USDA Natural Resources
Conservation Service

Ecological site RX142X00B005
Clayplain

Last updated: 3/03/2025
Accessed: 03/22/2025

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 142X–St. Lawrence-Champlain Plain

The St. Lawrence-Champlain Plain MLRA is a glaciated area of low relief dominated by broad expanses of nearly level, sandy deltas and shallow lacustrine basins or plains punctuated by low hills of glacial till. Rivers and streams have cut relatively deep but narrow valleys across the plain. Elevation ranges from 80 to 1,000 feet (25 to 305 meters), increasing gradually from the St. Lawrence River southward and from Lake Champlain to the east and west.

LRU notes

Land Resource Unit (LRU): Mesic Soil Temperature Regime

The lower St. Lawrence and Champlain Valleys are characterized with soils in the mesic soil temperature regime (mean annual soil temperature between 46°F and 59°F) at 20 inches below the surface or at a densic, lithic, or paralithic contact, whichever is shallower.

The Mesic Soil Temperature Regime (STR) will have a longer growing season than the upper St. Lawrence and Champlain Valleys which are characterized with soils in the frigid STR. Species more tolerant of milder year round temperatures would also be evident in the mesic LRU.

Classification relationships

USDA-NRCS
LRR: D-Northeastern Forage and Forest Region
MLRA: 142-St. Lawrence-Champlain Plain
LRU: XB - Mesic Soil Temperature Regime

EPA (Ecoregions)
Level III: 83-Eastern Great Lakes Lowlands
Level IV: 83b-Champlain Lowlands

USDA-USFS
Province: Laurentian Mixed Forest
Section: 212E--St. Lawrence and Champlain Valley
Sub-section: 212Ec Champlain Glacial Lake and Marine Plains

Ecological site concept

Landform:
The site occurs on a broad expanse of nearly level to steep glacial lake plains and terraces. The elevation range

varies from 49 to 1000 feet (15 to 549 meters) with low local relief generally less than 30 feet (10 meters). Slopes are typically less than or equal to 15 percent but, in extreme cases, can range up to 60 percent.

Soils:
The site consists of very deep and moderately well and somewhat poorly drained soils that are clayey throughout their profile. They formed in calcareous estuarine and glaciolacustrine clays. Representative soils are Vergennes, Wilpoint, Kingsbury, Hudson, Cayuga, Chaumont, Churchville, and Rhinebeck.

Vegetation:
Remnant clayplain forests are scarce, characterized by a mixed forest of deciduous and coniferous trees, often with an understory containing invasive shrubs such as bush honeysuckles and common buckthorn. Regularly occurring trees include white pine, red maple, white and red oak, and shagbark hickory. The shrub layer can be diverse, with varying coverage of sapling trees, witchhazel, mapleleaf viburnum, and American hornbeam, all depending on the length of time since agricultural abandonment. Herbaceous associates include barren strawberry, rosy sedge, wild sarsaparilla, enchanter's nightshade, shorthusk, and others.

Associated sites

F142XB007VT	**Wet Clayplain Depression** These sites consist of poorly and very poorly drained soils that are often in lower landscape positions or embedded within the Clayplain site in areas where tip ups have occured. Hydrophytic vegetation tends to be dominant. These sites will classify as a wetland.

Similar sites

F142XB019NY	**Shallow Acidic Till Upland** These sites will reflect similar natural vegetation on different soils materials. This site will consist of shallow loamy textured materials derived from till compared to the very deep fine to very-fine materials derived from glaciolacustrine deposits found within the Clayplain site.
F142XA018NY	**Rich Till Upland Frigid** These sites will reflect similar natural vegetation on different soils materials. This site will be found within the frigid soil temperature regime (LRU XA) and consist of moderately deep coarse-loamy to fine-loamy materials derived from till compared to the very deep fine to very-fine materials derived from glaciolacustrine deposits found within the Clayplain site.

Table 1. Dominant plant species

Tree	(1) *Quercus* (2) *Pinus strobus*
Shrub	(1) *Hamamelis virginiana* (2) *Carpinus caroliniana*
Herbaceous	(1) *Aralia nudicaulis* (2) *Carex rosea*

Legacy ID

F142XB005VT

Physiographic features

This ecological site and its associated plant communities occur on glacial lake plains ranging from nearly level to steep slopes. These will often occur on slopes up to 15 percent, but in its extreme, can range up to 60 percent along side slopes of hills, ridges, and knolls. Representative elevation will range from 126 to 835 feet (38 to 254 meters), with actual values ranging between 49 to 1017 feet (15 to 310 meters) with low relief generally less than 30 feet (10 meters).

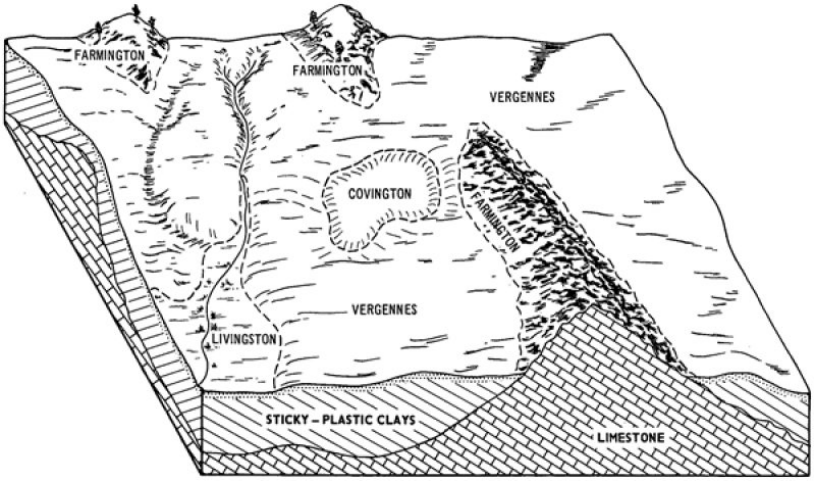


Figure 1. Block diagram of Clayplain ES (Vergennes soils) as represented in Chittenden County, Vermont.

Table 2. Representative physiographic features

Geomorphic position, terraces	(1) Tread
Hillslope profile	(1) Toeslope (2) Footslope
Landforms	(1) Lake plain > Flat (2) Lake plain > Terrace (3) Lake plain > Hill (4) Hills > Ridge (5) Hills > Knoll
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	126–835 ft
Slope	0–15%
Water table depth	24–40 in
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	49–1,017 ft
Slope	0–60%
Water table depth	12–40 in

Climatic features

The Koppen-Geiger climate classification of the area in which this MLRA occurs is Dfb, Warm-summer humid continental (Peel, Finlayson, and McMahon, 2007). The Lake Champlain Valley has a humid climate with cold winters and warm summers. Rainfall occurs as high-intensity, convective thunderstorms in the summer, and snowfall is heavy from late in autumn to early spring. The frost-free period in this area is longest in a narrow belt around Lake Champlain. The area falls within USDA Plant Hardiness zones 5a (and to a small extent, 5b-[-15 to -10 °F/-26.1 to -23.3 ° C]). The lake influences the climate of the valley by moderating temperatures enough with offshore winds to delay the onset of fall, and similarly, to delay the advance of spring. Climate change scenarios for

the Northeastern US predict an overall increase in temperature, particularly in the winter and predict a slight increase in annual precipitation.

Table 4. Representative climatic features

Frost-free period (characteristic range)	115-136 days
Freeze-free period (characteristic range)	145-172 days
Precipitation total (characteristic range)	36-41 in
Frost-free period (actual range)	104-141 days
Freeze-free period (actual range)	132-180 days
Precipitation total (actual range)	34-42 in
Frost-free period (average)	125 days
Freeze-free period (average)	158 days
Precipitation total (average)	38 in

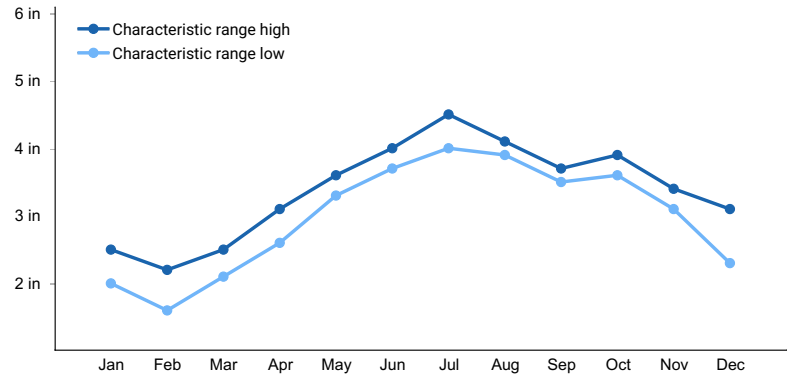


Figure 2. Monthly precipitation range

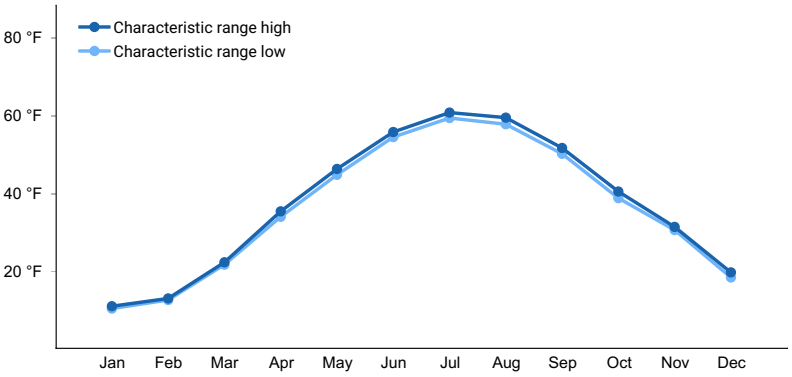


Figure 3. Monthly minimum temperature range

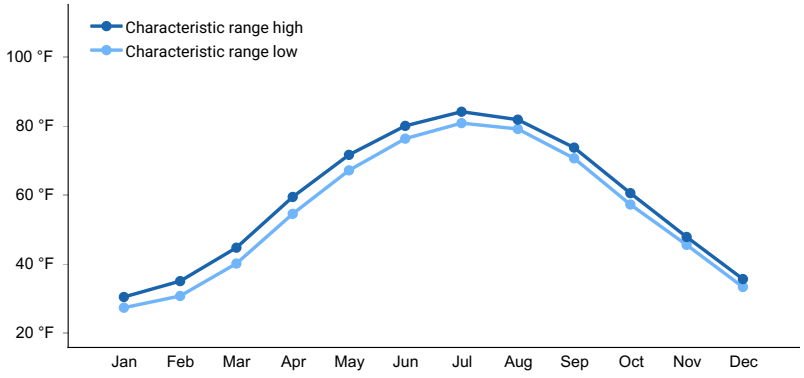


Figure 4. Monthly maximum temperature range

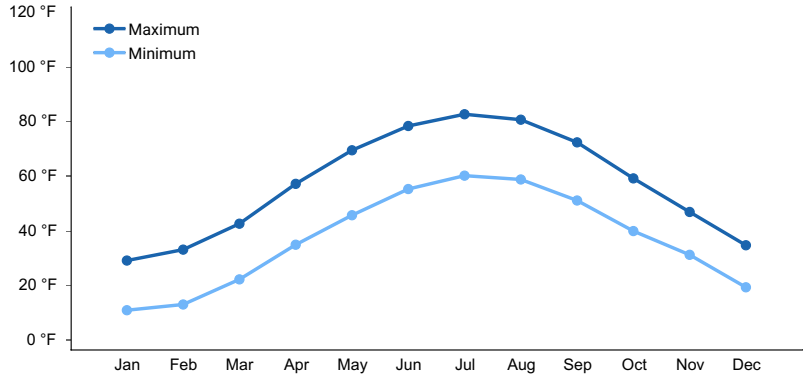


Figure 5. Monthly average minimum and maximum temperature

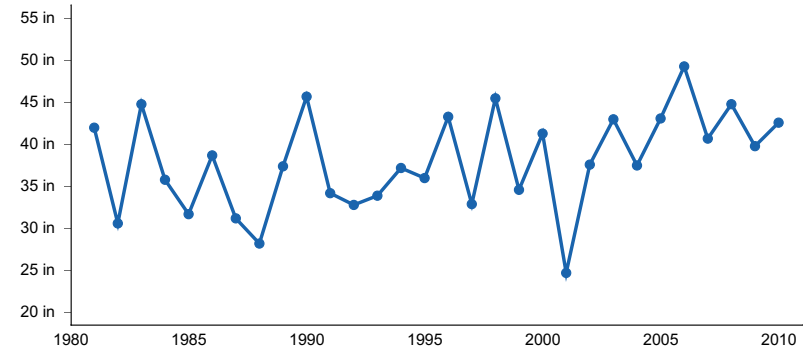


Figure 6. Annual precipitation pattern

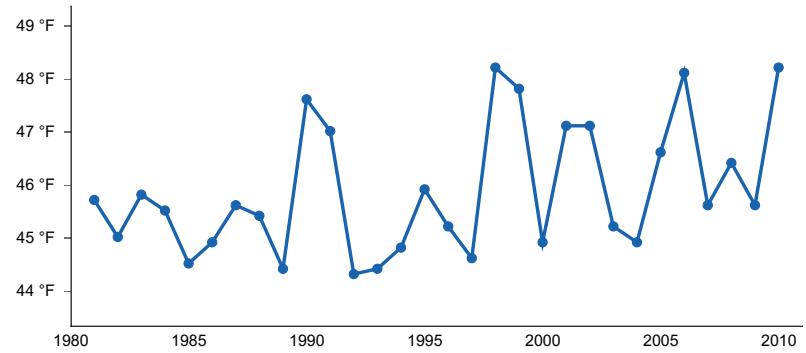


Figure 7. Annual average temperature pattern

Climate stations used

- (1) BURLINGTON INTL AP [USW00014742], South Burlington, VT
- (2) SOUTH HERO [USC00437607], South Hero, VT
- (3) WHITEHALL [USC00309389], Whitehall, NY
- (4) SALISBURY 2 N [USC00437098], Salisbury, VT

Influencing water features

This ecological site is not influenced by wetland or riparian water features.

Due to the heavy clay nature of these soils, from late in fall to early in spring, water is often less than 2 feet below the soil surface. It recedes to a depth of 2 feet or more during drier periods. These areas may puddle if worked on when wet, creating micro-depressions in the landscape.

Soil features

The site consists of very deep, somewhat poorly- to moderately well-drained soils that are clayey throughout their profile. They formed in calcareous estuarine and glaciolacustrine clays. Representative soils include Glassaquic

Hapludalfs (Vergennes, Hudson), Aquic Hapludalfs (Wilpoint), Aeric Endoaqualfs (Kingsbury, Chaumont, Churchville, Rhinebeck), and Oxyaquic Glossudalfs (Cayuga).

These soils have redox features throughout the subsoils, which often become more distinct as depth increases. These soils retain a high chroma and value in the upper part of the profile which indicates the upper subsoil is not frequently wet, but the lower part is saturated for significant periods. An argillic horizon, a subsurface layer with a higher clay content than the layers above it, indicating clay illuviation, will serve to perch water and result in a higher water-table. These are diagnostic horizons that will occur between 22 to 76 inches (56 to 183 centimeters) below the soil surface. These heavy clay soils have a moderate or high shrink-swell potential and will be reflected as cloddy structure with surface cracks when dry if unvegetated. This can lead to surface runoff and erosion issues.

***A NRCS Dynamics Soils Property (DSP) project (NASIS Project ID '2020-DSP-PAS-001) assessed the soil aggregate stability and nutrient loads present within three different land uses (forested areas, hayfields, and agricultural fields) along this soils catena. The three soil profile descriptions below show the drastic change different management strategies can have on soil health, structure, and composition. The results of the DSP project are currently being analyzed by the Kellogg Soil Survey Laboratory and data will be populated when returned.

Figure 8. Soil profile of a Rhinebeck series (Aeric Endoaqualfs) in a minimally managed secondary forest.

Figure 9. Soil profile of a Rhinebeck series (Aeric Endoaqualfs) in a managed grassland (hay field).

Figure 10. Soil profile of a Kingsbury series (Typic Endoaqualfs) in an agriculture state (row crops).

Figure 11. Surface cracks and cloddy structure on the topsoil in a conventionally tilled agricultural state (row crops).

Table 5. Representative soil features

Parent material	(1) Glaciolacustrine deposits (2) Glaciomarine deposits (3) Sedimentary rock
Surface texture	(1) Silty clay loam (2) Silty clay (3) Silt loam
Family particle size	(1) Very-fine (2) Fine
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Very slow
Depth to restrictive layer	0 in
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	5 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0 mmhos/cm

Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–8.2
Subsurface fragment volume <=3" (0-40in)	0–2%
Subsurface fragment volume >3" (0-40in)	0%

Table 6. Representative soil features (actual values)

Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Very slow to moderately slow
Depth to restrictive layer	0 in
Soil depth	80 in
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	3–6 in
Calcium carbonate equivalent (0-40in)	0–25%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	4.5–9
Subsurface fragment volume <=3" (0-40in)	0–13%
Subsurface fragment volume >3" (0-40in)	0–10%

Ecological dynamics

The vegetation groupings described in this section are based on the terrestrial ecological system classification and vegetation associations developed by NatureServe (Comer et al., 2003) and localized associations provided by the Vermont Fish and Wildlife Department Natural Heritage Inventory (Thompson, Sorrenson, and Zaino, 2019).

The reference community of this site is equivalent to the NatureServe plant association CEGL006122 - "*Quercus alba* - *Acer rubrum* - *Carya ovata* / *Viburnum acerifolium* / *Waldsteinia fragarioides* Clayplain Forest" and the 'Wetland, Woodland, Wildland - A Guide to the Natural Communities of Vermont' (Thompson, Sorrenson, and Zaino, 2019) "Mesic Clayplain Forest" plant association.

This community is described as a mesic deciduous forest that occurs on the clay and silt soils of the Champlain Valley, dominant prior to European settlement. Under the reference condition, the site is characterized by mature trees, well-developed strata, and high species diversity. More research is needed to determine the extent in the nearby eastern Ontario Plain and adjacent Canada.

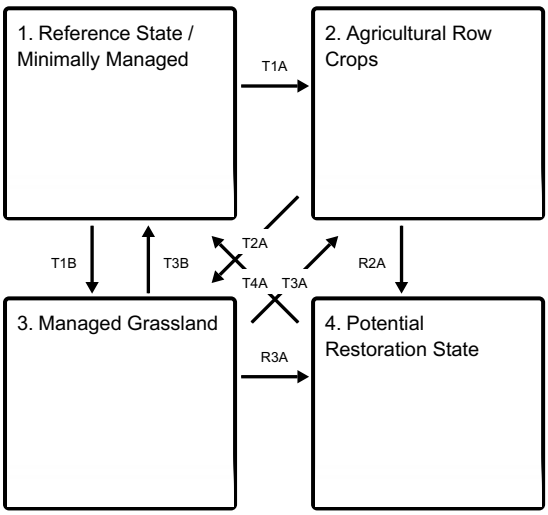
Small scale disturbances were the most common disturbances of these communities, often seen as individual tip ups from windstorm damage, mortality from ice shearing or snow loading, old age, or insect / disease. These disturbances would often create small changes in microtopography which would yield slight changes in species composition (Thompson and Sorrenson, 2010). Wetter areas, found within the matrix of this community, would often include more diverse species and a more well-defined shrub and herbaceous layer.

These clay soils are deep and fertile, resulting in long term conversion to agricultural fields. Today the reference condition is rare and critically imperiled (NatureServe, 2004). Complete removal of all native vegetation, mechanical disturbance to the soil (tilling, land leveling, etc.), and planting of desired grass /legume mixtures or crops converts the site for alternative land use, most of which today is pasture for dairy cows and corn fields. These cultural states can persist for long periods of time following proper management. When management of cropland or pastureland ceases, post-agricultural successional trends show the encroachment of undesirable non-native grasses, forbs, and scattered shrubs. Through proper management following short-term abandonment these fallow fields can transition back to fully operating pastures or cropland. If left unmanaged, early successional native and non-native trees and shrubs can become established, resulting in a patchy mosaic which may eventually revert to an early- to mid-successional forested state.

The most common post-agricultural succession community is often characterized as an open to closed white pine forest, with scattered early successional species such as green ash, quaking aspen, red maple, red cedar, and paper birch. Over time these hardwoods may form the dominant canopy under a relict canopy of white pine, slowly reverting to the reference condition where pine is not a dominant canopy species. Factors such as competition from invasive species, loss of viable seedbed, and loss of slight ground disturbances may result in diminished regeneration of oak seedlings that are characteristic of the pre-settlement reference condition (Murray and D'Amato, 2019). The remaining forested habitats are highly fragmented due to conversion to cultural states and often reflect large amounts of non-native and undesirable species. Only manual removal, monitoring of newly established invasive plants, and judicious planting of native trees and shrubs can convert these sites to a semblance of the reference state.

State and transition model

Ecosystem states



T1A - Natural Vegetation Clearing, Site Preparation, Planting of Crops

T1B - Natural Vegetation Clearing, Site Preparation, Introduction of Native and Non-Native Pasture Grasses and Legumes

R2A - Site Preparation, Reintroduce Tree Saplings and Native Species to Area

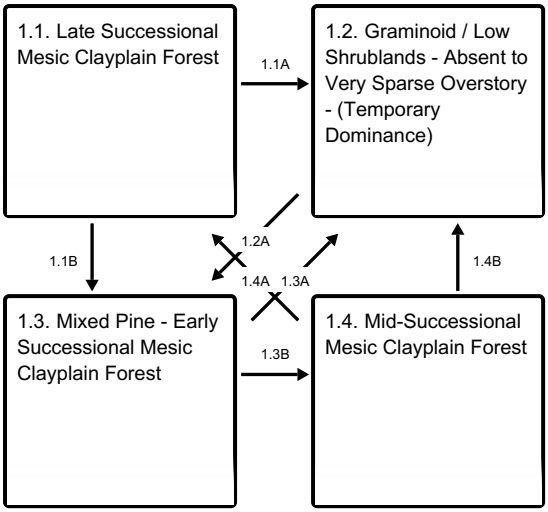
T3B - Long-term Post-Agricultural Succession

T3A - Removal of Grasses, Introduction of Crops

R3A - Site Preparation, Reintroduce Tree Saplings and Native Species to Area

T4A - Time, Natural Succession

State 1 submodel, plant communities



1.1A - Large Scale Disturbances (Clearcutting, wind events, insect damage, snow/ice damage, etc.)

1.1B - Small Scale Disturbances (single tree mortality)

1.2A - Natural Succession over Time

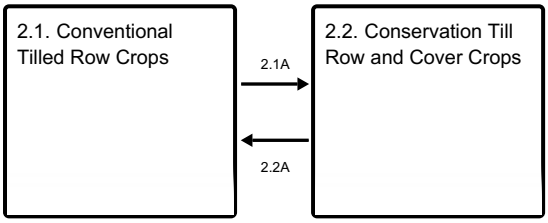
1.3A - Large Scale Disturbances (Clearcutting, wind events, insect damage, snow/ice damage, etc.)

1.3B - Natural Succession over Time, Shade Tolerant Species Dominate

1.4A - Oak Recruitment, Natural Succession over Time

1.4B - Large Scale Disturbances (Clearcutting, wind events, insect damage, snow/ice damage, etc.)

State 2 submodel, plant communities



2.1A - Reduced or Eliminated Tillage Operations, Crop Rotations Occur at Regular Intervals, Crop Residue and Amendments Remain on the Soil Surface, Planting of Cover Crops

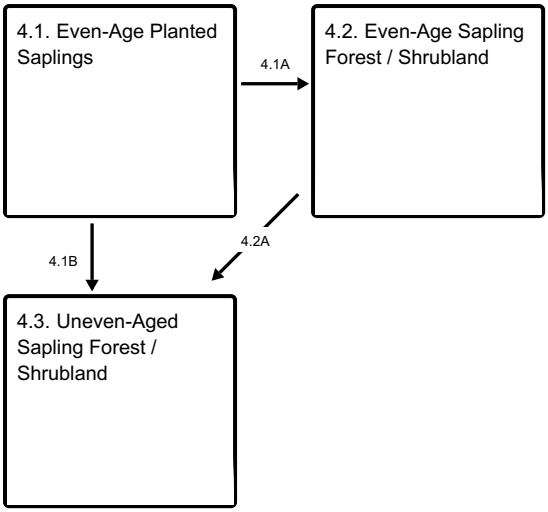
2.2A - Intensive Tillage Operations, Monoculture of Row Cropping Establishment

State 3 submodel, plant communities

3.1A - Reduced or Eliminated Grassland Management Operations, Natural Succession to Predominantly Invasive and Incursive Shrubs

3.2A - Removal of Undesirable Species via Management Practices (Brush, Chemical, etc.)

State 4 submodel, plant communities



4.1A - Time, Maturation of Replanted Species

4.1B - Individual Species Die Off, Replanting or Natural Reseeding Occurs

4.2A - Individual Species Die Off, Replanting or Natural Reseeding Occurs

State 1
Reference State / Minimally Managed

Figure 12. Mature mesic clayplain forest showcasing diverse species of overstory hardwoods and a diverse understory of forbs. This picture was part of the 2015 NatureServe Ecological Site Inventory project.

This state represents the reference mesic clayplain forest. The tree canopy is generally closed to partially open. Shrub and herb layers are of variable cover. These were once expansive forests within the Champlain Valley prior to European settlement and have since been subjected to intensive land use conversion and disturbances.

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates

Community 1.1
Late Successional Mesic Clayplain Forest

Figure 13. Mature Mesic Clayplain Forest. Image taken during 2015 NatureServe agreement for Ecological Site Inventory of the Champlain Valley.

This condition represents the dominant historical condition of mesic clayplain forests. These are typically uneven age late successional forests (Thompson, Sorenson, and Zaino, 2019). Dominant drivers consist of localized disturbances from wind events and ice storms, creating tip ups that provide microhabitats for understory species and tree regeneration. Fire was thought to be the preeminent driver of oak regeneration (whether intentionally lit by local tribes or entering the community from pyrogenic uplands), preventing shade tolerant species from being dominant (Murray and D'Amato, 2019). Other limiting factors to oak regeneration are believed to be wind disturbances (not creating canopy gaps large enough for oak regeneration to successfully recruit into the overstory), deer browse, and past land use (fragmentation of habitat prevents seed dispersal, agricultural conversion, etc.). These will typically occur on more sloping land were clearing for past agriculture may not have occurred. This community correlates with NatureServes '*Quercus alba* - *Acer rubrum* - *Carya ovata* / *Viburnum acerifolium* / *Waldsteinia fragarioides* Clayplain Forest' Association (CEGL006122).

Forest overstory. The closed canopy is Green ash, and Swamp wite oak admixed with slippery elm and red maple. Occasional trees include white pine and eastern hemlock. Northern white cedar is sometimes present.

Forest understory. The shrub layer is typically well developed consisting of Viburnum acerifolium (Maple-leaf viburnum), Rosa carolina (Carolina rose), Hamamelis virginiana (witch hazel), Rubus pubescens (dwarf raspberry), R. hispidus (swamp dewberry) and / or Vaccinium angustifolium (low sweet blueberry). The herb layer can be dense and very diverse, consisting of Waldsteinia fragariodes (barren strawberry), Moehringia lateriflora (grove sandwort), Impatiens capensis (jewelweed), Geranium maculatum (wild geranium), Uvularia sessilifolia (sessile-leaf bellwort), and Circaea lutetiana (large enchanter's nightshade). Graminoids may be sparse to locally abundant, typically occurring in canopy openings where light hits the forest floor. These may include Carex gracillima (graceful sedge), C. laxiculmis (loose sedge), C. rosea (rosy sedge), and C. pensylvanica (woodland sedge).

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- eastern white pine (*Pinus strobus*), tree
- eastern hemlock (*Tsuga canadensis*), tree
- red maple (*Acer rubrum*), tree
- shagbark hickory (*Carya ovata*), tree
- American beech (*Fagus grandifolia*), tree
- white ash (*Fraxinus americana*), tree
- sugar maple (*Acer saccharum*), tree
- bur oak (*Quercus macrocarpa*), tree
- hophornbeam (*Ostrya virginiana*), tree
- American hornbeam (*Carpinus caroliniana*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- swamp white oak (*Quercus bicolor*), tree
- mapleleaf viburnum (*Viburnum acerifolium*), shrub

- Carolina rose (*Rosa carolina*), shrub
- American witchhazel (*Hamamelis virginiana*), shrub
- dwarf red blackberry (*Rubus pubescens*), shrub
- bristly dewberry (*Rubus hispidus*), shrub
- lowbush blueberry (*Vaccinium angustifolium*), shrub
- graceful sedge (*Carex gracillima*), grass
- spreading sedge (*Carex laxiculmis*), grass
- rosy sedge (*Carex rosea*), grass
- Pennsylvania sedge (*Carex pensylvanica*), grass
- inland sedge (*Carex interior*), grass
- Appalachian barren strawberry (*Waldsteinia fragarioides*), other herbaceous
- bluntleaf sandwort (*Moehringia lateriflora*), other herbaceous
- jewelweed (*Impatiens capensis*), other herbaceous
- spotted geranium (*Geranium maculatum*), other herbaceous
- broadleaf enchanter's nightshade (*Circaea lutetiana*), other herbaceous
- sessileleaf bellwort (*Uvularia sessilifolia*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates

Table 7. Soil surface cover

Tree basal cover	2%
Shrub/vine/liana basal cover	1%
Grass/grasslike basal cover	0-1%
Forb basal cover	1-3%
Non-vascular plants	0-5%
Biological crusts	0%
Litter	87-96%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 8. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	5-36%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	2-10%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	2-5%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	1-3%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	1-2%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	
Tree snag count** (hard***)	

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Table 9. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	–
>0.5 <= 1	–	–	–	–
>1 <= 2	–	–	–	–
>2 <= 4.5	–	–	0-15%	25-60%
>4.5 <= 13	–	15-15%	–	–
>13 <= 40	0-5%	–	–	–
>40 <= 80	60-80%	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.2
Graminoid / Low Shrublands - Absent to Very Sparse Overstory - (Temporary Dominance)

Figure 14. Canopy gap opening representing a graminoid dominant phase consisting primarily of Carex and other forbs in lesser amounts. Vegetation subplot note within NASIS Veg Plot ID 2024VT007001.

This condition represents graminoid dominant and shrublands of temporary dominance following localized disturbances. This can be the result of large-scale disturbances such as clear cuts or naturalized mortality from wind events. Increased light availability allows for the dominance of shrubs and annual forbs while available tree saplings begin to grow into the overstory.

Forest overstory. The overstory will often be absent of live trees or very sparse, allowing for high amounts of light to reach the forest floor and the temporary dominance of understory species to flourish before saplings become dominant and grow greater than 15 feet in height.

Forest understory. These may consist of both native and introduced shrub species such as Vibrunum dentatum (southern arrowwood), Rubus pubescens (dwarf raspberry), R. hispidus (swamp dewberry), Rhamnus cathartica (common buckthorn), Fragaria virginiana (common strawberry), Lonicera morrowii (Morrow’s honeysuckle), Acer platanoides (Norway maple), and Rosa multiflora (multiflora rose).

Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- viburnum (*Viburnum*), shrub

- blackberry (*Rubus*), shrub
- buckthorn (*Rhamnus*), shrub
- honeysuckle (*Lonicera*), shrub
- rose (*Rosa*), shrub
- sedge (*Carex*), grass
- Virginia strawberry (*Fragaria virginiana*), other herbaceous
- sessileleaf bellwort (*Uvularia sessilifolia*), other herbaceous
- spotted geranium (*Geranium maculatum*), other herbaceous
- bedstraw (*Galium*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition

Table 10. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	–
>0.5 <= 1	–	–	–	–
>1 <= 2	0-25%	–	10-25%	25-80%
>2 <= 4.5	–	10-25%	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	0-25%	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.3
Mixed Pine - Early Successional Mesic Clayplain Forest

Figure 15. White pine- early successional species dominant forest on gentle slopes. The understory consists of primarily herbaceous litter and sparse forbs. Mid-successional hardwood trees are beginning to emerge. NASIS Veg Plot ID 2024VT021002,

Figure 16. White pine (Pinus strobus) dominated forest on gentle slopes. These are often a result of post agriculture succession or past harvest. Other early successional species are beginning to emerge. NASIS Veg Plot ID 2024VT001002.

Figure 17. White oak (Quercus alba) seedling present in the understory among a high amounts of pine litter and other forbs. NASIS Veg Plot ID 2024VT001002.

This condition represents the successional condition of a post-harvested or long-term agricultural abandonment reverted to an even-aged early succession forest. In time, pine and other early successional species will begin to thin out and will become replaced with mid- to late-successional species like that of the reference community. Oak regeneration and saplings are often minimal without small scale disturbances.

Forest overstory. Pinus strobus (white pine) is a canopy dominant, often of a single age class, but mixed with various other early to mid-successional species. These may include species such as Fraxinus pennsylvanica (green ash), Populus tremuloides (quaking aspen), Juniperus virginiana (eastern red cedar), Acer rubrum (red maple), Betula papyrifera (paper birch), Quercus macrocarpa (bur oak), and Fraxinus americana (white ash) may become dominant for a period. Shade tolerant mid to late successional species such as Tusga canadensis (eastern hemlock) and Fagus grandifolia (American beech) may be present in some amount in the midstory and understory

Forest understory. The understory is highly variable, but will often consist of a high percentage of leaf litter, predominantly pine needles. Forbs and low shrubs will be present in small amounts and tree regeneration will occur as single scattered individuals.

Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), tree
- eastern redcedar (*Juniperus virginiana*), tree
- sugar maple (*Acer saccharum*), tree
- hophornbeam (*Ostrya virginiana*), tree

- American elm (*Ulmus americana*), tree
- oak (*Quercus*), tree
- common buckthorn (*Rhamnus cathartica*), shrub
- chokecherry (*Prunus virginiana*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), shrub
- Morrow's honeysuckle (*Lonicera morrowii*), shrub
- bedstraw (*Galium*), other herbaceous
- Virginia strawberry (*Fragaria virginiana*), other herbaceous
- feathery false lily of the valley (*Maianthemum racemosum*), other herbaceous
- wreath goldenrod (*Solidago caesia*), other herbaceous
- broadleaf enchanter's nightshade (*Circaea lutetiana*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition

Table 11. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	10-40%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	10-30%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	5-10%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	0-5%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0-2%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	10-20 per acre
Tree snag count** (hard***)	0-20 per acre

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 12. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	–
>0.5 <= 1	–	–	–	–
>1 <= 2	0-5%	0-5%	0-2%	10-25%
>2 <= 4.5	–	–	–	–
>4.5 <= 13	0-10%	0-5%	–	–
>13 <= 40	15-30%	–	–	–
>40 <= 80	30-75%	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.4
Mid-Successional Mesic Clayplain Forest

Figure 18. Mid-successional clayplain forest with early to mid succession hardwood species dominant in the overstory and an understory of herbaceous litter, shrubs and forbs. NASIS Veg Plot ID 2024VT007001

Figure 19. Mid-successional forest with shagbark hickory, green ash, and maples present as moderate sized canopy trees with shrubs and forbs dominant in the understory. NASIS Veg Plot ID 2024VT007001.

Figure 20. Burr oak (Quercus macrocarpa) seedlings present in the understory of a mid-successional clayplain forest. NASIS Veg Plot ID 2024VT007001.

This condition represents a mid-successional mesic clayplain forest, distinguished by the lack of pine and oak dominance in the overstory and minimal oak recruitment in the understory as well as the dominance of aggressive non-native, invasive shrubs. These are often the result of secondary growth stands or stands that have been converted from agriculture. Early successional species have lost their dominance in the overstory and is replaced by a mixed hardwood stand of mid- to late-successional species. This will typically occur in lesser sloped areas that have been cleared in the past for agricultural uses and are currently secondary growth.

Forest overstory. Hardwoods such as Betula lenta (sweet birch), Acer rubrum (red maple), Cayra ovata (shagbark hickory), Ostrya virginiana (eastern hophornbeam), and Fraxinus americana (white ash) are often present in the overstory. Conifers may include Pinus strobus (white pine) and / or Tsuga canadensis (eastern hemlock) in variable amounts. Remnant pine will often be present as a relict emergent canopy but are losing dominance and following tip ups will allow for release of understory saplings. Invasive species such as Acer plantinoides (Norway maple) will often make up variable amounts in the overstory.

Forest understory. Diverse forbs and low shrubs will often be present in the understory. Oak regeneration and saplings are often minimal. Invasive understory shrubs are often present, and will include but are not limited to Lonicera morrowii (Morrow's honeysuckle), Lonicera tatarica (tatarian honeysuckle), Berberis thunbergii (Japanese barberry), Rhamnus cathartica (European buckthorn), and Frangula alnus (alder buckthorn) may be present in the understory.

Dominant plant species

- eastern white pine (*Pinus strobus*), tree
- red maple (*Acer rubrum*), tree
- shagbark hickory (*Carya ovata*), tree
- hophornbeam (*Ostrya virginiana*), tree
- white ash (*Fraxinus americana*), tree
- eastern hemlock (*Tsuga canadensis*), tree

- Norway maple (*Acer platanoides*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- quaking aspen (*Populus tremuloides*), tree
- birch (*Betula*), tree
- oak (*Quercus*), tree
- blue cohosh (*Caulophyllum thalictroides*), shrub
- wild sarsaparilla (*Aralia nudicaulis*), shrub
- honeysuckle (*Lonicera*), shrub
- red mulberry (*Morus rubra*), shrub
- Virginia creeper (*Parthenocissus quinquefolia*), shrub
- eastern poison ivy (*Toxicodendron radicans*), shrub
- common buckthorn (*Rhamnus cathartica*), shrub
- grape (*Vitis*), shrub
- sedge (*Carex*), grass
- Virginia strawberry (*Fragaria virginiana*), other herbaceous
- common dandelion (*Taraxacum officinale*), other herbaceous
- common gypsyweed (*Veronica officinalis*), other herbaceous
- littleleaf buttercup (*Ranunculus abortivus*), other herbaceous
- feathery false lily of the valley (*Maianthemum racemosum*), other herbaceous
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- bedstraw (*Galium*), other herbaceous
- dogtooth violet (*Erythronium americanum*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates

Table 13. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	0-10%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0-5%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0-5%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	0-3%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0-2%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	0-10 per acre
Tree snag count** (hard***)	0-20 per acre

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

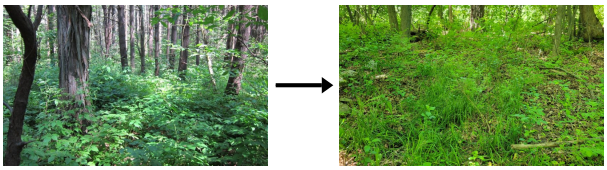
**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 14. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	–
>0.5 <= 1	–	–	–	–
>1 <= 2	0-5%	0-5%	0-5%	10-30%
>2 <= 4.5	–	5-10%	–	–
>4.5 <= 13	–	0-15%	–	–
>13 <= 40	5-15%	–	–	–
>40 <= 80	50-80%	–	–	–
>80 <= 120	0-10%	–	–	–
>120	–	–	–	–

Pathway 1.1A
Community 1.1 to 1.2



Late Successional Mesic Clayplain Forest

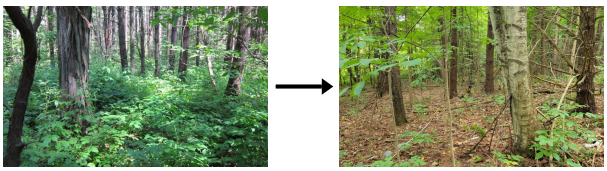
Graminoid / Low Shrublands - Absent to Very Sparse Overstory - (Temporary Dominance)

This transition may occur through large-scale disturbances including but not limited to clearcutting, large-scale wild events (hurricanes, nor'easters, etc.), pest insect outbreaks (emerald ash borer, etc.) or mortality from extreme snow / ice events. Fire in these systems may have been historically utilized by Native Americans. No recent reports of fire in these habitats has been issued.

Conservation practices

Forest Land Management
Prescribed Forestry
Forest Management Plan - Written
Forest Management Plan - Applied
Creating forest openings to improve hardwood stands

Pathway 1.1B
Community 1.1 to 1.3



Late Successional Mesic Clayplain Forest

Mixed Pine - Early Successional Mesic Clayplain Forest

This transition may occur through small scale disturbances, often seen but not limited to single tree tip ups and mortality, or selective harvesting.

Conservation practices

Brush Management

Upland Wildlife Habitat Management
Prescribed Forestry
Forest stand improvement for habitat and soil quality

Pathway 1.2A
Community 1.2 to 1.3

Graminoid / Low Shrublands - Absent to Very Sparse Overstory - (Temporary Dominance)

Mixed Pine - Early Successional Mesic Clayplain Forest

This transition may occur as natural succession over time. As canopy gaps create areas of temporary importance dominated by shrubs and graminoids, assuming a seed source is available, seedlings and sapling will begin to grow. Fast growing shade intolerant species such as white pine are often dominant in the regrowth process.

Pathway 1.3A
Community 1.3 to 1.2

Mixed Pine - Early Successional Mesic Clayplain Forest

Graminoid / Low Shrublands - Absent to Very Sparse Overstory - (Temporary Dominance)

This transition may occur through large- or small-scale disturbances including but not limited to clearcutting, large-scale wild events (hurricanes, nor'easters, etc.), pest insect outbreaks (emerald ash borer, etc.) or mortality from extreme snow / ice events. Fire in these systems may have been historically utilized by Native Americans. No recent reports of fire in these habitats has been issued.

Conservation practices

Forest Land Management
Prescribed Forestry
Forest Management Plan - Written
Forest Management Plan - Applied
Creating forest openings to improve hardwood stands

Pathway 1.3B
Community 1.3 to 1.4

Mixed Pine - Early Successional Mesic Clayplain Forest

Mid-Successional Mesic Clayplain Forest

This transition may occur as natural succession over time. White pine and other early successional species will

either self-thin or can be thinned manually as time passes, opening the canopy for mid-successional hardwood species to begin to grow.

Conservation practices

Forest Stand Improvement
Forest stand improvement for habitat and soil quality
Creating forest openings to improve hardwood stands

Pathway 1.4A
Community 1.4 to 1.1

Mid-Successional Mesic Clayplain Forest

Late Successional Mesic Clayplain Forest

This transition may occur as natural succession and oak recruitment in the understory create a forest resembling the reference condition of a late succession mesic clayplain forest. Pine will have lost its dominance in the canopy and be replaced by oak and other mixed hardwood dominance. Many of these forests will require some sort of management to address invasive or non-native plant species and can be removed via chemical, biological, or mechanical means.

Conservation practices

Forest Stand Improvement
Forest Land Management
Invasive Plant Species Control

Pathway 1.4B
Community 1.4 to 1.2

Mid-Successional Mesic Clayplain Forest

Graminoid / Low Shrublands - Absent to Very Sparse Overstory - (Temporary Dominance)

This transition may occur through large- or small-scale disturbances including but not limited to clearcutting, large-scale wild events (hurricanes, nor'easters, etc.), pest insect outbreaks (emerald ash borer, etc.) or mortality from extreme snow / ice events. Fire in these systems may have been historically utilized by Native Americans. No recent reports of fire in these habitats has been issued.

Conservation practices

Forest Stand Improvement
Prescribed Forestry
Forest Management Plan - Written
Forest Management Plan - Applied
Creating forest openings to improve hardwood stands

State 2
Agricultural Row Crops

Figure 21. Corn field in the early growing season (May) 2024 on a conventionally tilled site. NASIS Veg Plot ID 2024VT001001.

This state represents a once forested area now cleared for cropland. This will typically only occur on gentler slopes (less than15 percent) due to potential for water erosion. Corn is the dominant agricultural row crop on this site.

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Compaction
- Organic matter depletion
- Aggregate instability
- Inefficient irrigation water use
- Nutrients transported to surface water
- Nutrients transported to ground water
- Plant productivity and health
- Feed and forage imbalance

Community 2.1
Conventional Tilled Row Crops

Figure 22. Conventional tilled corn field on gentle slopes of the Champlain Valley. NASIS Veg Plot ID 2024VT001001.

Figure 23. Aerial photo showing spacing between rows, expressing bare soil and cracking due to the high shrink-swell potential of these soils. NASIS Veg Plot ID 2024VT001001.

This phase consists of cleared and cultivated fields for annual or perennial crops that are heavily managed with regular soil disturbances.

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Compaction
- Organic matter depletion
- Aggregate instability
- Nutrients transported to surface water
- Pesticides transported to surface water
- Plant productivity and health
- Plant structure and composition

Community 2.2
Conservation Till Row and Cover Crops

This phase consists of cleared and cultivated fields for annual or perennial crops that are managed with a conservation focus on tilling practices. These methods include strip till, vertical till, or no till systems. These methods may improve soil ecosystem function over time.

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition

Pathway 2.1A
Community 2.1 to 2.2

This transition can occur through the reduction or elimination of conventional tillage practices and the implementation of conservation practices. Conservation strategies may vary depending on local site conditions and should be addressed with management planners. Through the long term conservation practices, soil physical and chemical properties should improve and pose less of a risk with land management issues.

Conservation practices

Conservation Cover
Conservation Crop Rotation
Cover Crop
Long Term No. Till

Residue and Tillage Management, No-Till/Strip Till/Direct Seed

Pathway 2.2A
Community 2.2 to 2.1

This transition can occur through the use of intensive, regular mechanical soil disturbances.

Conservation practices

Deep Tillage

State 3
Managed Grassland

Figure 24. First cut hay field in May of 2024 found on a Madalin taxadjunct series in Shelburne, Vermont. NASIS Veg Plot ID 2024VT007002.

This state represents a once forested area now cleared and managed as pasture or hay fields. This will typically only occur on gentler slopes (less than15 percent) due to potential for water erosion. Pasture vegetation can consist of grasses, legumes, other forbs, shrubs or a mixture. Many of these forages are introduced, having originally come from areas in other states or continents. Overgrazed pastures can lead to soil compaction and numerous bare spots, which may then become focal points of accelerated erosion and colonization sites of undesirable plants or weeds.

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Compaction
- Organic matter depletion
- Aggregate instability
- Inefficient irrigation water use
- Nutrients transported to surface water
- Nutrients transported to ground water
- Plant productivity and health
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

Community 3.1
Orchardgrass - Smooth Brome - Common Milkweed Early Successional Meadow

Figure 25. Third cut hay field late in the growing season (August) of 2024. NASIS Veg Plot ID 2024VT021001.

Figure 26. Hay field cut exclusion for wildlife habitat showing species seeding and what prior to haying would look like. Included as a site note adjacent to NASIS Veg Plot ID 2024VT021001.

This community phase represents commonly planted forage species on pastureland and hay land. The suite of plants established on any given site may vary considerably depending upon purpose, management goals, and usage (e.g., horse vs. cattle). Most systems include a mixture of non-native cool-season grasses and legumes that provide forage throughout the growing season. Several additional plants and/or species combinations maybe present depending on the objectives and management approaches of the land manager/owner. This may also be the result of bare soil after cessation of agriculture, and will be short-lived without annual mowing, but can persist indefinitely when actively managed.

Resilience management. Mechanical mowing, at least annually but ranging up to four times during the growing season, helps maintain these areas as dominant grasslands.

Forest overstory. Trees and shrubs are generally absent from these communities but may occur as scattered mature individuals as shade structures for grazing animals.

Forest understory. Common species may include cool season grasses such as Dactylis glomerata (orchardgrass), Bromus inermis (smooth brome), Phleum pratense (timothy), Anthoxanthum odoratum (sweet vernal grass), Poa pratensis (Kentucky bluegrass), Agrostis spp. (bentgrass), Festuca rubra / ovina (red / hard fescue), Lolium perenne (perennial rye), and x Festulolium. Legumes may include Medicago sativa (alfalfa), Trifolium pratense (red clover), and Astragalus spp. (milkvetch). Forbs may be less abundant and can include Galium spp. (bedstraw), Fragaria virginiana (Virginia strawberry), Heracleum spp. (cowparsnip), Rhinanthus spp. (yellow rattle), Solidago spp. (goldenrods), Ranunculus spp. (buttercups), & Hieracium spp. (hawkweed).

Dominant plant species

- orchardgrass (*Dactylis glomerata*), grass
- smooth brome (*Bromus inermis*), grass

- timothy (*Phleum pratense*), grass
- sweet vernalgrass (*Anthoxanthum odoratum*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- bentgrass (*Agrostis*), grass
- red fescue (*Festuca rubra*), grass
- sheep fescue (*Festuca ovina*), grass
- perennial ryegrass (*Lolium perenne*), grass
- festulolium (×*Festulolium*), grass
- alfalfa (*Medicago sativa*), other herbaceous
- red clover (*Trifolium pratense*), other herbaceous
- common milkweed (*Asclepias syriaca*), other herbaceous
- milkvetch (*Astragalus*), other herbaceous
- bedstraw (*Galium*), other herbaceous
- Virginia strawberry (*Fragaria virginiana*), other herbaceous
- cowparsnip (*Heracleum*), other herbaceous
- plantain (*Plantago*), other herbaceous
- goldenrod (*Solidago*), other herbaceous
- buttercup (*Ranunculus*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

Table 15. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	100	1563	3601
Total	**100**	**1563**	**3601**

Table 16. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	30-95%
Forb foliar cover	5-80%
Non-vascular plants	0%
Biological crusts	0%
Litter	20-80%
Surface fragments >0.25" and <=3"	0-2%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	2-5%

Table 17. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0-5%
Grass/grasslike basal cover	30-75%

Forb basal cover	0-6%
Non-vascular plants	0%
Biological crusts	0%
Litter	40-98%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0-2%

Table 18. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	–
>0.5 <= 1	–	–	–	–
>1 <= 2	–	0-5%	0-100%	0-50%
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	0-5%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 3.2
Autumn Olive - Gray Dogwood - Multiflora Rose Ruderal Shrubland

This vegetation comprises shrubby old fields dominated by thickets. Variable amounts of invasive plants are present. Small trees are often present but often form less than 25% cover and consist of early successional species. The herbaceous layer is variable depending on the density of shrub cover. Typical species are those associated with old fields, grasslands, and agricultural sites. Vines can be absent or dominant, sometimes covering the tall and short shrubs. This phase is characterized by an abundance of fleshy fruited shrubs, both native and non-native, that become established by bird and small mammal dispersal. Many of the successional meadow species remain in openings, usually forming a patchy mosaic (NatureServe 2015). This correlates with NatureServes '*Elaeagnus umbellata* - *Cornus racemosa* - *Rosa multiflora* - *Juniperus virginiana* Ruderal Shrubland' Association (CEGL006451).

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- paper birch (*Betula papyrifera*), tree
- chokecherry (*Prunus virginiana*), tree
- eastern white pine (*Pinus strobus*), tree
- red maple (*Acer rubrum*), tree
- Russian olive (*Elaeagnus angustifolia*), shrub
- gray dogwood (*Cornus racemosa*), shrub
- blackhaw (*Viburnum prunifolium*), shrub
- Japanese honeysuckle (*Lonicera japonica*), shrub
- Morrow's honeysuckle (*Lonicera morrowii*), shrub
- European privet (*Ligustrum vulgare*), shrub
- multiflora rose (*Rosa multiflora*), shrub
- smooth sumac (*Rhus glabra*), shrub

- staghorn sumac (*Rhus typhina*), shrub
- Japanese barberry (*Berberis thunbergii*), shrub
- blackberry (*Rubus*), shrub
- sweet vernalgrass (*Anthoxanthum odoratum*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- red fescue (*Festuca rubra*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- smooth brome (*Bromus inermis*), grass
- redtop (*Agrostis gigantea*), grass
- quackgrass (*Elymus repens*), grass
- wrinkleleaf goldenrod (*Solidago rugosa*), other herbaceous
- giant goldenrod (*Solidago gigantea*), other herbaceous
- gray goldenrod (*Solidago nemoralis*), other herbaceous
- common yellow oxalis (*Oxalis stricta*), other herbaceous
- common blue violet (*Viola sororia*), other herbaceous
- common milkweed (*Asclepias syriaca*), other herbaceous
- garlic mustard (*Alliaria petiolata*), other herbaceous
- false baby's breath (*Galium mollugo*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- Queen Anne's lace (*Daucus carota*), other herbaceous
- clover (*Trifolium*), other herbaceous

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

Table 19. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	–
>0.5 <= 1	–	–	–	–
>1 <= 2	–	–	–	–
>2 <= 4.5	–	50-75%	0-25%	0-50%
>4.5 <= 13	–	–	–	–
>13 <= 40	0-25%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Pathway 3.1A
Community 3.1 to 3.2

This may occur when grassland management operations are reduced or eliminated, allowing for succession to predominately invasive and incursive shrubs.

Pathway 3.2A
Community 3.2 to 3.1

This may occur through the removal of undesirable species in a managed grassland and return to specific management practices for pasture or hay production.

Conservation practices

Brush Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan
Managed Haying/Grazing
Biological suppression and other non-chemical techniques to manage brush, weeds and invasive species

State 4
Potential Restoration State

This state represents an altered state that is undergoing restoration to reflect the mesic clayplain forest in composition and structure but also reflects the past land use. This may include a variety of phases that may or may not be successful.

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates

Community 4.1
Even-Age Planted Saplings

This phase represents the beginning of restoration, in which saplings of the appropriate species are planted at the desired density. These may need to be protected from the browse of animals. The ground cover may be bare ground or undesirable pasture grasses and forbs.

Community 4.2
Even-Age Sapling Forest / Shrubland

This phase represents the even aged stand of saplings that have become established and begin growth at the desired density. The groundcover may be a mix of native and non-native species as well as variable amounts of bare ground.

Community 4.3
Uneven-Aged Sapling Forest / Shrubland

This phase represents a restoration attempt in which the trees may become different age classes, whether intentionally or not. Some saplings will become established and begin growth at undesired density, until natural seeding or replanting occurs. The groundcover may be a mix of native and non-native species as well as variable amounts of bare ground.

Pathway 4.1A
Community 4.1 to 4.2

This may occur when planted species become established at a restoration site and begin to grow under passive and active management.

Pathway 4.1B
Community 4.1 to 4.3

This may occur through single or group species die off and replanted or regrowth of species occurs. Species die off may occur through many reasons, including but not limited to herbivory, fungal disease, insect outbreaks, lack of nutrients, unsuited planting, etc.

Pathway 4.2A
Community 4.2 to 4.3

This may occur through single or group species die off and replanted or regrowth of species occurs. Species die off may occur through many reasons, including but not limited to herbivory, fungal disease, insect outbreaks, lack of nutrients, unsuited planting, etc.

Transition T1A
State 1 to 2

Reference State / Minimally Managed

Agricultural Row Crops

Converted forested communities have often undergone the clearing of native vegetation and site preparation before conversion to agricultural fields is complete. Due to the complex microtopography of the native site, land smoothing and / or leveling may be required, as well as undergoing practices such as tilling for the field to be ready to plant. Planting of desired crops can be done by hand or machine at desired spacing and intervals.

Transition T1B
State 1 to 3

Reference State / Minimally Managed

Managed Grassland

Converted forested communities have often undergone the clearing of native vegetation and site preparation before conversion to a managed grassland state is complete. Due to the complex microtopography of the native site, land smoothing and / or leveling may be required. Planting of desired mixtures of grasses and / or legumes can be done by hand or machine at desired densities.

Transition T2A
State 2 to 3

Agricultural Row Crops

Managed Grassland

Cropland can be converted to managed grasslands following the removal of the crop and the planting of desired mixtures of grasses and / or legumes at the desired density. Short term abandonment of crop fields may also give rise to ruderal shrublands and undesirable grasses and forbs that, if managed correctly, can be converted into a persistently managed grassland.

Restoration pathway R2A
State 2 to 4

Conversion from an agricultural state to a restored function state may require the removal of the crop and the reintroduction of tree saplings and other native species to the area. Measures may need to be taken to prevent excessive soil erosion and failure of establishment due to browse.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Transition T3B
State 3 to 1

Managed Grassland

Reference State / Minimally Managed

Long-term abandonment of converted land may result in fallow fields that will allow for the growth and establishment of native and non-native species that over time can reflect an early- to mid-successional forest of the reference state. The presence of non-native species will often diminish the ecological value of the restored forest, but through proper management and care may reflect the reference condition over time.

Conservation practices

Tree/Shrub Establishment
Upland Wildlife Habitat Management
Native Plant Community Restoration and Management
Herbaceous Weed Control

Transition T3A
State 3 to 2

Managed Grassland

Agricultural Row Crops

Managed grassland can be converted to agricultural fields following the removal of the grasses / legumes (typically achieved by tilling) and planting the desired crop at the desired spacing and intervals.

Restoration pathway R3A
State 3 to 4

Conversion from a managed grassland state to a restored function state may require the cessation of management and the reintroduction of tree saplings and other native species to the area. Measures may need to be taken to prevent excessive soil erosion and failure of establishment due to browse. Passive restoration management may result in a condition similar to an old-field white pine forest, whereas active restoration management may result in more diverse species composition.

Conservation practices

Tree/Shrub Site Preparation
Tree/Shrub Establishment

Transition T4A

State 4 to 1

Following the success of tree sapling establishment in restoration areas, natural seeding can occur and result in regrowth of forest species to the proper age and site classes.

Additional community tables

Table 20. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
eastern white pine	PIST	*Pinus strobus*	Native	33–66	10–25	–	–
eastern hemlock	TSCA	*Tsuga canadensis*	Native	33–66	10–25	–	–
white ash	FRAM2	*Fraxinus americana*	Native	33–66	5–10	–	–
northern red oak	QURU	*Quercus rubra*	Native	33–66	5–10	–	–
bigtooth aspen	POGR4	*Populus grandidentata*	Native	33–66	5–10	–	–
white oak	QUAL	*Quercus alba*	Native	33–66	2–5	–	–
hophornbeam	OSVI	*Ostrya virginiana*	Native	–	–	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	–	–	–
red maple	ACRU	*Acer rubrum*	Native	–	–	–	–
bitternut hickory	CACO15	*Carya cordiformis*	Native	–	–	–	–
American beech	FAGR	*Fagus grandifolia*	Native	–	–	–	–
American basswood	TIAM	*Tilia americana*	Native	–	–	–	–
quaking aspen	POTR5	*Populus tremuloides*	Native	–	–	–	–
shagbark hickory	CAOV2	*Carya ovata*	–	–	–	–	–

Table 21. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
longstalk sedge	CAPE4	*Carex pedunculata*	Native	0.3–1.6	0.5–1
handsome sedge	CAFO4	*Carex formosa*	Native	–	–
plantainleaf sedge	CAPL4	*Carex plantaginea*	Native	–	–
rosy sedge	CARO22	*Carex rosea*	Native	–	–
whitegrass	LEVI2	*Leersia virginica*	Native	–	–
Pennsylvania sedge	CAPE6	*Carex pensylvanica*	Native	–	–
Forb/Herb					
wild sarsaparilla	ARNU2	*Aralia nudicaulis*	Native	0.3–1.6	0.5–1
Appalachian barren strawberry	WAFR	*Waldsteinia fragarioides*	Native	0.3–1.6	0.5–1
pointedleaf ticktrefoil	DEGL5	*Desmodium glutinosum*	Native	0.3–1.6	0.5–1
broadleaf helleborine	EPHE	*Epipactis helleborine*	Introduced	0.3–1.6	0.5–1
longstyle sweetroot	OSLO	*Osmorhiza longistylis*	Native	0.3–1.6	0.5–1
broadleaf enchanter's nightshade	CILUC	*Circaea lutetiana ssp. canadensis*	Native	–	–
spotted geranium	GEMA	*Geranium maculatum*	Native	–	–
white snakeroot	AGAL5	*Ageratina altissima*	Native	–	–
American hogpeanut	AMBR2	*Amphicarpaea bracteata*	Native	–	–

Canadian woodnettle	LACA3	*Laportea canadensis*	Native	–	–
woodland sunflower	HEDI2	*Helianthus divaricatus*	Native	–	–
gaywings	POPA5	*Polygala paucifolia*	Native	–	–
white baneberry	ACPA	*Actaea pachypoda*	Native	–	–
largefruit blacksnakeroot	SATR4	*Sanicula trifoliata*	Native	–	–
wreath goldenrod	SOCA4	*Solidago caesia*	Native	–	–
Fern/fern ally					
intermediate woodfern	DRIN5	*Dryopteris intermedia*	Native	0.3–1.6	0.5–1
Christmas fern	POAC4	*Polystichum acrostichoides*	Native	0.3–1.6	0.5–1
northern maidenhair	ADPE	*Adiantum pedatum*	Native	–	–
Shrub/Subshrub					
American witchhazel	HAVI4	*Hamamelis virginiana*	Native	7–16	5–10
American hornbeam	CACA18	*Carpinus caroliniana*	Native	3–16	2–5
mapleleaf viburnum	VIAC	*Viburnum acerifolium*	Native	–	–
eastern leatherwood	DIPA9	*Dirca palustris*	Native	–	–
alternateleaf dogwood	COAL2	*Cornus alternifolia*	Native	–	–
American witchhazel	HAVI4	*Hamamelis virginiana*	Native	–	–
Tree					
striped maple	ACPE	*Acer pensylvanicum*	Native	7–16	5–10
American beech	FAGR	*Fagus grandifolia*	Native	7–16	1–2
white ash	FRAM2	*Fraxinus americana*	Native	3–16	1–2
quaking aspen	POTR5	*Populus tremuloides*	Native	–	–
sweet birch	BELE	*Betula lenta*	Native	–	–
Vine/Liana					
eastern poison ivy	TORA2	*Toxicodendron radicans*	Native	0.3–1.6	0.5–1
Virginia creeper	PAQU2	*Parthenocissus quinquefolia*	Native	0.3–1.6	0.5–1

Table 22. Community 1.4 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
red maple	ACRU	*Acer rubrum*	Native	15–80	5–25	–	–
Norway maple	ACPL	*Acer platanoides*	Introduced	50–80	10–20	10–14	–
shagbark hickory	CAOV2	*Carya ovata*	Native	15–40	10–20	–	–
green ash	FRPE	*Fraxinus pennsylvanica*	Native	15–80	5–15	–	–
eastern white pine	PIST	*Pinus strobus*	Native	80–110	5–15	16–25	–
quaking aspen	POTR5	*Populus tremuloides*	Native	40–80	5–10	–	–

Table 23. Community 3.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
sweet vernalgrass	ANOD	*Anthoxanthum odoratum*	Introduced	0–3	50–75
orchardgrass	DAGL	*Dactylis glomerata*	Introduced	0–3	50–75
smooth brome	BRIN2	*Bromus inermis*	Introduced	0–3	25–50
timothy	PHPR3	*Phleum pratense*	Introduced	0–3	10–25
erect brome	BRER3	*Bromus erectus*	Introduced	0–3	2–5
plantainleaf sedge	CAPL4	*Carex plantaginea*	Introduced	0–3	0–2
Forb/Herb					
common milkweed	ASSY	*Asclepias syriaca*	Native	0–3	0–10
oxeye daisy	LEVU	*Leucanthemum vulgare*	Introduced	0–3	0–10
Canada goldenrod	SOAL6	*Solidago altissima*	Native	0–3	0–10
goldenrod	SOLID	*Solidago*	Native	0–6	0–10
Shrub/Subshrub					
Morrow's honeysuckle	LOMO2	*Lonicera morrowii*	Introduced	0–3	0–1
silky dogwood	COAM2	*Cornus amomum*	Native	0–3	0–1
nannyberry	VILE	*Viburnum lentago*	Native	0–3	0–1
gray dogwood	CORA6	*Cornus racemosa*	Native	0–3	0–1
Tree					
Kentucky bluegrass	POPR	*Poa pratensis*	Native	0–15	0–2
red maple	ACRU	*Acer rubrum*	Native	0–15	0–2

Table 24. Community 3.2 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Kentucky bluegrass	POPR	*Poa pratensis*	Introduced	–	–
redtop	AGGI2	*Agrostis gigantea*	Unknown	–	–
quackgrass	ELRE4	*Elymus repens*	Introduced	–	–
red fescue	FERU2	*Festuca rubra*	Native	–	–
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	–
sweet vernalgrass	ANOD	*Anthoxanthum odoratum*	Introduced	–	–
smooth brome	BRIN2	*Bromus inermis*	Introduced	–	–
Forb/Herb					
common yellow oxalis	OXST	*Oxalis stricta*	Native	–	–
common blue violet	VISO	*Viola sororia*	Native	–	–
flat-top goldentop	EUGR5	*Euthamia graminifolia*	Native	–	–
common yarrow	ACMI2	*Achillea millefolium*	Native	–	–
common yarrow	ACMI2	*Achillea millefolium*	Introduced	–	–
Queen Anne's lace	DACA6	*Daucus carota*	Introduced	–	–
white clover	TRRE3	*Trifolium repens*	Introduced	–	–
wrinkleleaf goldenrod	SORU2	*Solidago rugosa*	Native	–	–
Virginia mountainmint	PYVI	*Pycnanthemum virginianum*	Native	–	–
garlic mustard	ALPE4	*Alliaria petiolata*	Introduced	–	–
false baby's breath	GAMO	*Galium mollugo*	Introduced	–	–

common cinquefoil	POSI2	*Potentilla simplex*	Native	–	–
giant goldenrod	SOGI	*Solidago gigantea*	Native	–	–
gray goldenrod	SONE	*Solidago nemoralis*	Native	–	–
Shrub/Subshrub					
Russian olive	ELAN	*Elaeagnus angustifolia*	Introduced	–	–
gray dogwood	CORA6	*Cornus racemosa*	Native	–	–
blackhaw	VIPR	*Viburnum prunifolium*	Native	–	–
Morrow's honeysuckle	LOMO2	*Lonicera morrowii*	Introduced	–	–
European privet	LIVU	*Ligustrum vulgare*	Introduced	–	–
burningbush	EUAL13	*Euonymus alatus*	Introduced	–	–
multiflora rose	ROMU	*Rosa multiflora*	Introduced	–	–
smooth sumac	RHGL	*Rhus glabra*	Native	–	–
staghorn sumac	RHTY	*Rhus typhina*	Introduced	–	–
Japanese barberry	BETH	*Berberis thunbergii*	Introduced	–	–
blackberry	RUBUS	*Rubus*	Native	–	–
common buckthorn	RHCA3	*Rhamnus cathartica*	Introduced	–	–
Japanese honeysuckle	LOJA	*Lonicera japonica*	Introduced	–	–
Tree					
American elm	ULAM	*Ulmus americana*	Native	–	–
eastern redcedar	JUVI	*Juniperus virginiana*	Native	–	–
gray birch	BEPO	*Betula populifolia*	Native	–	–
chokecherry	PRVI	*Prunus virginiana*	Native	–	–
red maple	ACRU	*Acer rubrum*	Native	–	–
black cherry	PRSE2	*Prunus serotina*	Native	–	–
white ash	FRAM2	*Fraxinus americana*	Native	–	–
Vine/Liana					
summer grape	VIAE	*Vitis aestivalis*	Native	–	–
fox grape	VILA8	*Vitis labrusca*	Native	–	–
eastern poison ivy	TORA2	*Toxicodendron radicans*	Native	–	–
eastern poison ivy	TORA2	*Toxicodendron radicans*	Native	–	–
American ginseng	PAQU	*Panax quinquefolius*	Native	–	–

Animal community

Information for this interpretation has been sourced from Wetland, Wildland, Woodland - A Guide to the Natural Communities of Vermont (Thompson and Sorenson 2000)

Animals commonly associated with this site include:
Spotted salamander – Ambystoma maculatum
Eastern red-backed salamander – Plethodon cinereus
Wood frog – Lithobates sylvaticus
Gray treefrog – Hyla versicolor
DeKay’s brownsnake – Storeria dekayi
Eastern gray squirrel – Sciurus carolinensis
Southern flying squirrel – Glaucomys volans
Gray fox – Urocyon cinereoargenteus
Eastern chipmunk – Tamias striatus

Raccoon – Procyon lotor
Eastern wood pewee – Contopus virens
Black-billed cuckoo – Coccyzus erythropthalmus
Blue-headed vireo – Vireo solitarius
Scarlet tanager – Piranga olivacea
Hermit thrush – Catharus guttatus
Wood thrush – Hylocichla mustelina
Yellow-throated vireo – Vireo flavifrons
Ovenbird – Seiurus aurocapilla
American redstart – Setophaga ruticilla
Baltimore oriole – Icterus galbula
Hairy woodpecker – Picoides villosus
Rose-breasted grosbeak – Pheucticus ludovicianus
Tufted titmouse – Baeolophus bicolor
Carolina wren – Thryothorus ludovicianus
Wild turkey – Meleagris gallopavo
Andrena bee – Andrena distans

Animals that may be rare or uncommon to this site include:
Blue-spotted salamander – Ambystoma laterale
Indiana bat – Myotis sodalis
Northern long-eared bat – Myotis septentrionalis
Cooper's hawk – Accipiter cooperii
Sharp-shinned hawk – Accipiter striatus
Red-bellied woodpecker – Melanerpes carolinus
Hickory hairstreak – Satyrium caryaevorus

Recreational uses

This site has limited use for recreation other than occasional hiking on public lands. Hunting for deer may occur on private lands where food sources are available.

Other products

Most areas are cleared and used for hay, pasture, and to a lesser extent for silage corn and apple orchards.

Table 25. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
eastern white pine	*PIST*	50	115	–	–	–	–	–	
white ash	*FRAM2*	25	25	–	–	–	–	–	
American elm	*ULAM*	35	60	–	–	–	–	–	
hophornbeam	*OSVI*	19	40	–	–	–	–	–	
Norway maple	*ACPL*	52	61	–	–	–	–	–	

Inventory data references

Other Data Surveyed Not Entered in NASIS include:
2015VT021003 - Champlain Valley Ecological Site Inventory from NatureServe - Community Phase 1.1
2015VT021004 - Champlain Valley Ecological Site Inventory from NatureServe - Community Phase 1.1
s_36033_130801B_1_2014 - NRI Grazing Lands On-Site Survey - Community Phase 3.1
s_36045_070901R_2_2016 - NRI Grazing Lands On-Site Survey - Community Phase 3.1
s_50001_050302R_1_2017 - NRI Grazing Lands On-Site Survey - Community Phase 3.1

References

. Fire Effects Information System. http://www.fs.fed.us/database/feis/.

Other references

South Burlington Natural Resources Committee. 2011. Wheeler Nature Park, South Burlington, Vermont, management plan. Draft prepared for the City of South Burlington.

Thompson, E. H., Sorenson, E.R, and Zaino, B. 2019. Wetland, woodland, wildland: A guide to the natural communities of Vermont. The Nature Conservancy and the Vermont Department of Fish and Wildlife. University Press of New England, Hanover, NH. 515 pp.

Vermont Nongame and Natural Heritage Program, Barre, VT.

Murray, H. F., & D'Amato, A. W. (2019). Stand Dynamics and Structure of Two Primary Champlain Valley Clayplain Forests, Vermont. Northeastern naturalist, 26(1), 95-115.

Randall Morin. 2017. Tree Data for Intensive Sampling Forest Health Measurement (Phase 3) Plots. USDA Forest Service, Northern Research Station. FEMC. Can be found at: https://www.uvm.edu/femc/data/archive/project/federal-forest-inventory-analysis-data-for/dataset/tree-data-for-intensive-sampling-forest

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero (editors). 2014. Ecological Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschkes Ecological Communities of New York State. New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

Lapin, M. F. (2003). Nature conservation in an agricultural landscape: Forest ecology, fragmentation analysis, and systematic site prioritization, southern Champlain Valley, Vermont, United States. Cornell University.

Carey, Jennifer H. 1993. Pinus strobus. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).

Tirmenstein, D. A. 1991. Quercus rubra. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).

Peel, M. C., Finlayson, B. L., & McMahon, T. A. (2007). Updated world map of the Köppen-Geiger climate classification. Hydrology and earth system sciences, 11(5), 1633-1644.

Contributors

Nels Barrett, Original Author 2015
Joshua Hibit, Provisional Revisions 2021
Jack Ferrara, Provisional to Approved 2025

Approval

Nels Barrett, 3/03/2025

Acknowledgments

Lucille Zendzian (NRCS NE-STJ)
Chadd Cupit (NRCS VT)
Jerry Smith (NRCS 12-PAS)
Janella Cruz (NRCS 12-PAS)
Rebecca Fox (NRCS 12_PAS)

Caroline Alves (NRCS VT)

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	12/11/2024
Approved by	Nels Barrett
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth (in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

---

17. **Perennial plant reproductive capability:**
