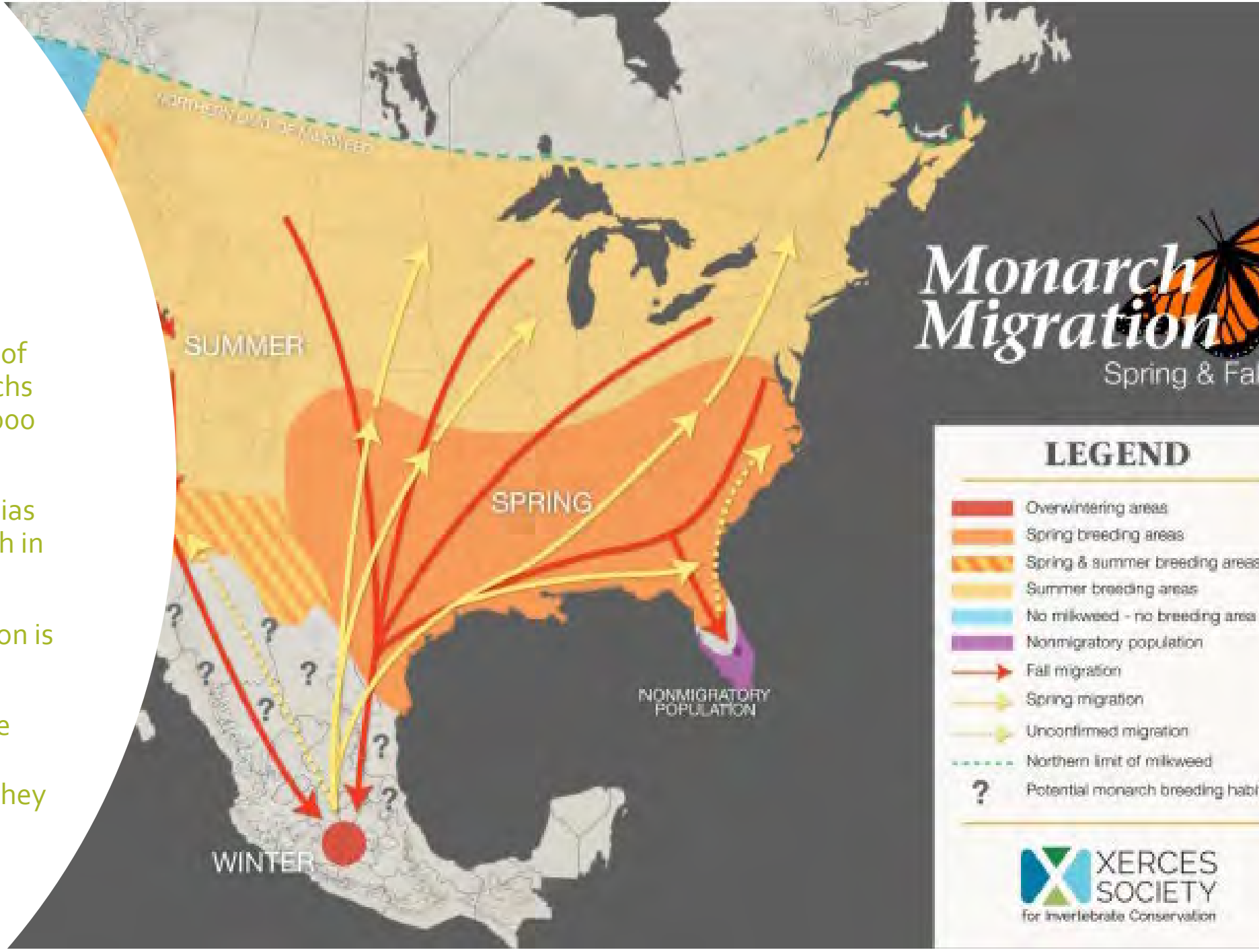
- This site had a slight slope.
- Therefore, it was important that the seed be kept in perpetually close contact with the soil.
- Straw matting was used to maintain seed-to-soil contact and prevent soil erosion.

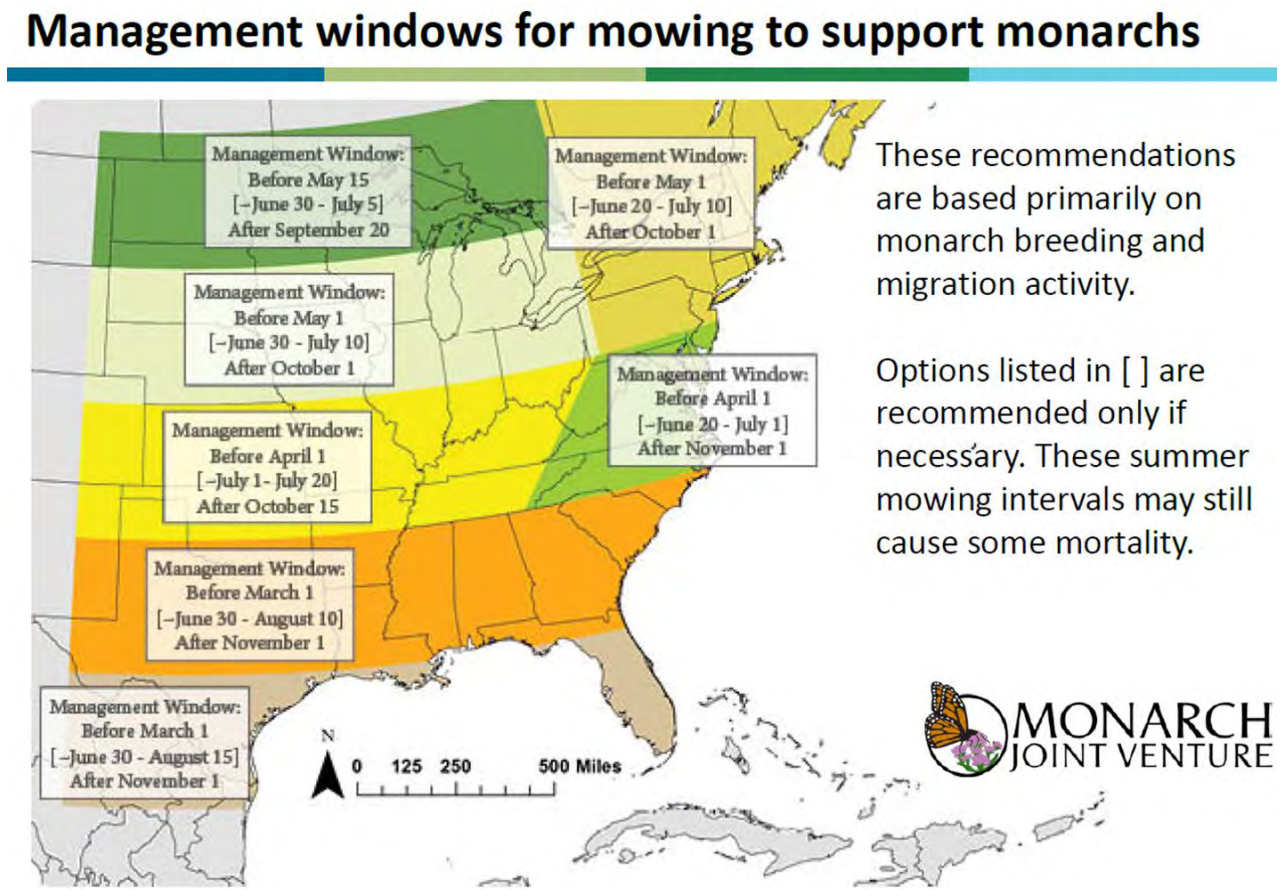
Monarch Butterfly

(Danaus plexippus)

Monarch Migration

- Each fall, North American monarchs travel from their summer breeding grounds to overwintering locations. East of the Rocky Mountains, monarchs travel up to an astonishing 3,000 miles to central Mexico.
- In search of milkweed (Asclepias spp.) habitats that are also rich in nectar plants.
- In Ct, monarchs' peak migration is in September.
- This migration is why roadside habitats are crucial.
  - If appropriately managed-they could provide connected habitat for the entirety of a monarchs' life cycle.





Mowing for Monarchs

- Therefore, mowing is best done (if at all) before May 1st or after October 1st.
- What's important to remember is monarch butterflies need nectar rich plants, so they have energy during their long journey,

BUT

- Monarch caterpillars need milkweed to feed on so they can become butterflies.
- NEED HABITATS WITH BOTH!

ROADMAP FOR DOTS TO TRANSITION

DOT Manual

- Decrease amount of mowing, especially while warm-season grasses are putting out their summer growth.
- Reduce mowing to either before May 15th , or After October 1st.
  - To allow for nectar plants to bloom and go to seed.
  - To allow for most monarch caterpillars to finish pupating.
  - Reduced mowing allows existing seed banks of native species to take root.
  - This is the best way to increase populations of ecotypic native species and preserve genotypic populations in the New England region.
  - This is especially important while the ecotypic seed production supply chain ramps up in the next few years because we also found out that…

The Northeast Seed Network

No wholesale ecotypic seed suppliers in the Northeast that could support a venture as large as reseeding Northeast roadsides.

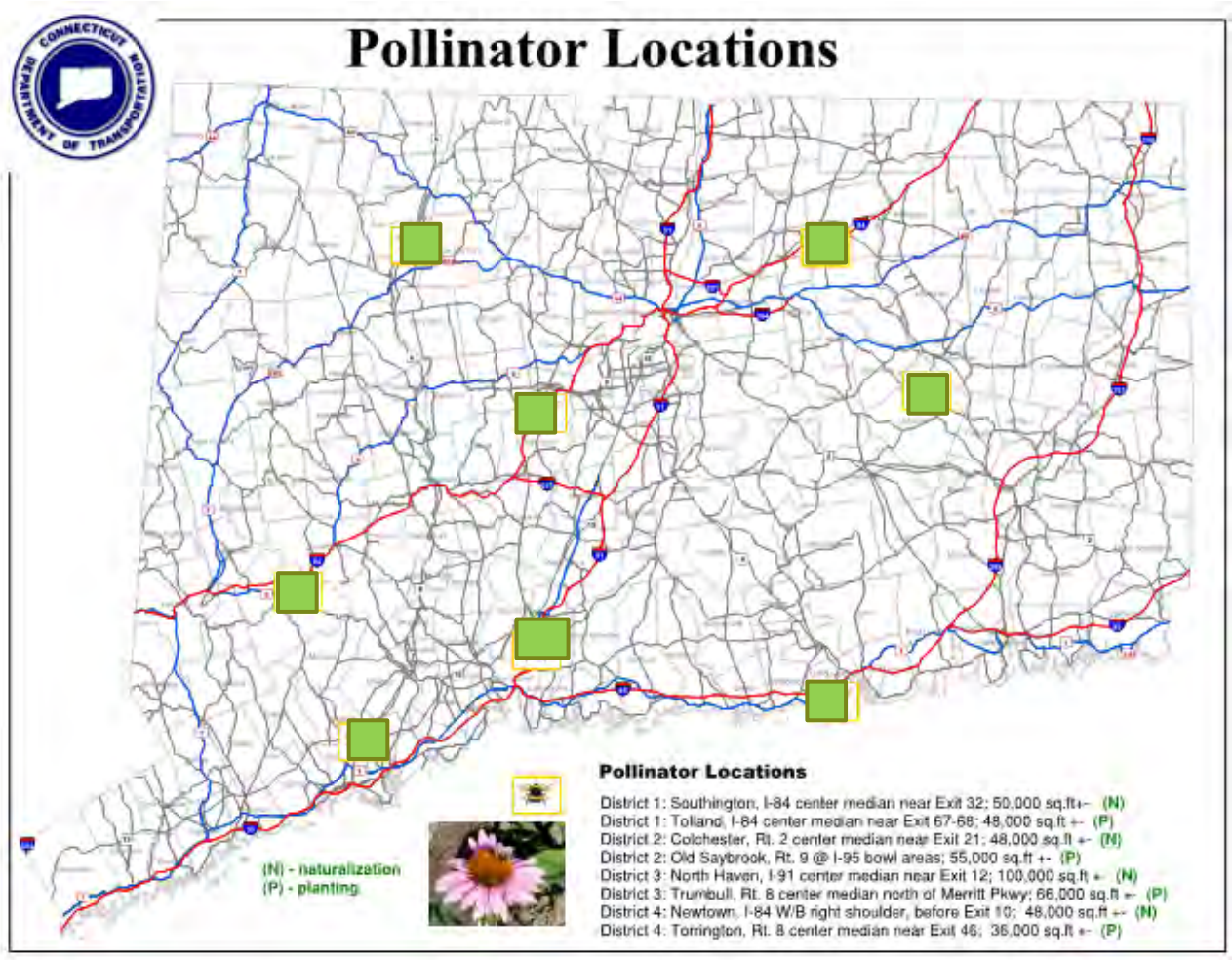
The Northeast Seed Network is composed of stakeholders who work with native plants.

They are trying to jumpstart the ecotypic seed production supply chain for the Northeast.

- The Native Plant Trust
- Eco59
- Norcross Wildlife Foundation and others.

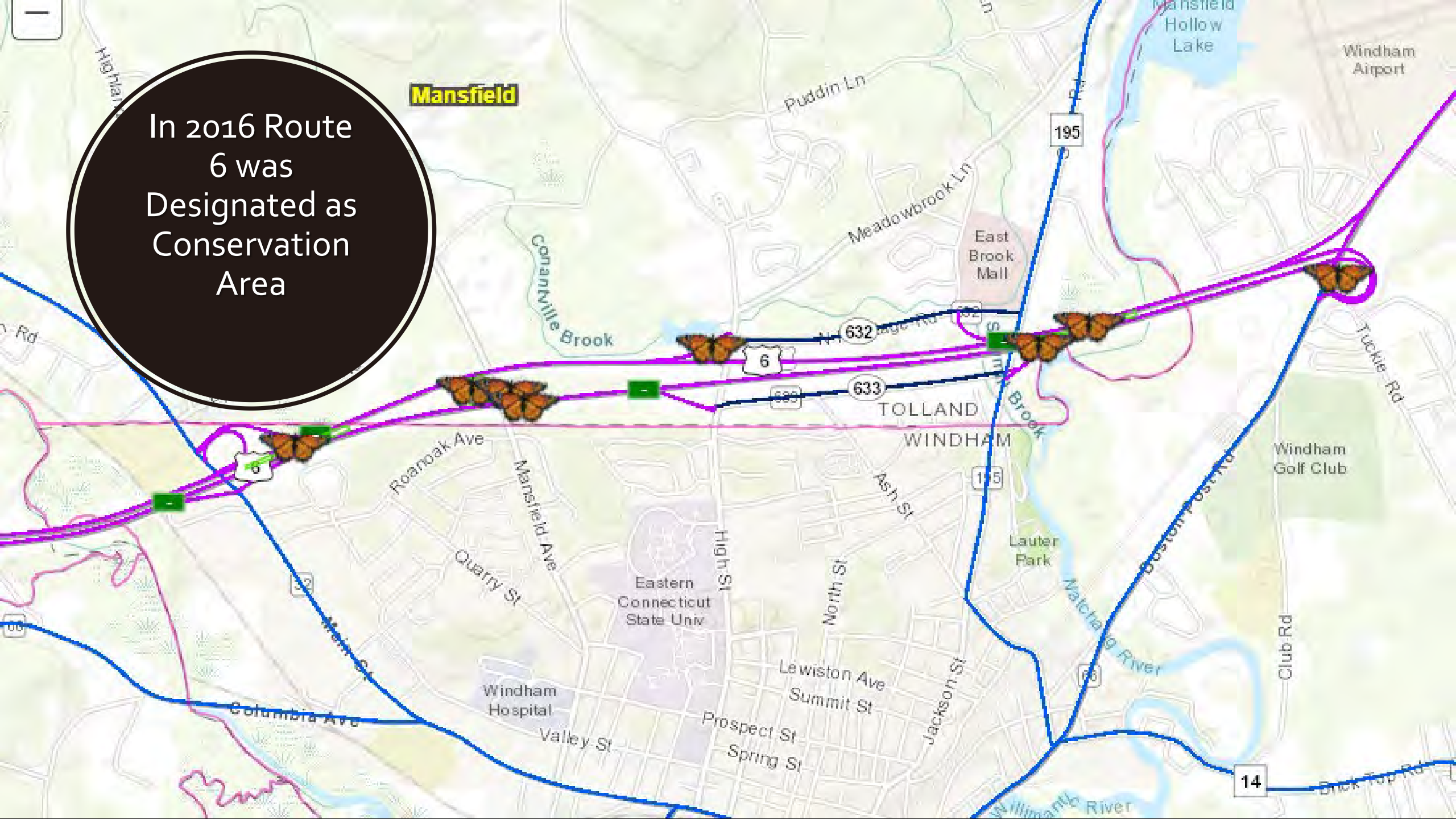
Spring ladies' tresses (*Spiranthes vernalis*) from Rt 6 site in Windham, CT

Reduced Mowing by CT DOT & Pollinator Locations



- The CTDOT Pollinator Program was implemented in 2017
  - 123 conservation areas made of 205 acres of state right of way.
- Pollinator Programs goal is to provide critical habitats for pollinating insects, such as bees and monarch butterflies, through strategic plantings and vegetation management.

CTDOT celebrates National Pollinator Week. (n.d.). CT.gov - Connecticut's Official State Website. https://portal.ct.gov/DOT/CTDOT-Press-Releases/2023/CTDOT-Celebrates-National-Pollinator-Week


In 2016 Route 6 was Designated as Conservation Area
Mansfield
Puddin Ln
Meadowbrook Ln
Conantville Brook
East Brook Mall
Mansfield Hollow Lake
Windham Airport
195
632
6
633
TOLLAND
WINDHAM
Roanoak Ave
Mansfield Ave
Quarry St
High St
Eastern Connecticut State Univ
North St
Ash St
Lauter Park
Natchaug River
Boston Post Rd
Windham Golf Club
Club Rd
Tuckie Rd
Lewiston Ave
Summit St
Prospect St
Spring St
Valley St
Jackson St
Windham Hospital
Columbia Ave
14
Willimantic River

NEWS › CONNECTICUT NEWS

UConn plant scientists imagine CT's I-91 as one long pollino
Here's why and what it would mean for butterflies and peop

University of Connecticut/University of Connecticut

6 of 6

Wildflowers along Route 6 between Willimantic and Coventry

Newspaper Articles Covering Our Research: Hartford Courant

25 February 2023

Project aims to seed wildflowers at spot along I-91 in Holyoke

Published: Sep. 16, 2023, 5:12 a.m.

Lewis Tree Service Inc. applying herbicide to land area at exit 14 on-ramp on the southern-bound of interstate 91 in Holyoke. (Hoang 'Leon' Nguyen / The Republican)

By Jonah Snowden | jsnowden@repub.com

HOLYOKE — On Friday morning, a group of workers prepared to lay down herbicide on a patch of grass along Interstate 91 in Holyoke.

Newspaper Articles Covering Our Research: Springfield Republican

16 September 2023

What's Next?

Develop a model for a Pollinator Conservation Corridor through an analysis of habitats along the highway.

- Using Geographic Information Systems (GIS) to identify areas best suitable for revegetation.
- Identify public and private properties that can work as "Supporting Habitats" to roadsides that may have little ecological value otherwise.

When suitable habitats are identified, a public engagement program will be designed and implemented.

- The more informed people are about pollinators the more supportive they will be to pollinator habitats.

THE END