ELATS

ENVIRONMENTAL & LANDSCAPE ARCHITECTURE TRAINING SERIES

BUILDING PARTNERSHIPS, TRANSFERRING KNOWLEDGE, ACHIEVING RESULTS

DEVELOP MANUFACTURED TOPSOIL MIXES TO SUPPORT THE GROWTH OF POLLINATOR-FRIENDLY VEGETATION IN ROADSIDE SETTINGS

C-16-02: Funded by UTRC and FHWA through NYSDOT SPR

Work performed by Cornell Waste Management Institute (CWMI)

ENVIRONMENT
NYSDOT OFFICE OF ENVIRONMENT

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

Project Personnel

NYSDOT Project Manager: Christine Colley, RLA

Principal Investigator: Jean Bonhotal, Sr. Extension Associate, CWMI

Project Assistant: Mary Schwarz, Extension Support Specialist, CWMI

Entomology Support: Peter Borst

Cornell Cooperative Extension: IPM and Plant Science Staff will be hired after sites are chosen.

Cornell Nutrient Analysis Lab & Students: Soil analyses

Institute for Resource Information Sciences (IRIS) :

GIS Support

DOT Project Direction

- **NYSDOT Project Manager:** Christine Colley, RLA
- Technical Working Group (TWG):Reviews plans and progress reports, provides technical support to the project.
- City University of New York (CUNY): Funding Source and support.

C-16-02

- Project Goal:

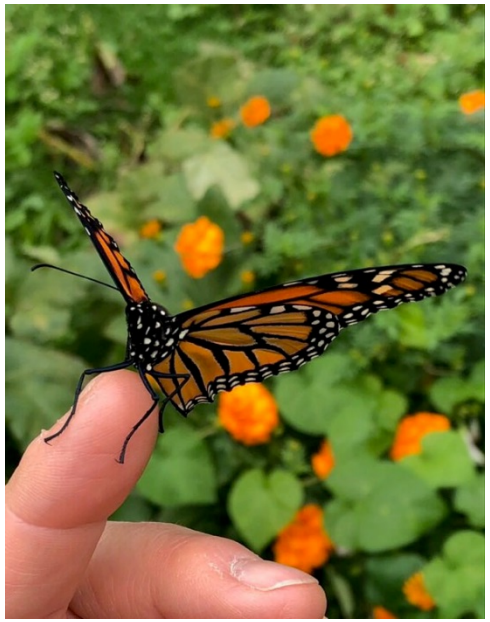
  Develop manufactured topsoil mixes to support the growth of pollinator-friendly vegetation in roadside settings

Background

Healthy soils are key in supporting plant populations that attract pollinators.

Components of C-16-02

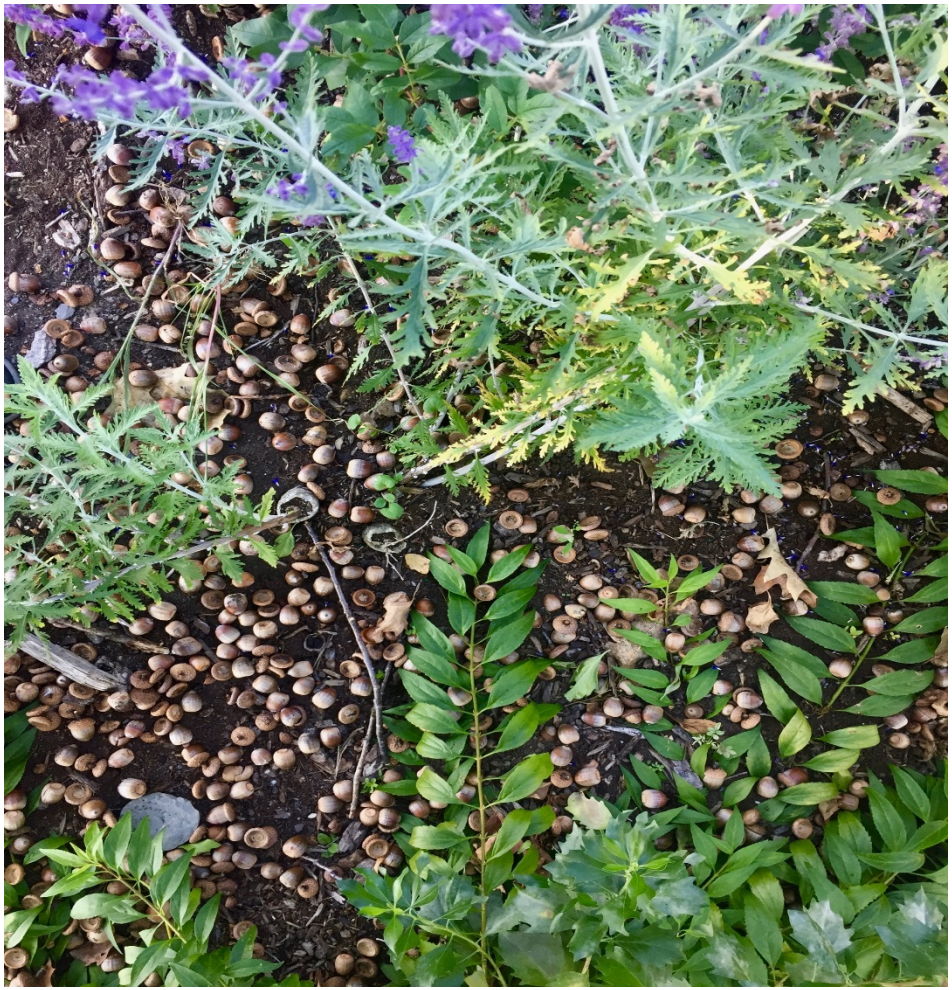
- Selecting Reference Sites – mapping 9-12 sites
- Ensuring that soils in selected plots are representative of the dominant soils in each ecoregion
- Explore reference site disturbance over 30 years
- Census plant pollinators
- Census pollinator-insect & animal



Variables in the success of sustainable pollinator stands

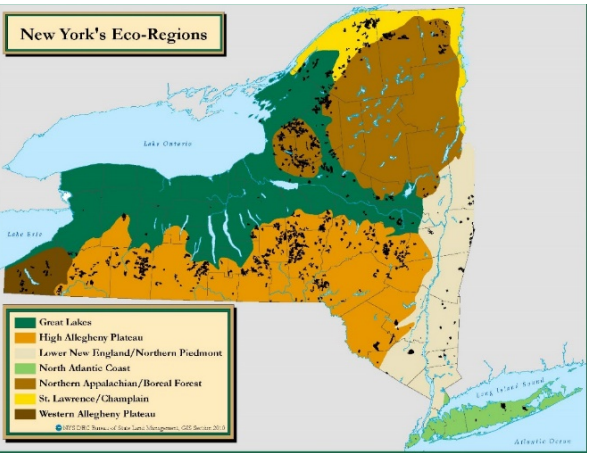
- Climate – drought/floods
- Short growing seasons
- Disturbance
  - Mowing , driving, people and animal traffic
- Soil moisture
- Organic Matter
- Seed Bank

Seed Bank



Divide the State into Ecoregions

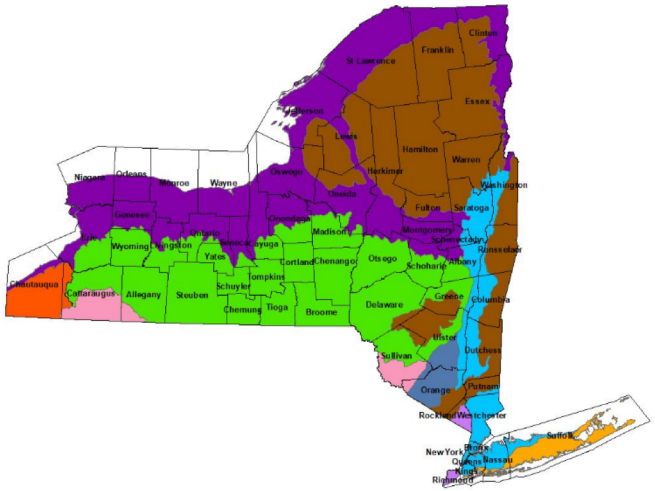
NYS DEC:
7 Ecoregions



https://www.dec.ny.gov/animals/9402.html

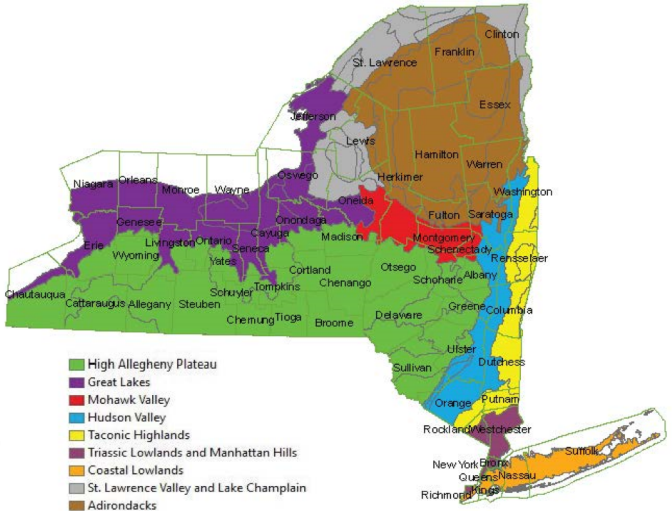
https://www.dec.ny.gov/docs/lands_forests_pdf/nyecoregions.pdf

EPA:
9 Ecoregions
(level III)



https://www.epa.gov/eco-research/ecoregions

C-16-02:
9 Ecoregions



Ecoregions of New York

What constitutes an Ecoregion?

The distribution of plant and animal species in New York closely corresponds with ecoregional boundaries. They are used in the New York Comprehensive Wildlife Conservation Strategy (CWCS) to reference some species distribution information.

Ecoregion v. Ecozone

- An **ecoregion** (ecological region) is an ecologically and geographically defined area that is smaller than a bioregion, which in turn is smaller than an **ecozone**. ... Secondly, **ecoregion** boundaries rarely form abrupt edges; rather, ecotones and mosaic habitats bound them.

Ecoregions of New York

What constitutes an Ecoregion?

Areas of ecological homogeneity are defined by similarities in:

- Soil
- Physiography
- Climate
- Hydrology
- Geology
- Vegetation

Ecoregions

Nine (EPA) or seven (DEC) ecozones are based on:

- similar soils
- mean annual precipitation
- frost free days
- mean low and high temperatures in January and July

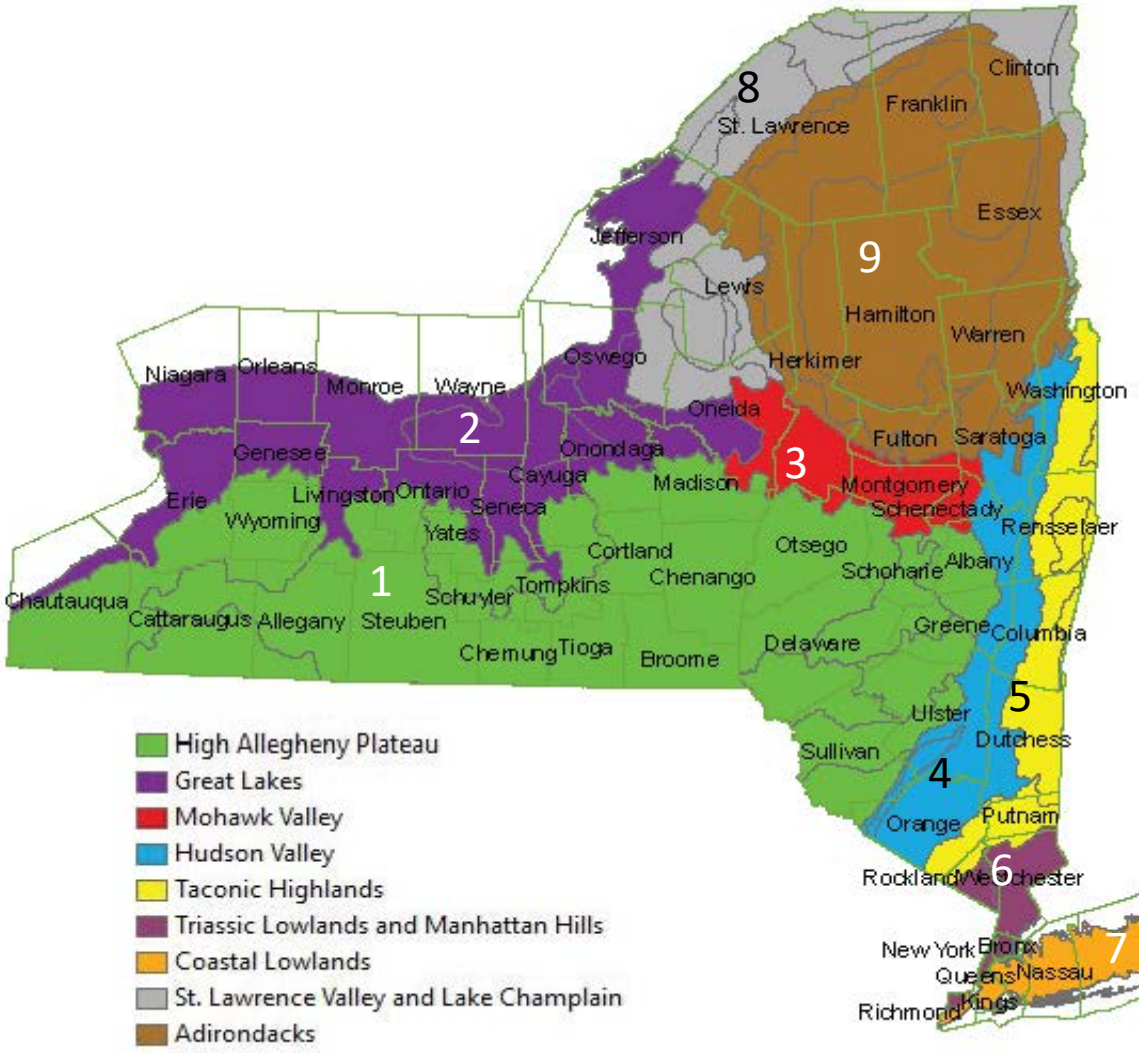
C-16-02 Ecoregions 1-5

C-16-02 Ecoregion	EPA Ecoregion	DEC Ecoregions
High Allegheny Plateau	Eastern Great Lakes Lowlands Erie Drift Plain North Central Appalachians Northern Allegheny Plateau Northeastern Highlands	Western Allegheny Plateau High Allegheny Plateau Lower New England/ Northern Piedmont Great Lakes
Great Lakes Plains	Eastern Great Lakes Lowlands Northern Allegheny Plateau Erie Drift Plain	Great Lakes
Mohawk Valley	Eastern Great Lakes Lowlands Northern Allegheny Plateau	Great Lakes Lower New England/ Northern Piedmont
Hudson Valley	Eastern Great Lakes Lowlands Ridge and Valley Northeastern Coastal Zone Northern Allegheny Plateau Northeastern Highlands	Lower New England/ Northern Piedmont High Allegheny Plateau
Taconic Highlands	Eastern Great Lakes Lowlands Northeastern Highlands Northern Piedmont Northeastern Coastal Zone	Lower New England/ Northern Piedmont

C-16-02 Ecoregions 6-9

C-16-02 Ecoregion	EPA Ecoregion	DEC Ecoregions
Triassic Lowlands & Manhattan Hills	Northeastern Coastal Zone Northern Piedmont	Lower New England/ Northern Piedmont North Atlantic Coast
Coastal Lowlands	Northeastern Coastal Zone Northern Piedmont Atlantic Coastal Pine Barrens	North Atlantic Coast
Saint Lawrence Valley & Lake Champlain	Eastern Great Lakes Lowlands Northeastern Highlands	Northern Appalachian/ Boreal Forest St. Lawrence/Champlain Valley Great Lakes
Adirondacks	Eastern Great Lake Lowlands Northeastern Highlands Northeastern Coastal Zone	Northern Appalachian/ Boreal Forest St. Lawrence/Champlain Valley Lower New England/ Northern Piedmont Great Lakes

C-16-02 EcoRegions



9 zones based on:

- similar soils
- mean annual precipitation
- frost free days
- mean low and high temperatures in January and July

C-16-02 Ecoregions 1-5

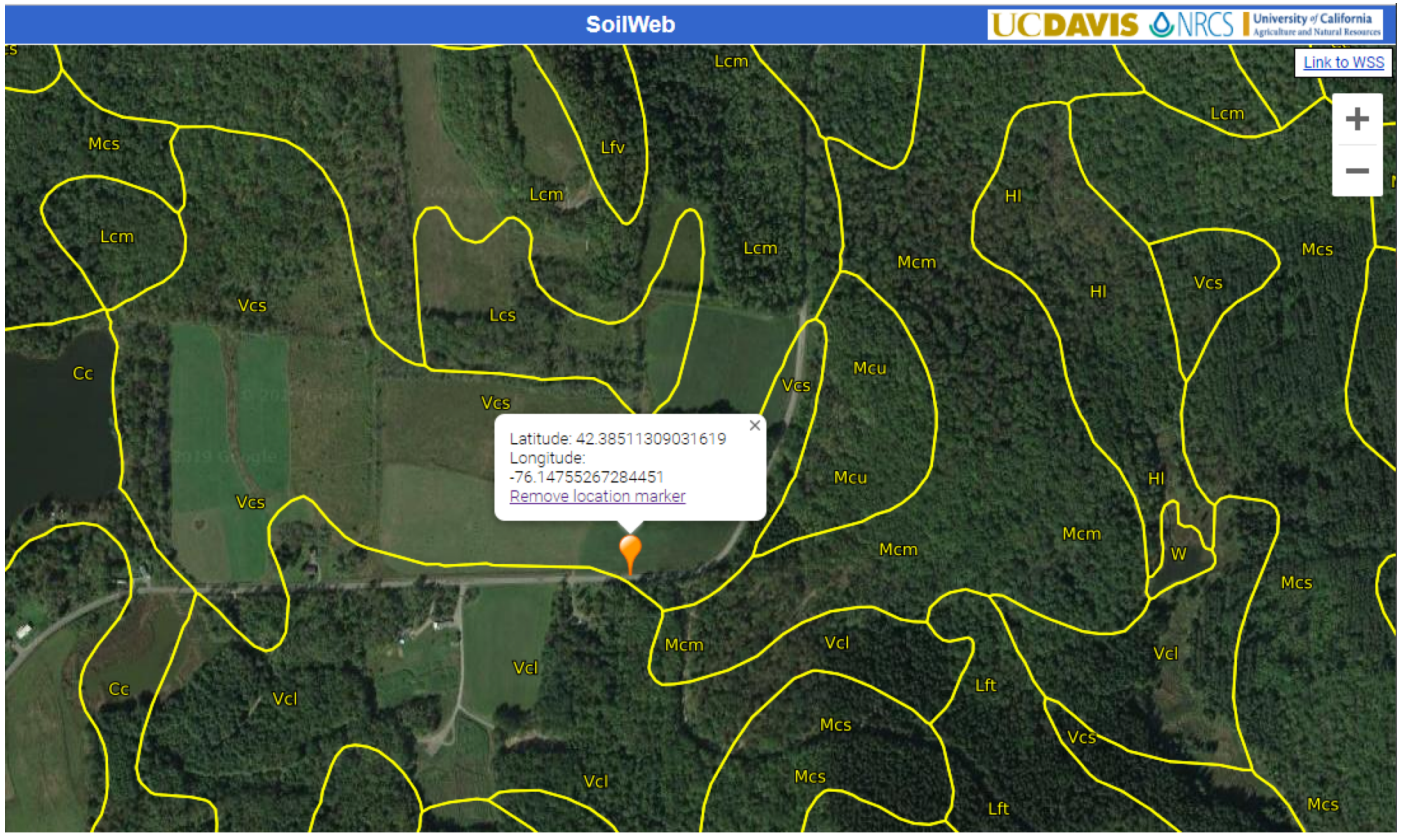
Ecozone	Soils	Precip	FF Days	Temps January	Temps July	#
High Allegany Plateau	Inceptisols Utisols Alfisols	30-40”	90-190	12/32	54/81	1
Great Lakes	Alfisols Inceptisols	26-45”	130-200	16/31	61/80	2
Mohawk Valley	Alfisols, Inceptisols Entisols	29-50”	120-180	11/28	58/81	3
Hudson Valley	Alfisols, Inceptisols Entisols	26-45”	120-185	15/34	60/84	4
Taconic Highlands	Inceptisols	30-50”	20-180	13/33	57/80	5

C-16-02 Ecoregions 6-9

Ecozone	Soils	Precip	FF Days	Temps January	Temps July	#
Triassic Lowlands/Manhattan Hills	Inceptisols Histosols	40-52	150-190	15/35	60/84	6
Coastal Lowlands	Entisols	44-48	170-220	20/38	61/82	7
St Lawrence Valley/Lake Champlain	Alfisols, Inceptisols Spodosols	30-55	90-200	5/31	55/80	8
Adirondacks	Alfisols, Inceptisols Spodosols	30-60	60-150	2/28	53/80	9

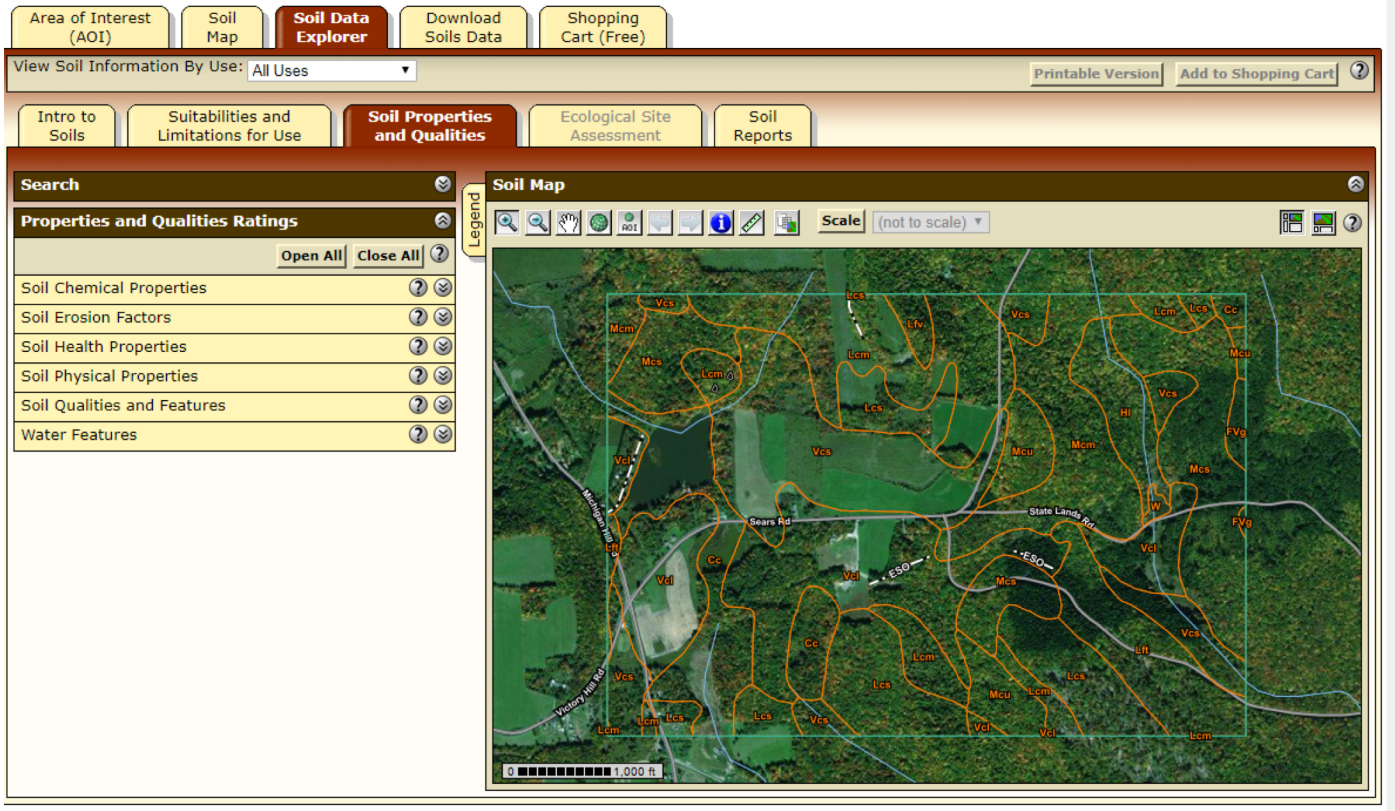
Scouting Soils

Use “Soil Web” app to identify soil type.



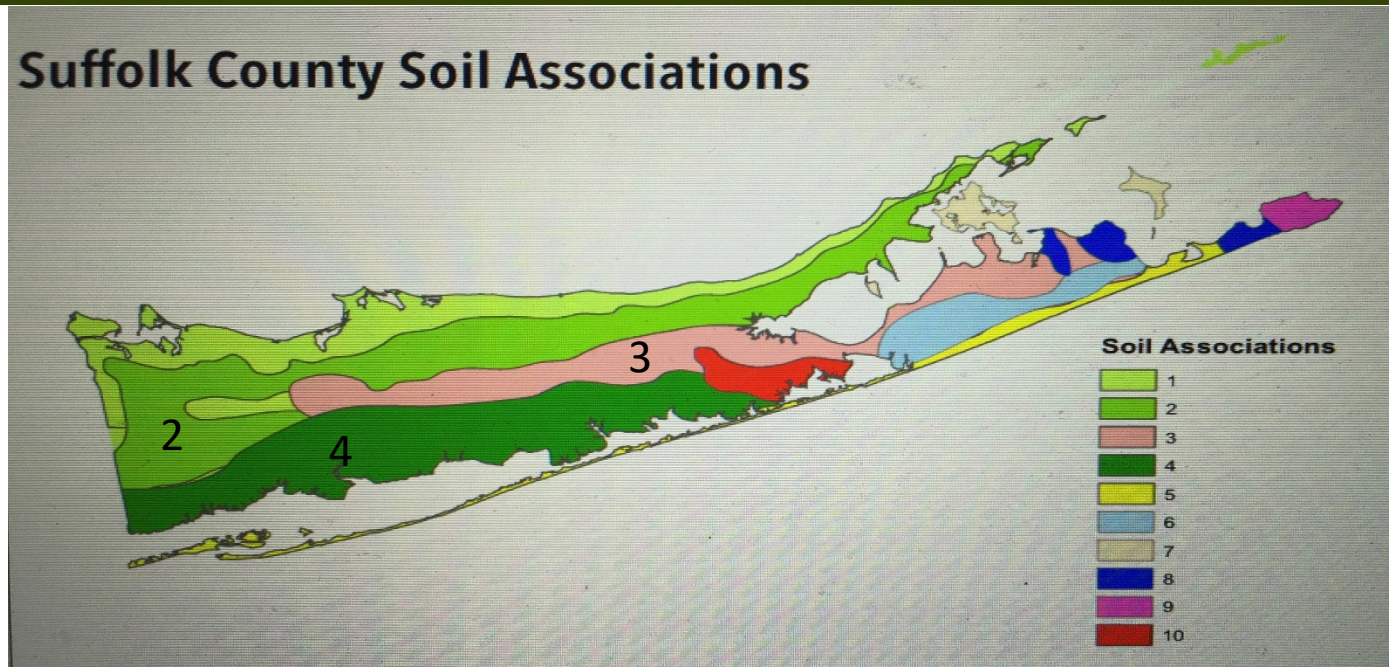
Scouting Soils

Get Soil information from Web Soil Survey



http://websoilsurvey.nrcs.usda.gov/

Selecting Predominant Soil: Suffolk County

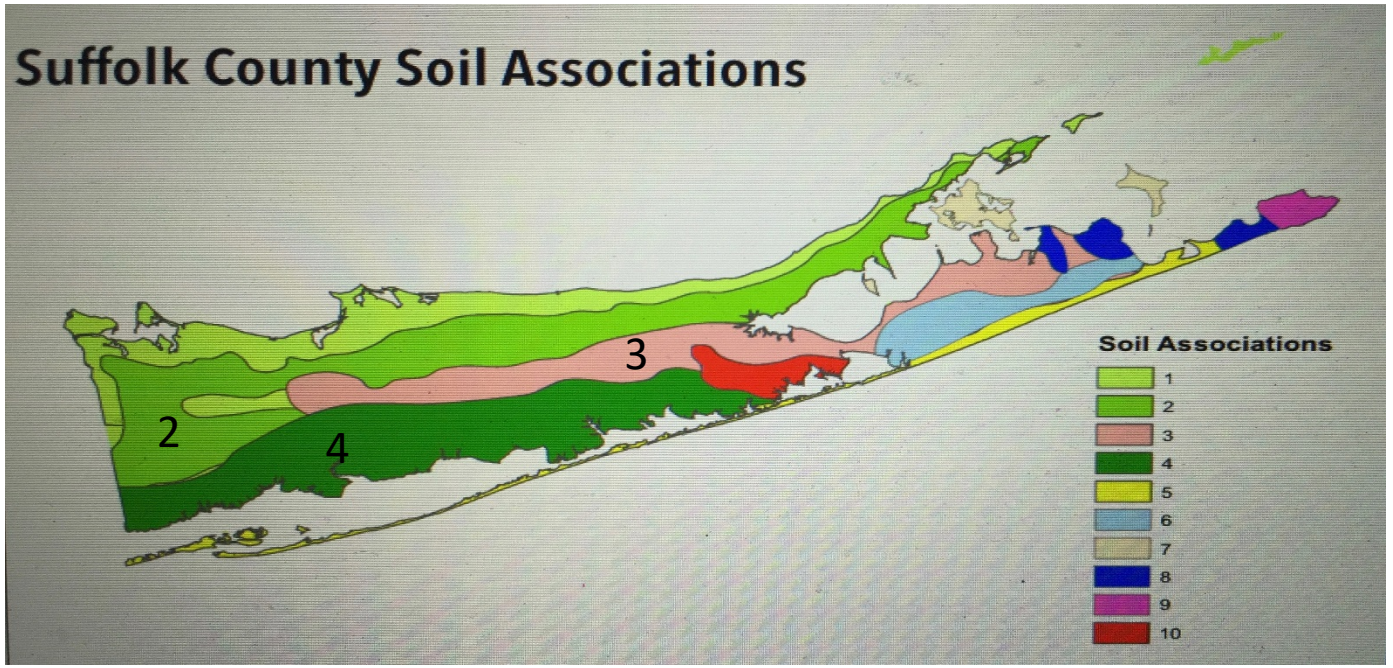


Association 2, which comprises 26% of Suffolk County, is made up of Haven loam and Riverhead sandy loam. There are four minor soils in this association as well.

Association 4, which comprises 21% of Suffolk County, is made up of Riverhead sandy loam, Plymouth loamy sand and Carver coarse sand. There are four minor soils in this association.

Selecting Predominant Soil: Suffolk County

Association 3, which comprises 19% of Suffolk County, is made up of Plymouth loamy sand and Carver coarse sand. There are five minor soil types in this association.



Criteria for choosing good reference sites

- Dense sustainable stands of pollinator species - 3 species for each season
- Size: ¼ mile x 6 feet wide
- Good safe area for parking and movement
- Not disturbed for many years

Reference Sites: Types of Plants

Queried the NYS Flora Atlas for all plants native to NY (**2000+** plants)

Plants likely to be found in ROW

Insect Pollinated Plants
(not wind-pollinated)

NY Flora Atlas website.

Developed a list of 140 plants.

Checked each plant's distribution on the NY Flora website.

(Shows locations where vouchered specimens for herbaria were collected – by county only).

Use that information to determine what we can expect to find in the ROW for each of the different ecoregions.

Reference Sites: Example Plants

Scientific Name	Common Name
Achillea millefolium	common yarrow
Actaea racemosa	black cohosh
Actaea rubra	red baneberry
Ageratina altissima	common white snakeroot
Amelanchier arborea	downy shadbush
Amelanchier laevis	smooth shadbush
Amelanchier sanguinea	round-leaved shadbush
Amelanchier spicata	dwarf shadbush
Anemone canadensis	canada anemone
Anemone virginiana	tall anemone
Apocynum androsaemifolium	spreading dogbane
Apocynum cannabinum	indian hemp
Aquilegia canadensis	wild columbine
Aronia melanocarpa	black chokeberry
Baptisia tinctoria	wild indigo
Bidens cernua	nodding beggar ticks
Bidens frondosa	devil's beggar ticks
Chelone glabra	white turtlehead
Clematis occidentalis var. occidentalis	american purple clematis
Cornus amomum ssp. amomum	silky dogwood

Partial list of Native NY Plants that would be viable to plant in the ROW

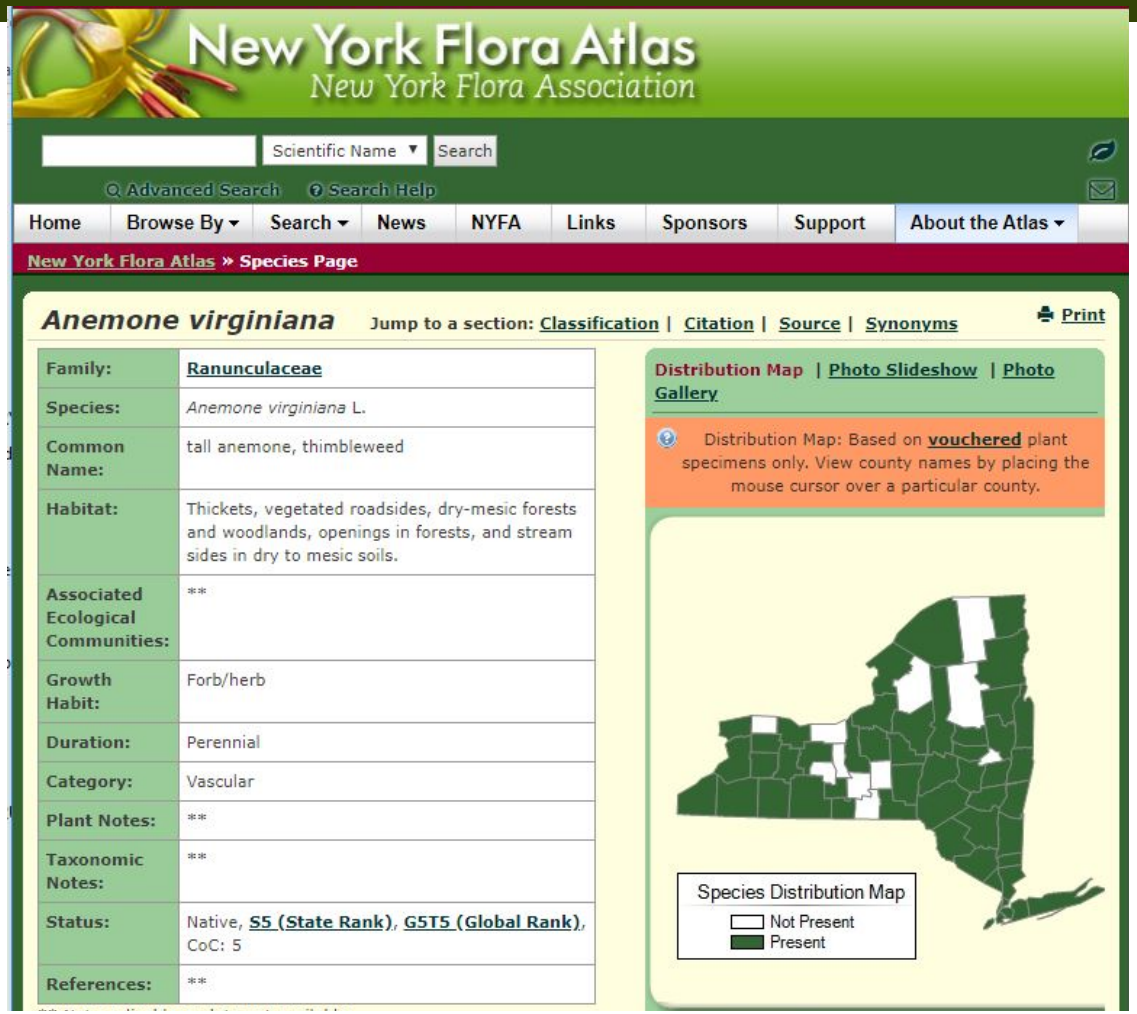
Each plant is:

- Insect pollinated
- Has a widespread distribution across NY
- Relatively suited for ROW/roadside habitat (as described by the NY Flora Atlas).

Shrubs/Trees: provide early food sources

- **Common Name:** Shadbush
- **Botanical Name:** *Amelanchier canadensis*
- **Plant Type:** Shrub
- **Plant Size:** 25-30 feet
- **Typical Bloom Time:** April to May
- The shadbush features fragrant white flowers. This large shrub (or small tree) is one of the earliest food sources each spring for bees and butterflies, and birds and other wildlife eat its fruit.

Reference Sites: Example Plants



Example description from NY Flora Atlas

http://newyork.plantatlas.usf.edu/Plant.aspx?id=2582

Reference Sites: Example Plants

Source

County	Year	Herbaria	Notes	Submission Info
Albany		NYFA_1990 Herbarium Name Used: none Anemone virginiana var. virginiana		
Albany		NYFA_1990 Herbarium Name Used: none Anemone virginiana var. alba		
Allegany		NYFA_1990 Herbarium Name Used: none Anemone virginiana var. virginiana		
Bronx		NYFA_1990 Herbarium Name Used: none Anemone virginiana var. virginiana		
Broome		NYFA_1990 Herbarium Name Used: none Anemone virginiana var. virginiana		
Cattaraugus		NYFA_1990 Herbarium Name Used: none Anemone virginiana var. virginiana		

Example description from NY Flora Atlas

http://newyork.plantatlas.usf.edu/Plant.aspx?id=2582

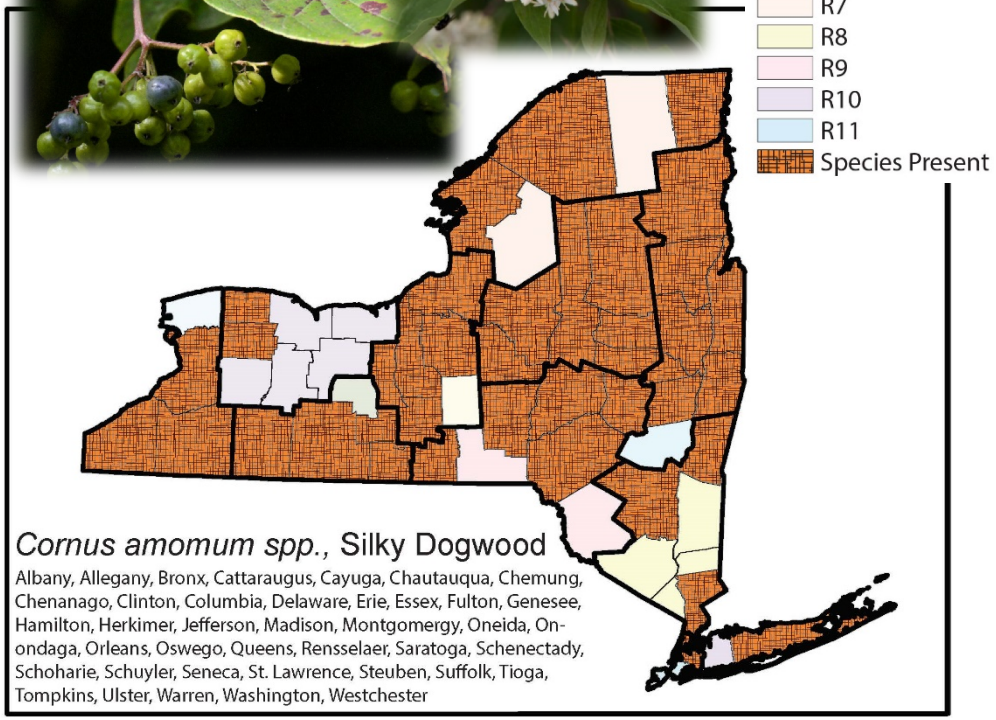
Reference Sites: Example Plants, Asclepias

Asclepias incarnata L, (NY Flora)

Asclepias verticillata, (NY Flora)

Reference Sites: Baptisia and Cornus

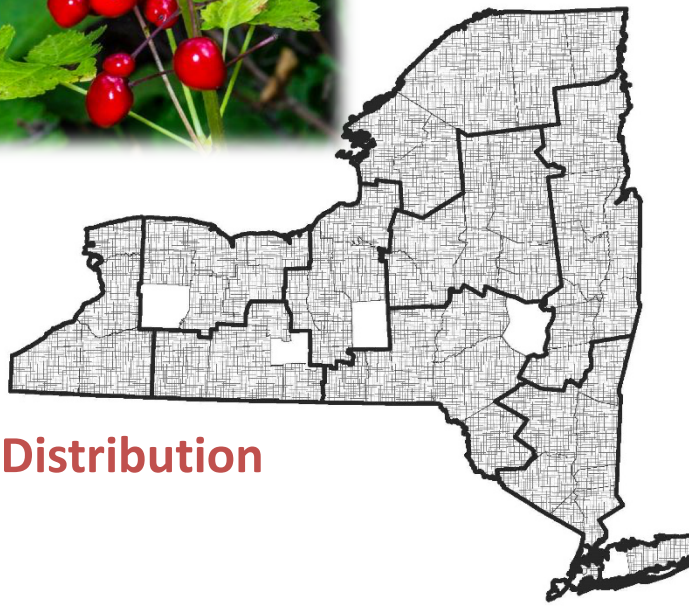
Baptisia tinctoria, (NY Flora)



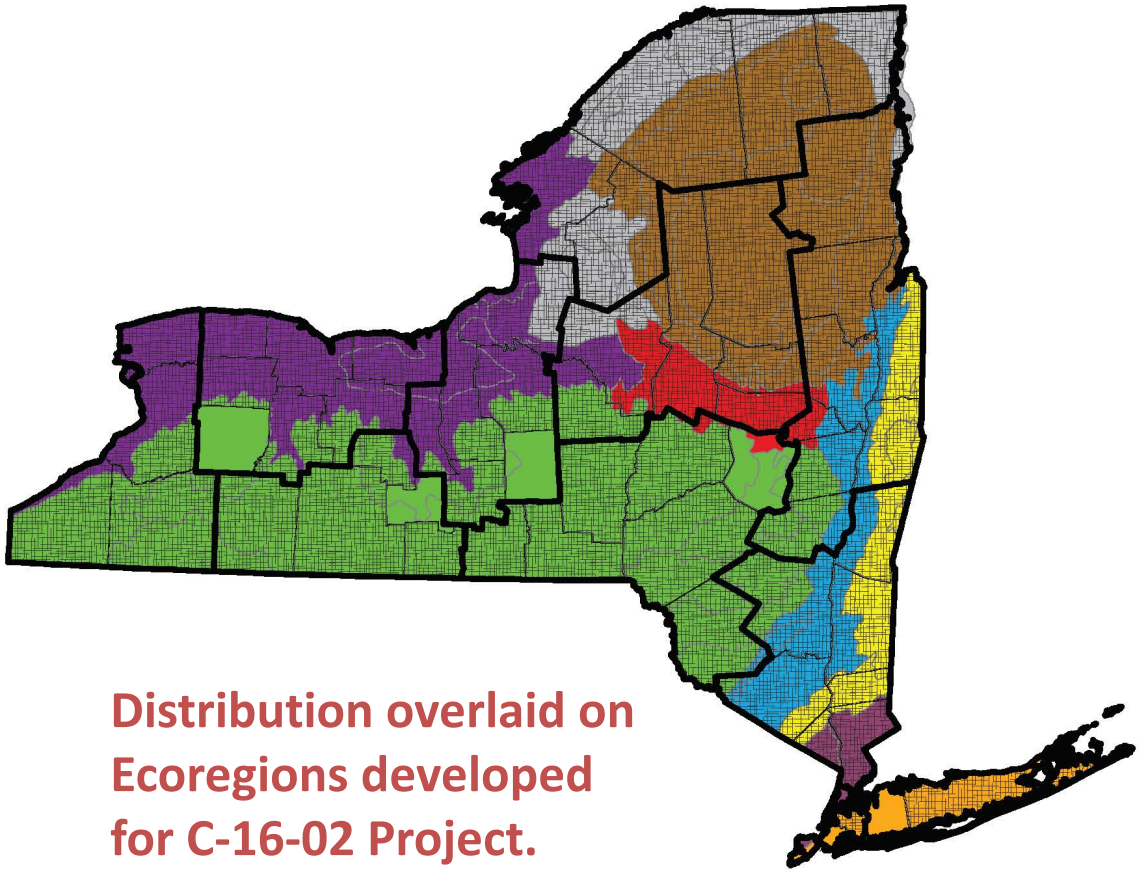
Cornus amomum spp., (NY Flora)

Reference Sites: Example Plants

Actaea rubra, red baneberry

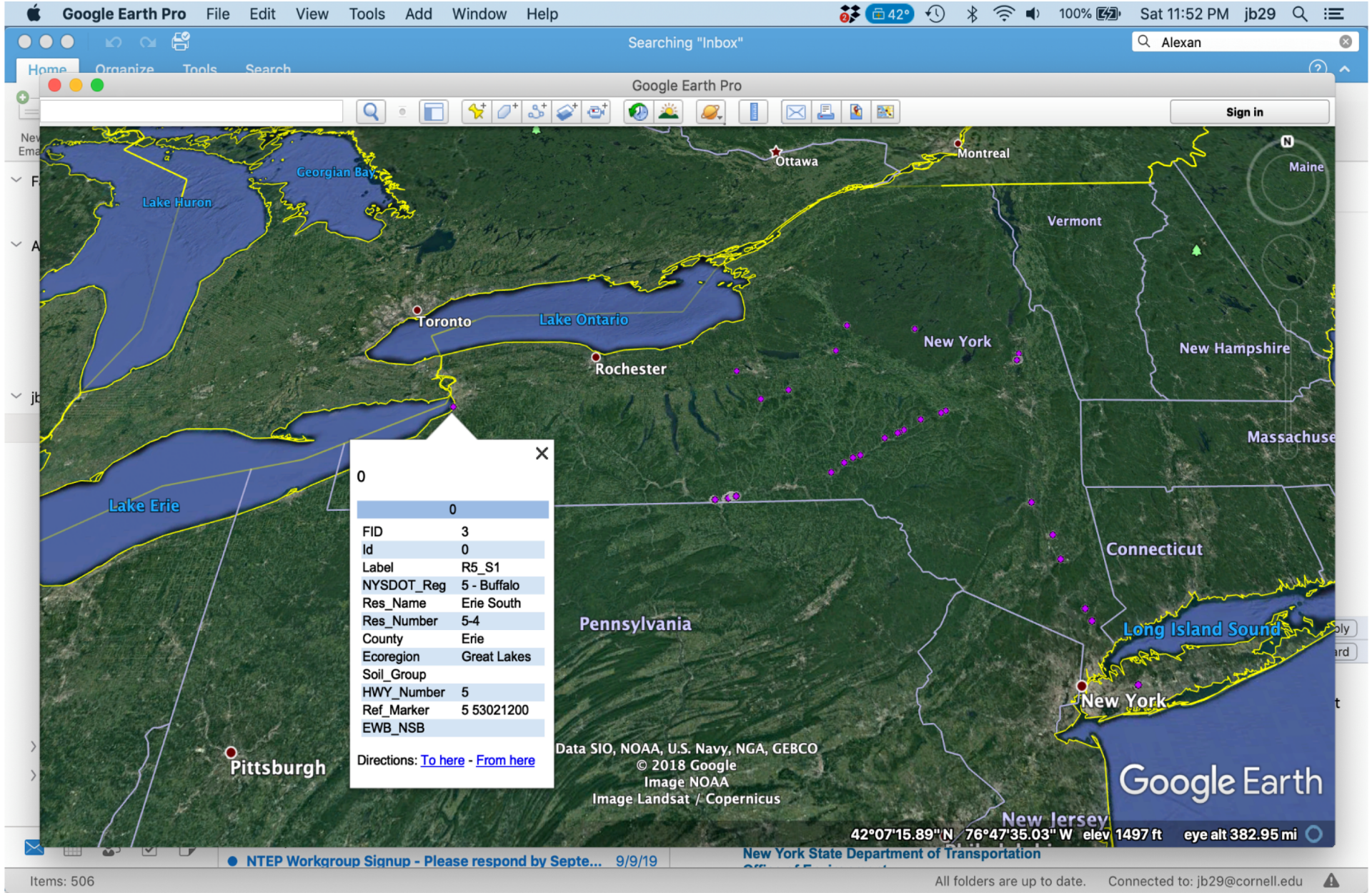


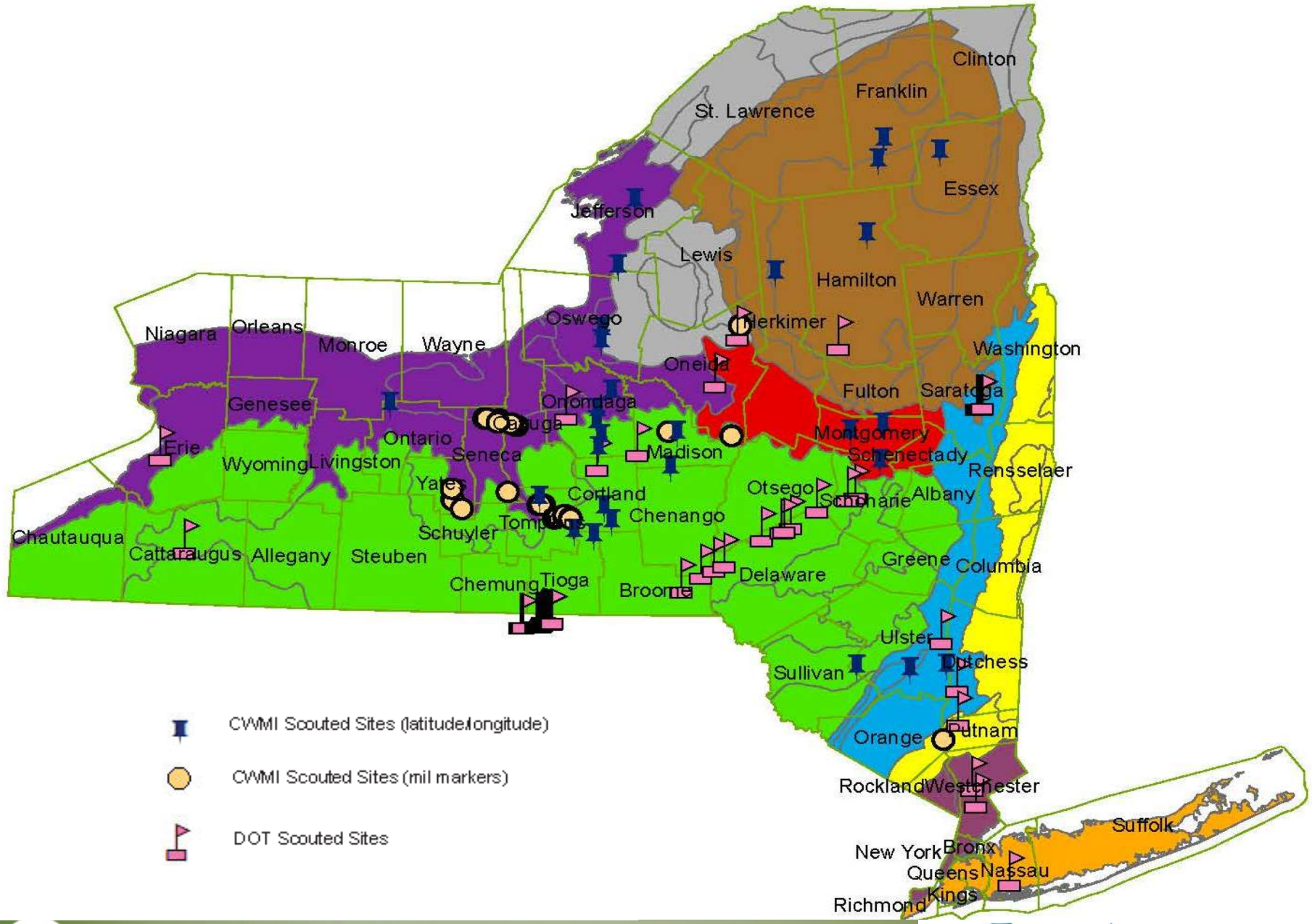
Distribution



Distribution overlaid on Ecoregions developed for C-16-02 Project.

Reference Sites – NYSDOT




Clinton
Franklin
St. Lawrence
Essex
Jefferson
Lewis
Hamilton
Warren
Herkimer
Washington
Oswego
Niagara
Orleans
Monroe
Wayne
Oneida
Fulton
Saratoga
Genesee
Onondaga
Montgomery
Erie
Ontario
Seneca
Madison
Schenectady
Wyoming
Livingston
Rensselaer
Yates
Cortland
Otsego
Albany
Chenango
Chautauqua
Schuyler
Cattaraugus
Allegany
Steuben
Greene
Columbia
Delaware
Chemung
Tioga
Broome
Ulster
Sullivan
Dutchess
Orange
Putnam
Rockland
Westchester
Suffolk
New York
Bronx
Queens
Nassau
Kings
Richmond
CVMI Scouted Sites (latitude/longitude)
CVMI Scouted Sites (mil markers)
DOT Scouted Sites

Possible Reference Sites

EcoRegion	County	HWY	Reference	Site Name	Flora	Scouted by
Adirondacks	Essex	NY 86	86 1202 1104 thru 86 1202 1109	Lake Placid		CWMI/Lat Long
	Franklin	NY 30	30 7209 1230 thru 30 7209 1234	Saranac		CWMI/Lat Long
		NY 3	3 7205 1099 thru 3 7205 1101	Tupper Lake		CWMI/Lat Long
	Hamilton	NY 8	8 2209 1120 8 2209 1121	R2 R2		DOT
		NY 30	30 2206 1630 thru 30 2206 1634	Old Forge		CWMI/Lat Long
	Herkimer	NY 28	28 2308 1081 thru 28 2308 1085	Old Forge		CWMI/Lat Long
Coastal Lowlands	Nassau	NY 908E	908E 0301 1100	R10		DOT

Possible Reference Sites

EcoRegion	County	HWY	Reference	Site Name	Flora	Scouted by
Great Lakes	Cayuga	NY 5	5 3107 1059 5 3107 1058 5 3107 1057	Route 5_1 Route 5_2 Route 5_3		CWMI
			5 3107 1043 5 3107 1042 5 3107 1041 5 3107 1040 5 3107 1039 5 3107 1038 5 3107 1037	Route 5_4 Route 5_5 Route 5_6 Route 5_7 Route 5_8 Route 5_9 Route 5_10		CWMI
	Erie	NY 5	5 5302 1200	R5_S1		DOT
	Jefferson	I 781	81I 7305 1289 thru 81I 7305 1292	I-781		CWMI/Lat Long
	Monroe	I 490	490I 4403 1012 thru 490I 4403 1016	Pittsford		CWMI/Lat Long
	Onondaga	NY 5	5 3308 1086	R3		DOT
		I 481	481I 3301 2089 thru 481I 3301 2093	481 Entrance		CWMI/Lat Long
		I 81	81I 3303 2021 thru 81I 3303 2025	Syracuse		CWMI/Lat Long
	Oswego	I-81	81I 3494 1112 thru 81I 3494 1116	Parish		CWMI/Lat Long
			81I 3404 1086 thru 81I 3404 1090	Central Square		CWMI/Lat Long
	Seneca	NY 318	318 3502 1156	318_1		CWMI

Possible Reference Sites

EcoRegion	County	HWY	Reference	Site Name	Flora	Scouted by
Ulster	NY 52	52 8602 1023 thru 52 8602 1027	Wawarsing			CWMI/Lat Long
Yates	NY 14A	14A 6604 1085 14A 6604 1084 14A 6604 1083 14A 6604 1082 14A 6604 1081	14A_1 14A_2 14A_3 14A_4 14A_5			CWMI
		14A 6604 1034	14A_6			CWMI
		14A 6604 1121	14A_7			CWMI
Hudson Valley	Dutchess	NY 55	55 8203 2010	R8_S1		DOT
		I-84	84I 8202 1063	R8_S4		
	Ulster	NY 299	299 8601 1123 thru 299 8601 1127	Highland		CWMI/Lat Long
			299 8601 1000 thru 299 8601 1004	New Paltz		CWMI/Lat Long
		9W	9W 8603 2008	R8		DOT

Possible Reference Sites

EcoRegion	County	HWY	Reference	Site Name	Flora	Scouted by
Mohawk Valley	Montgomery	NY 5S	5S 2503 1242 thru 5S 2503 1246	Canajoharie		CWMI/Lat Long
			5S 2503 1120 thru 5S 2503 1124	Fonda		CWMI/Lat Long
	Oneida	NY 365	365 2601 3025	R8		DOT
	Schenectady	US 20	20 9518 1156 thru 20 9518 1160	Carlisle		CWMI/Lat Long
St. Lawrence Valley and Lake Champlain	Oneida	NY 12	12 2604 3228 12 2604 3227	Barneveld_1 Barneveld_2		CWMI
			12 2604 3231 12 2604 3230	R2 R2		DOT
Taconic Highlands	Orange	US 9W	9W 8302 1052	West Point		CWMI
Triassic Lowlands Manhattan Hills	Westchester	NY 987G	987G 8701 1100	R8_S2		DOT
		NY 987D	987D 8701 2119	R8_S3		DOT

Site History

Construction, mowing practices and poor soil may be affecting the sustainable growth of pollinator-friendly species in the DOT ROWs.

Project Soils

- Determine disturbance regime, sample soils, complete plant and entomological inventory.
- Develop soil specifications
- Work with suppliers to manufacture soils

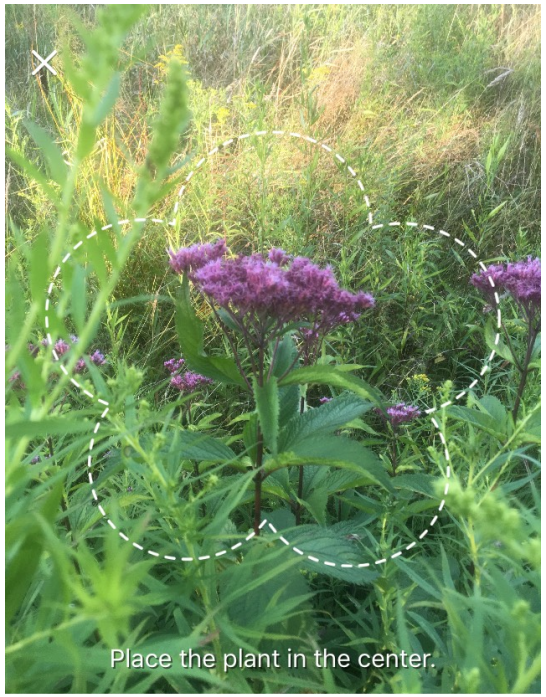
Tools for investigation

- Soil app
- “Picture This” app
- Plant and insect keys
- Xerces
- https://www.fs.fed.us/wildflowers/pollinators/documents/BumbleBeeGuideEast2011.pdf
- Soil Corers
- Penetrometers
- Infiltration units

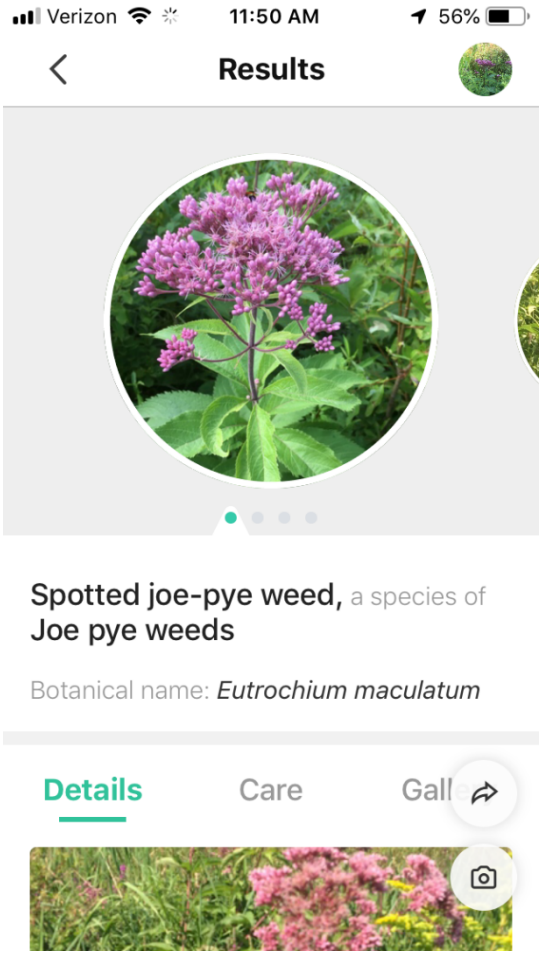
Soil Properties/Characteristics: Testing Parameters

- Electrical Conductivity and Soluble Salts
- pH
- Soil Fertility and Humic Acid
- Cation Exchange Capacity (CEC)
- Particle-Size Distribution
- Soil Morphology
- Bulk Density Structure and Consistence
- Water Retention Water Flow
- Infiltration Percolation Rate
- Soil Stability, Dispersion and Slaking Base Saturation
- Atterberg Limits
- Plasticity Index

Pollinator Plant Inventory



Use “Picture This” app on local roads to identify Joe pye weeds



Pollinator Flowers of NY

Scientific Name	Common Name
Aquilegia canadensis	Eastern Columbine-June
Asclepias syriaca	common Milkweed- July/august
Asclepias incarnata	swamp milkweed
Asclepias tuberosa	butterfly milkweed
Agastache scrophulariifolia	purple giant hyssop
Chelone glabra	white turtlehead
Chamaecrista fasciculata	Partridge Pea
Desmodium canadense	showy tick trefoil
Apocynum cannabinum	Indian Hemp
Doellingeria umbellata	flat top white aster-August/Sept
Gaillardia aristata	Blanket flower
Eutrochium maculatum	spotted joe pye weed
Eupatorium perfoliatum	Boneset
Eurybia macrophylla	bigleaf aster

Pollinator Flowers of NY

Scientific Name	
Grass-leaved Goldenrod	Euthamia graminifolia
Helenium autumnale	Common Sneezeweed
Hypericum perforatum	St Johnswort
Lespedeza capitata	round-headed lespedeza
Liatris spicata	marsh blazing star
Lobelia cardinalis	cardinal flower
Lobelia siphilitica	great blue lobelia
Lupinus perennis	wild lupine
Mimulus ringens	Alleghany monkey flower
Monarda fistulosa	wild bergamot
Monarda punctata	spotted beebalm
Oenothera biennis	evening primrose
Penstemon hirsutus	hairy beardtongue
Pycnanthemum virginianum	Virginia mountain mint

Pollinator Flowers of NY

Scientific Name	Common Name
Senna hebecarpa	wild senna
Solidago caesia	bluestem goldenrod
Solidago juncea	early goldenrod
Solidago nemoralis	gray goldenrod
Solidago patula	rough goldenrod –Sept./Oct.
Solidago speciosa	showy goldenrod
Symphyotrichum laeve	smooth blue aster
Symphyotrichum lateriflorum	calico aster
Symphyotrichum novae- angliae	new england aster
Symphyotrichum novi- belgii	NY aster- into October
Symphyotrichum oblongifolium	Aromatic aster
Symphyotrichum prenanthoides	zigzag aster

Pollinator Flowers of NY

Scientific Name	Common Name
Verbena hastata	blue vervain
Verbena urticifolia	white vervain
Vernonia noveboracensis	NY ironweed
Veronicastrum virginicum	culver's root
Zizia aurea	golden alexanders-April

White Turtlehead

- ***Chelone glabra*- White Turtlehead**
- Pollinator value - medium
- Bloom time - July to August
- Flower color - white
- Height - 2 to 4 feet
- Wetland Indicator - FACW
- Light requirements - full sun to shade
- Habitat - marshes, stream banks, wet ditches, low meadows, woodlands
- Soil Moisture - wet, moist
- **Value to Beneficial Insects** - Baltimore Checkerspot, hummingbirds

Pollinator Plants in NYS

Three-fourths of the world's flowering plants and about 35 percent of the world's food crops depend on animal pollinators to reproduce. More than 3,500 species of native bees help increase crop yields. Some scientists estimate that one out of every three bites of food we eat exists because of animal pollinators like bees, butterflies and moths, birds and bats, and beetles and other insects.

Pollinator Plants/Shrubs

Bombus impatiens

Common eastern bumble bee

- Common, possibly expanding range
- Select food plants: *Cirsium* (Thistles), *Eupatorium, Gelsemium, Solidago* (Goldenrods), *Pontederia* (Pickerel Weeds)
- Tongue length: medium
- Nests underground
- Parasitized by *B. citrinus*
- Can be confused with *B. bimaculatus*

Phenology Chart

Males

Workers

Queens

APR MAY JUNE JULY AUG SEPT OCT

https://www.fs.fed.us/wildflowers/pollinators/documents/BumbleBeeGuideEast2011.pdf

Bees pollinating


Honey bee
Common eastern bumble bee
Tri-colored bumble bee

Learning Assessment

1. List 4 components required when selecting typical soils in ecozones.

Learning Assessment

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- Soil Type
- Physiography
- Climate
- Hydrology
- Geology
- Vegetation

Learning Assessment

2. Non-native plant pollinator species stands are appropriate in this study.

True or False?

Learning Assessment

2. Non-native plant pollinator species stands are appropriate in this study.

False.
They are part of the stand in many cases but we will be targeting native species.

Learning Assessment

3. pH is a good indicator when selecting typical soils in ecozones.

True or False?

Learning Assessment

3. pH is a good indicator when selecting typical soils in ecozones.

True.

It is one of the indicators.

Learning Assessment

4. Safe parking and movement around sites is key to safety.

Ture or False?

Learning Assessment

4. Safe parking and movement around sites is key to safety.

True

Learning Assessment

5. Milkweed is a late season plant pollinator.

True or False?

Learning Assessment

5. Milkweed is a late season plant pollinator.

False.

Most milkweeds bloom in August.

Learning Assessment

6. Bees are the primary pollinators that we are looking for in this study.

Learning Assessment

6. Bees are the primary pollinators that we are looking for in this study.

False.

Bees, butterflies and animals help with pollination, though bees may be the most numerous in some sweeps.

Learning Assessment

7. Woody vegetation like honeysuckle is not part of this study.

True or False?

Learning Assessment

7. Woody vegetation like honeysuckle is not part of this study.

Yes and No.
It is a good pollinator species but we will not be planting it on roadsides as it could take over the ROW and block line of sight.

Learning Assessment

8. The world's food crops depend on pollinators.

True or False?

Learning Assessment

8. The world's food crops depend on pollinators.

TRUE

Questions