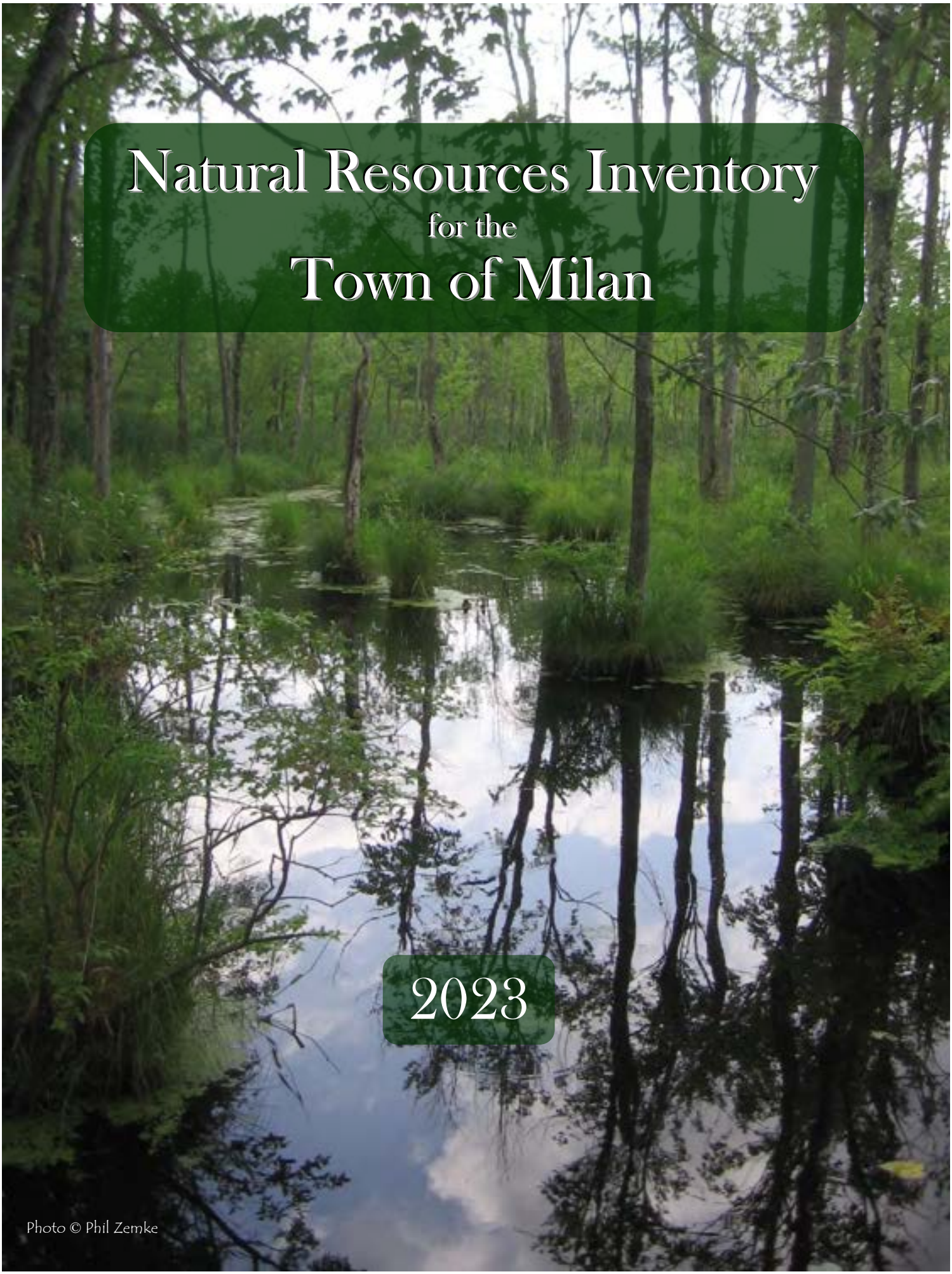

Natural Resources Inventory
for the
Town of Milan

2023

Photo © Phil Zemke

Abbreviations

ACOE	Army Corps of Engineers
asl	above mean sea level
ATV	all-terrain vehicle
CEA	Critical Environmental Area
CWA	federal Clean Water Act
dbh	diameter at breast height—a standard measure of tree size
ECL	Environmental Conservation Law
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
ft	feet
GHG	greenhouse gas—the major contributor to the global warming phenomenon
LED	light-emitting diode
m	meter(s)
mi	mile(s)
mm	millimeter(s)
MUA	Multiple Use Area
NAACC	North Atlantic Aquatic Connectivity Collaborative
NGO	non-governmental organization
NRCS	Natural Resource Conservation Service—an agency of the US Department of Agriculture
NRI	Natural Resources Inventory
NWI	National Wetland Inventory
NYGS	New York Geological Survey
NYNHP	New York Natural Heritage Program
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
SBA	Significant Biodiversity Area
SEQR	New York State Environmental Quality Review
SGCN	New York State Species of Greatest Conservation Need
US	United States
USDA	United States Department of Agriculture
USGS	United States Geological Survey

Natural Resources Inventory for the Town of Milan

2023

Prepared by

Hudsonia Ltd.

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View west from Turkey Hill. Photo © Phil Zemke

Preparation of the Natural Resources Inventory was funded by a grant to the Town of Milan from the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State Department of Environmental Conservation.

ACKNOWLEDGMENTS

This *Natural Resources Inventory* emerged from the work of many people. Doug Raelson was instrumental in preparing the successful grant application for the *NRI* project. The Milan *NRI* Advisory Committee met monthly or more frequently over eighteen months to discuss the scope and content of the document, and spent many more hours gathering information and photos, conducting interviews, compiling comments, and reviewing *NRI* drafts. Milan residents and members of town agencies reviewed *NRI* drafts and submitted comments, corrections, and additional information that improved the document. Jack Campisi, Tom Foote, Erik Kiviat, and Bonnie Wood contributed additional information about land use history and Milan plants, animals, and habitats. Town Historian Vicky Lo Brutto provided transcripts of historical interviews and information on cemetery locations. Barbara Butler scoured the records of the Ralph T. Waterman Bird Club for Milan bird data, and Frank Margiotta and Janet Allison provided additional information about their own observations of breeding birds. The Dutchess Land Conservancy and the Winnakee Land Trust provided data on land protected by those organizations. Hudsonia's Erik Kiviat and Amanda Bevan provided thoughtful comments on and edits to a near-final draft. Christine Vanderlan, Conservation and Land Use Specialist with the Hudson River Estuary Program, provided valuable guidance and information throughout the project.

The *NRI* has been greatly enhanced by the memories and observations captured in interviews and selected writings of the Milan residents listed below, adding personal perspectives on familiar places, events, and uses of the land.

Linda Ahlin	Burton Coon	Walt Hermans	Tom Odak
Anonymous	Harold Coon	Leland Jacoby	Janet & Gene Ohlson
Bob Bard	Web Coon	Roy & Stell Jacoby	Albrecht Pichler
Fred Battenfeld	Annie Battenfeld Doyle	Bill Jeffway	Esther Rider
Jack Campisi	Craig Fitzsimmons	Al & Vicky Lo Brutto	Barbara Thompson
Bessie Coon	Tom Foote	Larry Longo	Luzia Willms

Scientific illustrator Kathleen A. Schmidt contributed line drawings of animals, and many photographers provided photos of landscapes, habitats, plants, animals, and other subjects that help to illustrate the diverse natural resources of Milan.

Debra Blalock	Bill Jeffway	Kathy Rousseau
Glenn Butler	Erik Kiviat	Bradley Rubenstein
Chris Graham	Vicki McKenzie	Gretchen Stevens
Laura Heady	Kevin Pike	Phil Zemke

The project was funded by a grant to the town from the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State Department of Environmental Conservation. The grant enabled the town to obtain the services of Hudsonia Ltd. to compile information, create maps, compose the narrative, and work with the Advisory Committee over a 20-month period in 2022-2023. The committee hopes that the *NRI* will be widely used by town agencies, residents, landowners, conservation organizations, developers, and everyone else who is interested in learning about the natural resources of Milan.

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SUMMARY

This *Natural Resources Inventory* (*NRI*) was created to inform the people of Milan about the natural resources of the town, and to identify the places and features that deserve special attention in planning and decision-making about our uses of the land. The *NRI* describes and illustrates many aspects of the Milan landscape—topography, bedrock, soils, groundwater, surface water, habitats, plants and animals, farmland, and much more—and the significance of those resources to local ecosystems and to Milan residents.

Milan is a town of forested hills and valleys. There is no commercial or population center; residences are sparsely distributed along rural roads and in several small historical hamlets. The town lies in the **watersheds of seven streams**, all tributaries of the Hudson River estuary, and encompasses significant headwater areas for five of those streams. As the keepers of the headwaters, the people of Milan bear a special responsibility for the streams' water quality and habitat quality.

Shale bedrock predominates, but is present in combination with many other rock types including schist, phyllite, slate, quartzite, metagraywacke, argillite, graywacke, and conglomerate. These rocks are variously acidic to somewhat alkaline. There are also localized areas of the more alkaline **limestone** and **dolostone**—especially in the geological region known as the "Milan Window" which runs from the vicinity of Field Road and Hemmingway Lane south into the Town of Clinton. Limestone also occurs in a north-south corridor along Odak Farm Road and Shookville Road in the northwest corner of Milan and in the vicinity of Round Pond in the southwest. The limestones and dolostones create the calcium-rich, circumneutral (near neutral pH) and alkaline environments responsible for some of the unusual habitats of Milan, such as **rich forests, calcareous ledges, circumneutral bog lakes**, and the rare and uncommon species that inhabit those places.

Most of the drinking water wells in Milan are drilled in bedrock, tapping the water held in rock fissures and cavities. A few residences have access to the **unconsolidated aquifers**, identified in the Roeliff Jansen Kill, the Saw Kill, and the Little Wappinger Creek corridors, where large volumes of groundwater are held in sand and gravel deposits. While the abundant water in these aquifers is often accessible via shallow wells, the water is also especially vulnerable to contamination from our activities on the ground surface. Minimizing polluting activities is especially important in these areas.

Milan has changed much since the departure of the last glacier around 13,000 years ago. The barren land—scraped clean of vegetation and topsoil by the massive ice sheet—was slowly populated by plants and animals, including humans who arrived in the Hudson Valley in the early millennia of the post-glacial period. For thousands of years, the local natural resources provided for most of the day-to-day needs—for food, clothing, shelter, and tools—of the Indigenous people. For much of that time the land was substantially forested and remained so by the time Europeans started arriving in the Hudson Valley in the 1500s. Early European settlers in Milan also relied mainly on local

resources for their daily needs and income. They cleared land for agriculture, cut trees for lumber, fuel, charcoal-making, tanning, and tool-making, and dammed streams to provide water power to saw mills, grist mills, and other local resource-based industry. **By the mid-1800s, much of the forest was gone** and Milan's hills and valleys had become hayfields, pastures, and cropfields. By the late 1800s some of the region's keystone species—American beaver, eastern wolf, eastern cougar, white-tailed deer—had been trapped and hunted to regional extirpation. A combination of factors led to the decline of agriculture and industry in the late 1800s and early 1900s. Since then, **forests have retaken the land**, many dams have crumbled, and today the livelihoods of most Milan residents are earned elsewhere—no longer depending on hunting, trapping, farming, logging, mining, milling, or other uses of local natural resources.

Nonetheless, a few farms persist, and logging, hunting, and trapping still occur here. In addition, everyone depends on forests to provide clean air and clean and abundant drinking water, to moderate local air temperatures, to support wildlife, and to store large amounts of carbon. We depend on living soils to support local food production; and our spirits are buoyed every day by views of the forests, meadows, and streams of the scenic Milan landscape.

Several of Milan's many **large and small streams** have the clean, coolwater conditions and unsilted stream bottoms required by trout and other sensitive aquatic organisms. These conditions will persist only if we can protect the streams from sediment-laden runoff, warming, and other forms of pollution.

Map data from the Federal Emergency Management Agency show 100-year flood zones only along the Little Wappinger Creek and the Roeliff Jansen Kill, but many of the smaller streams also have significant **floodplains** that deserve prominent consideration in planning for or permitting new development. Avoiding the building of new structures in floodplains is an obvious precaution when large floods are becoming more frequent, more extensive, and more damaging. Allowing streams to expand unobstructed across their floodplains during large runoff events also helps to support the stream ecosystem and attenuates downstream flooding.

Milan's forests have been fragmented by many roads, driveways, and residences, but large forests still remain, some exceeding 1,000 acres. The *NRI* describes the great **value of forests for wildlife, for water resources, for carbon storage, and for many other services** provided to the ecosystem and to the human community. Using measures of size, fragmentation, habitat connectivity, habitat values, and carbon sequestration values, a study by the New York Natural Heritage Program found that many of Milan's forest areas are among the highest quality forests in the region, ranking in the 80th percentile and higher compared to other Hudson Valley forests. Maintaining the town's high quality forests will ensure that local ecosystems and the people of Milan can continue to benefit from the important services they provide.

Good **farmland soils** are well-distributed throughout the town at all but the highest elevations. Active agriculture, however, which once dominated the economic and cultural life of the town, is now restricted to a few active farms at scattered locations. The *NRI* outlines some ways that the town can support existing farms, encourage new ones, and ensure that farming remains viable and productive in Milan long into the future.

The areas open for outdoor **public recreation** include three state-owned Multiple Use Areas (MUAs)—Lafayetteville, Roeliff Jansen Kill, and a very small part of the Stissing Mountain MUA—the county-owned Wilcox Memorial Park, and the town-owned Milan Recreation Park. Together totaling 1452 acres, these areas are variously open for hiking, hunting, fishing, rustic camping, swimming, boating, and other forms of recreation, and are a valuable asset for Milan residents and visitors.

Approximately 2,450 acres of land in Milan has some kind of formal protection; these include state-owned and town-owned lands and the privately-held lands with conservation easements. In addition to lands with formal protected status, however, **all the other land areas in Milan can also be managed to promote clean and abundant surface water and groundwater, native biodiversity, and climate resilience**. At the end of this Summary are lists of **General Measures for conservation of water resources, biological resources, farmland, and scenic resources**, with many ideas applicable to privately-held parcels of any size, as well as public lands.

Below are lists of some general conservation measures that can be applied throughout the town by landowners who are managing their own lands, by developers who are considering the location or design of new development projects, and by town agencies who are revising the Comprehensive Plan, reviewing new projects, or considering new legislation for resource protection.

After studying the natural resources of Milan, their importance to the town, and the existing regulatory protections at the local, state, and federal levels, the *NRI* Advisory Committee has developed a list of recommendations for actions that can be taken by town agencies and by individual landowners for sound stewardship of land and water. The **Recommendations for Natural Resource Protections** at the end of the *NRI* narrative include ideas for strengthening the Milan town code, improving environmental review procedures, identifying important scenic areas, and proactively preparing for large floods, droughts and other disruptions brought on by the changing climate. The recommendations are aimed at ensuring that Milan's high quality natural resources are able to persist for generations to come.

General Measures for Water Resource Conservation

- Throughout the landscape, maintain forests with intact vegetation and undisturbed forest floors wherever possible.
- Minimize applications of polluting substances, such as de-icing salts to roads, parking lots, and driveways.
- Minimize applications of pesticides and fertilizers to lawns, gardens, and agricultural fields.
- In areas of unconsolidated aquifers, minimize impervious surfaces and avoid siting land uses with potential for contaminating soils and water. Educate landowners in these areas about the vulnerability of groundwater resources.
- On development sites, minimize impervious surfaces and manage stormwater in ways that maintain pre-development patterns and volumes of surface runoff and infiltration to the soils. Retrofit existing sites to achieve these goals where possible.
- Site, construct, and maintain septic systems such that septic leachate does not contaminate groundwater or surface water resources.
- Redesign and retrofit roadside ditches and other stormwater systems to maximize water infiltration to the soils, and minimize rapid and direct runoff into streams, ponds, and wetlands.
- Direct runoff from agricultural fields into basins and well-vegetated swales instead of directly into streams or wetlands to prevent sedimentation and introduction of excess nutrients, pathogens, and toxins to these sensitive habitats.
- Protect wetlands and streams from direct disturbance, and establish and maintain broad buffer zones of undisturbed vegetation and soils along streams and around wetlands, lakes, and ponds.
- Design new culverts and bridges and retrofit existing ones to maintain the continuity of stream gradients and substrates, and to accommodate storms of 500-year intensity in anticipation of more severe storms in coming decades.
- Keep floodplain meadows well-vegetated. Minimize tillage in floodplains, seed immediately after tilling, and leave abundant thatch to cover exposed soils; use cover crops in winter to help hold soils in place in the event of flooding.
- Prohibit the building of new structures in floodplains, and remove existing structures, pavement, and hazardous materials from floodplains wherever possible.
- In floodplains, shift to flood-resilient land uses that can withstand moderate to severe flooding: for example, parks, ballfields, hiking trails, picnic areas, fishing access sites, pastures, and hayfields.
- Regulate and monitor extractive commercial uses of water to ensure that water withdrawals from groundwater or surface water sources are at sustainable levels.

General Measures for Biological Resource Conservation

- Gather information about natural resources and consider environmental concerns early in the planning process for new development projects, and incorporate conservation principles into the choice of development sites, site design, stormwater management, and construction practices.
- Wherever possible, protect habitat areas in large, broad configurations with broad connections to other habitat areas.
- Protect a diverse array of common and rare habitat types, and especially those that are in good condition.
- Protect habitat complexes used by species of conservation concern wherever possible.
- Maintain broad buffer zones of undisturbed vegetation and soils around ecologically sensitive areas.
- Direct human uses toward the least sensitive areas, and minimize alteration of natural features, including vegetation, soils, bedrock, and waterways.
- Concentrate new development along existing roads; discourage construction of new roads or driveways in undeveloped areas. Avoid fragmentation of large forests or meadows by roads, driveways, and clearings.
- Minimize impervious surfaces and design new land uses (and retrofit existing uses wherever possible) to ensure that surface runoff of precipitation and snowmelt does not exceed pre-development patterns and volumes of runoff.
- Avoid fragmentation of contiguous farmland by roads, driveways, or other non-agricultural uses.
- Promote wildlife-friendly agricultural practices, such as late mowing to accommodate ground-nesting grassland birds, leaving unmowed strips and fallow rotations to support pollinators and other beneficial invertebrates, and minimizing applications of pesticides and fertilizers.
- Employ sustainable forestry practices in working forests and sustainable agricultural practices that maintain and build living soils and conserve water.
- Maintain natural disturbances, such as fires, floods, seasonal drawdowns, ice scour, and wind exposure to help create and maintain habitat for important components of native biological diversity.
- Encourage pedestrian-centered developments that enhance existing neighborhoods, instead of isolated developments requiring new roads and buildings in intact habitat areas and expanded vehicle use.
- Educate municipal agencies, landowners, developers, and the general public about the town's biodiversity to heighten awareness and build support for conservation measures.

General Measures for Farmland Conservation

Municipal Actions

- Adopt local farm-friendly policies and programs; for example, lowering property tax assessments for active farmland and farm structures, assisting farmers with grant acquisition, and promoting local markets for agricultural products, including uses by restaurants and institutions such as schools.
- Protect active farmland from non-farm development wherever possible.
- Design new subdivisions and other development sites in ways that preserve areas of Prime Farmland Soils and Farmland Soils of Statewide Importance intact and unfragmented as much as possible.
- Appoint an Agricultural Advisory Committee to advocate for agriculture and help ensure that the town's farm-friendly intentions are carried out.
- Support 4-H programs and the Future Farmers of America (FFA) programs in high school.
- Train municipal board members in farm-related issues and potential local actions to support successful farming.

Farmer Actions

- Where possible, shift tilled land in floodplains to other uses (such as pastures, hayfields) that are more resilient to flooding.
- Maintain cover crops and thatch to minimize soil loss during heavy precipitation or flood events.
- Maintain intact habitats in and near cropland, orchards, and pastures to support pollinators, other beneficial insects, and other wildlife.
- Employ farming practices that conserve water, prevent soil erosion and soil loss, and build living soils.
- Minimize applications of fertilizers and pesticides, especially in the more sensitive areas such as floodplain fields and near streams and wetlands.

General Measures for Scenic Resource Conservation

- Identify and map the places of greatest scenic importance to the Milan community.
- Enact special protections and/or environmental review procedures that apply in areas of designated scenic importance.
- Maintain intact (i.e., undeveloped) natural areas and farmland visible from public roads and public-access lands wherever possible.
- Maintain intact hilltops and hillsides with large viewsheds wherever possible.
- Minimize outdoor lighting, and design any necessary outdoor lighting to minimize visibility of lights in nearby habitat areas and offsite areas throughout the viewshed.
- Develop municipal policies that support working lands and land-dependent uses (e.g., farming, forestry) that employ sustainable practices, provide needed income to the landowner, and help to maintain the appealing visual landscapes unique to Milan.

General Measures for Conservation of Outdoor Recreation Resources

- Adopt the Dutchess County Greenway Connections and Complete Streets approaches to enhancing the quality and safety of town roads for biking, walking, and other uses, and for
- In existing public recreation areas,
    - properly maintain trails, campsites, and picnic areas;
    - discourage use of informal trails and other non-designated areas;
    - establish thresholds for acceptable and unacceptable levels of impact; re-route or discontinue trails that are unsustainable;
    - design new trails and access areas with the area of influence (e.g., 330 ft from trails) in mind and, when possible, follow existing habitat edges and avoid water resources, rare and sensitive habitats, wildlife travel corridors, and breeding areas for sensitive species; and
    - prohibit use of live bait and lead-containing bullets and fishing tackle.
- Educate the public about ways to avoid disturbing wildlife, Leave No Trace principles, and follow management rules (e.g., stay on marked trails; keep dogs on leash; do not feed wildlife; etc.) of public recreation areas.

INTRODUCTION

The natural resources of Milan provide us with clean air, clean and abundant drinking water, climate moderation, local food from domestic and wild sources, pollinators for gardens and agricultural crops, scenic landscapes, bird songs, and countless other benefits. The 2007 Town of Milan Comprehensive Plan noted that, according to past surveys, townspeople have valued protections for natural resources highly, but also noted that some of the features most valued are those most threatened by new land development. That Plan, which sets forth the longterm vision for the town, called for development of a Natural Resources Inventory (Ch. 3B) and states that "[p]rotection of natural resources should guide where and how we permit development" (Ch. 2B.1).

The first step toward sound stewardship of natural resources is understanding what we have.

The first step toward sound stewardship and protection of natural resources is understanding what we have. Starting in early 2022, an Advisory Committee appointed by the Milan Town Board began work on this *Natural Resources Inventory* (*NRI*). The committee included members of the Town Board, Planning Board, and Zoning Board of Appeals, the Highway Superintendent, a former town Supervisor, and a member of the Saw Kill Watershed Advisory Committee. The committee was assisted by staff of Hudsonia Ltd., whose work on the project was funded by the New York State Environmental Protection Fund through a grant awarded to the town from the Hudson River Estuary Program of the New York State Department of Environmental Conservation. The committee was also greatly assisted by staff of the Hudson River Estuary Program, and by many townspeople who contributed information, photographs, stories, and memories of people and the land.

Sunset over Academy Hill. Photo © Vicki McKenzie

This *NRI* describes natural resources found throughout the Town of Milan, their distribution, and their importance to local ecosystems and the human community, and provides recommendations for uses and conservation. It also includes recollections, musings, and observations from many townspeople about Milan's natural landscape and the place of land and resources in the lives of the community.

The *NRI* is designed to be used by municipal agencies and committees—such as the Town Board, Planning Board, Zoning Board of Appeals, and Highway Department, and a future Comprehensive Plan Committee, and Zoning Revisions Committee—as well as landowners, developers, conservation organizations, and others concerned with land use planning, land management, policy-making, and resource use and conservation.

Sun dog, Lakeside Drive. Photo © Glenn Butler

Milan is a rural town of 36.6 square miles in northern Dutchess County, New York (Figure 1), incorporated in 1818 from what was then part of the Town of North East. According to the US Census, the population was 2,245 in 2020, a slight drop from the 2,370 population at time of the 2010 Census. (These numbers exclude the second-home owners whose legal residence is elsewhere.) The population density of 61.3 people per square mile is among the lowest of Dutchess County towns. In the past, residences were somewhat concentrated in hamlets, such as Cases Corner, Jackson Corners, Lafayetteville, and Rock City, but today the population is substantially spread out along the network of rural roads, and the town has no commercial center. Past natural resource-based industries included water-powered saw mills, grist mills, woolen mills, and mining for sand and gravel. Today, the Milan zoning ordinance prohibits establishment of new mines, and allows mines existing as of August 2007 to continue operations but not expand their footprint. Forestry and agriculture are the main commercial uses of land and natural resources, although farming has much declined here over the last century.

Throughout the *NRI*, links to internal *NRI* sections are in red type, and links to external sites are in blue type.

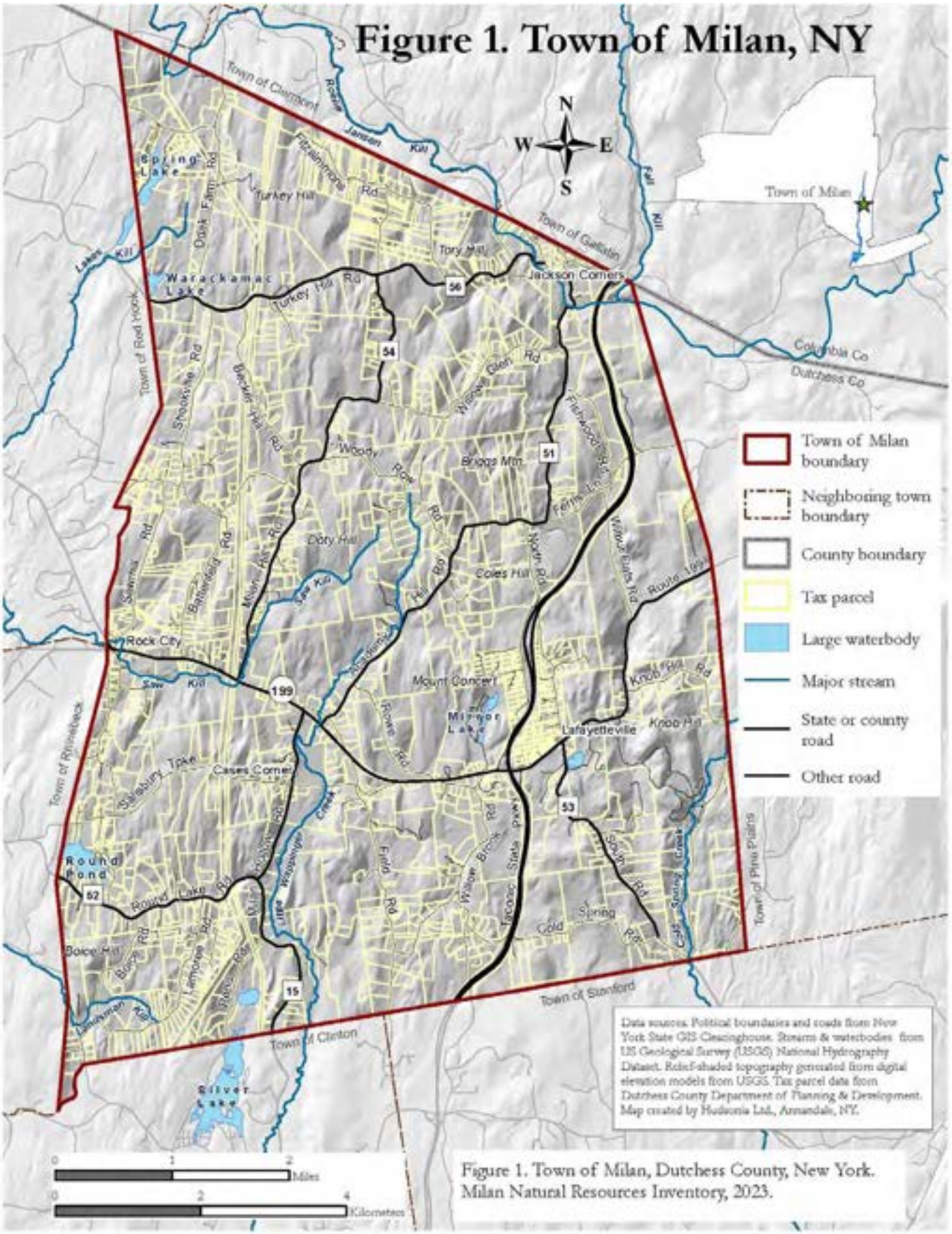


Figure 1. Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

PHYSICAL SETTING

TOPOGRAPHY

Milan is in the foothills of the Taconic Mountains and the landscape is characterized by low, rolling hills and flat or gently-sloped valleys. Most of the highest summits are in the eastern half of town, and most of the lowest in the western half (Figure 2). The highest elevation is at 960 feet above sea level (asl) on the Knob Hill ridge. Other high points are 906 feet asl on Old Roundtop, 886 feet on an unnamed hill, and 875 feet at the summit of Briggs Mountain. The lowest elevation is at approximately 247 feet asl where Spring Lake straddles the boundary with Red Hook.

WATERSHEDS

A "watershed" is the entire land area that drains to a particular stream, pond, lake, or wetland. Within any large watershed are "sub-basins" delineated around the watersheds of tributaries to the larger waterbody. Milan is entirely within the watershed of the Hudson River and within the sub-basins of six major tributaries that flow into the freshwater tidal reach of the Hudson River estuary: the Landsman Kill, the Roeliff Jansen Kill, the Saw Kill, Little Wappinger Creek, Stony Creek, and Crum Elbow Creek (Figure 3). (Only a few acres each of the last two sub-basins are in Milan.) More than one-half of the town is within the watersheds of the Roeliff Jansen Kill (the "Roe Jan") and Little Wappinger Creek, a tributary to Wappinger Creek.

The water volume, water quality, and habitat quality of any stream depends on the character of its watershed—all the land that feeds it. The land cover (e.g., forests, fields, wetlands, yards, pavement) and land treatment (e.g., soil disturbance, fertilizers, pesticides, road salt) all affect the stream conditions. As the keeper of the "headwaters" (the upper reaches) of these major Dutchess and Columbia County streams, Milan has a special responsibility for careful stewardship of those waters before sending them on their way to the Hudson. Headwater areas have a defining influence on the character and quality of downstream habitats.

Watersheds can be a convenient unit for natural resource planning because they unite people around common concerns for a shared resource that crosses properties and municipal boundaries. At least three watershed groups are active in monitoring, public education, and conservation initiatives in three of the Milan sub-basins: The Roe Jan Watershed Community, the Saw Kill Watershed Community, and the Wappinger Creek Intermunicipal Council. Planning documents for these sub-basins include the *Saw Kill Watershed and Flood Mitigation Assessment* (2018), the *Saw Kill Watershed Source Water Protection Scorecard Recommendations* (2019), and the *Natural Resource Management Plan for the Wappinger Creek Watershed* (2018).

BEDROCK GEOLOGY

This part of New York is within the Ridge and Valley Province of the eastern US, also known as the Folded Appalachians—a belt of folded and faulted bedrock extending from Tennessee to Canada.[1] Milan and much of the Hudson Valley lie within the Hudson-Mohawk Lowlands which are bounded on the east by the Taconic Mountains and on the west by the Catskills. Shale bedrock predominates in Milan, in combination with other rock types including metamorphic rocks such as schist, phyllite, slate, quartzite, and metagraywacke, and sedimentary rocks such as argillite, graywacke, and conglomerate, and Taconic Mélange. (See the boxed text below for brief descriptions of these rock types.) The actual bedrock geology is much more complex than shown in Figure 4, with more mixing of bedrock types, but this generalized depiction gives a sense of the kinds of bedrock that form the basic structure of the Milan landscape.

The Milan bedrock is variously acidic to somewhat alkaline, but there are also localized areas of more-alkaline carbonate bedrock types. Limestone and dolostone occur in the geological structure known as the "Milan Window"[2] which runs from the vicinity of Field Road and Hemmingway Lane in Milan south into the Town of Clinton through the Silver Lake-Mud Pond-Long Pond basin. The Milan Window was formed where erosion of the overlying rock, perhaps accelerated by local faulting, exposed the underlying limestone, dolostone, and shale. Limestone also occurs in a north-south corridor in the northwest part of Milan along Odak Farm Road and Shookville Road, at the western edge of Round Pond in the southwest, and perhaps other places not shown in Figure 4.

Ledge and talus, Torre Rock Road. Photo © Glenn Butler

The limestones and dolostones of these areas create the calcium-rich, circumneutral (near neutral pH) and alkaline environments responsible for some of the unusual habitats of Milan, such as rich forests and calcareous ledges, and the rare and uncommon species that inhabit those places. Graywacke and many of our shales, slates, and conglomerates are also somewhat calcareous, and may support similar habitats and species.

General Rock Types

metamorphic rock Rock that has been transformed in texture and composition by heat, pressure, or chemically active solutions.

igneous rock Rock formed from solidification of molten material deep in the Earth or from volcanic processes.

sedimentary rock Rock formed by layered deposition of mineral and organic material.

carbonate rock Sedimentary rock composed of carbonate minerals, chiefly calcium carbonate ($CaCO_3$) or calcium magnesium carbonate ($CaMg[CO_3]_2$).

Rocks and Minerals

argillite A fine-grained compact rock derived from mudstone or shale.

chert A sedimentary rock of micro- or cryptocrystalline quartz (silicon dioxide, SiO_2).

conglomerate A sedimentary rock made of rounded fragments of pre-existing rock greater than 2 mm in diameter.

dolostone A durable sedimentary rock composed primarily of dolomite (calcium magnesium carbonate); slightly harder than limestone, but otherwise similar in appearance, solubility, and human uses.

graywacke An impure gray sandstone.

limestone A fine-grained sedimentary rock composed of calcium carbonate.

mélange A mix of large blocks of many different kinds of rocks in a matrix of finer-grained sediments.

metagraywacke A partially metamorphosed graywacke.

phyllite A fine-grained metamorphic rock intermediate in grade between slate and schist.

quartzite A hard and durable medium-grained metamorphic rock derived from sandstone.

sandstone A sedimentary rock composed of sand-size grains of cemented mineral and rock particles.

schist A medium-grained, layered metamorphic rock derived from shale.

shale A fine-grained thinly layered sedimentary rock derived from silt and clay.

siltstone A sedimentary rock composed of silt-sized particles.

slate A fine-grained, layered metamorphic rock derived from shale or mudstone.

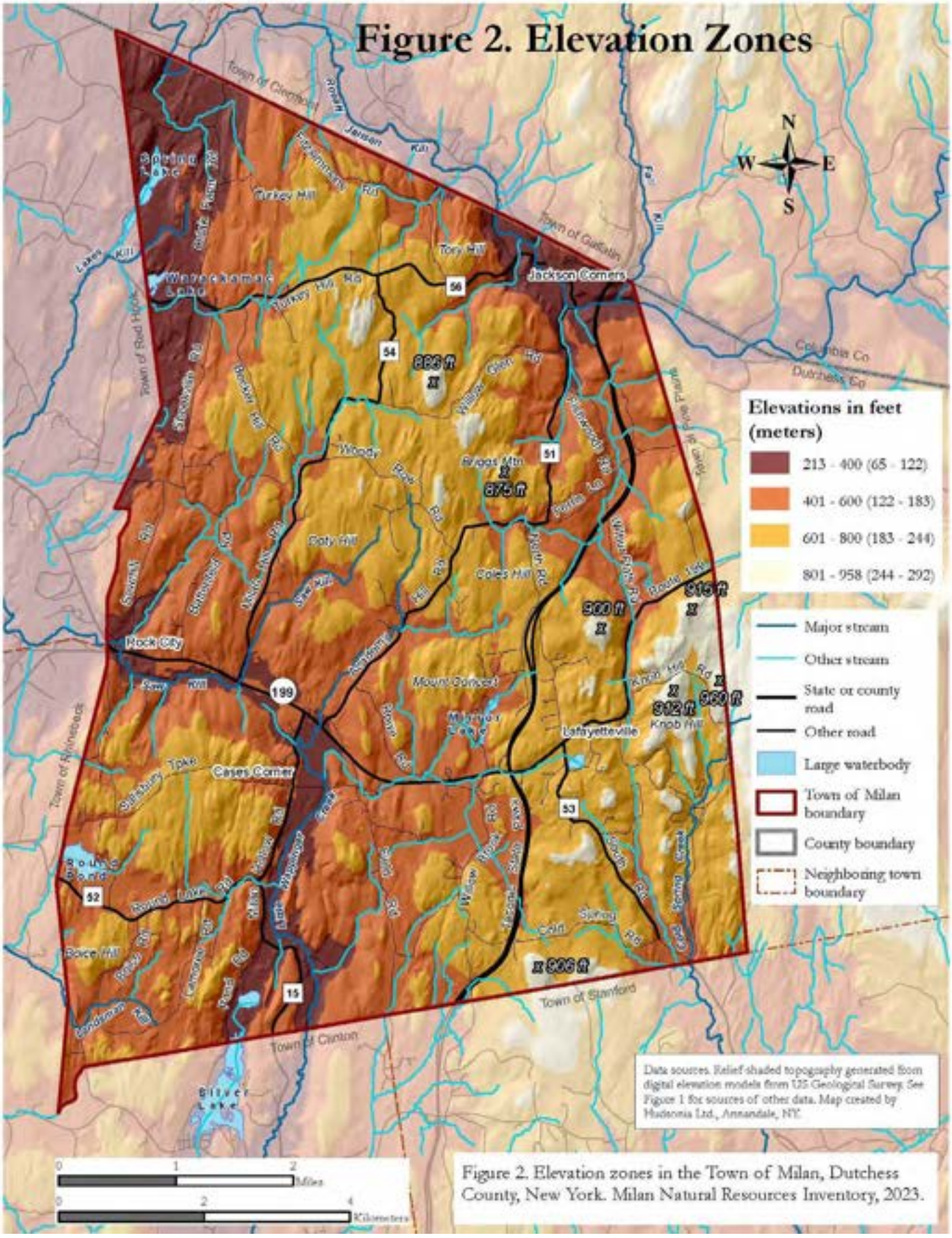


Figure 2. Elevation zones in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

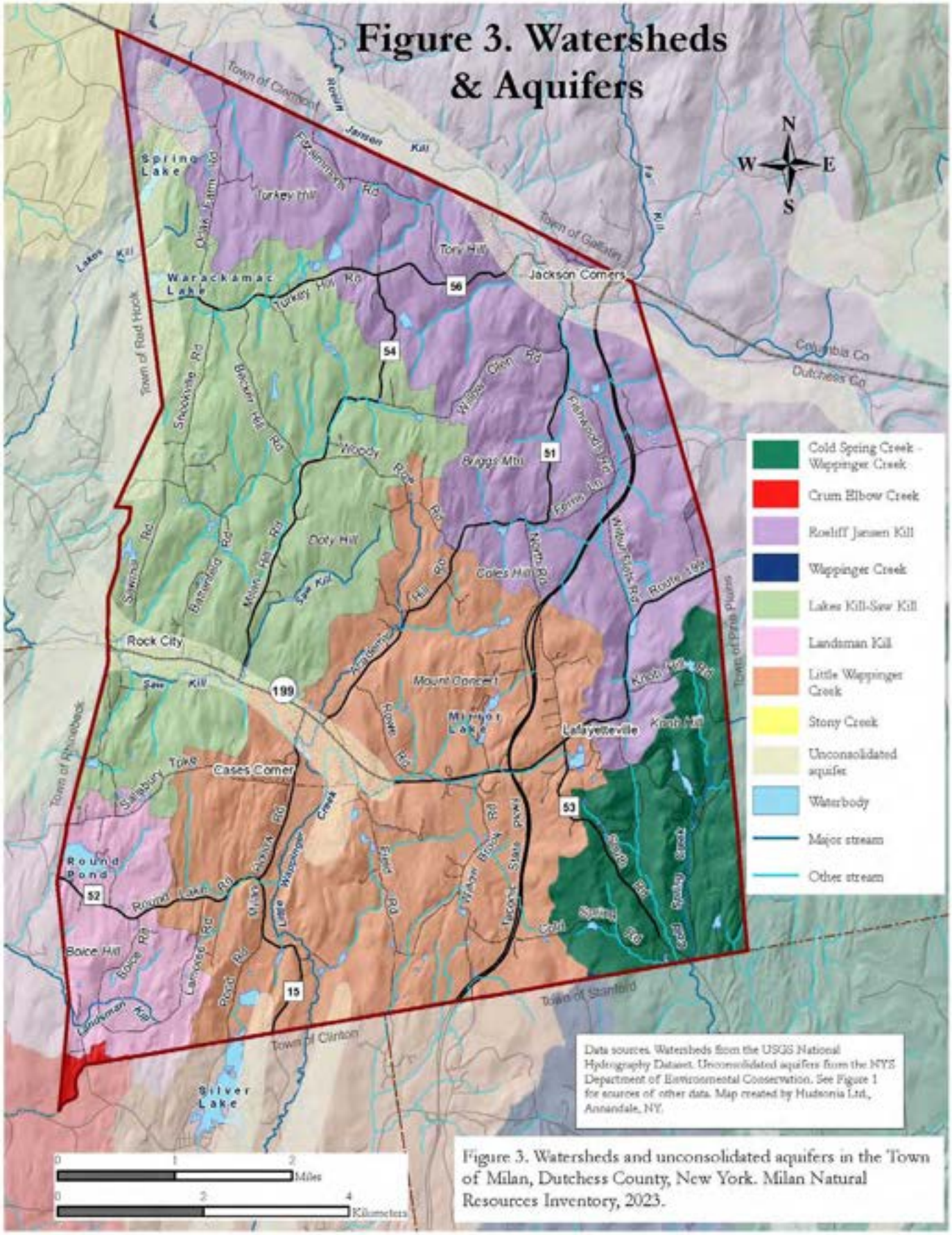


Figure 3. Watersheds and unconsolidated aquifers in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

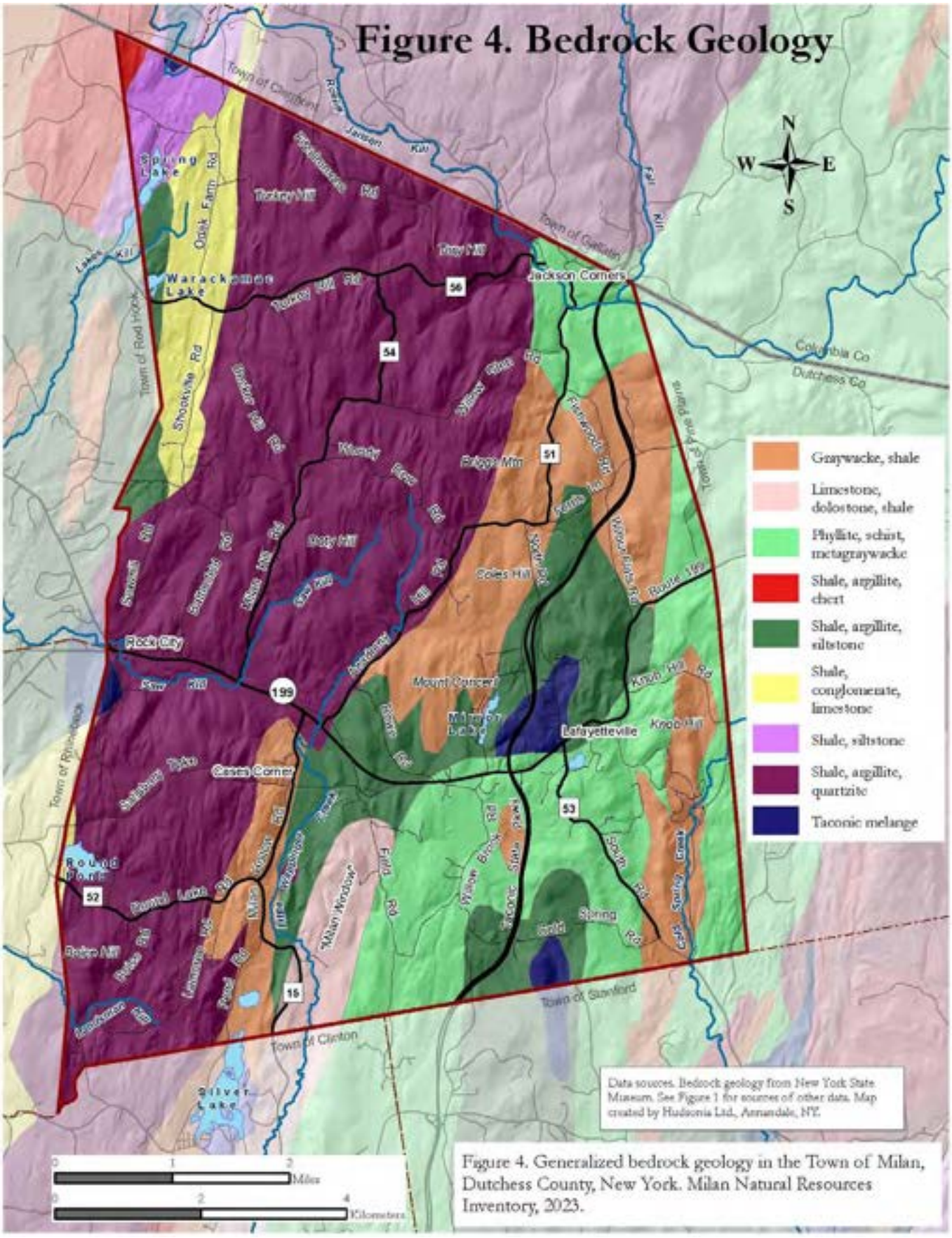


Figure 4. Bedrock Geology
N
W
E
S
Graywacke, shale
Limestone, dolostone, shale
Phyllite, schist, metagraywacke
Shale, argillite, chert
Shale, argillite, siltstone
Shale, conglomerate, limestone
Shale, siltstone
Shale, argillite, quartzite
Taconic melange
Data sources. Bedrock geology from New York State Museum. See Figure 1 for sources of other data. Map created by Hudsonia Ltd., Annandale, NY.
Miles
Kilometers
Figure 4. Generalized bedrock geology in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

SURFICIAL GEOLOGY

The term "surficial geology" refers to the loose material that overlies the bedrock. Much of this is the mineral material left behind as the ice sheet from the most recent glaciation receded approximately 13,000 years ago.[3] The glacial till and glacial outwash deposits (see sidebar and Figure 5) are the mineral and structural bases for most of the soils in Milan which formed over the ensuing thousands of years under the influence of plants, animals, water, weather, and organic processes.

Glacial *till*—unsorted clay, silt, sand, and boulders—predominates in Milan, and is the parent material for most of our upland soils (Figure 5). Most of the large areas mapped as "bedrock outcrops" in Figure 5 have shallow glacial till overlying bedrock, interspersed with occasional bedrock outcrops.

Glacial *outwash*—composed primarily of sand and gravel—occurs in stream corridors and on valley plains. A *kame* is a low hill or ridge of similar coarse material. Kame deposits are most prominent in Rock City, the Spring Lake corridor, and along the Roeliff Jansen Kill (Figure 5). The gravel mines such as those along the Roe Jan, in Rock City, and near Warackamac Lake drew from outwash and kame deposits.

SURFICIAL DEPOSITS
(loose material over bedrock)

Glacial till Mixtures of unsorted mineral materials of various textures (fine to cobble-size), deposited by melting glacial ice.

Glacial outwash Coarse mineral materials (sands and gravels) deposited by glacial meltwater streams.

Alluvium Clay, silt, sand, or gravel, sorted by texture and weight, and deposited by running water in the glacial or post-glacial period to the present.

Alluvium is mineral material deposited by running water, and is found along the current or former floodplains of streams. It can be of any texture—fine clays, silt, and sand, to coarse gravel—but is typically sorted by particle size and weight. Figure 5 shows alluvium only along the Roe Jan, but it also occurs along floodplains of smaller streams throughout Milan, wherever floodwaters have transported and deposited sediments.

Basins, depressions, and other areas where water has been held at the ground surface for long periods (hundreds or thousands of years) have developed a deep layer of *organic* material—plant and animal matter in various stages of decay; the material may be several to many meters deep in some of the oldest wetlands. Figure 5 shows these "swamp deposits" only in a wetland complex in the Little Wappinger Creek corridor, but there are many more such areas in the town where ancient wetlands have developed deep layers of peat and muck.

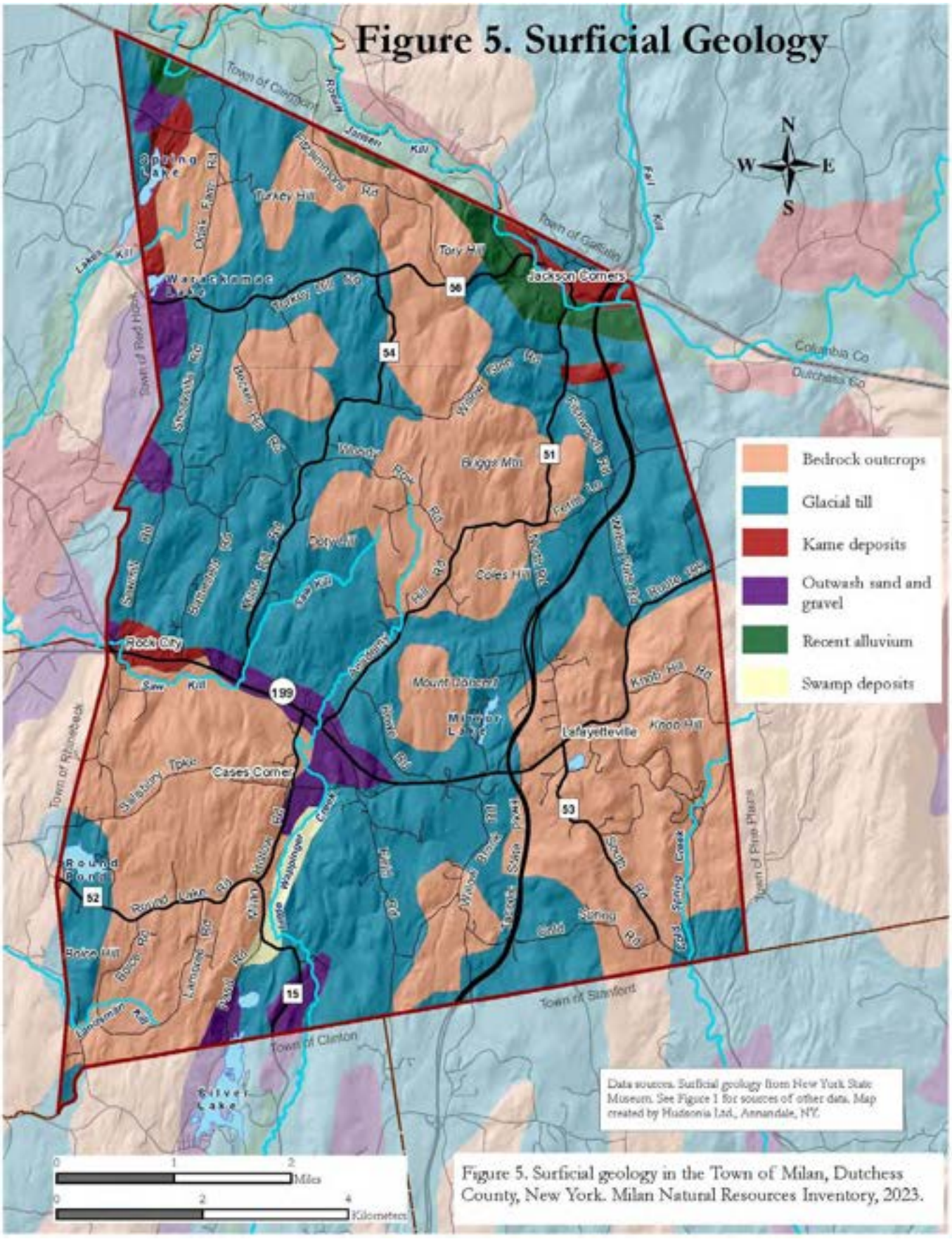


Figure 5. Surficial geology in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

LAND USE HISTORY

The Hudson Valley was occupied by Indigenous peoples for thousands of years after the last glacier receded from the region. Arriving around 12,600 years ago, the first humans navigated a treeless tundra-like landscape, and relied on hunting of big game—principally caribou—for sustenance. As the climate warmed over several millennia, spruce woodlands overtook the tundra, and were succeeded by deciduous forests. Caribou and mastodon were gone from the region by about 10,000 years ago, and the developing deciduous forests supported more abundant and diverse plant foods and game animals: white-tailed deer, elk, black bear, smaller mammals, and birds. The deciduous forests of about 5000 years ago were apparently similar in many respects to those of today.[4]

The archaeological record of those thousands of years before European contact is spotty and is based on analysis of artifacts, human remains, and natural features from scattered locations in the region. The patterns of land uses, lifestyles, encampments, and settlements would have changed significantly over that period, and we have only a few glimpses.

It is apparent, however, that the livelihoods of the Indigenous people depended almost entirely on local resources for food, tools, building materials, and fiber, although trade with distant groups for some materials and goods, and travel to obtain specialized materials, also occurred. Locations of temporary camps and more permanent settlements were chosen according to proximity to food and water. Archaeological evidence indicates that people gathered on major waterways (rivers, lakes) in spring and summer, where they fished and gathered aquatic plants for food and fiber. They disbanded into smaller groups in fall, and headed into back-country areas in winter to hunt deer and other game.[5]

Evidence of the presence of Indigenous people in Milan includes stone artifacts—projectile points, scrapers, hammerstones, drills—turned up by Milan farmers, and also by archaeologist Chris Lindner and his students at Bard College. Some artifacts have been dated to 3,000 years ago.[6] The shale, graywacke, quartzite, and other rocks of the region were used for stone implements, and the forests provided wood for weapon shafts, tool hafts, baskets, utensils, canoes, and dwellings. Forests also provided abundant acorns, nuts, berries, roots, seeds, and herbs, as well as game that was used for food, and the furs, skins, and bones for many other purposes. Deer and black bear were the hunting mainstays in the region, but beaver, woodchuck, raccoon, foxes, eastern wolf, bobcat, squirrels, striped chipmunk, fisher, muskrat, wild turkey, turtles, and waterfowl were also taken.[7]

Evidence of crop cultivation is most abundant in the region from the period starting around 2000 years ago,[8] but we do not know if or to what extent it was practiced in the area that would become Milan. The Indigenous people apparently burned small areas to create openings for farming or to clear the understory for hunting and gathering, and other openings were created by occasional

natural fires, blow-downs, and beaver meadows. Still, most of the region remained forested at the time of European contact.

The earliest contact of the Indigenous inhabitants with Europeans was probably with Spanish or Portuguese explorers in the 1500s.[9] Some trading may have occurred then, but more significant trading relationships developed after Henry Hudson's voyage up the river in 1609.

By that time, Wappingers and related communities of the Lenape people occupied what is now Dutchess County, east into central Connecticut, and south into Westchester County. In the period 1609-1664, Dutch settlers took the Wappinger lands, by force, by deception, or by paying only nominal fees to the inhabitants, and established the New Netherlands Colony. Many of the Wappingers moved away in that period; many died of new diseases brought by the Europeans; some were captured and sold into slavery; some were killed in battles with the Dutch.[10]

The English took over from the Dutch in 1664, and by 1683 the province of New York was divided into twelve counties including Dutchess County.[11] The first known European settlers arrived in Milan in 1760, and by the time of the Revolutionary War (1775-1783) very few Wappingers remained on their former lands.[12] Huge changes to the land, waters, and wildlife of the region were wrought over the next 150 years. The late 1700s and early 1800s saw widespread deforestation for timber, charcoaling, and agriculture.

The Town of Milan was formed in 1818, carved out of the western part of North East. In an 1824 issue of the Spafford-Gazetteer, Milan was called a post-township (a town with the chief post office for the region). "It is a good Township of land, though considerably uneven, but with rich arable swells, hills and ridges, and some flats. The soil is principally a warm productive loam. The inhabitants are principally farmers, and there are no villages, as yet,….the town is well supplied with mills." "Population 1,797; 358 farmers, 77 mechanics, 3 traders; 49 free blacks; 18 slaves; taxable property, $370,794; 11 schools, 10 months in 12;…348 electors; 15,892 acres of improved land; 1,834 cattle, 679 horses, 3,618 sheep, 17,866 yards of cloth; 7 grist mills, 4 saw mills, 1 fulling mill, 1 carding machine, 1 trip hammer, and 1 distillery."[13]

Plaque marking the Lafayetteville post station. Photo © Gretchen Stevens

Figure 6 shows the locations of many of the old mills and mines in Milan. Most of those grist mills, saw mills, and other industries of the 1700s and 1800s were driven by water power. The water of even small streams was exploited to power industrial processes; some of the remnants of dams and mill ponds are still visible today. In that 1824

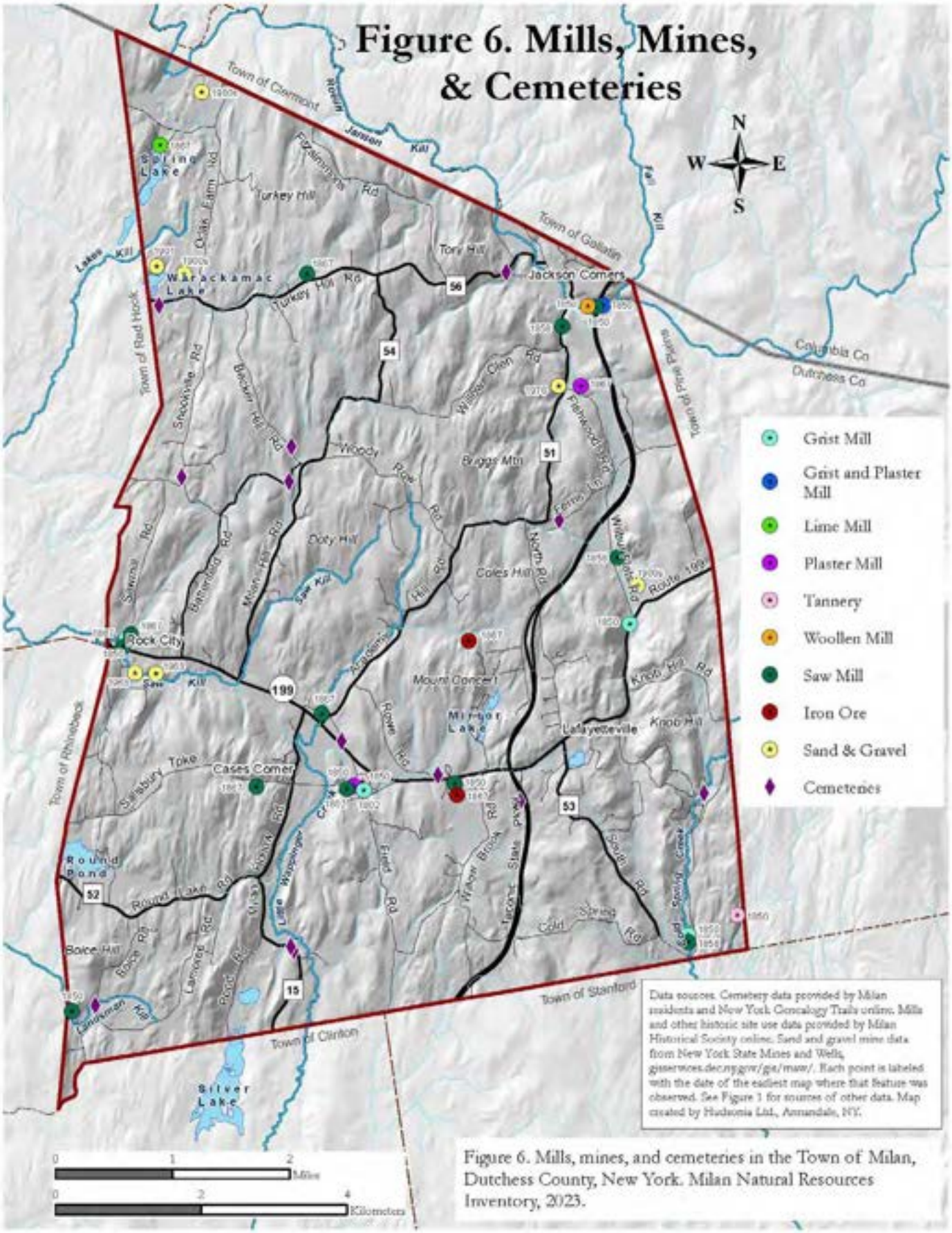


Figure 6. Mills, mines, and cemeteries in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

account, note that 15,892 acres—68% of the town— was considered "improved," which presumably meant cleared and actively farmed land, although that acreage may have also included some managed forest.

Charcoal
Marty Clarke
One day, Linda's (Linda Jacoby Ahlin) brother Stanley Jacoby, showed me a place in the farm where charcoalers from yet another age made charcoal. The burned ring, where nothing will grow due to the super-heating of organic material in the soil, is still visible there.

Forests were also cleared to feed charcoal kilns. Charcoal was a primary industrial fuel in the 1800s, used especially for iron smelting, but also for blacksmithing, metal manufacturing, and other industrial processes that require high heat.[14,15] Charcoal was made by slowly heating logs in an earthen kiln—a pile of logs covered with soil and green vegetation. A smoldering fire would vaporize the moisture in the logs, and leave only charcoal, which burns longer and hotter than firewood. Large areas of forests around the charcoal pits were cut for charcoal production.

In the 1700s and 1800s, Milan farms produced wheat, oats, rye straw (the raw material for paper making), hay, fruits, dairy, eggs, and wool for commercial purposes, and an array of vegetables and livestock for domestic uses.[16] With the growth of New York City and the improvement of north-south transportation in the 1800s, the city became a primary market for Hudson Valley farmers. For example, huge quantities of hay were sent to the city to feed the horses that were central to city transportation. The New York City market for hay declined in the 1890s with the introduction of streetcars powered by electricity and the consequent decline of horse-powered transportation.

From ***Stone by Stone***
(writings of Burton Barker Coon, edited by granddaughter Bonnie Wood)
As I walked from Shookville Methodist Church along the stone wall erected from the surrounding fields, I paused to reflect on how this wall stood as testament to my ancestors' tenacity. As I stood beside it I found a place to contemplate how the land might have appeared before any inhabitants. I imagined how my ancestors, descendants of Palatine immigrants, first stood here on soil that seemingly only grew rocks. Yet, they began by moving one stone. Stone by stone, these mighty souls persevered. Stone by stone, they cleared the land. Stone by stone, built a farm and a family.

The Town of Milan has never had a residential and commercial center. In the 1700s and 1800s, people, industry, schools, and commerce were instead concentrated in eight small hamlets: Cokertown (formerly Spring Lake Station, just over the line in Red Hook), Enterprise, Milanville (now Cases Corner), Jackson Corners, Lafayetteville, Rock City, Shookville, and Thorndale. The locations and alignments of roads reflect topography and the need to reach places beyond the town, especially industrial centers in New England and the Hudson River transportation corridor. Elsewhere in the Hudson Valley and probably here, too, some of the earliest roads were aligned along the trails of the Indigenous people.

Roy and Stell Jacoby

(Interviewed 11 October 1972)

CHARCOAL PITS - There were plenty around. They would be shallow depressions in the ground about the size of a large room. There are some up on Lee's Mountain. Probably up around Torre Rock too. Salable charcoal was in big hunks, they didn't want the dusty small stuff.

MILK CELLARS - The difference between a milk cellar and a root cellar. The milk cellar had a thick stone floor, plastered walls and laid up stone, was in another part off the main cellar with a door….A root cellar had a dirt floor. You could keep things in a root cellar, a proper one until June and sometimes July. Temperature in the milk cellar was about 15 degrees cooler than the rest.

In the 1820s, federal tariffs on imported wool and wool cloth raised the price of domestic wool and led to an explosion of sheep farming here and in much of the Northeast. Sheep pastures were expanded by clearing the forested hills where soils were too shallow and poor for other kinds of agriculture. Most of the land in Milan that is forested today was open pasture, hayfield, or cropland by 1850.

View from Rowe Lane

(Web and Bessie Coon)

Ferris Jackson and his sister Emma used to live on Rowe Lane. He was born 1856….He could see from a high point [probably Cornfield Hill] because there was a great deal more farms and less trees. He could see for a considerable distance.

Railroads were completed from New York City to Albany in the period 1848-1852, many secondary lines were completed in 1869-1875, and lines were extended to New England and Pennsylvania through 1892. The Connecticut West railroad line dipped into the northern part of Milan, where it ran along the west side of Spring Lake and the south side of the Roe Jan. Milan's one railroad station was at Jackson Corners, and another station was just outside Milan in Cokertown.[17]

Sheep farming had severely declined by 1875. Competition from grain production in the Midwest coincided with the arrival of railroads, and refrigeration made it more feasible to switch from grain production to dairy, as milk could then be safely transported to New York City and other population centers.

Shookville Changes

Burton Coon

I don't know when the store and the distillery and the tannery and blacksmith shop were discontinued—probably about the time Rock City began to grow. The process of development is very simple - first water, then a mill, then a blacksmith shop, then a store, then a group of dwellings and each follows the other quite naturally.

Deforestation and intense hunting and trapping pressure in the 1600s through the 1800s caused the decline or disappearance of many wildlife species in the region—for example, eastern wolf, eastern cougar, black bear, white-tailed deer, American beaver, and wild turkey were nearly or

entirely wiped out. Deforestation, dam-building, wetland-draining, and the extirpation of beavers led to dramatic changes in the character of streams, fish migrations and reproduction, and soil erosion and sedimentation.

With the arrival of, first, railroads and, later, automobiles, city dwellers could more easily travel upstate, and renting to urban refugees became a business when farmers opened their homes to vacationers, and others built bungalows and summer camps.[18]

In the early 1900s, agricultural and industrial production shifted away from the northeastern US, and populations shifted to urban areas. By 1930, the beginning of the Great Depression, the Milan population had declined to just 622. It has slowly increased since then and now exceeds its former peak in 1830 (Table 1). The gradual abandonment of agriculture allowed forests to reclaim the land.

Table 1 Milan population 1820 – 2020 (US Census).

Year	Population	Percent change	Year	Population	Percent change
1820	1,797	—	1930	622	−11.6%
1830	1,886	+5.0%	1940	695	+11.7%
1840	1,725	−8.5%	1950	806	+16.0%
1850	1,764	+2.3%	1960	944	+17.1%
1860	1,522	−13.7%	1970	1,322	+40.0%
1870	1,474	−3.2%	1980	1,668	+26.2%
1880	1,275	−13.5%	1990	1,895	+13.6%
1890	1,026	−19.5%	2000	2,356	+24.3%
1900	950	−7.4%	2010	2,370	+0.6%
1910	893	−6.0%	2020	2,245	−5.3%
1920	704	−21.2%			

Electrification came to Milan in the 1930s, and led to the widespread abandonment of water power. Dams at mill sites then fell into disrepair and slowly crumbled over ensuing decades, returning many of the streams to their free-flowing condition.

In the late 1800s and early 1900s, farmers in Milan and neighboring towns took advantage of the violet boom when violets were wildly popular for corsages and other flower arrangements and, by 1924, approximately 100 Milan families were growing violets.[19] Agriculture in Milan generally declined through the 1900s, and changing fashions in the 1920s and 1930s contributed to the decline of the violet industry. Today, the Battenfeld farm is the only remaining grower in town, although their primary crops are anemones and Christmas trees.

Other farms raise vegetables, grains, hay, sheep, poultry, cattle, and horses for commercial production, and many other landowners raise vegetables, fruits, and chickens for their own use, but the glory days of agriculture in Milan are long in the past.

Cemeteries are valued as places for remembrance and quiet reflection, and as repositories of historical information that connects families and communities to the past. Milan's cemeteries include small family plots on privately-held land, as well as larger community- or church-sponsored cemeteries. Just a few are shown on Figure 6 and on these two pages.

Ferris Lane cemetery. Photos © Glenn Butler

Yeoman's cemetery (left) and Shookville Road cemetery (right). Photos © Glenn Butler

Gravestone at Platner cemetery, Photos © Bill Jeffway

Milan Union cemetery. Photos © Glenn Butler

Teats cemetery. Photos © Glenn Butler

Boice Road cemetery (left) and Wilcox Park cemetery (right). Photos © Glenn Butler

Construction of the Taconic State Parkway, which runs from southern Westchester County to Chatham in Columbia County, began in 1929. The Milan segment was completed in 1949, and the remaining segment in 1963. A primary purpose of the Parkway at its inception was to bring city dwellers to Hudson Valley state parks.[20] The Parkway has two exits/entrances in Milan, near Lafayetteville and at Jackson Corners. The Lafayetteville junction of the Parkway with NYS Route 199—the major east-west road through the town—is the location of Milan's only gas station. Route 199 also connects Milan to the Kingston/Rhinecliff Bridge over the Hudson River, completed in 1957. Despite the increased accessibility of the town, Milan has seen little of the residential or commercial development experienced by nearby towns.

Figure 7 shows the change in forest cover at two locations since 1936 as farmland was increasingly abandoned and former cropland and pasture slowly returned to forest. The return of forests and the breaching and removal of many dams have improved the quality of stream water and stream habitats by increasing shade, reducing thermal pollution and other kinds of pollution from agricultural fields, and providing higher-quality detritus for the stream food webs and habitat structure.

Although the town is now substantially forested (Figures 10 and 11), the forests of the region today are quite different from those that supported the Indigenous people for millenia and the early European settlers. Now, most of Milan's forests are less than 100 years old, and lack the soil characteristics, the understory and ground vegetation, and the old growth trees of the past. The overpopulation and preferential browsing of white-tailed deer has changed the forest structure in many places and is altering the mix of species that constitute the forest vegetation. Non-native insect pests, invasive plant species, and suppression of wildfires have also altered forest composition, and the multiple stresses imposed by the warming climate makes even greater ecological change inevitable.

Oldfields, Rowe Road. Photo © Glenn Butler

Figure 7. Historical and Recent Aerial Photos

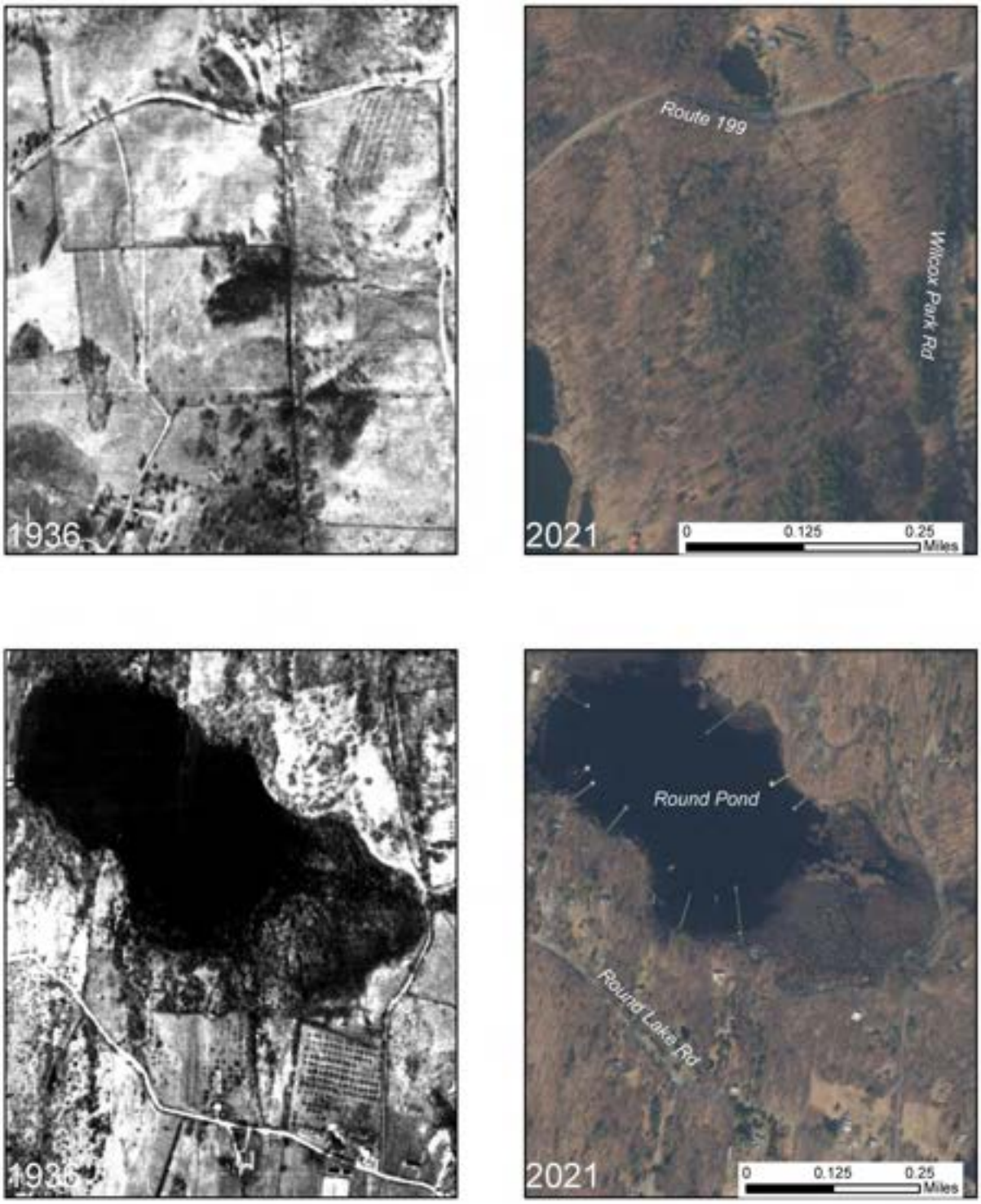


Figure 7. Aerial imagery from 1936 and 2021 in vicinity of Route 199 near the entrance to Wilcox Park (top) and Round Pond (bottom) in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

Data sources. 1936 Aerial Photographic Survey compiled by Dutchess County NY Real Property Tax Service Agency. 2021 Orthoimagery from NYS GIS Clearinghouse. Map created by Hudsonia Ltd., Annandale, NY.

NATURAL RESOURCES

MINERAL RESOURCES

Bedrock and Surficial Materials

We have found little evidence of hard rock mining in Milan. A Beers 1867 map indicates "iron" near Rowe Road, just south of Route 199, but we do not know if there was an iron mine at that location (Figure 6). Sand and gravel have been mined here since the first European settlers occupied this land. Sand and gravel are used both for private (e.g., on-farm or on-estate) and commercial purposes, serving a great variety of construction and other needs. In the last half-century Milan has had at least seven active commercial sand and gravel mines (Figure 6), but only one is active today. The town code prohibits the establishment of new mines.

Marl is a mud or mudstone rich in calcium carbonate, and thus chemically similar to limestone, but also containing clay and silt components. It forms from decaying plant and animal material in certain kinds of wetlands and may occur as rock or in semi-liquid form. Marl was mined elsewhere in the region in the 1800s for use as a soil amendment. Spring Lake is underlain by marl, so might have been a source of marl for this purpose, but we have found no such historical record.

Soils

Soils have taken thousands of years to develop and cannot easily be replaced.

Sands, gravels, silts, and clays are the building blocks of soils, but are not themselves "soils" until they have been acted on by weathering and organic processes. Decaying plants and animals, and the activities of earthworms, insects, fungi, and a host of other macro- and microscopic organisms break down and mix organic materials with mineral components and build the structure and chemistry of what we know as soils. Most of our soils have taken thousands of years to develop and are irreplaceable in the human time scale. When they are lost to erosion, or polluted or damaged in other ways, they cannot easily be replaced.

Soils have immeasurable value for the human community. They are the foundation of our forests, meadows, and wetlands, as well as our farmland, lawns, and gardens. Soils are also a critical resource for plants and animals that rely on them directly or indirectly for substrate, food, or shelter. Soil types differ from each other depending on their parent material (the mineral or organic material that they formed in), depth above bedrock, texture, and chemistry, and their seasonal patterns of wetness or dryness. All of these characteristics help to determine the kinds of biological communities that become established. For example, the shallow, droughty mineral soils of rocky hill summits support plants such as chestnut oak, bracken fern, and lowbush blueberries; the mesic soils of lowland

hardwood forests support red oak, white ash, and sugar maple; and the wet, calcareous organic soils of a shrub swamp in the Milan Window support plants such as buttonbush, water-willow, and Fraser's marsh St. Johnswort.

SOILS

(Organic or unconsolidated mineral materials that have been acted on by weathering and organic processes.)

Soil types are distinguished and classified according to depth, texture, color, chemistry, wetness or dryness, and landscape position. Soil characteristics are much influenced by the "parent" materials of origin (e.g., the bedrock, surficial deposits, or organic material), and by topography, climate, hydrology, vegetation, disturbance, and time.

The texture, drainage, and chemistry of any soil strongly influence the kinds of biological communities that are present and the suitability for agriculture. Considering those characteristics, the soil types throughout Dutchess County have been identified and mapped by soil scientists through remote sensing (analysis of maps, aerial photos, and other data) and field observations. Although much field work was conducted for the survey, many of the mapped soil units have not been visited by a soil scientist, and any map unit (polygon) for a particular soil type may contain up to two acres of other soil types. For this reason the soil maps are not suitable for detailed site-specific land use planning, but they nonetheless provide a wealth of information about the general character of the soils at any site.

The *Soil Survey of Dutchess County, New York* [21] has maps showing the distribution of soil types in Milan and throughout the county, describes many of the characteristics of the soils, and describes their suitability for human uses such as lawns, septic leachfields, structural support for roads or buildings, and agriculture. Soil maps and descriptions for any particular location can also be viewed online at the Web Soil Survey page of the Natural Resources Conservation Service (NRCS).

Most of the soils in Milan were formed in glacial till. According to the county soil survey, silt loams and channery silt loams in the Cardigan, Dutchess, and Nassau series are the predominant upland soils. These are strongly to moderately acidic, well-drained to excessively well-drained soils. Gravelly loams and silt loams in the Hoosic and Copake series are concentrated in the northwest corner of Milan and in the Rock City vicinity. Hoosic soils are strongly acidic and Copake soils are close to neutral on the pH spectrum. In marked contrast to the acidic upland soils are the calcareous soils of the Farmington-Galway-Stockbridge series. These are loams, gravelly loams, and silt loams which, in Milan, are underlain by the limestone bedrock of the Milan Window and the Shookville area (see Bedrock Geology section).

Wetland soils ("hydric soils") are defined as those that remain saturated in their upper layers long enough during the growing season to develop anaerobic conditions, and are hence able to support wetland-adapted ("hydrophytic") plants. Wetland soils include those classified as "very poorly drained" or "poorly drained" and some instances of those classified as "somewhat poorly drained."

(Soil scientists use the term "drainage" to refer simply to wetness or dryness, which is often unrelated to percolation rate or the movement of water through the soil.)

Some wetland soils are saturated or inundated year-round; some are saturated for only a few weeks in the spring, and some are saturated intermittently throughout the growing season. The wetland soils in Milan are variously developed in mineral or organic material, but the oldest, wettest wetlands have developed deep layers of peat. The hardwood and shrub swamp north of Round Pond, for example, has peat over six feet deep. But the wetlands that typically dry out for significant periods during the growing season may have little or no peat development at the surface.

The NRCS has classified the soils best suited to agriculture as "Prime Farmland Soils" and "Farmland Soils of Statewide Importance." See the **Farmland Resources** section for further discussion of these soils. Uncompacted soils that are high in organic matter and have diverse macro- and microbiota are the most effective for water retention, carbon storage, and herbaceous crop production. Those soils as well as soils with other characteristics—shallow soils, low-fertility soils, wetland soils, or those with uncommon mineral or chemical composition—can have great value for native biological diversity. The habitat implications of some of these soil characteristics are discussed in the **Biological Resources** section.

Soils are living systems that are continuously developing through the weathering of mineral materials, decomposition of plant and animal detritus, and mixing and transformation of the two by biological and physical forces. Soil microbes and soil invertebrates carry out much of the essential work of retaining nutrients and processing them into forms available to other organisms. Bacteria, protozoa, algae, fungi, centipedes, millipedes, ants, beetles, other larval and adult insects, snails, slugs, snakes, shrews, and small mammals are just a few of the groups that help to develop the soil. In fact, soils are the most species-rich communities on Earth; it is estimated that, worldwide, soils contain more than four million species of organisms. [22]

Soils are the largest reservoirs of carbon in most ecosystems.

Soils are the largest reservoir of carbon in most ecosystems. Carbon is stored both in the soil organic matter—composed of decomposing plant and animal matter and microbes—and in the soil mineral material.[23] Where soils remain substantially undisturbed, the carbon can remain sequestered for thousands of years. But disturbance by soil erosion, drying, removal of vegetation, plowing, or excavation can lead to rapid releases of carbon to the atmosphere, contributing to the greenhouse gases responsible for global warming. Conventional cultivation results in large (up to 50%) losses of soil carbon to the atmosphere.[24] Perennial crops, and tillage systems that rely on cover crops, nitrogen fixation, incorporating organic matter into the soils, no-till or minimum tillage practices tend to increase the carbon storage as well as soil fertility.[25,26,27]

WATER RESOURCES

Groundwater

Groundwater is the water held beneath the soil surface in spaces between sediment particles and in rock fissures. Groundwater is fed and replenished by rainwater, snowmelt, and other surface water that seeps through soils and other surficial material, and through rock pores and seams. It can be depleted by overuse or inadequate recharge from the surface, and can be degraded by contaminated seepage.

Unconsolidated aquifers store large volumes of groundwater but are vulnerable to contamination.

Most of the water for residences and farms in Milan is from groundwater wells. Groundwater also feeds our upland habitats as well as springs, ponds, and wetlands, and is the source of base flow for our perennial streams.

Most of the drinking-water wells in Milan tap the water held in bedrock, but some are in unconsolidated aquifers—where groundwater is stored in saturated sand and gravel deposits (Figure 3). These places store large volumes of groundwater that is often accessible from shallow wells, but is also most vulnerable to contamination due to the permeability of the overlying material (sand and gravel) that can be an efficient conduit for contaminants introduced by above-ground human activities (e.g., spills of petroleum or other toxins, or applications of pesticides or de-icing salts).

Springs are places where groundwater discharges to the ground surface under gravitational pressure. Springs occur in a variety of settings in Milan, emerging unseen into wetlands, streams, and waterbodies, and also more visibly into upland habitats where they are often the origins of small streams. The habitat values of springs and seeps are discussed in the **Biological Resources** section below. Springs can be important drinking water sources for humans and livestock.

Marsh at Jacoby Farm. Photo © Erik Kiviat

Surface Water

Milan has abundant streams, lakes, and ponds (Figure 3) that have influenced the locations and character of Indigenous human settlements and land uses since the last glaciation, and European settlements and agriculture from the 1700s to the present. These water features are also integral to the natural habitats of the town, and the wildlife, plants, and communities that depend on their proximity to surface water.

The character, condition, and uses of streams, lakes, and ponds have changed dramatically since the 1700s and 1800s when many streams were exploited for water power and the forests were cleared for agriculture (see the **Land Use History** section). But over the last century, abandonment of water power, regional reforestation, and environmental protection laws since the 1960s have all helped to restore some of the water quality and aquatic habitats of Milan's streams and lakes. Nonetheless, streams are still subject to obstruction from dams and culverts, and pollution from residences, agricultural lands, and roads. The residential development around some of the lakes has contributed nutrient pollution and has partially cut off the biological communities of lakes from the surrounding terrestrial habitats that were once integral to the lake ecology.

Canada goose adult and goslings on Spring Lake. Photo © Phil Zemke

Streams

Figure 3 shows most of the perennial streams (i.e., those with year-round flow) in Milan, but omits many of the smaller streams that run only intermittently throughout the year. Small streams, including intermittent streams (those that dry up at some time in a normal year) provide valuable in-stream habitat used by aquatic and semi-aquatic animals, and are also used by many kinds of terrestrial wildlife. Small streams supply essential water, organisms, and organic materials to larger streams, lakes, and ponds and to wetlands. Users of this *NRI* should be alert to the presence of small streams that do not appear in the publicly available stream data used for the map figures in this *NRI* and other public maps.

The major streams in Milan are Cold Spring Creek, the Landsman Kill, the Roeliff Jansen Kill, the Saw Kill, and Little Wappinger Creek. Each of these is fed by multiple smaller streams as well as overland sheetflow.

Today our streams are used mostly for recreational fishing, occasional trapping, and swimming. Some may be tapped for irrigating crops or watering livestock, but present-day uses are minor compared to those of the 1700s and 1800s (see the **Land Use History** section).

The water quality, flow volumes, and flow patterns of a stream, as well as the types and quality of instream habitats, depend to a large extent on characteristics of the stream's watershed—the entire land area that drains to the stream. The depths and textures of the soils in the watershed, the depth and quality of organic duff at the soil surface, the kinds of vegetation, the extent of impervious

Tributary to the Roe Jan. Photo © Phil Zemke

surfaces (e.g., roads, parking lots, roofs), the management of stormwater, and the amount of ditching and other surface water channelization throughout the watershed all influence the volumes and patterns of surface runoff during precipitation and snowmelt events, the degree of water infiltration to the soils, and the amount and quality of water reaching streams, wetlands, ponds, and groundwater reserves throughout the year.

Floodplains

A "floodplain" is the area bordering a stream, lake, or pond that is subject to flooding. Some streamside areas flood annually or more frequently, and some flood only in the largest storms or snowmelt events. Floodplains at some locations are just a few feet wide, and elsewhere are a half-mile wide or more, depending on the stream size and local topography. The floodplain is integral to the stream ecology and flow dynamics and becomes part of the stream during high-water events.

The Federal Emergency Management Agency (FEMA) maps the areas expected to flood at statistical intervals based on historical flood records. The "100-year flood zone" is the area believed to have a 1 percent chance of flooding in any given year. The "500-year flood zone" is the area believed to have a 0.2 percent chance of flooding in any given year. What does that mean for property owners? During the span of a 30-year mortgage, a house in the 100-year flood zone has a 26 percent chance of being flooded at least once in those 30 years.[28]

Figure 8 shows the extent of the 100-year flood zones identified by FEMA on Milan streams. These zones are mapped by FEMA on only the larger streams—the Roe Jan and Little Wappinger Creek—even though smaller streams can also have significant floodplains. The current flood data are based on a 30-year baseline ending in May 2012, so do not take into account the large storms since then (including, for example, Tropical Storm Sandy of October 2012) and the future storms that may be even larger. Climate scientists predict that floodplains will expand in response to future large storm events.

Roeliff Jansen Kill at Turkey Hill Road. Photo © Phil Zemke

A well-vegetated floodplain absorbs runoff and floodwaters, and serves as a groundwater recharge area. The vegetation helps to stabilize the streambank, reduce stream channel erosion, and trap and remove sediments and other pollutants from runoff and floodwaters. A forested floodplain can help to maintain cool water temperatures. A well-vegetated floodplain also provides important habitat for terrestrial plants and animals, and contributes woody debris and other organic detritus to the habitat structure and food base for stream organisms.[29] Many rare plants occur on streambanks and floodplains in the region, such as cattail sedge, Davis's sedge, and goldenseal.

Three rare plants of floodplain habitats (top to bottom): cattail sedge, Davis's sedge, and goldenseal. Photos © Chris Graham (sedges) and Laura Heady (goldenseal)

The "riparian corridor" can be loosely defined as the zone along a stream that includes the stream channel, stream banks, floodplain, and adjacent areas, but it can be delineated differently according to local conservation concerns. Intact (i.e., undeveloped, untilled) riparian areas tend to have high species diversity, and many species of animals depend on riparian areas in some way for their survival.[30,31] Floodplains and riparian corridors support many different kinds of habitats, including wetland and non-wetland forests, shrubland, meadows, and ledges.

Streams are an unusually dynamic kind of ecological system, with water, substrates, and organic materials moving and changing continuously, and footprints that narrow, widen, and shift on a seasonal or episodic basis in response to storm events or land uses in the stream's watershed. These ongoing changes account in part for the unusual biological diversity of stream corridors.[32]

The New York Natural Heritage Program (NYNHP) delineated "riparian buffer zones" to encompass the estimated 50-year flood zone based on US Geological Survey stream gage data, local topography, and adjacent wetlands.[33] (The 50-year flood zones were developed through modeling and have not been field-verified.) The mapped buffer zones overlap partially with the FEMA 100-year flood zones and extend beyond the FEMA zones at some locations. The riparian buffer zones were delineated along many smaller streams that

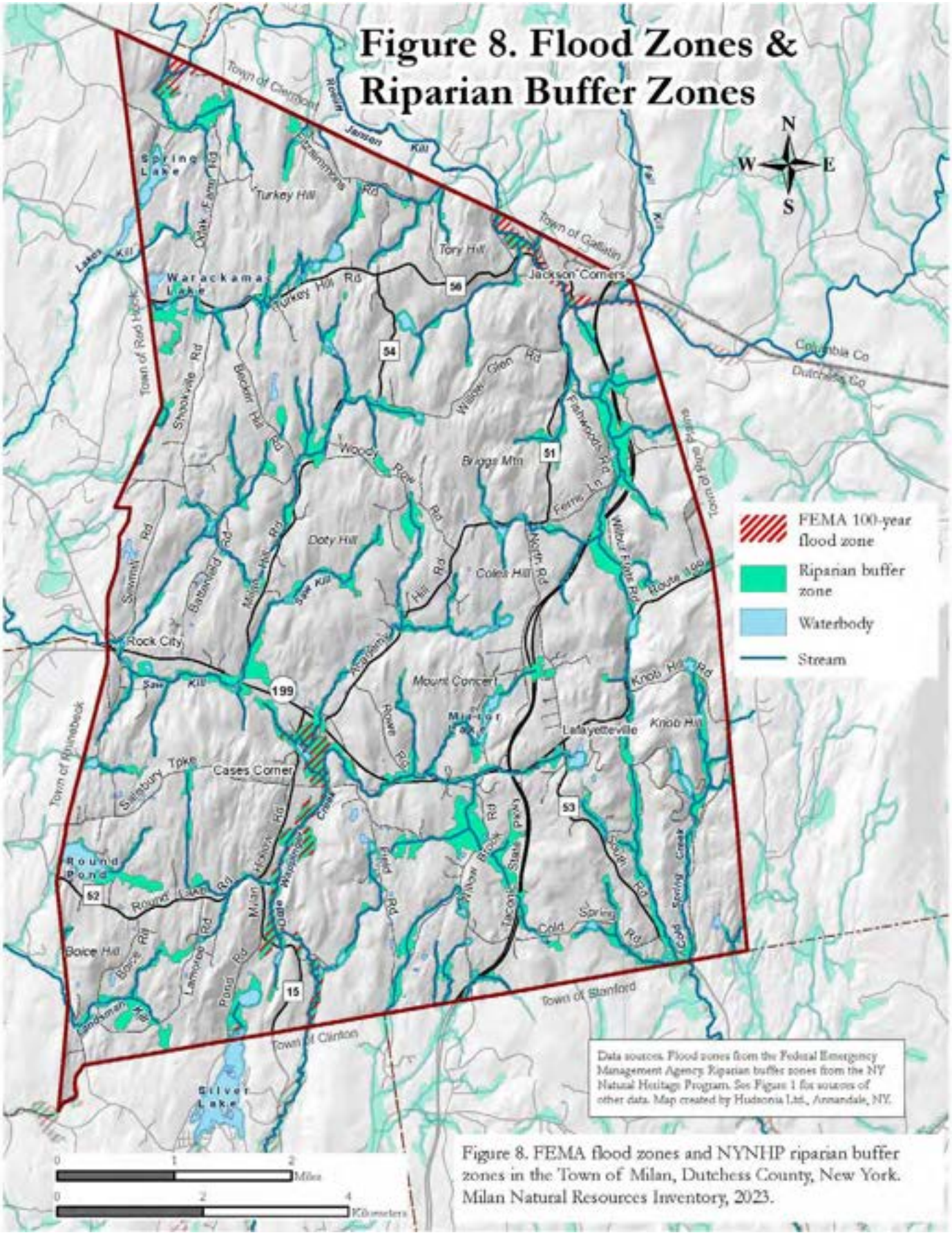


Figure 8. FEMA flood zones and NYNHP riparian buffer zones in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

are not included in the FEMA flood zone mapping. Figure 8 shows the FEMA 100-year flood zones and the NYNHP riparian buffer zones to provide a picture of the areas most closely associated with the streams and most likely to be affected in large flood events. The map can inform land use and stream protection efforts, but is not a substitute for the FEMA flood insurance rate maps (FIRMs).

Lakes and Ponds

Many of the larger ponds and lakes in Milan were originally created for or were later used as millponds and/or water sources for industrial processes. Other constructed ponds are numerous in the town. Some farm ponds were built for watering livestock, crop irrigation, or fire control. Many backyard ponds were built for fire control, recreation, or as ornamental landscaping features. The creation of some ponds was incidental to mining of gravel or rock, such as the one visible from Route 199 at the reclaimed Rock City gravel mine.

Yellow iris (non-native) on the shore of Spring Lake.
Photo © Phil Zemke

Several of Milan's lakes, ponds, and wetlands are in "glacial kettles." Kettles were formed in the waning of the last Ice Age where a stranded block of glacial ice became buried in sediments and slowly melted in place, leaving a shallow basin. In many but not all cases, the kettle basin filled with water. Kettle ponds and wetlands in this region often have a distinctive community of plants and animals, including plants such as buttonbush, highbush blueberry, and swamp azalea, and animals such as spotted turtle and (rarely) Blanding's turtle.

Spring Lake is a marl pond, a rare kind of waterbody in New York.

Spring Lake is an alkaline kettle pond fed by springs, intermittent streams, and sheet runoff. An unpublished NYSDEC fish survey document (1981) reported that the maximum depth of the north basin was 63 feet, and the south basin 15 feet, and that the substrates were gravel, marl, muck, and sand. Marl ponds are a rare kind of waterbody in New York, and Spring Lake may be the only one in Milan. A railroad bridge and concrete culvert separate the north and south basins of Spring Lake. The railroad grade for the old Connecticut West (the Huckleberry Line) is still visible along the west side of the lake, and the western and northeastern shorelines are bordered by roads and residences, but much of the eastern shoreline is forested state-owned land. Other kettle

ponds, much smaller, are here and there in areas of Milan with glacial outwash deposits. Warackamac Lake appears to be a quarry pond, perhaps excavated in a glacial kettle.

Round Pond is an example of a "circumneutral bog lake"—a rare habitat type known to support several rare species of plants and animals elsewhere in the region. Some ecological characteristics of circumneutral bog lakes are described in the **Habitats** section. Parts of the pond and adjacent wetland are underlain by deep layers of peat (decaying plant and animals material) and, because of the shape and the crisp shoreline evident in aerial photos, we speculate that the pond and wetland were mined for peat in the past. An 1867 Beers map has two "Peat" labels in the wetland east of the open water pond, which may indicate sites of peat harvest. Peat has long been used as a soil amendment, as it is today.

Silver Lake is the northern-most of the chain of circumneutral bog lakes—Silver Lake, Mud Pond, and Long Pond—next to the Milan Window. These are kettle ponds that drain to Little Wappinger Creek via a small tributary exiting Long Pond (in the Town of Clinton).

Water Use Classification

Milan streams are subject to impairment from sources such as runoff from roads, construction sites, lawns, and farmland; leachate from failing septic systems; streambank erosion; and atmospheric deposition. Residential and other land development typically leads to more stormwater runoff carrying silt, nutrients, chlorides, and other contaminants into streams; stream flows that swiftly increase and decrease in response to runoff events; and unstable stream channels, bank erosion, and degraded habitat. Although the incremental harm from each new development site may seem minor, the cumulative effects of multiple development sites in a watershed can be significant for the character and habitat quality of the stream.

NYSDEC has classified many of the perennial streams and other waterbodies in the state according to the "existing or expected best usage of each water or waterway segment," which forms the basis for New York State Protection of Waters regulations. Freshwater streams and waterbodies are classified by the letters A, B, C, or D (see sidebar). The letter classifications and their best uses are

NYSDEC Waterbody Classes

Class	Best Use
AA	drinking (with disinfection), bathing, fishing
A	drinking (with disinfection and treatment), bathing, fishing
B	bathing, fishing
C	fishing (reproduction and survival)
D	fishing (survival)

Modifiers

T	sufficient dissolved oxygen to support trout
TS	suitable for trout spawning

described in NYS regulation 6 NYCRR Part 701. For more information about classifications, see the NYSDEC webpage on Water Quality Standards and Classifications. These classifications are based on limited information, and do not necessarily reflect up-to-date or site-specific habitat conditions.

Streams classified as AA, A, B, C(T) or C(TS) are "protected streams" subject to additional state regulations to protect the associated uses. State permits are required for disturbance of the bed or banks of those streams. Any perennial streams that have not been classified by NYSDEC share the classification of the larger stream that they flow into. Intermittent streams are considered to be Class D *(*Article 15 of the ECL, 6NYCRR Part 608). NYSDEC has the final authority to determine if a waterbody has perennial or intermittent flow.

Note that the waterbody classification does not necessarily indicate good or poor water quality—it relates simply to the designated "best uses" that should be supported. NYSDEC recognizes that some waterbodies have an existing quality that is better than the assigned classification and uses an anti-degradation policy to protect and maintain high-quality streams.

NYSDEC also establishes water quality standards, found in NYS regulation 6 NYCRR Part 703, to protect the uses associated with these classifications. Standards can be numerical or narrative. For example, dissolved oxygen has a numerical standard of no less than 7.0 mg/l in trout spawning waters. Turbidity has a narrative water quality standard which states there should be "no increase that will cause a substantial visible contrast to natural conditions." Information on surface water and groundwater quality standards can be found at Water Quality Standards and Classifications.

Lakes Kill at Turkey Hill Road. Photo © Phil Zemke

Waterbodies that are not supporting their best uses may be listed on the **Priority Waterbodies List** (see below) as impaired, and are slated for watershed restoration plans and implementation. Certain activities allowed in and around waterbodies are regulated based on their classification and standard. C(T), C(TS) and all types of A and B streams (as well as waterbodies under 10 acres located in the course of these streams) are collectively referred to as "protected streams." They are subject to the stream protective provisions of the Protection of Waters regulations in Article 15 of the Environmental Conservation Law. NYSDEC regulates the bed and banks of protected streams, defined as the areas immediately adjacent to and sloping toward the stream.

Activities that excavate, fill, or disturb these beds or banks require a NYSDEC permit. See the Protection of Waters page on the NYSDEC website for more information.

Article 15 of New York State's Environmental Conservation Law also offers protection to navigable waters of the state. DEC permits are required for direct or indirect excavating or filling of navigable waters, which can include perennial streams and intermittent streams (Protection of Waters: Excavation and placement of fill in navigable waters). DEC water quality certification permits and permits from the U.S. Army Corps of Engineers (ACOE) may also be required for work involving streams.

Figure 9 shows the use classifications of Milan's streams. Most streams in the Roe Jan, Landsman Kill, and Lakes Kill/Saw Kill watersheds are classified as "C" (best use = fishing). An exception is the stream that feeds and drains Round Pond, which is classified as "B" (best use = bathing and fishing). Most streams in the Little Wappinger and Cold Spring/Wappinger basins are also classified as "B."

Streams that can support brook trout are a declining resource in the region.

A few of Milan's streams are also classified as "trout waters" (T) or suitable for "trout spawning" (TS). Brown trout and brook trout require clean, cool, well-oxygenated conditions. Streams that can support trout are a disappearing resource in the Hudson Valley due to water pollution, stream-bed siltation, loss of forest canopies in stream corridors, altered stream flows, suspended culverts, and other consequences of human activities. (The problems posed by suspended culverts and other aquatic barriers are discussed in the **Threats to Biological Resources** section.) The degradation of streams coincides with the decline of wild-reproducing populations of brook trout and other organisms of unpolluted coldwater streams.

The Roeliff Jansen Kill, which dips into the northern edge of Milan, is classified as a trout stream for much of its 56-mile length, as are many of its tributaries. A small part of the Roe Jan mainstem in Milan and a significant tributary—Fishwoods Creek—are classified as suitable for trout spawning, as are the headwaters of the Saw Kill and of Cold Spring Creek (Figure 9).

Priority Waterbodies

NYSDEC has a waterbody inventory program that monitors water quality and trends throughout the state, and identifies the impaired streams, lakes, and ponds most in need of improvement.[34] Streams are assessed for invertebrates, water and sediment chemistry, turbidity, and sediment toxicity, and classified into six categories:

Impaired waterbodies: Well-documented water quality problems that result in precluded or impaired uses

Waterbodies with minor impacts: Less severe water quality problems; uses are considered fully supported

Threatened waterbodies: No apparent water quality problems or use restrictions, but may be threatened by land use or changes in the watershed

Waterbodies with impacts needing verification: Believed to have water quality problems, but documentation is insufficient

Waterbodies with no known impacts: No use restrictions, although minor impacts may be present

Unassessed waterbodies: Insufficient water quality information

The water quality data are evaluated to assess the ability of each waterbody to support specific water uses (e.g., water supply, swimming, aquatic life, or secondary recreation). Waterbodies that do not meet the standards for their "best uses" may be listed as "impaired" on NYSDEC's Priority Waterbodies List.

The Milan streams in the Little Wappinger and Landsman Kill watersheds are yet unassessed, but most of the streams that have been assessed in the other watersheds in Milan were found to have "no known impacts." Those in the Roe Jan basin (assessed in 2012 and 2017) were found to have low dissolved oxygen and a pH impairment that would affect uses for fishes and for primary and secondary recreation. Silver Lake is known to have excessive growth of algae and aquatic weeds due to excessive nutrient concentrations. The suspected source is inadequate or failing septic systems at residences around the perimeter. Other Milan lakes are so far unassessed in this program.

Dissolved oxygen (DO) is an important measure of water quality in a stream, lake, or pond. All aquatic animals need dissolved oxygen to breathe, and low DO levels can make the waterbody uninhabitable. Low oxygen levels are often the consequence of elevated nutrient concentrations (e.g., nitrogen and phosphorus compounds) leading to large algal blooms or lush growth of vascular plants. Oxygen is depleted by the bacteria involved in the decay of the algae and plants. Warm water temperatures also reduce the amount of oxygen that the water can hold, so removal of trees (and thus shade) along a waterbody, adding pavement or other impervious surfaces in the watershed, and global warming itself will all affect the DO levels. Some organisms such as stoneflies and brook trout are especially sensitive to low DO and are among the first to disappear from streams when oxygen levels begin to drop.

pH is a measure of the water's acidity, which helps to determine the solubility and the availability of nutrients, metals, and other substances to aquatic plants and animals. Especially high or low pH can be harmful to aquatic life. For example, heavy metals are more soluble and thus more toxic in more acidic waters (lower pH). High pH can make other environmental substances such as ammonia more toxic, can damage the gills, eyes, and skin of fish, and can interfere with their olfactory detection of food and pheromones.

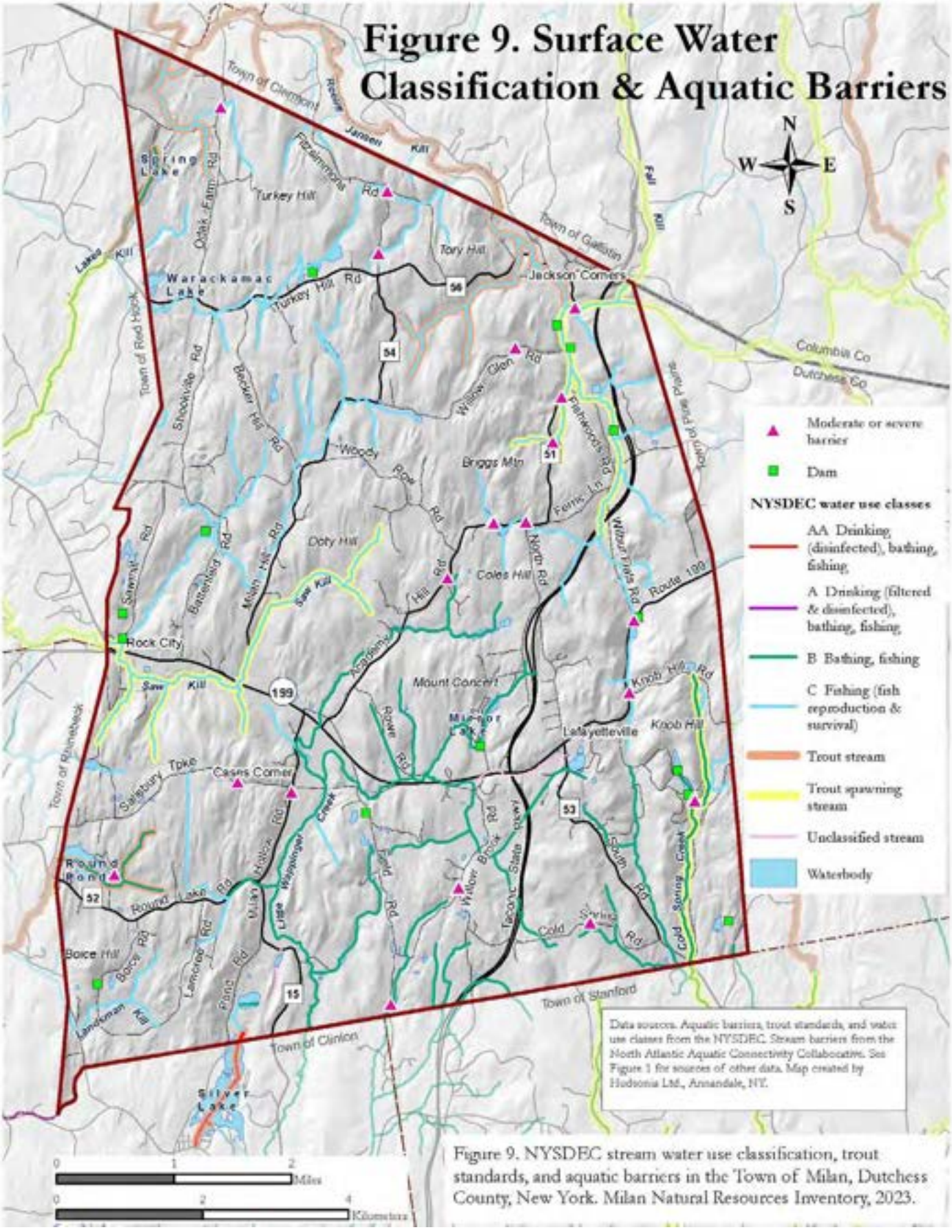


Figure 9. NYSDEC stream water use classification, trout standards, and aquatic barriers in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

BIOLOGICAL RESOURCES

Habitats

A "habitat" is simply the place where an organism or population lives or where a biological community occurs. A habitat is defined according to both its biological and non-biological components, including the vegetation, the climate or microclimate, the kind of rock, soil, or water substrate, and the hydrology.

There has been no detailed identification and mapping of habitats in Milan, but the map in Figure 10 gives a coarse representation. The cover types in the map were identified by the US Geological Survey by remote sensing (using satellite imagery) without field verification, and the data contain many errors and omissions, but still provide a picture of the distribution of general habitat types in the town. "Developed" areas in Figure 10 are those with buildings and/or pavement. "Barren" areas are unvegetated places, equivalent to the "waste ground" habitats profiled below.

Below are brief biological profiles of some of Milan's habitats. Each profile describes the habitat, its distribution in the town, some of the characteristic plants and animals, and some of the species of conservation concern (see box). A subsection on **Species of Conservation Concern** follows the plant and animal profiles. In the text below, a dagger symbol (†) indicates a species with a federal or statewide rarity rank. Appendix Table C-1 gives the scientific names of all plants mentioned in the *NRI*.

SPECIES OF CONSERVATION CONCERN

In the *NRI* we use the term "species of conservation concern" for species of plants and animals that:

- are ranked as Endangered or Threatened under the federal Endangered Species Act, or
- are ranked as Endangered, Threatened, or Special Concern (for animals), or Endangered, Threatened, or Rare (for plants) under the New York State Environmental Conservation Law, or
- are listed as a New York State Species of Greatest Conservation Need (for animals), or
- are ranked as S1, S2, or S3 on the Active Inventory lists of plants and animals of the New York Natural Heritage Program.

Upland Habitats

In this document the term "upland" refers simply to areas that are not wetlands or waterbodies. Upland habitats may occur at any elevation in Milan, from the bottomlands of the lowest valleys to the highest elevations of the Milan hills.

Upland Hardwood Forest

Upland hardwood forests are those dominated by hardwood trees such as oaks, hickories, white ash, maples, beech, birches, and cherries. These forests are the predominant land cover in the town, and are extremely variable in species composition, size and age of trees, and vegetation structure. Virtually all forests in the town are "secondary"—that is, they have regrown after clearing in the past for timber, agriculture, charcoaling, or other purposes. If any truly "old growth" forests still exist they are likely to be small patches in relatively inaccessible places such as on steep ledges or steep rocky slopes.

Common understory species in our second-growth upland hardwood forests include maple-leaf viburnum, witch-hazel, shadbush, Japanese barberry, common buckthorn, Bell's honeysuckle, lowbush blueberries, and a wide variety of wildflowers, sedges, grasses, ferns, and mosses. Local areas of "rich forest," supporting plant species such as American basswood, early meadow-rue, bloodroot, hepaticas, wild leek, yellow ladyslipper, grape fern, and maidenhair fern, are found in places where soils are calcareous (calcium-rich), as in the Milan Window or the Shookville vicinity.

Upland forests provide habitat for a large array of wildlife, including many species of conservation concern. Eastern box turtle[†] spends most of its time in upland forests and meadows, finding shelter under logs and

Maidenhair fern, yellow lady's-slipper, and round-lobed hepatica are plants of rich forests in Milan.
Photos © Erik Kiviat

organic litter. Spotted turtle† uses upland forests for summer dormancy and travel. Many snake species such as black rat snake,† black racer,† eastern garter snake, and red-bellied snake forage widely in upland forests and other habitats. Red-backed salamander may be present in large numbers in forests with intact forest floors including lots of rocks or woody debris. Spotted salamander, Jefferson/blue-spotted, and marbled salamanders may also be present where intermittent woodland pools (vernal pools) are part of the forest habitat complex.

Upland hardwood forests provide important nesting habitat for raptors, including red-shouldered hawk,† Cooper's hawk,† sharp-shinned hawk,† broad-winged hawk, and barred owl, and many species of songbirds, including warblers, vireos, thrushes, and flycatchers. American woodcock† forages and nests in young hardwood forests and shrublands. Wood thrush† and scarlet tanager† are two of the birds that may require large forest-interior areas to nest successfully and maintain populations in the long term.

Mammals such as black bear, bobcat, and fisher also require large expanses of forest, although they roam widely through the rest of the landscape, including developed and agricultural land. Many small mammals are associated with upland hardwood forests, including eastern chipmunk, gray squirrel, southern flying squirrel, and white-footed mouse. Higher densities of small mammals and amphibians occur in forest areas with abundant logs and other woody debris, and these forests are favored by snakes such as copperhead, black rat snake, and black racer that prey on those animals. Hardwood trees larger than five inches diameter at breast height (dbh)—especially snags with peeling bark and live trees with loose, platy bark such as shagbark hickory, or deeply furrowed bark such as black locust—can be used by bats for summer roosting and nursery colonies.

Hardwood forest, Old Knob Hill Road. Photo © Glenn Butler

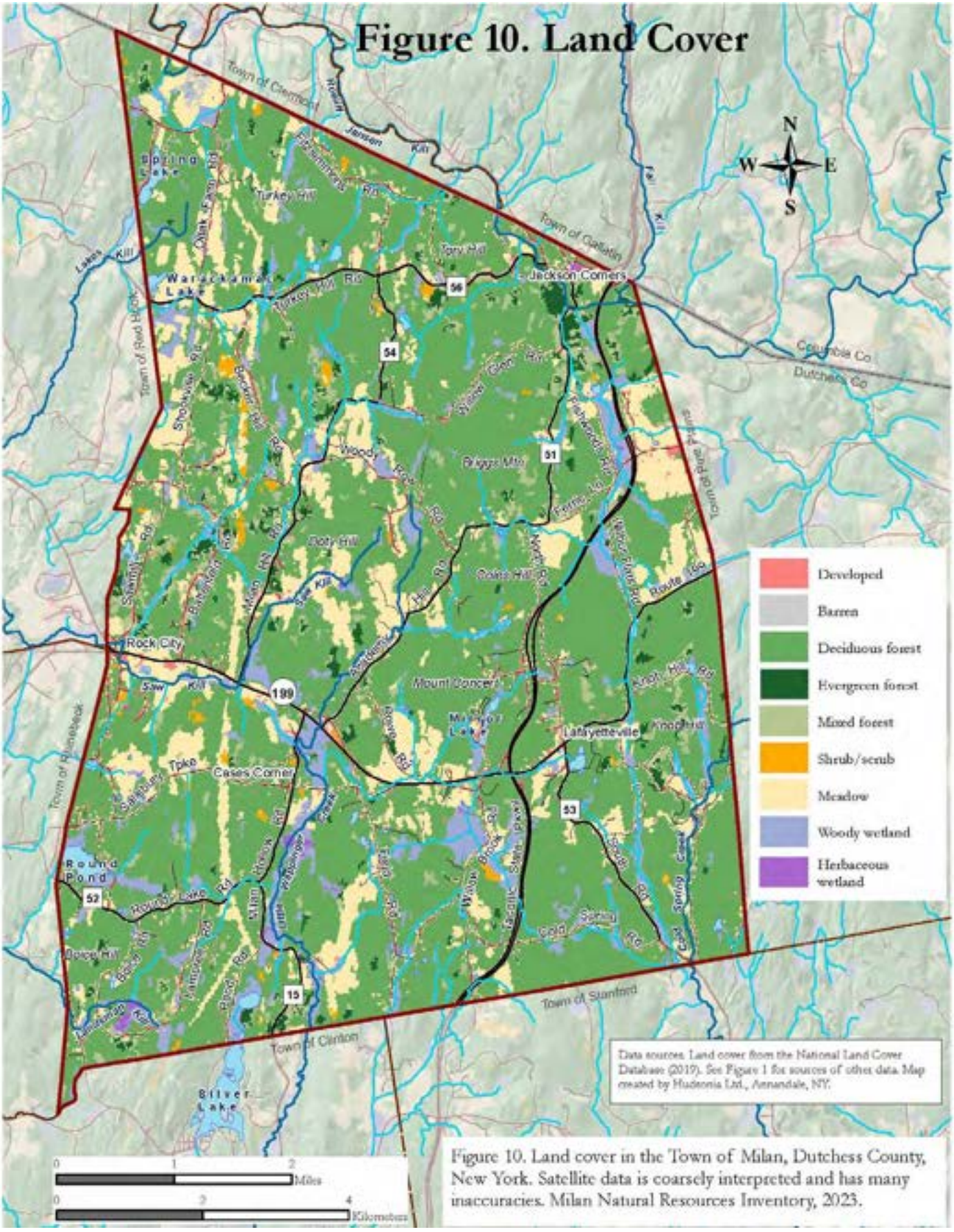


Figure 10. Land cover in the Town of Milan, Dutchess County, New York. Satellite data is coarsely interpreted and has many inaccuracies. Milan Natural Resources Inventory, 2023.

Upland Conifer Forest

Eastern hemlock, eastern white pine, and eastern red cedar are the typical tree species of naturally-occurring conifer forests in Milan. Individuals of pitch pine might occur here and there on bedrock outcrops, and eastern white pine, red pine, Norway spruce, Scotch pine, and European larch may be in conifer plantations. A mature plantation with large trees often shares many of the ecological attributes of a naturally-occurring conifer grove, and may be used by many of the same animal species.

Winter sunset. Photo © Glenn Butler

While eastern red cedar trees occur in a variety of habitats with a range of soil conditions, whole forests dominated by red cedars are generally on calcareous soils, such as those in the Milan Window. Eastern hemlock trees occur in many kinds of forests, and hemlock forests occur in a variety of settings, but they are especially characteristic of deep ravines, north-facing slopes, and acidic ledgy habitats. Individuals and small groves of white pine occur in a variety of habitats, but whole forests of unplanted white pine tend to be on well-drained sandy soils in locations of former agricultural fields or other former openings.

Conifer forests and groves are used by many species of owls (e.g., barred owl, great horned owl, short-eared owl†) and other raptors (e.g., Cooper's hawk† and sharp-shinned hawk†) for roosting and sometimes nesting. Red-breasted nuthatch, evening grosbeak, purple finch, and black-throated green warbler† sometimes nest in conifer stands. American woodcock† sometimes uses conifer stands for nesting and foraging. Conifer stands provide important habitat for a variety of mammals, including eastern cottontail, red squirrel, and eastern chipmunk. The dense canopy offers winter protection for white-tailed deer and can be especially important for them during periods of deep snow cover.

Upland Mixed Forest

Upland mixed forests have a mix of hardwood and conifer trees in the overstory, and tend to share many of the habitat values of both forest types. Mixed forests are less densely-shaded at ground level and tend to support a higher diversity and greater abundance of understory species than pure conifer stands. Mixed forests occur throughout Milan at all elevations (Figure 10).

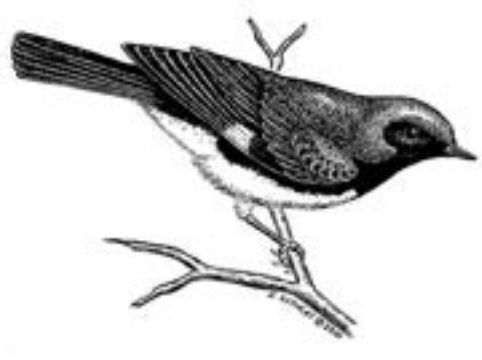
Floodplain Forest

Both wetland forests (swamps) and non-wetland forests occur on floodplains of small and large streams in Milan. Some of these areas flood frequently—e.g., annually or every few years—and some flood only in the largest flood events, but all are important contributors to stream habitats, water quality, and bank stability. The plant communities of floodplain forests share some species of both forested swamps and non-floodplain upland forests, and also include plants that have special affinities for floodplains, such as eastern sycamore, eastern cottonwood, northern hackberry, and ostrich fern. The forests help to absorb and dampen floodwaters, provide shade that helps maintain cool streamwater temperatures; contribute organic matter that supports the stream food web and habitat structure; and provide habitat and movement corridors for wildlife. Floodplain forests are used by many kinds of resident and transient wildlife.

Floodplain forests help to absorb and dampen floodwaters, maintain cool stream temperatures, and provide organic matter to the stream food web.

Forest Values

Forests of all sizes can provide valuable habitat for plants and animals, and ecological services that benefit the human community, but large forests are especially important for area-sensitive wildlife and provide movement corridors for many other kinds of wildlife. Wood thrush,† black-throated blue warbler,† and scarlet tanager† are some of the birds that may require large forest-interior areas to nest successfully and maintain populations in the long term. Forests of 50 acres, 500 acres, and 5000 acres can provide some of the special "interior-forest" habitat conditions that are not present in smaller forest patches and support some of our most sensitive species. Figure 11 shows the large forest areas ($\geq$ 100 acres) in Milan, color-coded by size. The darker greens denote the "core" forests. The lightest green areas are forests of less than 100 acres, and also the 330-ft "edge zones" within which the disturbance factors from the forest edge are most concentrated.



Black-throated blue warbler.
Drawing by Kathleen A. Schmidt © 2001

Forests of large old trees are less common in the region and provide habitat conditions that are not duplicated in younger forests.

Figure 12 shows a regional context for Milan forests. The Nature Conservancy (TNC) and the New York Natural Heritage Program (NYNHP) have delineated "matrix forests" and "forest linkage zones" of the Northeast. The matrix forests are contiguous forest areas whose large size and intact condition enable them to support ecological processes and viable large-forest communities of plants and animals that cannot necessarily persist in

smaller or poorer-quality forests. The linkage zones are the next-largest patches (mostly of 2000+ acres) adjoining and nearby that may provide the best avenue of connectivity for the populations of plants and animals of the matrix forests; that is, the parts of the landscape that are most permeable for safe and efficient movement of migrating organisms between larger forest blocks. Some of these zones are "stepping stone" patches, or stream corridors, and others are broad areas of undeveloped land.[35] Nearly all of Milan is in a broad linkage zone running southwest-to-northeast through the Hudson Valley (Figure 12), connecting large matrix forests of the Shaupeneak and Shawangunk ridges in Ulster County to the Taconic Ridge and Rensselaer Plateau in Columbia and Rensselaer counties. The matrix forests and linkage zones may become even more important with the warming climate, as plants and wildlife are forced to shift their ranges northward.

Forest habitat quality can be measured by a variety of factors depending on the species for which quality is being assessed. Different species of plants and animals each have different requirements

Standing snags and downed logs are essential parts of the living forest. Photos © Erik Kiviat

for habitat components and conditions but, in general, diverse overstory tree species, well-developed and diverse shrub and/or herbaceous layers, few or absent non-native invasive plants, minimal human disturbance, abundant snags (standing dead trees) and coarse woody debris (fallen trees and branches), thick leaf litter, and substrate complexity (in microtopography, rockiness, or soil moisture) that provides diverse microhabitats all contribute to overall habitat quality for many native plants and animals. The trees may be old or young, but forests of large old trees (or stunted old trees) are less common in the region and provide habitat conditions that are not duplicated in

younger forests. Standing dead trees and downwood are also important to the forest ecosystem, providing habitat for fungi, insects, cavity-using amphibians, songbirds, and feeding the life of the forest floor.

Quality assessments of forest habitats should not be overly simplistic, however. Plant diversity or abundance are not always good measures of quality. Some kinds of habitats such as rocky crests may have sparse vegetation and few plant species because of the harsh conditions associated with shallow, droughty soils, but are very important habitats for certain rare plants and animals.

The NYNHP conducted an analysis of forests throughout the Hudson River Estuary watershed, and assigned a "condition" score to forest patches based on remote indicators of size, fragmentation, connectivity, stressors, habitat value, and carbon sequestration. The analysis looked at continuous (unfragmented) forest patches of at least 100 acres, and assigned points to each for 22 metrics, which were then summed to obtain the index score for each patch. This Forest Condition Index is further explained on the NYNHP website and the index results for Milan forests are shown in Figure 13. Half of the forest area in Milan ranks in the 80th percentile or higher against other forests in the region. The highest-ranked forests (in the 90th percentile and higher) are those in the Briggs Mountain area, in Milan Hollow and the adjacent hills to the east, the Cold Spring area, and the northern part of the Knob Hill ridge. The northern and southeastern forests of Milan are also well-connected to larger forest areas in Gallatin and Pine Plains.

Gray treefrog breeds in wetlands but spends most of its time in the trees of upland deciduous forests. Photo © Debra Blalock

In addition to their tremendous value for wildlife, forests are the most effective type of land cover for maintaining clean and abundant water in streams, lakes, ponds, wetlands, and groundwater. Forests with intact canopy, understory, ground vegetation and floors promote infiltration of precipitation to the organic duff and soils,[36,37,38,39] and may be the best insurance for maintaining groundwater quality and quantity, for reducing rapid runoff and soil erosion, and for maintaining flow volumes, cool temperatures, water quality, bank stability, and habitat quality in streams. Forests provide long-term storage of large amounts of carbon in above-ground and below-ground biomass and soils, so maintaining and restoring forests can help to offset some of the carbon emissions of human activities. Forests also help to moderate local and regional air temperatures and the water temperatures of streams and wetlands.

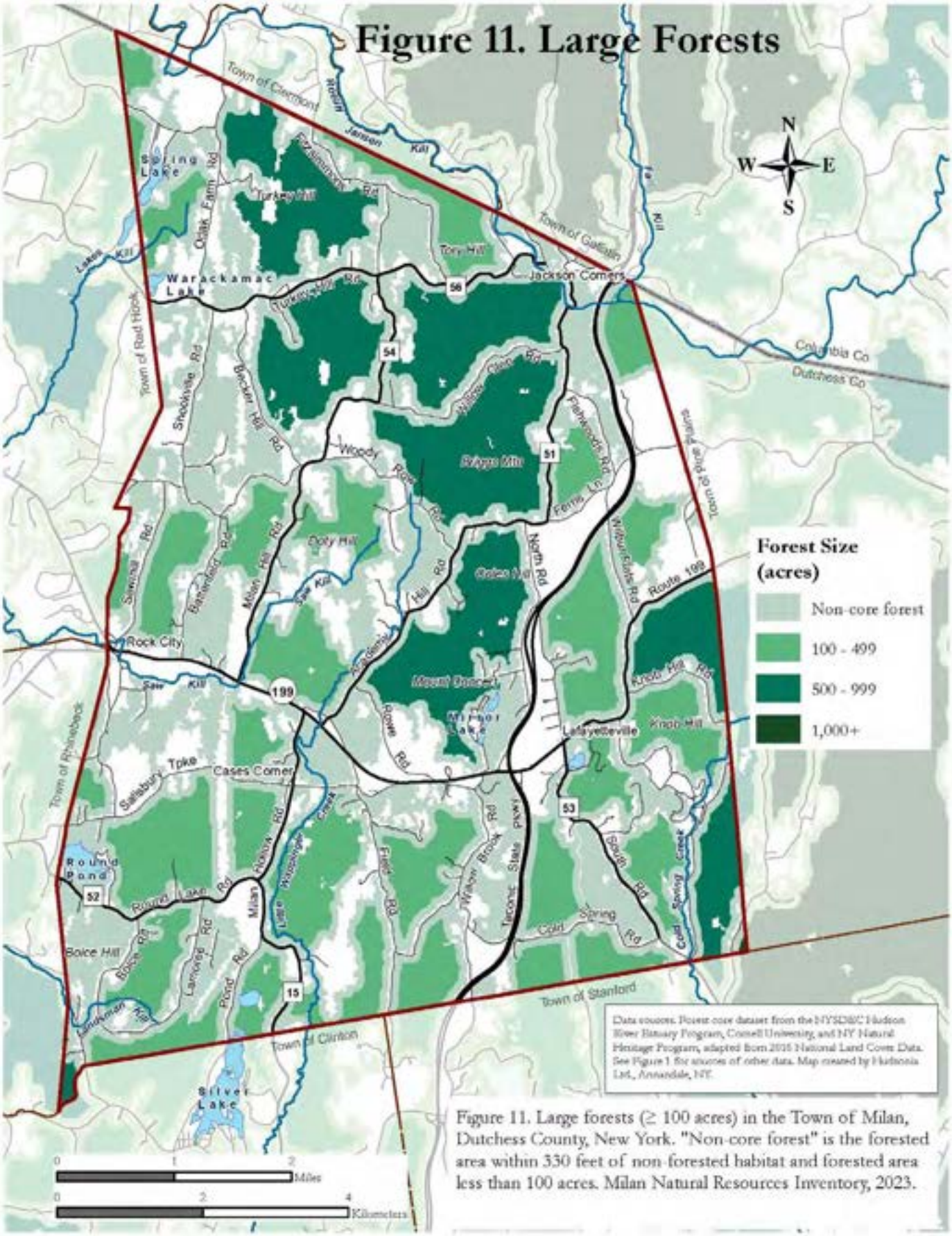


Figure 11. Large forests (≥ 100 acres) in the Town of Milan, Dutchess County, New York. "Non-core forest" is the forested area within 330 feet of non-forested habitat and forested area less than 100 acres. Milan Natural Resources Inventory, 2023.

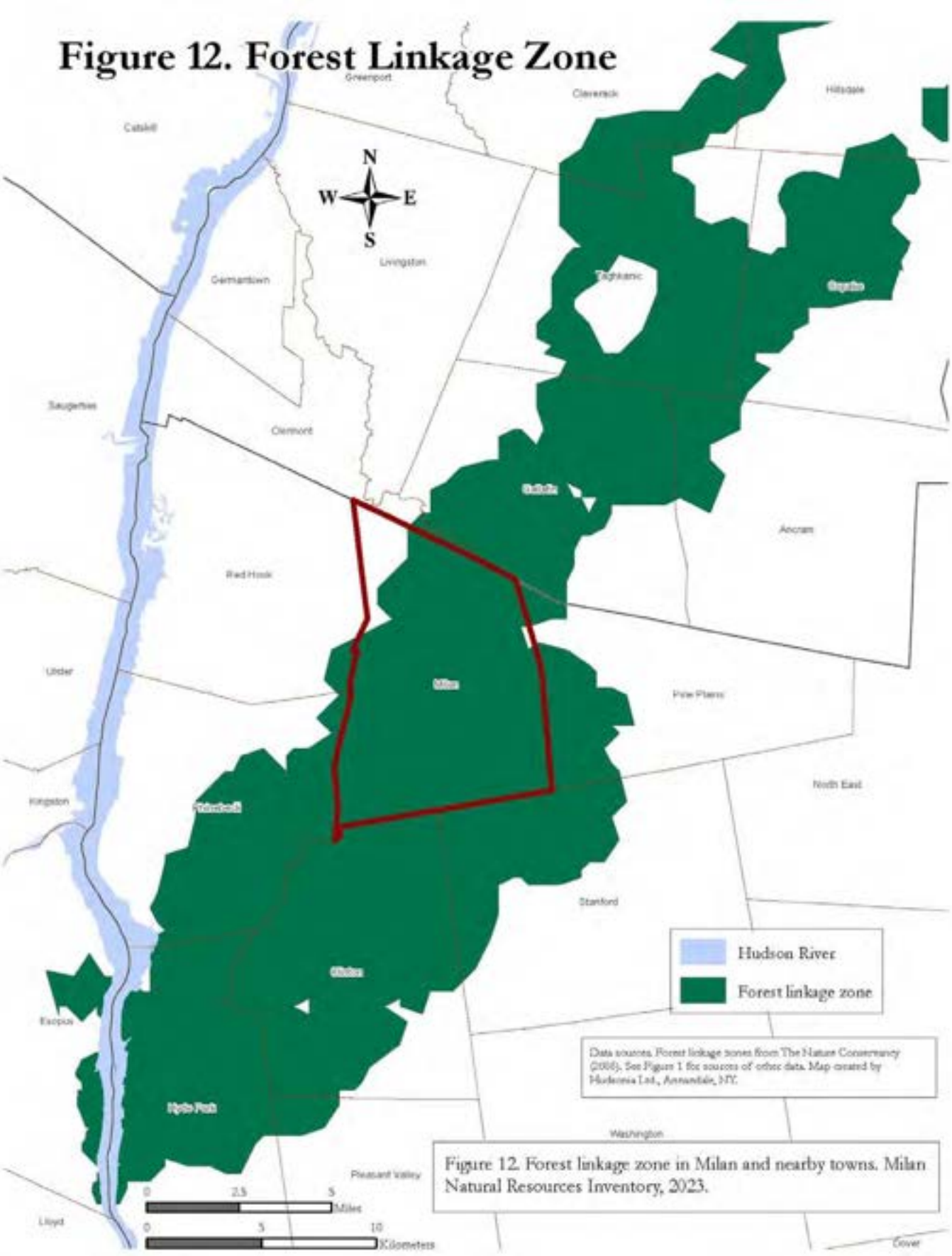


Figure 12. Forest linkage zone in Milan and nearby towns. Milan Natural Resources Inventory, 2023.

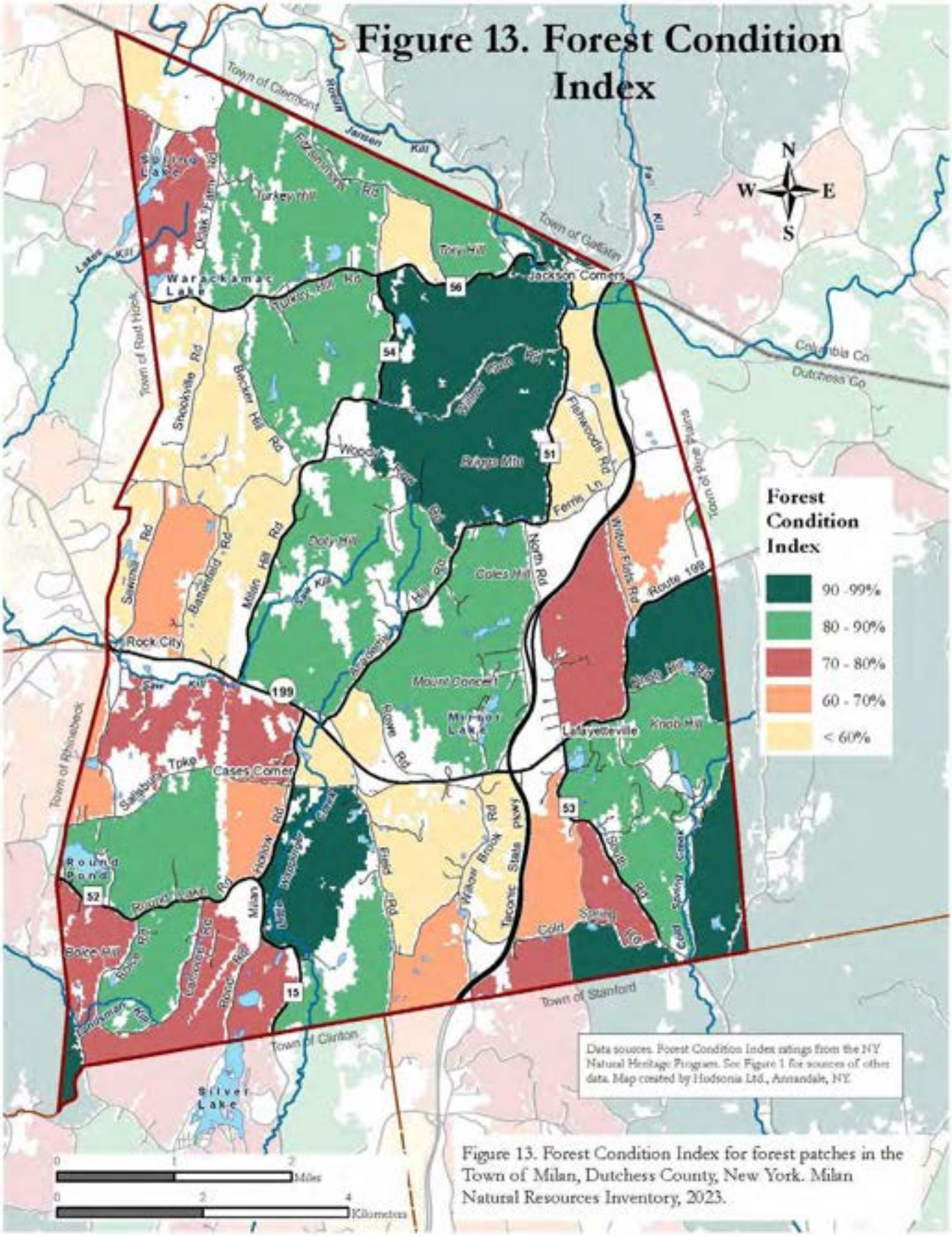


Figure 13. Forest Condition Index for forest patches in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

Upland Shrubland

The term "upland shrubland" refers to shrub-dominated, non-wetland habitats. In most cases these are places in transition between meadow and young forest, but they also occur along utility corridors maintained by cutting or herbicides, in areas of recent forest clearing or blowdowns, and in permanently shrubby areas such as rocky crests where shallow soils discourage the establishment of trees. Upland shrublands are not uncommon in Milan (Figure 10), but in the absence of human intervention they are usually an ephemeral habitat type, on the way to becoming young forest.

Soil characteristics and land uses—both historical and recent—strongly influence the species composition of shrub communities. Shrublands may be dominated by non-native, invasive species such as Japanese barberry, Bell's honeysuckle, oriental bittersweet, autumn-olive, common buckthorn, and multiflora rose, or they may be more diverse, with native shrubs such as

Shrubland and meadow, Rowe Road. Photo © Glenn Butler

meadowsweet, gray dogwood, northern blackberry, raspberries, blueberries, huckleberries, black chokeberry, and seedlings and saplings of eastern red cedar, hawthorns, eastern white pine, gray birch, red maple, quaking aspen, and oaks. Recently-logged areas also tend to develop shrubby cover including abundant tree saplings and northern blackberry.

Occurring among the shrubs are native and non-native grasses and forbs (broad-leaved herbaceous plants) typical of oldfields. Occasional large, open-grown trees (e.g., sugar maple, red oak, white oak, shagbark hickory, eastern sycamore) previously left as shade for livestock, boundary markers, or for ornament may be present.

Uncommon and rare butterflies such as Aphrodite fritillary, dusted skipper,† Leonard's skipper, and cobweb skipper may occur in shrublands where their larval host plants are present (the fritillary uses violets and the skippers use native grasses such as little bluestem). Upland shrublands and other non-forested upland habitats may be used by turtles for nesting, resting, or foraging (e.g., painted turtle, wood turtle,† spotted turtle,† and eastern box turtle†).

Many bird species of conservation concern nest in upland shrublands and adjacent upland meadow habitats, including brown thrasher,† blue-winged warbler,† golden-winged warbler,† and prairie warbler.† American woodcock† and ruffed grouse† nest and forage in shrublands and young forests. Most of these birds avoid forest edges,[40] so large upland shrublands (>12.4 acres [5 hectares]) and those that form large complexes with meadow habitats may be particularly important. Fruiting native and non-native shrubs are an important food source for migrating and resident birds. Several species of hawks and falcons use upland shrublands and adjacent meadows for hunting small mammals such as meadow vole, white-footed mouse, eastern cottontail, and New England cottontail.†

The New England cottontail (NYS Special Concern), once common in the Northeast but now rare, seems to do best in large shrubland areas with dense shrub thickets. This species looks very similar to the non-native and much more common eastern cottontail. Milan is within the area of New England and eastern New York believed to be a very important part of the remaining range of the New England cottontail.[41]

Milan is within the remaining range of the rare New England cottontail.

Crest, Ledge, and Talus

Rocky crest and ledge habitats occur where soils are shallow or absent and bedrock is exposed at and above the ground surface, either where rocks form a steep or near-vertical cliff (ledge), or at the summit of a hill or knoll, or any large bedrock outcrop (crest). These habitats can occur at any elevation, but may be most familiar on hillsides and hilltops. "Talus" is the term for the large rock fragments that often accumulate below steep ledges. Some crest, ledge, and talus habitats support well-developed forests, while others have only sparse, patchy, and stunted vegetation.

Crest, ledge, and talus habitats often appear to be harsh and inhospitable, but they can support a surprising diversity of uncommon and rare plants and animals. Some species, such as wall-rue, smooth cliffbrake,† purple cliffbrake, and northern slimy salamander are found only in and near rocky places in the region.

Rocky outcrops can support a surprising diversity of uncommon and rare plants and animals.

Distinctive communities develop in calcareous and non-calcareous rocky environments. Calcareous crests and ledges often have trees such as eastern red cedar, northern hackberry, American basswood, and butternut; shrubs such as bladdernut, American prickly-ash, and Japanese barberry; and herbs such as wild columbine, ebony spleenwort, maidenhair spleenwort, maidenhair fern, and fragile fern. These places can support numerous rare plant species, such as walking fern (regionally rare) and smooth cliffbrake.† Acidic crests often have trees such as red oak, chestnut oak, gray birch, and eastern hemlock; shrubs such as low blueberries, black chokeberry, and scrub oak; and herbs such as Pennsylvania sedge, little bluestem, common hairgrass, bristly sarsaparilla, and rock polypody.

Rocky habitats with large fissures, cavities, and exposed ledges may provide shelter, denning, and basking habitat for northern copperhead,† black rat snake,† and other snakes of conservation concern. Northern slimy salamander occurs in wooded ledge and talus areas. Breeding birds of crest habitats include worm-eating warbler† (where there is a dense understory) and cerulean warbler† (where there are mature deciduous trees). Bobcat and fisher use crests and ledges for travel, hunting, and cover. Porcupine and bobcat use ledge and talus habitats for denning. Eastern small-footed bat† uses talus habitats for summer roosting.

Wild columbine occurs on calcareous ledges in Milan. Photo © Erik Kiviat

Areas of crest, ledge, or talus are most likely to occur in the areas mapped as "bedrock outcrops" in Figure 5, although large parts of those areas have no exposed bedrock. Small areas of ledge and talus are widely distributed in Milan, but crest habitats are rare. Calcareous ledges are most common in the limestone areas of Shookville and the Milan Window.

Upland Meadow

The general term "upland meadow" encompasses active and fallow croplands, hayfields, pastures, oldfields, and other non-wetland areas dominated by herbaceous (non-woody) vegetation. The ecological values of upland meadow habitats can differ widely according to the types of vegetation present and the types of historical and current disturbance (e.g., tilling, mowing, grazing, pesticide applications). Large hayfields and lightly-to-moderately grazed pastures dominated by grasses, for example, may support grassland breeding birds, depending on the mowing schedule or intensity of grazing. Upland meadows are common in Milan (Figure 14). Most are active or abandoned farm fields.

Intensively cultivated cropfields and overgrazed pastures have comparatively little wildlife habitat value, but are used for foraging by white-tailed deer, raccoon, wild turkey, Canada goose, songbirds, and other wildlife. Killdeer and turtles will nest in farm fields, but large percentages of nests fail due to predation, trampling, and destruction by farm machinery. After abandonment, agricultural lands tend to develop diverse plant communities of grasses, forbs, and shrubs (i.e., "oldfield" vegetation) and support an array of wildlife, including invertebrates, amphibians, reptiles, mammals, and birds. Meadows with shallow, nutrient-poor soils often support a higher abundance and diversity of native, warm-season grasses and other native plants. (The great value of agricultural land to the human community is discussed in sections below.)

Oldfield in a utility corridor at Turkey Hill Road. Photo © Phil Zemke

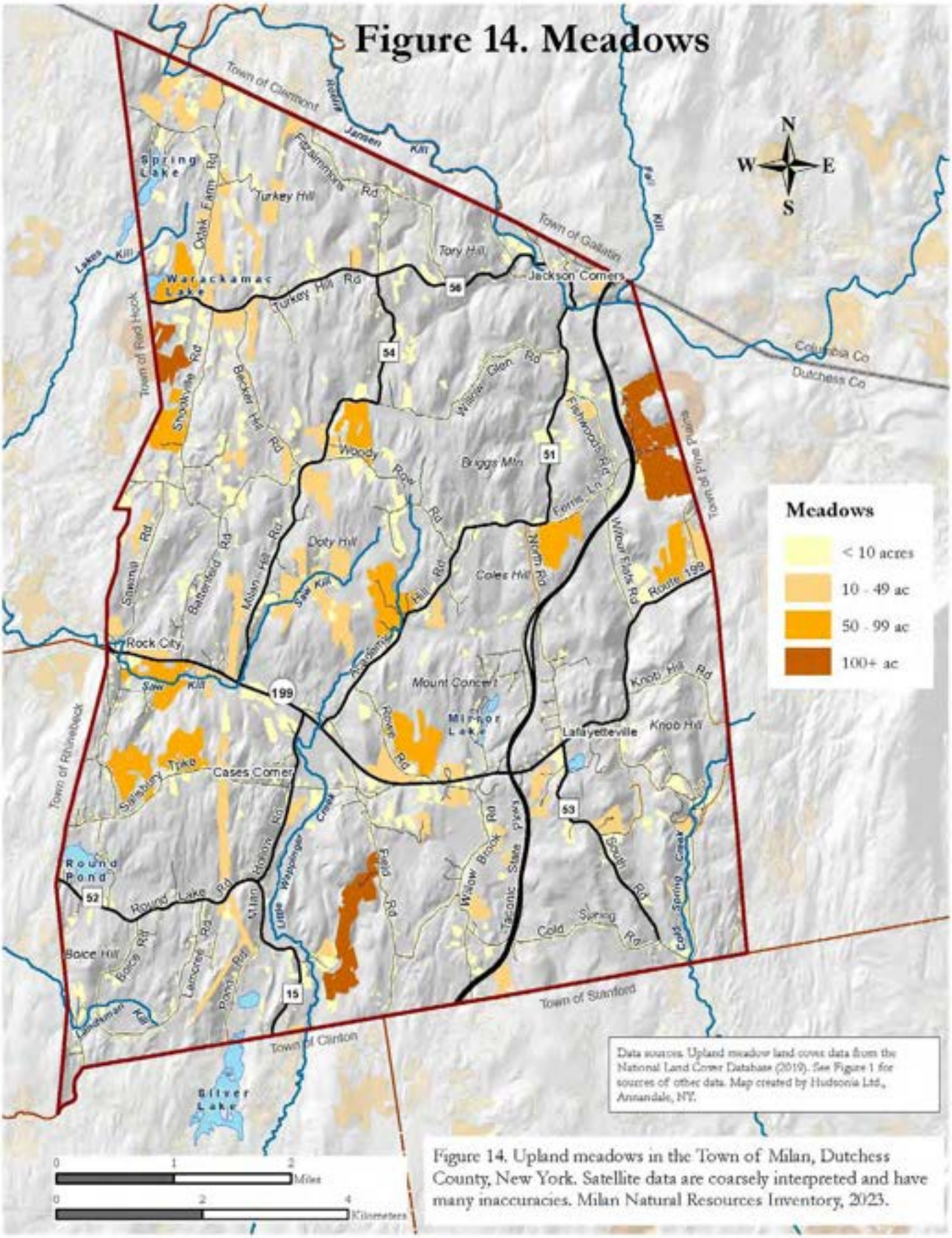


Figure 14. Upland meadows in the Town of Milan, Dutchess County, New York. Satellite data are coarsely interpreted and have many inaccuracies. Milan Natural Resources Inventory, 2023.

Meadows off Academy Hill Road. Photo © Phil Zemke

Several species of uncommon butterflies, such as Aphrodite fritillary, meadow fritillary, Leonard's skipper, and striped hairstreak use upland meadows that support their particular larval host plants. Adult butterflies, moths, native bees, and honey bees nectar at the wildflowers of oldfields. Dragonflies and damselflies hunt over upland meadows that are near streams, ponds, or lakes. Upland meadows can be used for nesting by wood turtle,† spotted turtle,† Blanding's turtle,† box turtle,† painted turtle, and snapping turtle.† American kestrel† hunts over meadows and nests nearby in tree cavities or other sheltered microhabitats. Northern harrier† also hunts over large meadows, but nesting has been rare in the Hudson Valley in recent decades. Hawks, northern harrier, and short-eared owl† hunt over large meadows in winter. Wild turkey forages on invertebrates and seeds in upland and wet meadows. Upland meadows often have large populations of small mammals (e.g., meadow vole) and can be important hunting grounds for raptors, foxes, and eastern coyote.

Large meadows (10+ acres) have particular value for grassland breeding birds whose populations have experienced sharp declines in recent decades due primarily to loss of suitable habitats. Species such as vesper sparrow,† savannah sparrow,† eastern meadowlark,† and bobolink† use large meadow habitats for nesting and foraging. Different species of grassland birds require meadows of different sizes and conditions (vegetation heights, grasses vs. forbs vs. shrubs, depth of thatch). Figure 14 shows the meadows of Milan coded by size.

The habitats of utility corridors in Milan are typically a mix of upland meadows, upland shrublands, wet meadows, and shrub swamps. Some areas have exposed ledges. These corridors can have significant habitat value for wildlife, but the use of herbicides to prevent the establishment of trees can turn them into toxic environments for plants and animals. Use of mechanical means (occasional cutting or brush-hogging) instead will achieve the same management goals while also maintaining valuable habitat.

Orchard and Nursery

This habitat type includes actively maintained or recently abandoned fruit orchards, tree farms, and plant nurseries. The habitat values of active orchards or plantations are often limited by frequent mowing, application of pesticides, and other human activities. Orchards and plantations have some of the vegetation structure and ecological values of upland meadows and upland shrublands and, if they remain undisturbed after abandonment, will ordinarily develop into young forests with mixtures of fruit trees, conifers, and other tree species. Conifer plantations with larger, older trees have similar habitat values as spontaneous upland conifer forests. Fruit orchards with old trees may provide breeding habitat for eastern bluebird and can be valuable to other cavity-using birds, bats, and amphibians. When the trees are small, Christmas tree farms are potential northern harrier† nesting habitat.

Milan had several commercial orchards in the past, but there are none operating today, and the Battenfeld Christmas tree farm in Rock City and the Northern Dutchess Botanical Gardens on Salisbury Turnpike are the only nurseries in town.

Waste Ground

Several plants and animals of conservation concern are known to use waste ground environments.

"Waste ground" is an ecologists' term for land that has been severely altered by previous or current human activity, but lacks pavement or structures. (The term is unrelated to the "garbage" sense of "waste.") Most waste ground areas have been stripped of vegetation and topsoil, or filled with soil or debris, and remain unvegetated or sparsely vegetated. This habitat type encompasses a variety of areas such as active and abandoned sand and gravel mines, rock quarries, mine tailings, dumps, organic waste piles, unvegetated fill, covered landfills, and construction sites. Although some waste ground areas may have low habitat value, there are notable exceptions. Several rare plant species are known to inhabit waste ground environments in the region, including variegated horsetail, rattlebox,† slender pinweed, field dodder,† and slender knotweed.† Several snake and turtle species of conservation concern, including Blanding's turtle,† box turtle,† spotted turtle,† and wood turtle† may use the open, gravelly areas of waste grounds for nesting habitat. Bank swallow, northern rough-winged swallow, and belted kingfisher often nest in the stable walls of inactive portions of soil mines. Bare, gravelly, or otherwise open areas provide nesting grounds for spotted sandpiper, killdeer, and possibly whip-poor-will† or common nighthawk.†

The Red Wing sand and gravel mine in the northwest corner of town is the largest example of waste ground in Milan. All of the other gravel mines are closed and have been reclaimed to meadow, forest, ponds, or wetlands.

Wetland, Lake, and Pond Habitats

The term "wetland" refers to vegetated areas that have saturated soils in the rooting zone of plants for a prolonged period during the growing season. Some wetlands (e.g., marshes) have permanent standing water, and some (e.g., wet meadows) have little or no standing water, and may appear to be quite dry for a significant part of the year. Wetlands can occur at any elevation, from the lowest areas along Milan streams up to near the summits of the highest hills, wherever a vegetated area has 1) the water table at or near the ground surface for prolonged periods, or 2) groundwater seepage emerging under hydrostatic or gravitational pressure for prolonged periods, or 3) a confining layer—such as bedrock or a compacted soil layer—that holds water perched near the ground surface for prolonged periods.

Wetlands are one of the few parts of the landscape that receive some regular protections from the state and federal governments, but many wetlands are excluded from those protections. Wetlands have been mapped by New York State and the US Fish and Wildlife Service, but those maps (Figure 15) show inaccurate wetland boundaries, and omit many small wetlands and even some large ones.

Where are the additional wetlands likely to occur? They can occur almost anywhere, but the first places to go looking for them are 1) in areas mapped as very poorly, poorly, or somewhat poorly drained soils (Figure 15); in topographic basins (even small ones); on hillside benches; in flattish areas along streams; and in seepage areas on slopes.

State and federal wetland maps omit many wetlands.

Further discussions of state and federal wetland maps and wetland regulatory programs are in the **Regulatory Protections** section. Many of the wetlands that are excluded from state and federal jurisdiction have great ecological value, and could still be protected under the local code if Milan decides to extend protections to these small or isolated wetlands.

The wetland complex bordering Silver Lake and along Little Wappinger Creek is within the Dutchess County Wetlands Significant Biodiversity Area (Figure 17), designated by NYSDEC because of its importance for a variety of reptile, amphibian, and bird species of conservation concern. See more discussion of the **Significant Biodiversity Area** below.

Below are brief descriptions of the major wetland habitat types in the Town of Milan. In this *NRI* we use the term "swamp" in its technical sense—a wetland dominated by woody vegetation (trees or shrubs). Swamps in Milan may be dominated by trees (a forested swamp) or by shrubs (a shrub swamp), and forested swamps may have a canopy of mostly hardwoods, mostly conifers, or a mix of both.

Hardwood Swamp
Hardwood swamps in Milan are typically dominated by red maple and/or green ash, but may also have trees such as pin oak, swamp white oak, black ash, American elm, or slippery elm in the overstory. Typical shrubs of hardwood swamps are silky dogwood, northern arrowwood, winterberry holly, and highbush blueberry. Non-woody (herbaceous) plants include a variety of wetland ferns (e.g., cinnamon fern, royal fern, marsh fern, crested fern, sensitive fern), sedges, grasses, and forbs; for example, tussock sedge, lakeside sedge, fowl mannagrass, common jewelweed, and skunk-cabbage.

Swamp habitats can be extremely variable in their hydrology, appearance, and plant species composition. Some have more-or-less permanent standing water, with much of the vegetation on raised woody hummocks, and others have little or no standing water for most of the year and a densely-vegetated swamp floor.

Conifer Swamp
A conifer swamp is a forested swamp dominated by conifer trees, such as hemlock or eastern red cedar, or occasionally white pine or American larch. Hardwood trees (see above) may also be present. Where the evergreen canopy is dense, the deep shade makes for sparse shrub and herbaceous layers and a cool microclimate, sometimes allowing snow and ice to persist longer into the spring growing season than in nearby habitats. Conifers growing in wetlands frequently have very shallow root systems and are thus prone to windthrow. The resulting tip-up mounds, root pits, and coarse woody debris all contribute to the habitat's complex structure and microtopography. The most likely locations for conifer swamps and mixed forest swamps (described below) are in the wetland complex along Little Wappinger Creek in Milan Hollow.

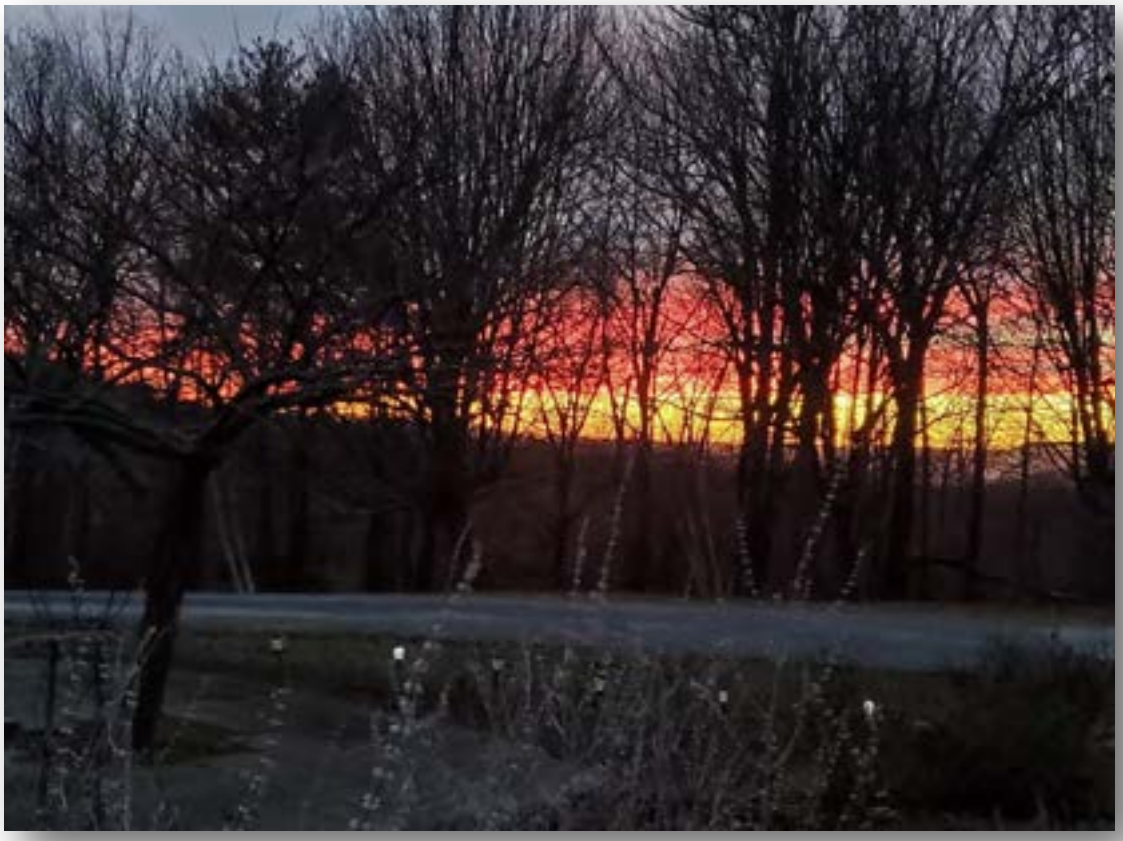
Mixed Forest Swamp
Mixed forest swamps have a canopy composed of a mix of conifers and hardwood trees. The habitat has characteristics intermediate between those of hardwood and conifer swamps, and shares many of the ecological values of those habitats.

Shrub Swamp
A shrub swamp is a wetland dominated by shrubs with no forest canopy, although scattered trees may be present. Common wetland shrub species in the region are silky dogwood, winterberry holly, nannyberry, and highbush blueberry. Swamp azalea and buttonbush are typical of kettle wetlands, and occasional in other somewhat calcareous shrub swamps. Herbaceous plants of shrub swamps overlap with those of forested swamps and wet meadows.

Values of Swamps
Forested and shrub swamps provide important habitat for a wide variety of birds, mammals, amphibians, reptiles, and invertebrates, especially when contiguous with other wetland types or embedded within large areas of upland forest or upland meadow/shrubland. Forested and shrub swamps in the floodplains of clear, low-gradient streams can be important components of wood

turtle† habitat. Other turtles such as spotted turtle† and eastern box turtle† frequently use swamps for summer foraging, drought refuge, overwintering, and travel corridors. Pools within swamps are used by several pool-breeding amphibian species, and are the primary breeding habitat of blue-spotted salamander.† Four-toed salamander† uses swamps with abundant, moss-covered rocks, logs, or woody hummocks. Eastern ribbon snake† forages for frogs in swamps. Red-shouldered hawk,† barred owl, great blue heron, wood duck, American black duck,† American woodcock,† red-headed woodpecker,† and Canada warbler† nest in hardwood swamps and other habitats. Rusty blackbird† uses Dutchess County swamps on its seasonal migrations.

Forested and shrub swamps are here and there throughout Milan (Figure 10). Although they typically occur on level ground or in depressions, and sometimes at the edges of open waterbodies, spring-fed swamps sometimes occur on moderate to steep slopes. The largest swamps in Milan are associated with streams, but many small swamps have no surface-water connection to streams or waterbodies.



Sunset, Turkey Hill Road. Photo © Debra Blalock

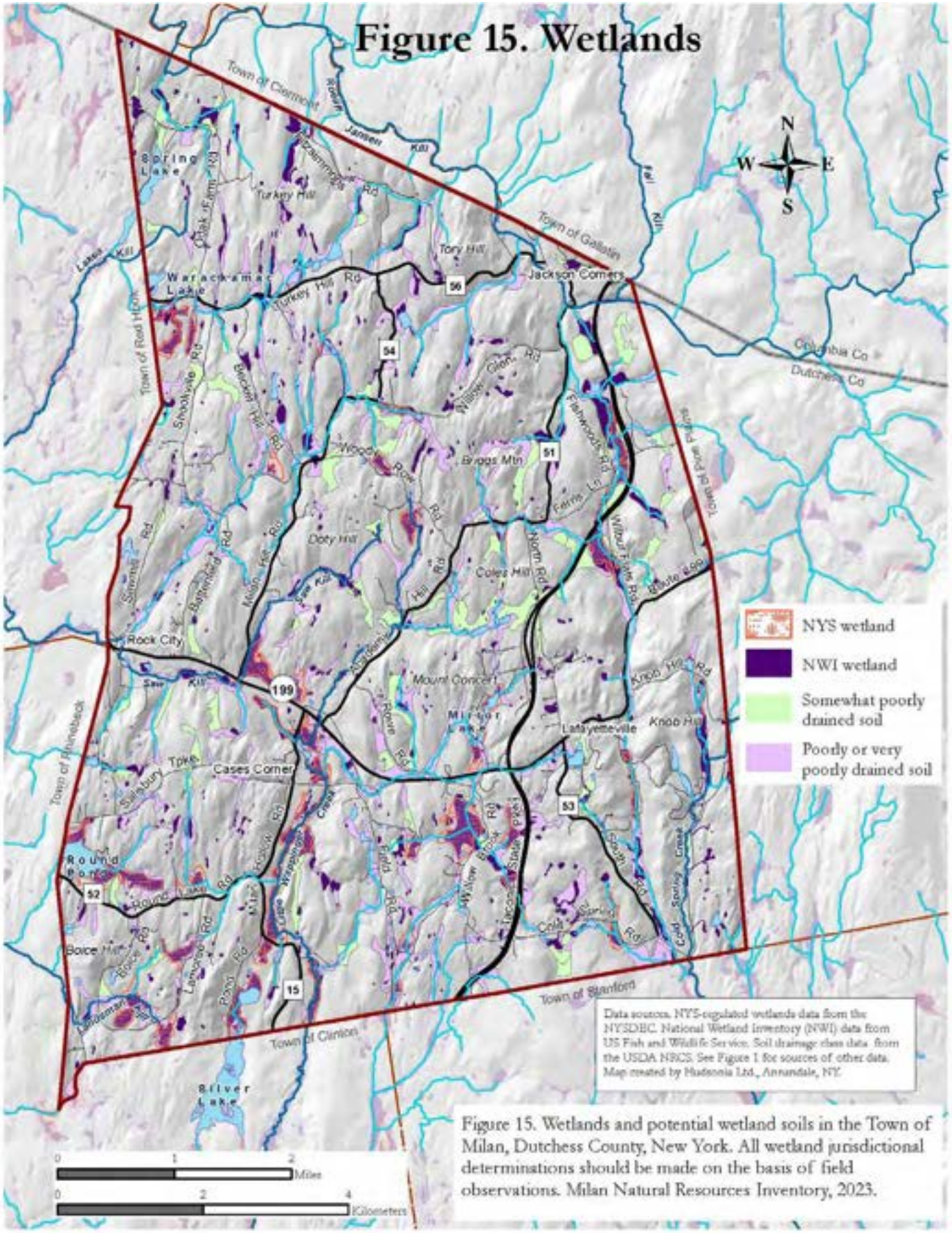


Figure 15. Wetlands and potential wetland soils in the Town of Milan, Dutchess County, New York. All wetland jurisdictional determinations should be made on the basis of field observations. Milan Natural Resources Inventory, 2023.

Intermittent Woodland Pool (Vernal Pool)

An intermittent woodland pool is a small wetland that is partially or entirely surrounded by forest, typically has no surface water inlet or outlet (or an ephemeral one), and has standing water during fall, winter, and spring that dries up by mid- to late summer during a year of normal precipitation. This habitat is a subset of the widely recognized "vernal pool" habitat, which may occur in forested or open settings. Intermittent woodland pools may be devoid of vegetation, or may have a few trees or patches of sedges, ferns, forbs, or shrubs.

Seasonal drying and lack of a stream connection ensure that these pools do not support fish, which are major predators on amphibian eggs and larvae. The fish-free environment makes this the critical breeding habitat for a special group of pool-breeding amphibians—marbled salamander,† Jefferson salamander,† spotted salamander, and wood frog—that is especially vulnerable to fish predation. These pools often support a rich invertebrate fauna, including animals especially adapted to the seasonal drying, such as fairy shrimp and fingernail clams. They can also be important foraging, resting, and rehydrating habitats for terrestrial wildlife. The surrounding forest supplies organic detritus to these pools—the base of the pool's food web—and is the critical adult habitat for pool-breeding amphibians.

Intermittent woodland pools occur in forested areas throughout Milan. Many intermittent woodland pools are omitted from public wetland maps (such as Figure 15 which shows wetlands on the National Wetland Inventory maps and the NYS Freshwater Wetlands maps) because of their small size and their isolation from other wetlands or streams or lakes. Those that are omitted must be identified independently by remote sensing or field observations.

Marsh

A marsh is a wetland that has standing water for most or all of the growing season and is dominated by herbaceous (non-woody) vegetation. Marshes often occur at the fringes of deeper waterbodies (e.g., lakes and ponds), or in close association with other wetland habitats such as wet meadows or swamps. The edges of marshes, where standing water is less permanent, often grade into wet meadows. Cattails, tussock sedge, common reed, arrow-arum, broad-leaved arrowhead, water-plantain, bur-reed, and purple loosestrife are some typical emergent marsh plants in this region. Some marshes are dominated by floating-leaved plants such as pond-lilies, watershield, and duckweeds.

Several rare plant species are known from nontidal marshes in the region, and the diverse plant communities of some marshes provide habitat for butterflies such as the Baltimore checkerspot, monarch, and northern pearly-eye. Marshes are also important habitats for reptiles and amphibians, including northern water snake, eastern painted turtle, snapping turtle,† spotted turtle,† green frog, pickerel frog, and spring peeper. Numerous bird species, including marsh wren, common gallinule, American bittern,† least bittern,† great blue heron, Virginia rail, sora, American black duck† and wood

Marsh and pond in Milan Hollow wetland complex. Photo © Phil Zemke

duck, use marshes for nesting and nursery habitat. Some of these require large areas of marsh for nesting. Pied-billed grebe† also uses this habitat where it occurs adjacent to open water areas. Many raptors, wading birds, and mammals use marshes for foraging.

Marshes occur here and there in Milan, sometimes occurring by themselves, and sometimes embedded in or at the edges of other wetlands, lakes, or ponds. The most extensive marshes are in the Milan Hollow wetland complex and in the large wetland north of Lamoree Road in the southwestern corner of the town.

Beaver Pond

A beaver pond is a changing environment that undergoes predictable phases as the beavers arrive to a stream in a topographically and biologically choice location, construct their dam, remain for a few months or many years, leave (or are trapped out), and return again sometime (weeks, months, or years) later. Most beaver ponds have been occupied by beaver, off and on, for thousands of years, and will continue to be used for as long as the trees and shrubs that are their favored foods continue to reestablish. The habitats of beaver ponds change with each of those phases, and typically include, in sequence:

1) stream through forested swamp or upland forest;
2) pond (after dam is constructed);
3) pond and marsh with swamp at edges;
4) mudflat along stream (after the beaver have left and the dam is breached or deteriorates);
5) wet meadow along stream;
6) shrub swamp along stream;

7) forested swamp or upland forest along stream;
8) pond (when beavers return), and the sequence repeats.

The American beaver has been a part of the Northeast landscape since long before the arrival of humans, and has been shaping the habitats and biological communities of the region for all of that time. Beaver were trapped to near extirpation in the early decades of European settlement because of the commercial value of their pelts, but the Hudson Valley population has slowly recovered over the last century or so.

Beavers build dams and impound water to make their food sources (trees and shrubs) accessible and their lodges safe from predators. Each phase of the beaver pond evolution creates habitats that benefit different communities of plants and animals—including invertebrates, mollusks, fishes, amphibians, reptiles, songbirds, waterfowl, wading birds, raptors, and mammals. The beaver's activities thus contribute immensely to the biological richness of the region. Where the dammed impoundments threaten to encroach on lawns, infrastructure, or other features of value to people, there are techniques to manage the dam to prevent the pond from expanding. But where the pond encroaches only on natural habitats, leaving the beaver to their own devices is usually the best conservation measure. Tampering with a dam or trapping or killing beaver without a permit is illegal in New York, and significant fines are imposed for violations (NY ECL §11-0505).

Fresh beaver chew. Photo © Erik Kiviat

Beaver lodge and beaver pond at Jacoby Farm. Photos © Erik Kiviat

Circumneutral Bog Lake

A circumneutral bog lake is a spring-fed, calcareous waterbody that commonly supports vegetation of both acidic bogs and calcareous marshes.[42] These lakes typically have a deep organic substrate, mats of floating vegetation, drifting peat rafts, and abundant submerged and floating-leaved plants such as fragrant pond-lily and watershield. While the standing water is circumneutral or alkaline, floating peat mats often have plant communities of acidic bogs, with carpets of *Sphagnum* mosses, along with leatherleaf, cranberries, and purple pitcher-plant. Shoreline areas may support cattails, purple loosestrife, water-willow, alder, buttonbush, and leatherleaf, and the lakes may have swamps, calcareous wet meadows, and/or fens at their margins.

This is a rare habitat type in the region and known to support many rare and uncommon species of plants and animals. Rare fauna associated with circumneutral bog lakes in the region include eastern ribbon snake,† spotted turtle,† Blanding's turtle,† blue-spotted salamander,† marsh wren, and river otter. These habitats have also been found to support diverse communities of mollusks, dragonflies, and damselflies. Circumneutral bog lakes in Milan include Round Pond, Silver Lake, and Spring Lake.

Wet Meadow

A wet meadow is an open (unforested) wetland habitat with predominantly herbaceous (non-woody) plants that may include any combination of grasses, sedges, rushes, ferns, and forbs. The vegetation may be low and sparse, or tall and dense, depending on a variety of environmental and land use factors. Although standing water may be present at times, there is typically little or no standing water through much of the growing season. Wet meadows occur in pastures and hayfields, oldfields, and utility corridors, on floodplains and stream terraces, in former beaver pond areas after the dam is breached, and at the edges of other kinds of wetlands and ponds. Wet meadows are found throughout Milan at all elevations. They are a commonly-overlooked wetland type since they are often dry enough during part of the year to be mowed or grazed, and often do not appear on public wetland maps (including Figure 15).

Pickerel frog is often found in wet meadows that are near permanent water.
Photo © Erik Kiviat

The plant communities of wet meadows are extremely variable and diverse. Wet meadows often share some of the plant species of upland oldfields, but plants with affinities for wet soils predominate. A few of the characteristic plants include reed canary-grass, rice-cutgrass, soft rush, dark-green bulrush, fox sedge, sensitive fern, purple loosestrife, Joe-Pye weed, and smooth goldenrod. Wet meadows on calcareous soils may also have plants such as sweetflag, lakeside sedge, rough-leaved goldenrod, and blue vervain. The diverse plants of wet meadows provide abundant food for butterflies, moths, bees, and wasps; hunting

habitat for dragonflies and damselflies; and important habitat for a host of other insects and other invertebrates. Because they often support forbs that flower in late summer, wet meadows can be important late-season food sources for butterflies, moths, and native bees.

Plants of conservation concern that may occur in wet meadows include ovate spikerush,† golden-fruit sedge, smaller fringed gentian, and swamp birch.† Dion skipper, two-spotted skipper, and Baltimore checkerspot are among the regionally rare butterflies of wet meadow habitats. Eastern garter snake, eastern ribbon snake,† pickerel frog, green frog, and other snakes and frogs hunt in wet meadows, and spotted turtle† and wood turtle† use these habitats for foraging and resting. Red-winged blackbird and swamp sparrow nest and forage in wet meadows with tall, robust vegetation, and many other songbirds forage in these habitats for seeds and insects. Virginia rail and sora nest in wet meadows dominated by dense, tall grasses or sedges and adjacent to open water. The margins of wet meadows can be important resting and foraging areas for migrating least sandpiper and other shorebirds of conservation concern. Small mammals such as meadow vole and meadow jumping mouse use wet meadows and other open fields, and owls, hawks, eastern coyote, and foxes hunt for their small mammal prey in these habitats.

Springs and seeps help to maintain cool water temperatures in streams.

Spring and Seep

Springs and seeps are places where groundwater actively discharges to the ground surface, either at a single point (a spring) or diffusely (a seep). Springs and seeps may discharge into lakes, ponds, streams, or wetlands such as fens or swamps, or may discharge into upland habitats such as forests, meadows, or ledges. Springs and seeps originating from deep groundwater sources flow more or less continuously, and emerge at a fairly constant temperature, usually in the range of 45-55 °F year-round, creating an environment that is cooler in summer and warmer in winter than the surroundings. For this reason, seeps and springs sometimes support aquatic species that are ordinarily found at more northern or southern latitudes. The habitats created at springs and seeps are determined in part by the hydroperiod and the chemistry of the soils and bedrock through which the groundwater flows before discharging. Springs and seeps are water sources for many streams, and they help maintain the cool water temperature of streams, an important habitat characteristic for many aquatic organisms. Some springs and seeps also serve as water sources for wildlife during droughts and in winters when other water sources are frozen.

Golden saxifrage is a plant more-or-less restricted to springs and groundwater-fed wetlands and streams. Northern dusky salamander and two-lined salamander use springs and cool streams. Gray petaltail† and tiger spiketail† are two rare dragonflies found in seeps that could occur in Milan. Springs emanating from calcareous bedrock or calcium-rich surficial deposits sometimes support an abundant and diverse snail fauna.

Springs and seeps occur in a great variety of settings in Milan but, unlike many other habitats, their locations are difficult to predict by analysis of topography, soils, and bedrock. They rarely appear on maps, so their locations are known mainly by those who discover them on the ground.

Lake and Pond

Described here are lakes and ponds that are "open water" habitats, including those that developed naturally and those that were constructed by humans by excavating an upland or wetland area, by damming a stream, or by a combination of excavation and damming. These habitats typically lack emergent vegetation (plants that emerge above the water surface) except at the lake or pond edge, although some have abundant submerged aquatic vegetation that may be invisible at the pond surface. Lakes and ponds that are well-vegetated are described elsewhere (as marsh or circumneutral bog lake).

Open water areas can provide habitat for many common animals, including invertebrates, fishes, frogs, turtles, waterfowl, wading birds, shorebirds, muskrat, beaver, and bats. Any of our lakes and ponds can serve as stopover sites for migrating gulls, common loon, herons, and waterfowl. Open water areas often support submergent aquatic vegetation that can provide good habitat for aquatic invertebrates and fish, and food for waterfowl. Spotted turtle† uses ponds and lakes during both drought and non-drought periods, and wood turtle† may mate in open water areas and overwinter at the edges of such waterbodies. Wood duck, American black duck,† pied-billed grebe,† osprey,† bald eagle,† American bittern,† and great blue heron use the shallows of open water areas for foraging. Bats, mink, and river otter also forage at open water habitats.

Ponds that lack a sufficient buffer of natural vegetation and undisturbed soils are more likely to receive polluted runoff.

Because many backyard, farm, or recreational ponds are not buffered by sufficient natural vegetation and undisturbed soils, they are vulnerable to the adverse impacts of agricultural runoff, septic leachate, and pesticide or fertilizer runoff from lawns and gardens. Many ponds in the region that are maintained for ornamental and recreational purposes are treated with herbicides and perhaps other pesticides that kill aquatic invertebrates or reduce the aquatic vegetation that serves as their habitat, and often have introduced non-native fish such as grass carp, largemouth bass, and smallmouth bass, which disrupt the native aquatic communities.

In general, the habitat values of lakes or ponds are higher when the shorelines are undeveloped, unmanaged (i.e., uncleared, unmowed, unmanicured), are relatively undisturbed by human activities, are untreated with herbicides, algicides, or insecticides, have more vascular plant vegetation at their edges, have no non-native fishes, and are embedded within an area of intact habitat.

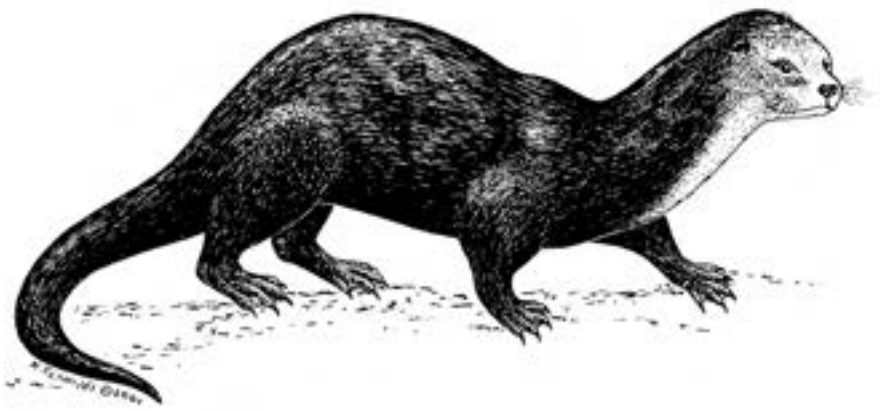
Backyard ponds and farm ponds are numerous and widespread in Milan; larger lakes are few. The shorelines of Spring Lake and Round Pond are fairly intensively developed, but those of Warackamac and the Milan portion of Silver Lake are mostly undeveloped.

Great egret meets great blue heron, Spring Lake. Photo © Phil Zemke

Stream and Riparian Corridor

A perennial stream flows continuously in years with normal precipitation (although some may dry up during severe droughts), and an intermittent stream flows for a few days, weeks, or months, but dries up at some time during a normal year. Perennial streams provide essential water for wildlife throughout the year, and are critical habitat for many aquatic plant, vertebrate, and invertebrate species. The fish and aquatic invertebrate communities of perennial streams may be diverse, especially in clean-water streams with unsilted bottoms. Coolwater and coldwater stream habitats have declined dramatically throughout the Northeast due to impacts of land uses, pollution, and the fragmentation of free-flowing streams by dams and inadequate and poorly-installed culverts. Native coldwater fishes such as brook trout† and slimy sculpin are sensitive to water temperature increases and sedimentation of stream habitats. They are further threatened by the introduction of exotic species such as smallmouth bass and non-native trout, which are better adapted to warm water temperatures, and compete with brook trout for food and habitat.

Brook trout† require clear, cool, well-oxygenated habitats of streams and lakes for most of their life needs, and require clean, unsilted, coarse substrates for spawning, conditions no longer present in many streams in agricultural and other unforested landscapes. Wild-reproducing brook trout are increasingly confined to small headwater streams, due to degraded water quality and stream habitat quality in lower reaches, and competition from brown trout, a non-native species that is stocked by NYSDEC in the Roe Jan and Wappinger Creek each year.



River otter frequents stream corridors, ponds, and wetland complexes. Drawing by Kathleen A. Schmidt © 2001

Wood turtle† uses perennial streams with deep pools and recumbent logs, undercut banks, or muskrat or beaver burrows year-round, but also travels away from the streams during the warm months for foraging and nesting. Perennial streams and their riparian zones, including sand and gravel bars, provide nesting or foraging habitat for many species of birds, such as spotted sandpiper, belted kingfisher, tree swallow, bank swallow, winter wren, Louisiana waterthrush,† great blue heron, and green heron. Red-shouldered hawk† nests in areas with extensive riparian forests, especially those with mature trees. In their study of riparian forests in Columbia and Dutchess counties, the Farmscape Ecology Program found little brown bat, northern myotis,† big brown bat, eastern red bat,† eastern small-footed bat,† and tri-colored bat† foraging in riparian corridors.[43] Some of these bats will use riparian and nearby forests as summer roosting sites and/or nursery areas. Muskrat, American beaver, American mink, and river otter are some of the mammals that depend on or regularly use riparian corridors. Rare plants of riparian areas in the region include cattail sedge,† Davis's sedge,† winged monkeyflower,† and goldenseal.†

Intermittent streams are the headwaters of most perennial streams, and are significant water sources for lakes, ponds, and wetlands of all kinds. The condition of these streams therefore influences the water quantity and quality of those larger waterbodies and wetlands. Intermittent streams provide microhabitats not present in perennial streams, supply aquatic organisms and organic debris to downstream reaches, and can be important local water sources for local wildlife.[44] Their loss or degradation in a portion of the landscape can affect the presence and behavior of wildlife populations over large areas.[45] Plants such as winged monkeyflower† and may-apple are sometimes associated with intermittent streams. Although intermittent streams have been little studied by biologists, they have been found to support rich aquatic invertebrate communities, including regionally rare mollusks[46] and dragonflies elsewhere in the region. Both perennial and intermittent streams provide breeding, larval, and adult habitat for northern dusky salamander and northern two-lined salamander. The forests and, sometimes, meadows adjacent to streams provide foraging habitats for adults and juveniles of these species. Figure 3 shows many of the streams in Milan, but omits many of the intermittent streams.

Riparian corridors in general are important both as habitat areas in their own right, and as components of the stream ecosystem. The condition of the riparian zone strongly influences the habitat quality and water quality of the stream. All undeveloped areas (without pavement or structures) in a floodplain serve to temporarily store floodwaters, and thus help to protect downstream areas vulnerable to flooding. Areas with dense herbaceous or woody vegetation are especially effective at dampening floodflows and holding soils in place. Intact riparian habitats also facilitate the regular movement of nutrients, sediment, organic matter, and living organisms between the stream, floodplain, and upland areas.

Intact stream corridors may be increasingly important in the face of climate change.

Riparian zones serve wildlife in many ways—as travel corridors, as resting habitat, and as places for foraging, nesting, or overwintering. Intact stream corridors may be increasingly important in the face of climate change, as they can assist wildlife in their migrations to cooler habitats northward or at higher elevations.

Figure 16 shows the larger streams in Milan classified by size, gradient, and predicted temperature. These classifications can help predict the kinds of aquatic communities that are likely to occur in those streams. Stream size, gradient, water temperature, and water quality are habitat characteristics that influence the aquatic communities of each stream segment, including the kinds of invertebrates and fish and the trophic structure of the stream community. Stream gradient influences the shape of the stream bed, the flow velocity, and the kinds of substrate materials. Stream temperature affects levels of dissolved oxygen and determines which fish and invertebrate species can survive. Stream temperature also triggers the onset of migration and developmental stages in certain stream organisms; influences the growth rates of eggs and juvenile fishes; and affects the body size and fecundity of fishes.[47]

For example, high-gradient streams often have swift water, step pools, and boulder and cobble substrates, while low-gradient streams tend to have slow water with riffles and pools, and with alluvium, sand, gravel, and cobble substrates. A swift coldwater stream is likely to support wild brook trout,[†] stoneflies, and other aquatic organisms of coldwater habitats. A "warm medium river" is more likely to support warmwater fish such as smallmouth bass, largemouth bass, and chain pickerel. If stocked brown trout are present, they are unlikely to survive year-round and reproduce in a warm stream. Of the Milan streams that have been assessed, many are in the cool-to-cold range and moderate-to-high gradient (Figure 16).

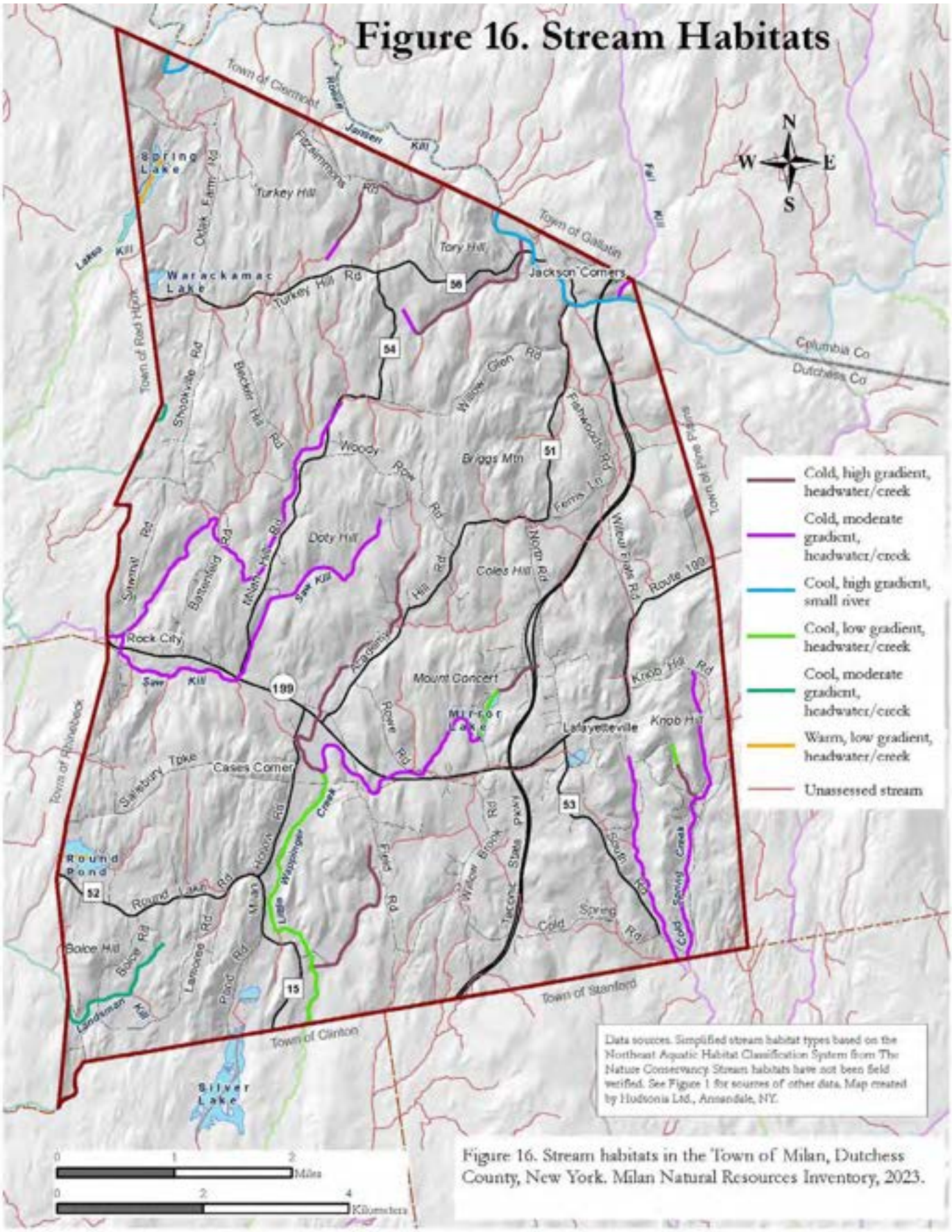


Figure 16. Stream habitats in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

Plants

Plants are the primary producers of the atmospheric oxygen (O_2) that we breathe, and they also process nutrients, build soils, provide food and microhabitats for animals and other plants, directly provide food, fiber, tools, and medicines for humans, and provide uncountable other services that make the world habitable.

All of our plant species are tied to particular kinds of environments. For that reason, you will find most grass species in meadows and shrublands but not in deeply-shaded hemlock forests; you will find pond-lilies in marshes and ponds but not in wet meadows that lack standing water; and you will find chestnut oak in dry, rocky hillside forests but not in forested swamps.

Mountain laurel. Photo © Kathy Rousseau

Conditions of moisture, temperature, light, and the chemistry and texture of soil or rock substrates are some of the obvious factors governing where a plant species might occur and persist. Among the less-obvious factors are relationships with other organisms; for example, beechdrops obtains its nutrients solely from the roots of beech trees, and pink lady's-slipper requires certain soil fungi for successful germination. Even the effects of long-ago land uses and catastrophic events (hurricanes, tornadoes, floods) can be detected in plant communities of today. While many of our plant species are fairly common in suitable habitats, some are quite rare in the town, the region, or the state. Many of the rarities occur where either the general habitat or the microhabitat is itself unusual.

From a conservation standpoint, rare species of plants and animals are a particular concern for several reasons: 1) their rarity may be a signal that some aspect of the environment is being lost or degraded, and that other parts of the biological community are also in trouble, and 2) they are in the greatest danger of disappearing from our landscapes, along with their known and unknown ecological roles and services. Some rare species are at or near the edge of their range and are living close to the limits of their environmental tolerances. Some are surviving at locations disjunct from their main populations, and may have limited resilience due to a depleted gene pool. Some are in rare habitats, or in habitats that have been stressed by habitat fragmentation, pollution, non-native invasive species, or extreme weather events.

Loss of rare species often indicates a degraded environment, and can alert us to needs for protection and restoration before other species or communities are lost. Table 2 lists the plant and animal species of conservation concern that have been reported from Milan, and the kinds of habitats where they are likely to occur.

Loss of rare species often indicates a degraded environment, and can alert us to needs for protection or restoration.

Non-native Plants

Non-native plant species are those that were introduced here over the last 350+ years, mostly from other parts of North America or from Eurasia. Many of the non-native grasses and forbs of pastures and hayfields were intentionally brought here with European-style agriculture. Many other non-natives were brought as ornamental plants and have since spread into forests, shrublands, meadows, wetlands, and roadsides. Others were brought here unintentionally as hitchhikers on ships, with imported goods, or in travelers' luggage.

Purple loosestrife (left) and Japanese knotweed (above), two non-native plant species that are widespread in Milan. Photos © Erik Kiviat

Some of these non-natives are apparently harmless in their new environments, occurring as single individuals or in small stands that do not readily spread, or are confined to highly-disturbed areas where native plants do not easily take hold. Some are even beneficial, such as those that can quickly colonize and stabilize disturbed soil before native plants have time to establish. But some—the "non-native invasive species"—reproduce and spread rapidly, and threaten native plants and

communities directly through competition, or indirectly by changing habitat characteristics, i.e., by altering soil chemistry, soil microbiota, nutrient cycling, vegetation structure, or plant community composition.[48] In many cases where a non-native invasive species takes over a site, it is merely a symptom of a larger problem—such as damaged or contaminated soils, or excess nutrients from polluted runoff.

Multiflora rose, Japanese barberry, Bell's honeysuckle, autumn-olive, oriental bittersweet, garlic-mustard, and purple loosestrife are some of the common invasives. Appendix Table C-2 lists many of the non-native invasive plants known to occur in Dutchess County, and their typical habitat(s). Despite their known invasive tendencies, some of these plants are still offered by nurseries and other gardening retailers. Removing them from landscaped areas will reduce their chances of spreading into nearby habitats and disrupting native biological communities.

The Lower Hudson Partnership for Regional Invasive Species Management is a clearinghouse for information about long-established, recent, and emerging invasive species of plants and animals in the region. iMapInvasives is an online site for gathering and disseminating information about invasive species. Information on the ecology of some of the local invasive plants and Best Management Practices for non-toxic methods of managing them is on the Hudsonia website.

Fungi

Fungi are nearly ubiquitous in the environment, although largely unseen and unappreciated by most of us. Their most visible representatives are mushrooms, puffballs, and shelf fungi—the fruiting bodies of fungi whose larger life occurs in the soil, in the organic duff or thatch on the ground surface, hidden beneath the bark of trees, or in rotting logs.

Mushrooms are the fruiting bodies of fungi that carry on most of their lives underground. Photo © Phil Zemke

Fungi are especially abundant in soils with high organic matter, where they work with microbes and other organisms in the decomposition of plant material and in nutrient transport.[49] Soil fungi play crucial roles in nutrient cycling—especially for carbon, nitrogen, and phosphorus. Some fungi (mycorrhizae) form mutually beneficial partnerships with host plants for which they increase water and nutrient uptake and receive carbon resources in return. Many fungi break down plant detritus, recycle carbon, minerals, and

nutrients for use by other organisms, and contribute to the soil structure. The mycelia (root-like structures) and the fruiting bodies (e.g., mushrooms) of fungi are also a food source for many species of microbes, insects, other invertebrates, amphibians, mammals, and other organisms, including humans.[50]

Fungi are also present in many environments besides soils—in fact, practically everywhere: on the skin, fur, and hair of mammals; in the digestive tracts of vertebrates; on leaf, twig, and bark surfaces; in nests of birds and mammals; and lots of other places.

Edible and Inedible Mushrooms

(by Tom Foote)

There are many, many poisonous mushrooms in Milan and around the world. Never eat any mushroom that you are unsure about. If you are certain that you have found an edible species, first eat just a very small bit to make sure your personal system can tolerate it with no adverse effects, like allergies.

Always cook mushrooms before you eat them. Commercial button mushrooms, porcini, et al., are grown in composted "sterilized" horse poop. Wild ones grow where they will. You want to eat the mushroom, but you do not want to eat any living microscopic flora or fauna that also likes mushrooms.

It is always best to consult with an expert before you consume any wild fungi. Here are some common poisonous mushrooms.

Amanita, aka Death Angel, will produce no symptoms for awhile. In the meantime, chemical compounds from any of the Amanita family, white, yellow, purple, whatever color, will turn your liver to jelly within a day and you will bleed to death. Period. When the Amanita first appears as a little button mushroom it looks somewhat like an edible puffball. It ain't.

Jack-O'-Lantern mushrooms can easily be confused with the delectable chanterelle, but will send you to the emergency room to have your stomach pumped.

Mushrooms in the Bolete order are most generally edible and easily identifiable, with caution. If they turn purple quickly when bruised or have a bitter taste, don't eat them. There is one bolete in Milan, the Slippery Bolete, which is deliciously edible if and only if you peel off the top skin. If you eat the skin of the Slippery Bolete, it will be slippery going down, and very slippery coming out a few hours later.

Morels, early spring, always hollow, are safe, easily identifiable, and delicious. The False Morel is not hollow inside, and is not to be eaten.

Finally, there are many varieties of Little Brown Mushrooms, affectionately known as LBMs, in Milan. Do not eat them.

Mushrooms are how most of us are aware of encountering fungi. Some mushrooms are edible and delicious, some are edible but undistinguished, and some are poisonous. Because of the danger posed by poisonous look-alikes, no one should collect mushrooms for consumption without the assistance of an expert.

We have no list of fungi species for Milan or for Dutchess County, but Tom Foote and Luzia Willms have found morels, black trumpets, boletes, hen-of-the-woods, jelly mushrooms, chicken mushrooms, oyster mushrooms and other edibles here. Kevin Pike has seen shrimp-of-the- woods on his farm.

Animals

Like most organisms, each animal species has a distinctive life history tied to a particular habitat or complex of habitats that fulfills its particular needs. The black rat snake,† for example, needs ledgy areas for denning, open unshaded rocky crests for basking and breeding, and a variety of forested and unforested habitats for hunting. The Blanding's turtle† spends much time in wetlands, but moves overland between wetlands during the warm months, and the female travels to and from upland nesting sites in the spring. The cerulean warbler† needs deciduous forests with mature trees for nesting and foraging here in its summer habitat, before migrating to the tropics for winter. For any species, the population will persist only if its habitats remain intact and its movement corridors safe.

The New York State Wildlife Action Plan[51] identified conservation actions that would prevent more animal species from becoming critically imperiled. The plan includes a list of NYS Species of Greatest Conservation Need (SGCN) for rare, declining, and at-risk species. The New York State SGCN list includes all species on the federal and state lists of Threatened and Endangered species, and others identified by NYSDEC, NYNHP, and other experts as species of regional conservation concern. The SGCN species are the focus of many ongoing and planned actions by New York State to identify, improve, restore, and protect important habitats. Recognizing that land in private ownership supports much of New York's biological diversity, an important goal of the State Wildlife Action Plan is to engage the public in biodiversity conservation.

Profiled below are just a few of the animal groups that occur in Milan and represent different kinds of life histories and habitats.

Invertebrates

The term "invertebrates" refers to all the animals that lack a spinal cord—an immense group that constitutes 97% of all animal species on Earth.[52] It includes insects, crustaceans, earthworms, millipedes, mollusks, tardigrades, and many other groups. The ecological importance of invertebrates cannot be overstated. Biologist E. O. Wilson[53] referred to them as "the little things that run the

world." They act as decomposers, soil builders, pollinators, distributors of seeds, grazers, predators, and prey.

Although some invertebrates such as butterflies and dragonflies are colorful and charismatic, and others such as earthworms, honeybees, termites, and mosquitoes are considered useful or bothersome, most invertebrates go about their lives unnoticed by us, despite their indispensable roles in our ecosystems. Indeed, some groups of organisms are so poorly known that many species in the region have yet to be recognized and described by science. Mentioned below are descriptions of just a few of the invertebrate groups that are known to serve outsized functions.

Seed bug (Lycaeidae) on Queen Anne's Lace.

Bees

Bees are the most important pollinators of both wild and domestic plants, because they collect both nectar and pollen as food, and have physical structures—specialized hairs on their hind legs or abdomens—that are evolved for transporting pollen.[54] In the process of visiting flowers to feed themselves and collecting pollen to feed their young, bees transport pollen between plants as they move from flower to flower on their collecting rounds. Many other insects, including butterflies, moths, beetles, wasps, and flies, visit flowers for the nectar and also carry pollen incidentally between flowers, but are usually less efficient as pollinators because they lack the highly developed structures for transporting pollen in large amounts.

New York State is home to an estimated 450 wild bee species. Of these, 21-22 species are introduced (including the honey bee) and 428 are considered native.[55]

Native bees are more effective than honey bees at pollinating many plants, including some domestic crops.

Native bees are more effective pollinators of many plants, including some domestic crops, than are honey bees, and many species of native bees are also able to forage earlier and later in the day, earlier and later in the season, and in wetter and colder conditions than honey bees.[56] Native bees feed on and collect nectar from a variety of plant species, but a few specialize on a particular species, genus, or family of plants for their pollen sources. For example, squash bees specialize on pollen from squashes, pumpkins, and cucumbers; a species of sweat bee specializes on primroses, and the pickerel bee specializes on pickerelweed. Some native bees are more efficient pollinators than honey bees for certain plants with tightly-held pollen, such as tomatoes, potatoes, and blueberries, because they are able to use a special "buzz-pollination" technique, vibrating their flight muscles at a certain frequency to cause the flower to release the pollen that is largely inaccessible to honey bees and other pollinating insects.

Honey bee (non-native) on purple loosestrife (also non-native). Photo © Erik Kiviat

Populations of many native bee species in North America have been declining at local and regional scales, due to causes such as habitat loss, pesticides, pollution, invasive species, pathogens, and climate change.[57] Exposure to these multiple threats can make the bees more vulnerable to any particular threat, such as pesticides. Bees are

Wood betony at Jacoby Farm. This wildflower is partially parasitic on other plants, and is pollinated by native bumble bees. Photo © Erik Kiviat

especially sensitive to pesticides (fungicides, herbicides, insecticides) and other toxins which they can absorb through their exoskeleton, and also consume in contaminated nectar or pollen. The exposure is not only from above-ground applications to plants, but also from soil fumigants that can be harmful to ground-nesting bees and other beneficial soil biota.[58] "Neonicotinoid" pesticides, now the most widely used class of pesticides worldwide, are absorbed by the treated plants and eventually stored in the plant tissue as well as the nectar and pollen, thus passing on the toxins to all organisms consuming those materials. Furthermore, only about five percent of the applied substance is absorbed by the target plants, and the remainder disperses into the environment where it affects many other organisms.[59]

Native bees and honey bees visit flowers in all habitats of Milan but the nesting habitats of individual species are more specialized. The majority of native species are ground nesters, and need suitable soil conditions to support their tunnels and brood cells. Habitats with bare or sparsely vegetated, friable soil are important for nesting by many bees, wasps, and other insects. Other bees nest in hollow stems of woody plants or in channels created by beetles or other animals in standing trees or downwood.[60] In general, maintaining diverse open and forested habitats that are free of toxic contaminants may be the best way to help sustain our populations of native bees and other insects that we rely on for pollination and a host of other services.

Dragonflies and Damselflies

Dragonflies and damselflies ("odonates") play key roles in ecosystems. They are predators in both their nymph and adult stages, and are themselves important prey of fish, amphibians, birds, bats, and other organisms. They are sensitive to the water chemistry, temperatures, and flows in their stream, pond, or wetland environments, as well as the kinds of vegetation, and the kinds of aquatic predators present. For these reasons odonates are sometimes used as indicators of habitat quality and the health of aquatic ecosystems.

Dragonflies and damselflies are aquatic in the larval (nymph) stage, and each species has its own affinities for moving or still water; rocky, sandy, or silty substrates; sun or shade. Some are more sensitive than others to conditions of water temperature, water clarity, or dissolved oxygen levels. Some are closely tied to special inland habitats such as acidic bogs, seeps, or rocky streams. As adults, many stay around wetlands, ponds, and streams, but some are more often seen hunting over

meadows or along hedgerows or forest edges. As with most other animals, understanding the habitats can help you predict where certain odonate species are likely to occur.

In 2005-2009 the county was included in the New York Dragonfly and Damselfly Survey conducted throughout the state by agency biologists and trained citizen volunteers. That project found 86 odonate species in Dutchess County, which is 44% of all the odonate species (194) known to occur in the state.[61] Appendix Table C-3 lists the dragonflies and damselflies known to occur in inland parts of Dutchess County, and the habitats where they are most likely to be found. A few of these species are of statewide conservation concern, including two that are known to occur in Milan—the brook snaketail and the lyre-tipped spreadwing.

The brook snaketail† is associated with fast-flowing streams with sandy and rocky substrates. It is vulnerable to water contamination, hydrological alteration, and other degradation of the stream habitats.[62] The lyre-tipped spreadwing† is a damselfly of small ponds and marshy wetlands, including unshaded wetlands and pools that dry up in the summer. It is vulnerable to pollution and hydrological alteration of those habitats.

The abundance and diversity of odonates is often used as a measure of habitat quality. The larvae of most dragonfly and damselfly species are sensitive to changes in the hydroperiods of their stream and pond habitats, and to water pollution and siltation. The adults eat a great variety of insect prey but are sometimes limited by food availability. They do best where diverse habitats—such as wet meadows, upland meadows, shrublands, and forests—are in close proximity to each other, providing plentiful perching and basking sites and varied prey throughout the active season.

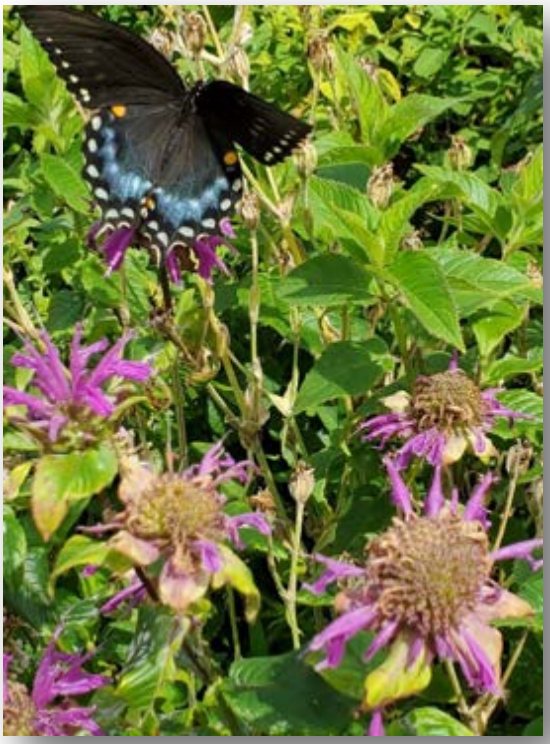
According to a study by the International Society for the Conservation of Nature (IUCN) published in 2021, 16% of the 6000 species of dragonflies and damselflies assessed worldwide are at risk of extinction.[63] Loss and degradation of wetland and stream habitats seem to be responsible for the declines of many North American odonate species. The best measures for supporting local odonate populations are maintaining water levels and seasonal hydroperiods in streams and ponds; maintaining good water quality in streams and ponds; avoiding the use of pesticides and introduction of predatory fishes; and maintaining diverse, intact terrestrial habitats near streams and ponds.

Tiger swallowtail. Photo © Phil Zemke

Butterflies and Moths

Butterflies and moths are some of our most conspicuous and charismatic insects, and they play important but sometimes hidden roles in ecosystems. They can contribute to the pollination of certain plants, serve as prey to other organisms—including other insects, spiders, reptiles, amphibians, mammals, and birds—and, especially through their voracious caterpillars, consume and process large amounts of vegetation, making nutrients available to other parts of the food web. Some species of butterflies and moths are closely tied to particular habitats or plant species, and many are very sensitive to environmental contaminants, such as pesticides.

Adults of butterflies and moths feed primarily on nectar and, although a few specialize on particular plant species, most are generalists, visiting whatever nectar-producing flowers are available during the adult flight periods. The larvae (caterpillars) of many species are much more specialized, and require particular species or genera or families of plants. For example, the caterpillars of the monarch butterfly feed on milkweeds; those of the Baltimore checkerspot feed on white turtlehead; those of the tawny emperor feed on hackberry; and those of the deceptive snout moth feed on basswood. Some other host plants for butterfly larvae are nettles (for red admiral, eastern comma), cherries (tiger swallowtail), oaks (certain hairstreaks and duskywings), ashes (mourning cloak), and grasses (skippers). Clovers, asters, violets, and willows are also hosts for many other butterfly species of the region. Appendix Table C-4 lists the known host plants for butterflies in the region.



Spicebush swallowtail on bee-balm.
Photo © Debra Blalock

Good sources of larval food plants and nectar sources for adults are key components of butterfly habitat, and local butterfly populations will persist only if their host plant species are present. Land management to encourage such species will help to ensure that butterfly food sources are not limiting.

Most butterfly species overwinter here as eggs, pupae, or adults[64] so, in addition to food sources during the active seasons, butterflies also need safe places for egg-deposition, pupation, and overwintering. Although not well understood, sites for basking and mating may also be important; for example, some butterflies are "hilltoppers" and congregate on open hilltops for mating. Pupation usually occurs in tall herbaceous vegetation, shrubs, trees, or woody debris, so leaving untidy patches of undisturbed soils and vegetation in fields or at field edges will help to maintain appropriate

microhabitats. The few butterflies and moths that overwinter as adults find shelter in tree cavities, under loose bark, under logs, rocks, or similar features.

Silver-spotted skipper on garden zinnia.
Photo © Debra Blalock

Our eastern monarch butterfly migrates to upland forests of Mexico for the winter. The population is under stress from loss of forest habitat in their wintering grounds, mortality from exposure to cold and wet conditions during large storms in recent years, and loss of milkweed (the larval host plant) in their summer habitat due to intensification of agriculture. The monarch life history helps illustrate the complexity of ecological relationships that also affect many other butterfly and moth populations.

New York State has over 2,500 species of butterflies and moths, occurring in all kinds of wetland and upland habitats. Appendix Table C-4 lists the butterflies known to occur in Dutchess County.

Mollusks

Mollusks play important roles in aquatic and terrestrial ecosystems. Some are good indicators of water quality.

Mollusks are a diverse group of invertebrates that include clams, mussels, snails, and slugs, among many others. They occur in upland, wetland, and aquatic habitats, and play important roles in aquatic and terrestrial ecosystems. Freshwater snails, for example, consume algae and organic debris obtained from the surfaces of rocks, plants, and other substrates, and are a food source for many other animals—e.g., crayfishes, fishes, amphibians, waterfowl, turtles, and mammals. The gilled mollusks are sensitive to low levels of dissolved oxygen, and even small amounts of petroleum hydrocarbons, certain metals, agricultural fertilizers and pesticides, and suspended sediments. They are thus considered to be good indicators of water quality. The snail species with lungs are more tolerant of pollution.[65]

Most land snails (including shelled snails and slugs) live in the leaf litter of forests, organic debris (thatch) of oldfields, and in wetlands, but some also use gardens, agricultural fields, and lawns. They feed on live and dead herbaceous material, bark, rotting wood, fungi, algae, and other things, and they are eaten by a large array of invertebrate predators, along with salamanders, turtles, small mammals, and birds. Most of our land snails are native to the region, but a few non-natives have become pests to farmers and gardeners. For example, the slugs most familiar to many of us are the several non-native species that are often pests in gardens and crop fields. There has been no survey

of mollusks in Dutchess County, but the group should be recognized for their essential ecological roles.

Fishes

The fishes of tidal and nontidal waters of New York have been studied for centuries, and two publications—*The Inland Fishes of New York State*[66] and *The Atlas of Inland Fishes of New York*[67]—compile much of present-day knowledge of the presence and distribution of fish species throughout the state. The fishes of Dutchess County occupy our swift-running hillside streams and our sluggish and meandering lowland streams, as well as lakes, ponds, and the Hudson River.

Tributaries to the Hudson provide important spawning habitat for certain migratory fishes, some of them migrating many miles inland. Dams on the tributaries, however, many of which have been in place for over 300 years, present insurmountable barriers to the upstream movement of most fish species, and have disrupted these spawning migrations that occurred for thousands of years before European settlement. Unlike other fishes, the American eel† can move overland to circumvent certain dams and waterfalls, and does so in small numbers on some tributaries. The eel is known to occur in the Roe Jan in and upstream of Milan. The eel arrives in the Hudson from the Sargasso Sea in the tiny, translucent "glass eel" stage, and spends many years in the Hudson and tributaries where it matures before migrating back to its ocean spawning grounds.

Other fishes of Milan streams do not depend on epic migrations to and from the Hudson River and the ocean, but spend their entire lives in nontidal streams, lakes, and ponds where they move seasonally between different areas as they seek suitable water depths, water temperatures, and feeding areas. Some, such as bridle shiner and fathead minnow, inhabit slow-moving streams or ponds, and are somewhat tolerant of polluted waters. Others such as brook trout† and slimy sculpin need faster-flowing, clean, cool, well-oxygenated streams. Trout streams are a declining resource in the Hudson Valley due to water pollution, stream-bed siltation, removal of forest canopies in the stream corridors, altered stream flows, and other consequences of human activities. The degradation of streams coincides with the decline of wild-reproducing populations of brook trout and other organisms of high-quality coldwater streams.

Stream degradation coincides with the decline of wild-reproducing populations of brook trout.

To support recreational fishing, NYSDEC stocks brown trout (non-native) annually in several Dutchess County streams and ponds. In 2023 the plan was for spring stocking of yearling and older brown trout in the Milan reach of the Roe Jan, downstream reaches of Wappinger Creek, and several other streams. Brown trout competes with brook trout for habitat and food resources, and may interfere with the growth of slimy sculpin, another fish of coldwater streams.[68]

Figure 17 shows zones along selected streams and lakes that have been designated by NYSDEC as **Areas of Known Importance** for sensitive coldwater stream habitats. Those mapped areas include wild brook trout locations identified in NYSDEC fish surveys since 1980, as well as zones along associated stream and waterbody segments that are most likely to affect the stream habitat quality. The map does not account for stream habitat fragmentation that might be caused by dams and suspended culverts preventing trout from occupying some of those areas. The identification and mapping of these coldwater stream habitat areas is intended to promote conservation and stewardship to maintain or restore high quality streams that may support wild native brook trout† and other sensitive stream organisms. The map does not indicate areas with public fishing rights, however, and many of these mapped areas are unsuitable for recreational trout fishing due to small fish populations and small fish size. Appendix Table C-5 lists the fish species known to occur in nontidal habitats of Dutchess County. Measures to protect these coldwater habitats include 1) maintaining or restoring streambank and riparian forests, 2) minimizing impervious surfaces in the stream's watersheds, and 3) preventing polluted runoff from entering the stream.

Amphibians and Reptiles

Of the 69 species of amphibians and reptiles occurring in New York State,[69] 27 are known to or are likely to occur in Milan, including nine species of salamanders, ten toads and frogs, eight turtles, and eleven snake species. Although each species has its own habitat affinities, as a group these animals use all parts of the landscape, including intermittent and perennial streams, springs and seeps, wetlands of all kinds, ponds, lakes, upland meadows, shrublands, forests, and exposed ledges and talus. Appendix Table C-6 lists the amphibians and reptiles that are known to or are likely to occur in Milan. Below are brief descriptions of just a few that represent various parts of the Milan landscape.

Green frog breeds in ponds and marshes with more-or-less permanent water, and forages in a variety of other kinds of wetlands.
Photo © Debra Blalock

Common garter snake and DeKay's brown snake are probably the two most abundant snakes in Dutchess County, but garter snake is the one we see most often. Both species use all kinds of upland habitats, and even our yards and gardens. The smooth green snake† uses wet meadows more than other habitats. It is not

Painted turtle lives mainly in permanent ponds, but nests in nearby upland areas.
Photo © Glenn Butler

uncommon in the region, but is often unseen because it spends much time under rocks, logs, and other cover objects and, when not sheltering, its bright green color blends with the meadow vegetation. Black rat snake† and black racer† use all kinds of upland habitats during the warm months, and overwinter in deep rock crevices or rock talus, or sometimes other sheltered areas including the basements of buildings.[70] Although many of our snakes are capable swimmers, the northern watersnake is the only aquatic snake in the county. It occupies a great variety of habitats with permanent water—lakes, ponds, streams, marshes, and other wetlands— and, although sometimes found on land, it rarely moves very far from wet areas. The only venomous snake in Milan is the copperhead.† It spends much of its time in forests near exposed ledges and talus. Milan is at the northern limit of the species' range.[71]

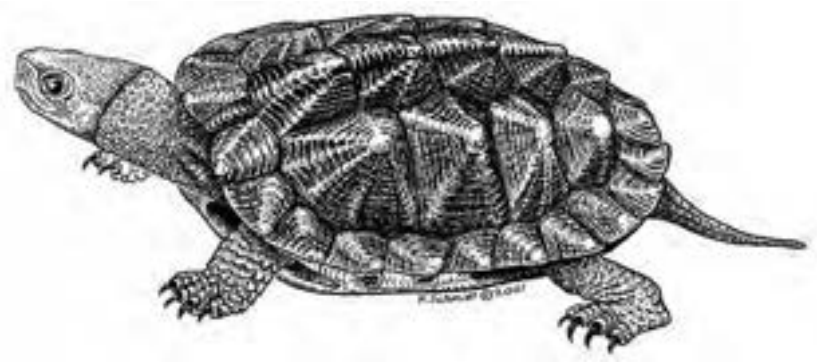
The turtles most commonly seen by Milan residents are the painted turtle and snapping turtle.† These species use a wide range of wetland and pond habitats and nearby upland areas. Painted turtles are often seen basking on logs, rocks, or shorelines, and both species are often seen crossing roads during their nesting migrations in the spring and early summer. They nest in unshaded upland areas near their home wetlands, including roadsides, lawns, and meadows. Our other turtles are less conspicuous, and more specialized in their habitat needs, and all but the painted turtle are listed as NYS Species of Greatest Conservation Need.

The Blanding's turtle† is a Threatened species in New York that occurs in only a few towns in Dutchess County, in Saratoga County, and in northern New York in the St. Lawrence Valley. The turtles typically spend winter, spring, and fall in their core wetland,[72] but during the warm months (April – October), they also use other nearby wetlands, including emergent marshes, swamps, intermittent woodland pools, and lakes, for foraging, rehydrating, and resting, sometimes moving up to 3,300 feet from their core wetlands. Females nest in open upland habitats with (usually) coarse-textured, well-drained soil (often gardens, agricultural fields, utility rights-of-way, and soil mines), in late spring to early summer. During drought periods and during the nesting season migrations, individuals may move into constructed ponds or other waterbodies that retain standing water. Maintaining a Blanding's turtle population requires protecting not only the core wetland habitat (i.e., a kettle shrub pool or buttonbush pool), but also the associated foraging and drought refuge wetlands, the upland nesting areas, and the upland areas between these habitats. Blanding's turtles

are known to occur in Milan, and their populations are likely to persist only if their habitat complexes are not further fragmented by developed uses.

The musk turtle†—named for the odorous musk emitted when it is disturbed—is an aquatic turtle of large streams, lakes, and associated wetlands, and it rarely moves far from those habitats. It is known to occur in Spring Lake,[73] and probably occurs at other locations too.

The wood turtle† mainly uses low-gradient perennial streams. Although it spends much time in and near streams and overwinters in streambanks, it also travels widely to other wetland and upland habitats for foraging and nesting during the warm months. These travels expose the turtles to the many hazards posed by vehicles on roads, driveways, agricultural fields, and golf courses.



Wood turtle. Drawing by Kathleen A. Schmidt © 2001

The spotted turtle† uses a variety of wetland and upland habitats. It overwinters in wetlands; nests in unshaded wetland or upland habitats in the spring; spends long periods in upland habitats—especially forests—during the warm months, and moves between wetland habitats for foraging in summer. The box turtle† is the most terrestrial of the Dutchess County turtles, spending most of its time in upland forests, shrubland, and meadows, but it uses wetlands or ponds at times in the summer, especially during heat waves or droughts.

Box turtle on Becker Road. Photo © Phil Zemke

The critical habitat for the bog turtle† is a fen, an uncommon kind of wetland characterized by calcareous (calcium-rich) groundwater seepage and low herbaceous and shrubby vegetation, and a distinctive plant community with species such as shrubby cinquefoil, grass-of-Parnassus, and bog goldenrod. The turtles typically spend the entire year in the fen and adjacent wetlands, but sometimes need to move overland to reach other fens. Fen habitats can be damaged by direct disturbance and by disruption or pollution of water sources. The bog turtle is known from just one location in Milan. Like other rare turtles, this species is very vulnerable to illegal collecting, so known locations are not typically divulged to the public unless there is an imminent threat of harm or disturbance.

The northern dusky salamander is closely tied to forested streams and seeps, where adults spend much of the daytime beneath rocks and woody debris, and emerge at night to forage, rarely moving more than a couple of meters from the stream or seep. The two-lined salamander is another species of forested streams and seeps, but is sometimes found in unforested streams or even long distances from water.[74]

Jefferson salamander,† spotted salamander, marbled salamander,† and wood frog constitute the special group of "vernal pool-breeding amphibians" in this region because of their need for intermittent woodland pools (vernal pools in forested settings) for breeding and nursery habitat. These are typically small, isolated pools that hold water in the winter and spring but dry up during the summer and, consequently, do not support fish. These four amphibians are especially vulnerable to fish predation on their eggs and larvae, so the fish-free environment eliminates an important threat to reproductive success. Although they use the pools for breeding and nursery habitat, the adults and metamorphosed juveniles spend most of the year in the surrounding upland forests, so the pool and forest are equally important to maintaining local populations.

While some of our amphibians spend most of their time in and near water, the red-backed salamander and slimy salamander spend all their time in upland (non-wetland) habitats. Many others, including the pool-breeding salamanders, American toad, gray treefrog, and spring peeper, need wetlands and ponds for breeding but are otherwise terrestrial. The red-spotted newt breeds in permanent pools. The young spend two or more years in upland forests as "red efts," and then return to a permanent pool to spend their adulthood.

The red-spotted newt is most conspicuous during its terrestrial "red eft" stage. Photo © Bradley Rubenstein

The American toad breeds in temporary or permanent pools but spends the rest of the year in upland habitats. Photo © Vicki McKenzie

The common frog and toad species of Milan are green frog, bullfrog, pickerel frog, wood frog, gray treefrog, spring peeper, and American toad. Northern leopard frog and Fowler's toad occur elsewhere in Dutchess County, but are not yet documented in Milan. Green frog and bullfrog spend most of their time in and at the edges of permanent ponds and sometimes streams. Pickerel frog breeds and overwinters in ponds or ponded areas of wetlands, but spends much time in upland meadows and moist forests during the warm months. Wood frog, gray treefrog, and spring peeper are mostly terrestrial. They breed and spend their early 2-3 months in vernal pools (wood frog), or semi-permanent pools of ponds and wetlands (gray treefrog and spring peeper), but spend the rest of their lives in upland forests. American toad breeds in a variety of pool-like habitats, but is otherwise terrestrial, using a variety of meadow and forest habitats.

Birds

The New York State Ornithological Association has records of 252 bird species breeding in New York State, and the Breeding Bird Atlas (BBA)[75] shows approximately 157 species confirmed or probably breeding in inland Dutchess County in one or both of the 1980-85 and 2000-2005 BBA surveys. Appendix Table C-7 lists the breeding birds of Milan noted in those surveys. These include waterfowl, shorebirds, wading birds, raptors, songbirds, and others. Many additional species overwinter here or travel through during migrations. The Ralph T. Waterman Bird Club keeps a record of birds seen throughout the county, and publishes the notable sightings in their bi-monthly newsletter, *Wings Over Dutchess*.

Like other animals, most bird species are associated with particular kinds of habitats that suit the species' life history. Some species are well-adapted to human-settled landscapes, where they take advantage of lawns, bird feeders, gardens, shade trees, hedgerows, pastures, cropfields, or even buildings and bridges. Others need permanent water (pied-billed grebe†) or the interior areas of large meadows (vesper sparrow†) or large forests (black-throated blue warbler†) to help defend their nests from predators that frequent the habitat edges. Some need forests with large trees (cerulean warbler†) and others do best in young forests or shrublands (American woodcock†). Some prefer forests with abundant shrubs in the understory (worm-eating warbler†), and some prefer open understories (whip-poor-will†). Knowledge of habitat types and characteristics can help you predict the kinds of birds that are likely to nest, roost, forage, or hunt there.

The population status of Dutchess County bird species—that is, their presence, abundance, or rarity—depends on a great variety of factors, including some factors that are beyond our control. Stresses from loss or degradation of wintering habitats in the southern US or the tropics or stopover habitats on migration routes can weaken the birds or reduce the numbers that reach their Dutchess County breeding grounds and nest successfully. For some species this region is near the southern or northern limits of their breeding range and climate tolerances, so the birds may be especially vulnerable to weather extremes and other stresses. For many birds the habitat conditions here are a

Juvenile bald eagle at Spring Lake. Juvenile and adult eagles are often seen fishing at large waterbodies and sometimes eating carrion at upland sites. Photo © Phil Zemke

large factor in determining their population status, and our uses of the land strongly influence the survival and persistence of local populations.

Factors affecting Dutchess County bird habitats include fragmentation (e.g., for large meadows or large forests), loss of suitable habitat due to succession (as of meadow to shrubland, shrubland to young forest, young forest to mature forest), human disturbances, pesticides, water pollution, and climate change, among others. In many cases, combinations of factors may be at play. Observations of eastern whip-poor-will,† for example, in the two Breeding Bird Atlas surveys declined by 57% throughout the state. Reasons for the declines are unknown, but some possible causes are forest maturation, increases in air pollution and pesticide use, decline in saturniid moths (a major food source), loss of open-understory forest due to fire suppression, and loss of forests due to land development and agriculture.[76,77] Declines of ruffed grouse† have been attributed to loss of young forest habitat.

The term "grassland breeding birds" refers to several ground-nesting bird species that require large meadow areas to reproduce successfully and maintain local populations in the long term. These include species such as northern harrier,† bobolink,† eastern meadowlark,† vesper sparrow,† savannah sparrow, and grasshopper sparrow† that use meadows for nesting as well as feeding. The dramatic declines of grassland breeding birds in the Northeast since the 1960s have been attributed to loss of large meadows due to intensification of agriculture, abandonment of agricultural land, and subsequent transitions to shrubland and young forest, conversion to developed uses, and burgeoning populations of human-subsidized predators (on eggs and nestlings) such as raccoon and striped skunk. Conservation of grassland birds is discussed in the **Conservation Principles and Measures** section, below.

Meadows are also essential foraging, hunting, and courtship habitat for American woodcock† which uses meadows for springtime courtship displays, and meadow edges (along with shrublands and forests) for foraging throughout their active season. American kestrel† hunts in meadows and uses hedgerows, forest edges, or isolated large trees for hunting perches and nesting. Eastern bluebird nests in tree cavities or artificial nest boxes in or at the edges of large meadows. Eastern kingbird nests in trees or shrubs of meadows, shrublands, or orchards, and hunts in open areas.

Among the birds that nest in shrublands are common species such as northern cardinal, common yellowthroat, song sparrow, and chestnut-sided warbler, and less-common or rare species such as prairie warbler,† blue-winged warbler,† golden-winged warbler,† and brown thrasher.† The populations of many shrubland-nesting birds have declined in recent decades with the disappearance of shrubland; fire suppression and declining agriculture over the last 60-80 years has reduced shrubland extent to an 80-year low in the Northeast.[78] Most upland shrublands are temporary habitats that, without occasional natural (e.g., fire, tornado) or artificial (e.g., brush-hogging) disturbance will transition to young forest over two to three decades.

Mammals

Mammals occur in all kinds of habitats in Milan, including human-made structures. Many mammal species are well-adapted to human-settled landscapes, and some, such as white-tailed deer and raccoon, especially thrive on the bounty of our cropfields and gardens. American beaver, muskrat, river otter, and American mink are rarely far from streams, ponds, lakes, or marshes, and New England cottontail† is usually in shrubland. Others, such as bobcat, black bear, eastern coyote, and foxes range widely over the landscape for hunting and foraging, although they may retreat to a remote place for denning. Meadow vole populations can be immense in large meadows,

Black bear, Battenfeld Road. Photo © Glenn Butler

where they are a favored prey of coyote and foxes. Most of our mammals spend their entire lives here, but three bat species—eastern red,† silver-haired,† and hoary bats†—migrate to southern places for the winter.

Of the nine bat species known to occur here, all but one is listed as NYS Species of Greatest Conservation Need.

Bats are the mammals of greatest conservation concern in the county. Of the nine bat species known to occur here, all but one is listed as NYS Species of Greatest Conservation Need. Those that spend the winter in caves are subject to the white-nose syndrome (WNS), a fungal disease that has spread rapidly through eastern caves since 2006 and has devastated the populations of many bat species. The New York population of northern long-eared bat,† for example, has suffered a 99% decline due to WNS. NYS regulates land use near known bat-occupied caves and sets rules for cave visitation to protect bats.[79,80]

The New England cottontail† is a rare rabbit listed as a Species of Special Concern in New York. It occurs only east of the Hudson River, and is the only cottontail rabbit native to New York and New England. It is very similar in appearance to the non-native—and much more common—eastern cottontail, although the New England cottontail has shorter ears and has a black spot between the ears. The species' range has shrunk by 86% since 1960,[81] apparently due to loss of habitat, but competition with eastern cottontail may also play a part. The New England cottontail is a habitat specialist, requiring dense shrub thickets and young forests with dense, shrubby understories.[82] NYSDEC has been conducting surveys to identify places where the New England cottontail still occurs, and has been working with local landowners to create, restore, and maintain shrubland habitat suitable for this species.

White-tailed deer occupy a unique place in the ecology and history of the region. They are an indigenous component of northeastern ecosystems, have long provided humans with food, clothing, shelter, and tools, and are still a significant resource for recreational hunting. Although they were hunted to near-extirpation by the late 1800s, the population has since recovered and in recent decades has exploded in and near our settled landscapes, creating nuisances for property owners and gardeners, economic losses for farmers, road hazards, and ecological problems in forests.

White-tailed deer grazing and browsing ("herbivory") profoundly affects forest structure and succession. When deer populations are high, selective browsing and seed predation prevents the regeneration of many of our forest tree, shrub, and wildflower species, and encourages infestations of non-native plants. Those alterations to the plant community also affect bird nesting habitat, the invertebrate fauna, and the prevalence of tick-borne diseases.[83] The ecological threats from the large deer population are discussed further in the **Threats to Natural Resources** section.

Appendix Table C-8 lists the mammals known to occur in Dutchess County, most of which are also likely to occur in Milan.

Rare Species and Significant Natural Communities

Table 2 lists the plant and animal species of conservation concern that have been documented in Milan. The information comes from the New York Natural Heritage Program's biodiversity databases, the 1990-1999 New York Amphibian and Reptile Atlas, and the New York State Breeding Bird Atlas (NYBBA). Species from the NYBBA are included in the table if they were documented in Atlas blocks that are more than 50% in Milan. The table includes species listed in New York as Endangered, Threatened, Special Concern, Rare, Species of Greatest Conservation Need (SGCN), or ranked S1, S2, or S3 by the New York Natural Heritage Program. Generalized primary habitat types are provided for each species, but for conservation and planning purposes, it is important to recognize that many species use more than one kind of habitat. More information on rare animals, New York State Endangered and Threatened animal species and species of special concern are listed in section 182.5 of Title 6 of the New York Codes, Rules, and Regulations (NYCRR). New York State Endangered, Threatened, and rare plants are listed in section 193.3 of 6NYCRR.

SGCN are species identified in the New York State Wildlife Action Plan that are experiencing some level of population decline, have identified threats that may put them in jeopardy, and need conservation actions to maintain stable population levels or sustain recovery.[84] High priority SGCN are species that, without timely management intervention, are likely to reach critically low population levels in New York within ten years.

The New York Natural Heritage Program maintains a statewide list of rare species and exemplary natural communities. Each rare species and subspecies in the NYNHP inventory is assigned a rank based on its rarity, population trends, and threats. This *NRI* refers only to the three ranks—S1, S2, S3—that indicate rarity or limited occurrence in New York State. Appendix D provides more information on the criteria used for each of these rankings and listings for species of conservation concern. An important caution: The NYNHP has records of rare species known from the research of their own biologists, from reports submitted by other biologists, and from specimens vouchered in museums, herbaria, and other institutions. But most places have never been surveyed for rarities by biologists or naturalists, so no one knows all the other places where rare species might occur. It is expected that other rare species also occur at locations in Milan in addition to those listed in Table 2 and shown in Figure 17. Habitat assessments and, where needed, onsite surveys by qualified observers are the best ways to determine the likely presence or absence of rare species.

How to use the list of species of conservation concern? In the course of planning for development or conservation on any site, knowing what kinds of habitats are present, and their condition, can help you predict the kinds of rare or uncommon plants and animals that might occur there. For example, if the site has young forest or shrubland, it might have nesting black-billed cuckoo, brown thrasher, Canada warbler, prairie warbler, or whip-poor-will—all are NYS Species of Greatest Conservation Need. If you are concerned about protecting the potential habitat for those species,

Table 2 Species of conservation concern in Milan.

Most places in Milan have never been surveyed for rare species, and only a few groups of species are tracked by the NYNHP and NYSDEC, so this list is necessarily incomplete.

Common Name	Scientific Name	General Habitat	NYS Ranks[1] SGCN	NYS Ranks[1] E,T,SC,R	NYNHP Rank[2]
PLANTS					
clustered sedge	*Carex cumulata*	rocky summit, wetland		T	S2S3
Davis's sedge	*Carex davisii*	floodplains		T	S2
fairy wand	*Chamaelirium luteum*	forest, meadow		E	S1S2
false hop sedge	*Carex lupuliformis*	wetland		T	S2
rattlebox	*Crotalaria sagittalis*	disturbed sites		E	S1
DRAGONFLIES & DAMSELFLIES					
brook snaketail	*Ophiogomphus aspersus*	stream	SGCN		S3
lyre-tipped spreadwing	*Lestes unguiculatus*	stream, forest	SGCN		S2S3
FISHES					
American eel	*Anguilla rostrata*	stream, lake, pond	SGCN^{HP}		S2S3
brook trout	*Salvelinus fontinalis*	stream	SGCN		
REPTILES					
Blanding's turtle	*Emydoidea blandingii*	forest, wetland	SGCN^{HP}	T	S2S3
bog turtle	*Glyptemys muhlenbergii*	wetland	SGCN^{HP}	E	S2
common snapping turtle	*Chelydra s. serpentina*	wetland, open water	SGCN		
eastern box turtle	*Terrapene c. carolina*	forest, young forest	SGCN	SC	
eastern ribbon snake	*Thamnophis sauritus sauritus*	lake, stream, wetland	SGCN		
northern black racer	*Coluber c. constrictor*	forest, shrubland, meadow	SGCN		
smooth greensnake	*Opheodrys vernalis*	stream, lake, wetland	SGCN		
spotted turtle	*Clemmys guttata*	wetland	SGCN^{HP}	SC	
wood turtle	*Clemmys insculpta*	stream	SGCN^{HP}	SC	

(continued)

Table 2. (cont.)

Common Name	Scientific Name	General Habitat	NYS Ranks[1] SGCN	E,T,SC,R	NYNHP Rank[2]
AMPHIBIANS					
blue-spotted salamander	*Ambystoma laterale*	swamp, vernal pool, upland forest	SGCN[HP]	SC	
four-toed salamander	*Hemidactylium scutatum*	swamp, upland forest	SGCN[HP]		
Jefferson salamander	*Ambystoma jeffersonianum*	vernal pool, upland forest		SC	
marbled salamander	*Ambystoma opacum*	vernal pool, upland forest	SGCN	SC	
BIRDS					
American kestrel	*Falco sparverius*	meadow	SGCN		
black-billed cuckoo	*Coccyzus erythropthalmus*	young forest, shrubland	SGCN		
blue-winged warbler	*Vermivora pinus*	young forest, shrubland	SGCN		
bobolink	*Dolichonyx oryzivorus*	grassland	SGCN[HP]		
brown thrasher	*Toxostoma rufum*	young forest, shrubland	SGCN[HP]		S3S4B
Canada warbler	*Wilsonia canadensis*	young forest, shrubland	SGCN[HP]		
Cooper's Hawk	*Accipiter cooperii*	forest		SC	
eastern meadowlark	*Sturnella magna*	grassland	SGCN[HP]		
grasshopper sparrow	*Ammodramus savannarum*	grassland	SGCN[HP]	SC	S3B
Louisiana waterthrush	*Seiurus motacilla*	forest	SGCN		
northern goshawk	*Accipiter gentilis*	forest	SGCN	SC	S3S4B, S3N
prairie warbler	*Dendroica discolor*	young forest, shrubland	SGCN		
red-shouldered hawk	*Buteo lineatus*	forest	SGCN	SC	
scarlet tanager	*Piranga olivacea*	forest	SGCN		
sharp-shinned hawk	*Accipiter striatus*	forest		SC	
whip-poor-will	*Caprimulgus vociferus*	young forest, shrubland	SGCN[HP]	SC	S3B
wood thrush	*Hylocichla mustelina*	forest	SGCN		
worm-eating warbler	*Helmitheros vermivorum*	forest	SGCN		

(continued)

Table 2. (cont.)

Common Name	Scientific Name	General Habitat	NYS Ranks[1] SGCN	E,T,SC,R	NYNHP Rank[2]
MAMMALS					
tri-colored bat (eastern pipistrelle)	*Pipistrellus subflavus*	cave, wooded stream corridor, forest	SGCN^{HP}		S1
New England cottontail	*Sylvilagus transitionalis*	shrubland, shrub swamp, young forest	SGCN^{HP}	SC	S1S2

[1] New York State ranks: SGCN = Species of Greatest Conservation Need; SGCN^{HP} = High Priority Species of Greatest Conservation Need
E = Endangered; T = Threatened; SC = Special Concern; R = Rare
[2] New York Natural Heritage Program (NYNHP) ranks are explained in Appendix D.

you could consult the NYNHP Conservation Guides[85] which provide ecological and habitat information for many species of species of conservation concern, including birds. Another good source of information on birds is the Cornell Lab of Ornithology website. Once you learn about the particular habitat needs of the species of interest, you will be better equipped to manage the land accordingly. Or, if you are considering subdividing or developing the property, you could design those changes in ways that would protect the young forest or shrubland habitats, and preserve intact connections to other nearby habitat areas.

Areas of Known Importance

The New York Natural Heritage Program (NYNHP) has identified "Areas of Known Importance" in the vicinities of known occurrences of rare species in the region. These are areas deemed to be important for the continued persistence of those species, based on their life histories and habitats, and the physical and hydrological features of the landscape. Figure 17 shows Areas of Known Importance for rare plants near Cold Spring Creek; diadromous fishes (those that migrate between fresh and salt water) in the Roe Jan and rare aquatic animals in a Roe Jan tributary; coldwater stream animals along the Roe Jan, the Lakes Kill, and tributaries; rare wetland animals along many Milan streams; and rare terrestrial animals in the vicinities of Saw Mill/Shookville roads and Academy Hill Road.

The actual species of concern in those areas are not divulged here because of the sensitivity of the information. Rare species are vulnerable to illegal collecting, harassment, or removal, so the NYNHP and NYSDEC are careful to keep exact locations confidential unless there is an important reason to make them known to a landowner or the public. If there is a potential or imminent threat to an Area of Known Importance, further information can be obtained from those agencies.

The NYNHP has also identified rare or exemplary natural communities in the region as "Significant Natural Communities," including two significant "Palustrine Communities" in the southeast corner of town (Figure 17).

The Areas of Known Importance for sensitive coldwater stream habitats include locations with wild brook trout populations identified in NYSDEC fish surveys since 1980, and streamside areas most likely to affect the quality of the stream habitat. Most of the mapped areas have no public fishing rights, however, and many are unsuitable for recreational trout fishing due to small fish populations and small fish size.

Significant Biodiversity Area

In the 2006 Wildlife and Habitat Conservation Framework,[86] NYSDEC has identified twenty-three "Significant Biodiversity Areas" (SBAs) throughout the ten counties of the Hudson River estuary corridor. One of these—the Dutchess County Wetlands Significant Biodiversity Area—encompasses several land areas between the southern part of Milan (Figure 17) and southern Dutchess County. This is by no means the only significant area for biodiversity in Milan, but has been recognized for especially high concentrations of rare and vulnerable habitats and species.

The Dutchess County Wetlands SBA is a network of four major wetland complexes that provide important habitat for a variety of amphibian, reptile, bird and plant species of conservation concern, and the highest diversity of turtles of any region in New York State. Both the wetlands and the intervening upland habitats are important parts of the habitat complexes for these species. The SBA also includes several exemplary ecological communities including floodplain forests, marshes, and fens. The purpose of the SBA designation is to raise awareness among public agencies, landowners, and other land use decision-makers and planners about these sensitive resources that are threatened by residential development, the fragmentation of habitat complexes, and polluted runoff from nearby roads, agricultural lands, and developed areas.

The NYNHP's Areas of Known Importance and NYSDEC's Significant Biodiversity Areas carry no legal weight, but the designations are intended to guide planning, environmental reviews of land development projects, and other land use decision-making, and to promote conservation and stewardship of lands including and surrounding these areas. Maps such as Figure 17 can alert landowners, developers, municipal agencies, and other land use decision-makers to the potential for impacts to rare species and rare communities, so that the most sensitive areas can be protected.

When new land uses are contemplated within an SBA or an Area of Known Importance, people are encouraged to contact the NYNHP to learn more about the particular elements of concern in the vicinity. These areas should not be interpreted, however, as the only areas of conservation concern, or the only areas where rare species may occur. The maps of Areas of Known Importance should never be used as a substitute for onsite habitat assessments or rare species surveys where such studies seem warranted.

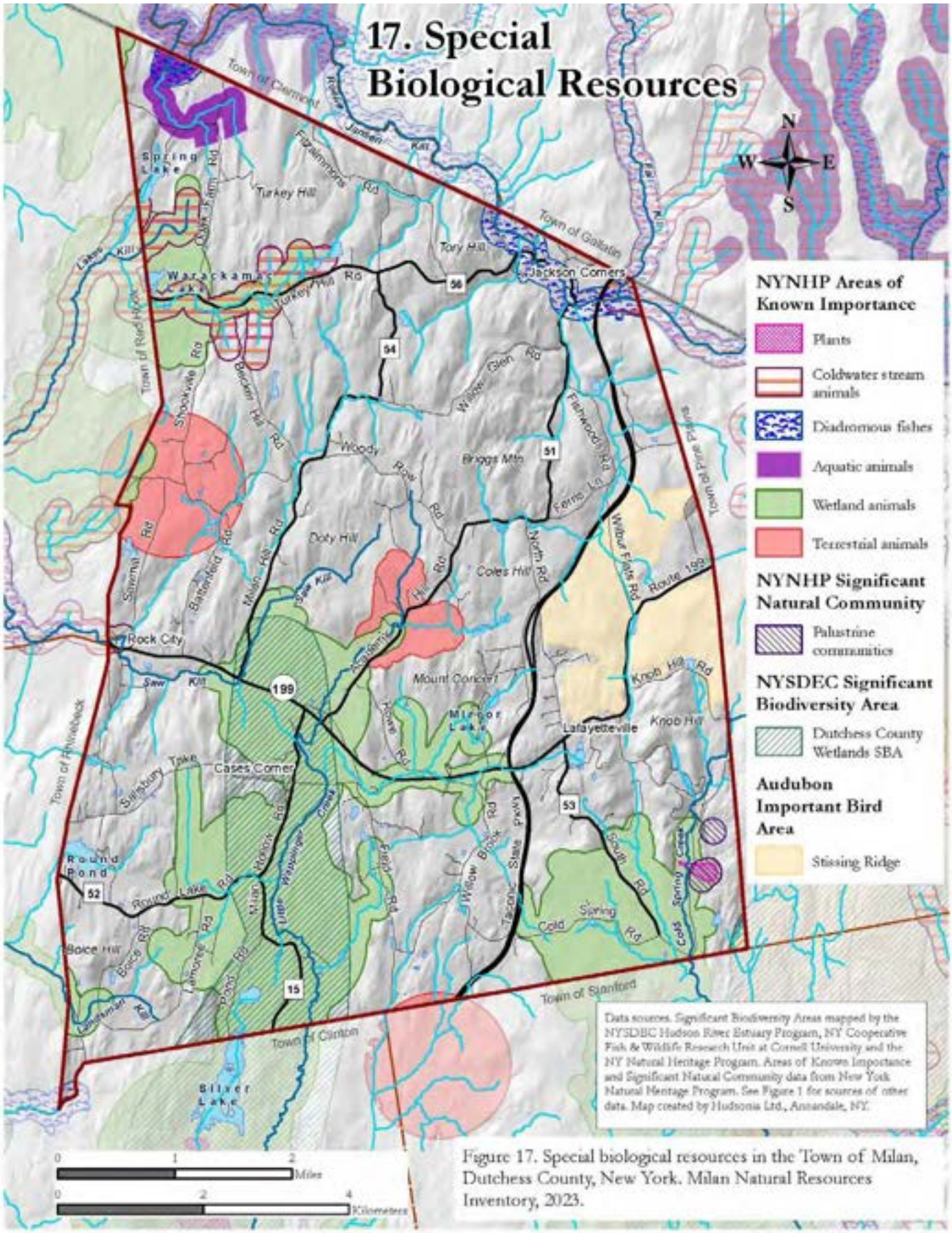


Figure 17. Special biological resources in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

FARMLAND RESOURCES

Today, the farmed lands in Milan are much reduced since the peak of agriculture in the 1800s, but farmland parcels still encompass over 6000 acres in the town. Milan has large areas of good agricultural soils. Figure 18 shows the extent of Prime Farmland Soils and Farmland Soils of Statewide Importance in town, based on the soils map in the *Soil Survey of Dutchess County New York*.[87]

PRIME FARMLAND SOILS

The technical criteria established by Congress to identify Prime Farmland Soils, include:

- adequate natural moisture content;
- specific soil temperature range;
- pH between 4.5 and 8.4 in the rooting zone;
- low susceptibility to flooding;
- low risk to wind and water erosion;
- minimum permeability rates; and
- low rock fragment content

Prime Farmland Soils are those that have the "best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and [are] also available for these uses."[88] Typically they are deep soils on level or nearly-level land, and are well-drained, fertile (e.g., with high pH and high base cations), and stable. These soils have "the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management."[89] Farmland Soils of Statewide Importance are considered to be nearly as productive as Prime Farmland Soils and produce high yields of crops when properly managed.[90] Table 3 lists these soils that occur in Dutchess County.

Leland Jacoby
(interview)

Farming - low income, low return, all goes back into the farm and hours are long and hard. Father had a little of everything cows, pigs, crops of rye and buckwheat. Diversified farming, self sufficient, used eggs for barter….Tax on land in 1944 was $48 dollars.

Prime farmland may be cultivated land, pasture, forest, or other land potentially available for growing crops, but does not include developed or surface water areas. The soils identified as "prime farmland if drained" are too wet unless artificially drained sufficiently to meet the prime farmland criteria. (Although draining land for agriculture was widely practiced in the past, today it is strongly discouraged. The "Swampbuster" program withholds federal farm program benefits from farmers who clear or drain a wetland.)

Protecting areas of the town with the best farmland soils will help to preserve the ability to produce high-quality local food, and support the local economy in numerous ways. Active farmland is an important part of the town's scenic landscapes.

Agriculture creates open habitats—pastures, hayfields, row cropfields, fallow fields, and oldfields—that are used in various ways by native plants and animals. Meadows can provide important habitats

for invertebrates, mammals, grassland birds, and other wildlife, as well as plants of conservation concern (see the **Habitats** section above). Farm practices that build living soils, conserve and protect water resources, and support local ecosystems can improve habitats for rare and vulnerable wildlife and native plants, while maintaining or improving farm productivity and efficiency. Some of these practices include mowing, tilling, and grazing schedules, patterns, and techniques that improve habitat for butterflies, bees, nesting birds, and nesting turtles. Other practices include land management for water and soil conservation; management of field borders to improve pollination, reduce pest problems, and support wildlife; and reduction in the use of broad-spectrum, persistent pesticides (herbicides, insecticides, algicides, fungicides, rodenticides).

Table 3 Farmland soils in Dutchess County, NY (USDA Natural Resource Conservation Service).

Soil Name	Map Unit Symbol	Soil Name	Map Unit Symbol
Prime Farmland Soils		**Prime Farmland Soils if Drained** (cont.)	
Bernardston silt loam, 3 to 8 percent slopes	BeB	Massena silt loam, 3 to 8 percent slopes	MnB
Charlton fine sandy loam, 3 to 8 percent slopes	ChB	Punsit silt loam, 0 to 3 percent slopes	PzA
Charlton-Chatfield complex, undulating, rocky	CrB	Punsit silt loam, 3 to 8 percent slopes	PzB
Copake channery silt loam, fan, 0 to 3 percent slopes	CwA	Raynham silt loam	Ra
Copake channery silt loam, fan, 3 to 8 percent slopes	CwB	**Farmland Soils of Statewide Importance**	
Copake gravelly silt loam, nearly level	CuA	Bernardston silt loam, 8 to 15 percent slopes	BeC
Copake gravelly silt loam, undulating	CuB	Canandaigua silt loam, neutral substratum	Ca
Dutchess silt loam, 3 to 8 percent slopes	DuB	Charlton fine sandy loam, 8 to 15 percent slopes	ChC
Dutchess-Cardigan complex, undulating, rocky	DwB	Charlton-Chatfield complex, rolling, rocky	CrC
Galway-Farmington complex, undulating, rocky	GfB	Copake gravelly silt loam, rolling	CuC
Georgia silt loam, 0 to 3 percent slopes	GsA	Dutchess silt loam, 8 to 15 percent slopes	DuC
Georgia silt loam, 3 to 8 percent slopes	GsB	Dutchess-Cardigan complex, rolling, rocky	DwC
Haven loam, nearly level	HeA	Galway-Farmington complex, rolling, rocky	GfC
Haven loam, undulating	HeB	Georgia silt loam, 8 to 15 percent slopes	GsC
Knickerbocker fine sandy loam, nearly level	KrA	Hoosic channery loam, fan, 0 to 3 percent slopes	HtA
Knickerbocker fine sandy loam, undulating	KrB	Hoosic channery loam, fan, 3 to 8 percent slopes	HtB
Pawling silt loam	Pg	Hoosic gravelly loam, nearly level	HsA
Pittstown silt loam, 3 to 8 percent slopes	PwB	Hoosic gravelly loam, rolling	HsC
Scio silt loam	Sc	Hoosic gravelly loam, undulating	HsB
Stockbridge silt loam, 3 to 8 percent slopes	SkB	Hudson and Vergennes soils, 3 to 8 percent slopes	HvB
Stockbridge-Farmington complex, undulating, rocky	SmB	Hudson and Vergennes soils, 8 to 15 percent slopes	HvC
Unadilla silt loam, 3 to 8 percent slopes	UnB	Kingsbury and Rhinebeck soils	Kn
Wappinger loam	We	Knickerbocker fine sandy loam, rolling	KrC
Prime Farmland Soils if Drained		Pittstown silt loam, 8 to 15 percent slopes	PwC
Fredon silt loam	Fr	Stockbridge silt loam, 8 to 15 percent slopes	SkC
Linlithgo silt loam	Ln	Stockbridge-Farmington complex, rolling, rocky	SmC
Massena silt loam, 0 to 3 percent slopes	MnA	Sun silt loam	Su

Maintaining intact habitat areas and building living soils in cropland areas can reduce agricultural pests and foster populations of native insects that are beneficial to agricultural crops, including pollinators, pest predators, and parasitoids. Reducing tillage can improve soil health, reduce the need for artificial soil amendments, and reduce soil loss due to erosion. It also increases carbon storage and is thus a climate-friendly practice. (No-till techniques that rely on herbicides, however, may harm the soil life and other non-target organisms.) There is now considerable literature on agricultural practices that support local ecosystems and native biological diversity, and use ecological processes and interactions to boost farmland productivity.[91,92,93,94,95,96,97]

William Landauer

(interview, January 1973)

The Landauers raised Percherons until WWII. They brought them from France through Milan first. Raised them for work on the farm and breeding stock….. They started with the Angus in 1938. It was a working farm, they had chickens, ducks, goats, a pony, horses, and sheep they bought from J.C. Penny in White Plains (gene farm) and brought up here in the back of the station wagon.

As of the 2015 Dutchess County Census and Demographics, 6,393 acres of land in Milan were in agricultural parcels, representing 27% of the Milan land area. Most of that acreage is not actively farmed, however; many of those parcels are partially wooded or in other uses. Two-thirds of the agricultural parcels (4,258 acres) were used for livestock feed crops and pasture (Table 4).

Table 4 Milan farm enterprises by acreage as of 2015 (Dutchess County Census and Demographics).

Enterprise	Acres
Production agriculture (hay, corn, other feed crops)	3148
Livestock (beef cattle, sheep, goats)	1110
Horses	430
Specialty crops (e.g., flowers, Christmas trees, fruit, vegetables)	429
Other (timber, small fruits, multiple farm enterprises)	396
Buffer*	880
Total	6393

* "Buffer" parcels are undeveloped, residential, or open space parcels that border farm property and/or contain farmland soils that could be developed for farming operations.

The Battenfeld Anemone and Christmas Tree Farm is a fifth generation farm now growing primarily anemones and Christmas trees. Trees and flowers are sold in the wholesale market as well as through local and mail-order retail. Branchwater Farms raises grains for their distillery, along with ducks and chickens for meat and eggs, and may add other livestock. The Morehouse Farm has raised prize-winning Merino sheep since 1983, and sells yarns, knitting patterns, tools, and accessories online. The Fitzsimmons farm raises beef cattle, and the Longo farm pastures cows, produces hay and vegetables for market, and has a small saw mill for winter and spring income. Apple Ridge farm raises beef cattle and pigs.

Fields at Briggs Farm, Academy Hill Road.
Photo © Phil Zemke

An Agricultural District is a land area identified through New York's Agricultural Districts Law (Article 25-AA) to help protect current and future farmland from non-agricultural development by reducing competition for limited land resources and helping to prevent local laws that would inhibit farming and raise farm taxes. Agricultural Districts are developed when interested landowners, who collectively own at least 500 acres of land, request formation of such a district. Farmers and rural land-owners enrolled in a state-certified Agricultural District receive important "right-to-farm" protections. Also, because of the state's interest in maintaining the viability of farmland, proposals for new non-agricultural land uses or actions in an Agricultural District may be subject to closer scrutiny in the State Environmental Quality Review (SEQR) process (6 CRR-NY 617.4[b][8]). In Milan, 6,428 acres were in Agricultural District 20 as of 2017 (Figure 18).

The New York Commissioner of Agriculture is authorized to review local comprehensive plans, legislation, regulations, and approve or disapprove them according to whether they unreasonably restrict or regulate farm operations within an Agricultural District. The Commissioner also reviews any purchase by a municipal or state agency of active farmland larger than one acre, or any land over ten acres within an Agricultural District, to assess the potential impacts on local agricultural resources.

The Agricultural Districts Law allows reduced property tax bills for land in agricultural production by limiting the property tax assessment of such land to its prescribed agricultural assessment value. Owners whose land satisfies the eligibility requirements may apply for an agricultural assessment. To qualify, land

- must consist of seven or more acres that were used in the preceding two years for the production for sale of crops, livestock, or livestock products; and
- the annual gross sales of agricultural products generally must average $10,000 or more for the preceding two years. If an agricultural enterprise is less than seven acres, it may qualify if average annual gross sales equal $50,000 or more.

Agricultural assessments are limited to land used in agricultural production, which is defined to include cropland, pasture, orchards, vineyards, sugarbush, support land, and crop acreage either set aside or retired under federal supply management or soil conservation programs.

Hayfield, Odak Farm Road, 2022. Photo © Phil Zemke

Albrecht Pichler, Morehouse Farm, 2022.
Photo © Debra Blalock

Briggs Farm, Academy Hill Road, 2022. Photo © Phil Zemke

Craig Fitzsimmons and friends. Photo © Debra Blalock

Pasture, Odak Farm Road, 2022. Photo © Glenn Butler

Larry Longo at his saw mill. Photo © Debra Blalock

Ducks at Branchwater Farm. Photo © Kevin Pike

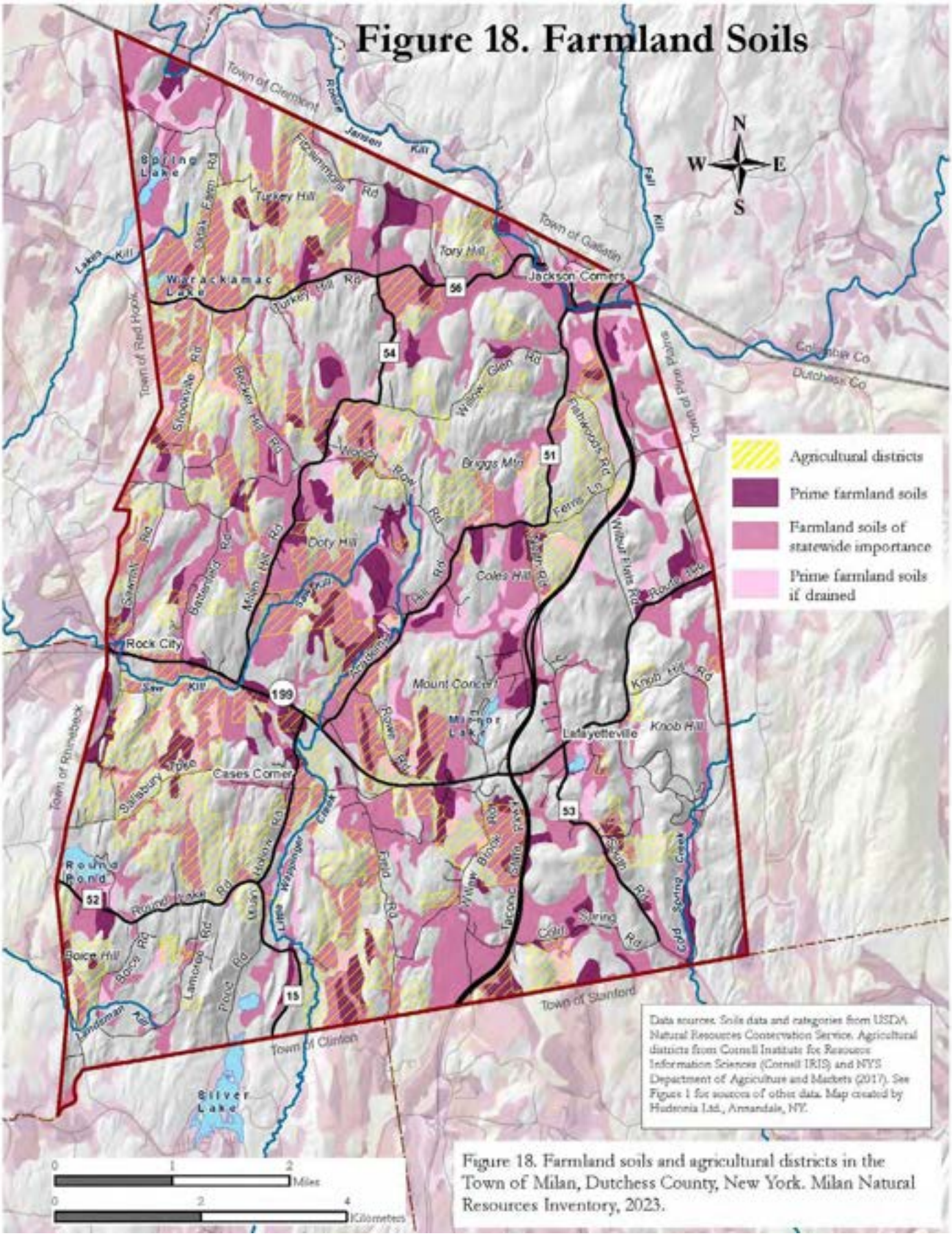


Figure 18. Farmland soils and agricultural districts in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

SCENIC RESOURCES

Scenic resources are landscape patterns and features that are visually appealing and help to define the character of a community or region. Beyond aesthetic value, scenic resources help connect people to the land, foster an appreciation of the natural landscape, display the natural resources of an area, distinguish one community from its neighbors, and promote the economic benefits associated with tourism and recreation.

Scenic areas occur in many places in the town where there are pastures, cropfields, meadows, marshes, streams, ponds, and open and forested hills. We encourage the town to identify the areas of greatest scenic importance that should be considered in land use planning and decisions, and add them to future updates of the Comprehensive Plan and the *NRI*.

The scenic quality of the town and the region is intimately tied to the natural resources described in this *NRI*—the physiography, streams, ponds, wetlands, forests, meadows, and farmland. Many scenic areas are associated with other resources of concern, such as large forests, farmland, streams, and ponds. Scenic areas that are visible to the public from roads, public lands, parks, and trails may be of special importance to the town.

> I love Milan's beautiful rural character (here you can actually see the stars at night!) with its rolling hills and open farmland—perfect for grazing animals, especially my beloved sheep.
>
> -Albrecht Pichler

The landscape settings of historic sites can be important components of the present-day experience of the site, so the visual appearance of the viewshed of an historic building or farm, for example, may be a worthwhile consideration in addition to the historical fidelity of the farm property itself or the historic house and grounds. The town could identify and map the places and landscapes that seem especially important for this purpose, so that future land use planning and decisions can take these landscapes into account.

Protection of scenic areas is often very compatible with and even dependent on protection of natural habitats, water resources, and farmland, but where they are incompatible, visual concerns should not necessarily take precedence over conservation of other resources. For example, it is often tempting to site a new house deep inside a forest so that the house is invisible from public roadways. The adverse ecological effects of forest fragmentation, however, and the harm to water resources often caused by long driveways, may outweigh the visual disruption caused by a house visible from a road. From a biodiversity standpoint, building a new house close to an existing road and close to other existing development is often the much better choice because it minimizes habitat fragmentation and confines the ecological "edge effects" of human uses (caused by lights, noise, pets, polluted runoff, etc.) to a smaller area.

Among the recommendations in the Milan *Comprehensive Plan* are to designate selected scenic areas as Critical Environmental Areas, to nominate NYS Route 199 as a Scenic Byway, and to add a Scenic Resource Protection and Overlay District to the zoning code. See the **Land Use Legislation and Other Local Measures** section for descriptions of these conservation tools.

Eastern shore of Spring Lake. Photo © Phil Zemke

RECREATION RESOURCES

Photo © Glenn Butler

Many of the land parcels in Milan are posted against trespassing, so most private lands are inaccessible for walking, hiking, biking, skiing, motor sports, hunting, or other recreational uses without landowner permission. But state, county, and town-owned lands provide a wide array of opportunities for public enjoyment of the outdoors in Milan (Figure 19). Each of these is briefly described below. The Winnakee Land Trust also owns a parcel—Henkin Woods—that is open for public use but is undeveloped with trails or other recreation amenities. Not described here are private recreation sites owned and managed by sporting clubs, such as the Mirror Lake Retreat or other organizations for use by members or paying guests.

Photo © Glenn Butler

The **Milan Recreation Park** is a 30-acre town-owned site on Matecki Road. It has meadows, forest, wetlands, and a small stream, and recreational amenities including a softball field, a basketball court, a children's play area, and a trail maintained by the Milaners Youth Group.

Photo © Glenn Butler

Wilcox Memorial Park is a 620-acre county park in eastern Milan, with forests, wetlands, meadows and ponds, and opportunities for hiking, camping, swimming, boating, fishing, disc golf, basketball, and baseball. The land was formerly part of the Wilcox farm, and was sold by Irene Kilmer Wilcox to Dutchess County in 1961. She used the proceeds to build Wilcox Memorial Hall in 1966 as a town hall and community center.

The **Lafayetteville Multiple Use Area** is a 718-acre area straddling Wilbur Flats Road and NYS Route 199. It is owned by New York State and managed by NYSDEC, and offers opportunities for hiking (no marked trails), primitive camping, fishing and paddling on Wilbur Pond, hunting, and trapping. The site is stocked with ring-necked pheasant during hunting season. The parking area is on Route 199.

The **Roeliff Jansen Kill Multiple Use Area** is a 128-acre site adjacent to the Roe Jan just east of the Taconic State Parkway and south of Jackson Corners Road. There are no trails or other amenities, but the site is open for hunting, trapping, and fishing, and passive uses. The only access is from a pull-off on the Parkway. The site borders a reach of the Roe Jan that is stocked annually by NYSDEC with brown trout.

The **Stissing Mountain Multiple Use Area** is a 590-acre area that straddles the towns of Milan, Pine Plains, and Stanford. The small part of the MUA that overlaps the southeast corner of Milan is accessible from a parking lot on Hicks Hill Road. Primitive camping, hiking, hunting, trapping, fishing, and paddling (on a beaver pond) are permitted. Snowmobiling, mountain biking and horseback riding are also allowed but there are no designated trails or maintained areas for these activities. The site includes a part of Stissing Mountain itself but does not encompass the summit.

There is a **Public Fishing Access** site along the Roe Jan at Jackson Corners, adjacent to and west of Academy Hill Road. A Public Fishing Access site is a place where permanent easements have been purchased by NYSDEC from willing landowners to provide anglers fishing access from the banks (usually within a 33-foot-wide strip). That reach of the Roe Jan is stocked annually with brown trout by NYSDEC.

Public fishing access below the Academy Hill Road bridge.
Photo © Phil Zemke

Hunters at the Lafayetteville MUA.
Photo © Glenn Butler

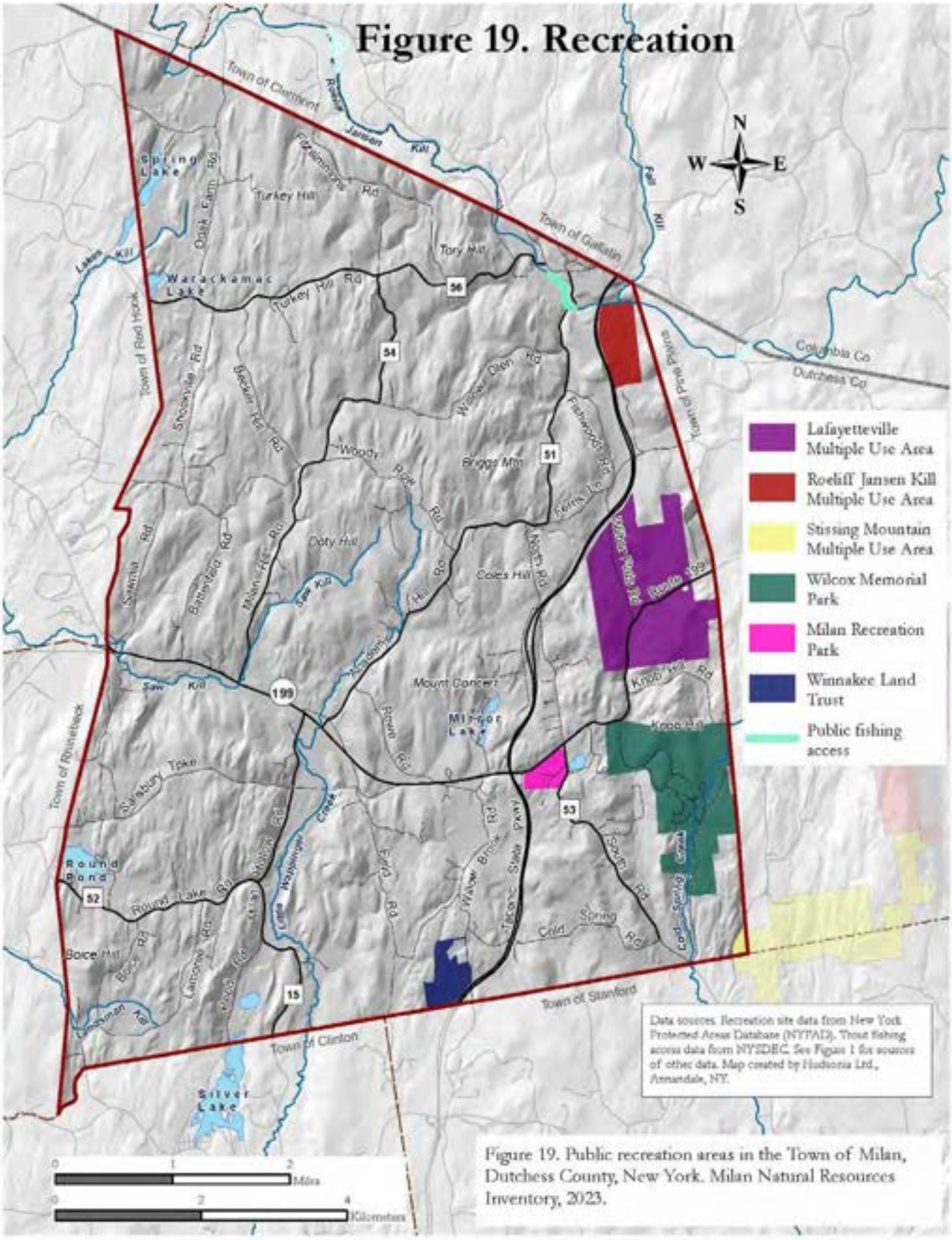


Figure 19. Public recreation areas in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

THREATS TO NATURAL RESOURCES

Natural resources are subject to numerous direct and indirect threats from human activities that include the obvious, such as filling a wetland or emitting atmospheric pollutants, or the less obvious such as leachate from failing septic systems entering a lake. They include threats that may go unnoticed for years until the effects become apparent, such as depletion of groundwater supplies due to incremental additions of impervious surfaces, or loss of bird populations due to forest fragmentation, human-subsidized predators, or use of pesticides. Climate change poses over-arching and wide-ranging threats to water supplies, agriculture, wildlife, and human health. Some of the threats from climate change and other sources are described below. Ways to reduce these stresses or improve ecosystem resiliency are described in the **Conservation Principles and Measures** section.

CLIMATE CHANGE

Large rainstorms and snowstorms, ice storms, heat waves, and droughts have long occurred here, but overall climate patterns remained fairly consistent since European settlement until the late decades of the 20th century.[98] The climate is now changing rapidly, and some aspects are changing more rapidly in the Northeast than in the rest of the US or the world.[99]

The effects of global warming are likely to be felt more acutely in the coming years.

We have been experiencing changes in the length of the frost-free season, the depth and duration of the snowpack, and the frequency and duration of heat waves, for example, and the effects of global warming are likely to be felt more acutely in the coming years—larger and more frequent floods, higher temperatures, more severe droughts, more frequent and extensive wildfires and severe rainstorms, as well other symptoms such as increases in invasive pests, pathogens affecting humans, livestock, and wildlife, and depletion of native biological diversity.[100]

Climate change is driven by emissions of greenhouse gases (GHGs) to the atmosphere—especially carbon dioxide, methane, and nitrous oxide—that trap heat near the Earth's surface. The increased emissions are largely due to human activities, such as production, transport, and burning of fossil fuels for heating, transportation, and industry, and the accumulated effects of many other activities, such as deforestation, emissions from agriculture, and burning of wood and other organic materials. If worldwide GHG emissions are lowered in the coming years, then the changes we experience will still be significant but reduced. But if emissions continue to grow at the current rate, these changes are likely to increase dramatically over the coming decades.

Much of the climate data in the discussion below is from the publication *Responding to Climate Change in New York State*—called the ClimAID report, published by the NYS Energy Research and Development Agency (NYSERDA) in 2011[101] and updated in 2014. The ClimAID projections for air temperature, precipitation, heat waves, sea-level rise, and flooding for the state through 2100 were developed with regional data in a

global model used for the Intergovernmental Panel on Climate Change (IPCC) *Fifth Assessment Report*. Dutchess County is in ClimAID Region 5 which encompasses the counties east of the Hudson River in southeastern New York and other counties to the north.

Some additional information applicable to the Northeast in general is from the Fourth National Climate Assessment (NCA4), published in November 2018—a product of the US Global Change Research Program. The message in Chapter 18 of the NCA4, which applies to the northeastern US, is similar to that of the New York ClimAID report, except that the changes are happening more rapidly than predicted a few years earlier.[102]

Rising Air Temperatures

Summer heat waves are expected to be more frequent, more intense, and lengthier.

Global air temperatures have been increasing for decades and temperature rise in the northeastern US has been much more rapid than national or global averages. In New York, annual average temperatures have risen 2 °F since 1970, and average winter temperatures have increased 5 °F. Higher temperatures are creating new problems for human health, agriculture, energy demand, and recreation, as well as for plants, animals, and habitats of natural areas. The average annual temperature in Dutchess County is projected to increase approximately 2-4 °F by mid-century and could be upwards of 7 °F by the 2080s (Table 5).

Table 5 Air temperature projections for ClimAID Region 5 (includes Dutchess County) from the 2014 ClimAID report.[103]

	Actual 1971-2000	Projected 2020s	Projected 2050s	Projected 2080s	Projected 2100
Annual average air temperature	50 °F	52.3 – 53.2 °F	54.5 – 56.2 °F	55.6 – 59.7 °F	56.1 – 61.4 °F
Increase in annual average	-	2.3 – 3.2 °F	4.5 – 5.2 °F	5.6 – 9.7 °F	6.1 – 11.4 °F

Summer heat waves are expected to be more frequent, more intense, and lengthier. Even at the lowest projected rate of carbon emissions, Dutchess County summers by 2100 could be similar to those of North Carolina today.[104]

Changing Precipitation Patterns

In the northeastern US, precipitation volumes have increased modestly in recent decades but have become much more variable and more extreme. The amount of rain falling in heavy storm events increased 74% from 1958 to 2011. Precipitation patterns are difficult to predict, and the climate models are being continually refined on the basis of up-to-date regional data, but recent models predict that total annual precipitation could increase as much as 12% by 2050 and 21% by 2100 (Table 6).

The models also project more droughts, heavier rains in the intervening periods, and reduced snow cover in winter.[105] More frequent and more severe floods may threaten buildings and infrastructure, including those in expanding floodplains, wash away cropland and lawns that are in the floodplain, and delay farmers' access to flooded fields.

Table 6 Precipitation projections for ClimAID Region 5 (includes Dutchess County) from the 2014 ClimAID report.[106]

	Actual 1971-2000	Projected 2020s	Projected 2050s	Projected 2080s	Projected 2100
Total annual precipitation (inches)	51	52-54.5	53-57	53.5-58.5	53.5-61.5
Increase in annual precipitation	-	2-7%	4-12%	5-15%	5-21%
Number of days with precipitation >1 inch	10	14-15	14-16	15-17	*
Number of days with precipitation > 2 inches	1	3-4	4	4-5	*

* Projections not available

Periods of drought are predicted to become more frequent and more severe in New York. Droughts can threaten local drinking water supplies, crop production, and livestock, and can severely stress aquatic communities of streams and ponds, as well as plants and wildlife in upland and wetland habitats. Droughts can extend the low-flow period of streams and further stress the fish and other organisms that may already be suffering from pollution, warmer stream temperatures, and artificial stream barriers such as dams and culverts. Drought may become a long-term concern for agriculture and could threaten drinking water supplies from groundwater wells. In a higher-emissions scenario, long-term droughts (longer than three months) that now occur every 20-30 years could occur every 6-10 years.[107]

Wetlands that have perennially saturated soils develop deep layers of peat (decaying organic matter) that continue to accumulate over hundreds and thousands of years if the wetland hydrology and vegetation remain intact. Due to this capability for peat accumulation, wetlands have the greatest capacity of any ecosystem for long-term carbon storage, and are believed to hold 20-30% or more of the total stored organic carbon in the Earth's soils.[108] But the drying of wetlands due to a warmer climate and longer and more frequent droughts could result in large releases of carbon to the atmosphere, further exacerbating the conditions for global warming. Although both intact and disturbed wetlands can also be large sources of methane emissions to the atmosphere (methane is the third most important greenhouse gas) those emissions are far outweighed by the carbon storage services of an intact wetland.[109]

Drying of wetlands could result in large releases of carbon into the atmosphere.

More frequent and intense heat waves pose threats to human health, agriculture, wildlife, and native plants, and are likely to alter many aspects of the natural landscape. Warmer, shorter winters are predicted to increase the occurrence of rainfall while the ground is frozen, which has numerous implications: hastening snowmelt, reducing groundwater recharge, heightening the likelihood of flooding, and increasing the frequency and consequences of drought. Warmer winters with less snow will alter the habitat suitability for

native plants and animals. The frequency of extreme precipitation will continue to increase and may dramatically affect the quality and quantity of water supplies as well as the plants and animals of upland, wetland, and aquatic habitats. Alterations to air temperatures, snow cover, and freeze/thaw patterns are likely to disrupt the seasonal synchrony between pollinators and plants and between predators and prey. Warming temperatures are likely to significantly affect the composition and distribution of habitats and wildlife and force many species to migrate to cooler parts of the local landscape, to more northern latitudes, or to higher elevations as former habitats become unsuitable.

This section has described some of the general threats posed by climate change. The more specific threats that climate change poses to water resources, biological resources, and agriculture are described in sections below.

THREATS TO WATER RESOURCES

Human activities on the land have been changing the character, habitat quality, and water quality of streams, lakes, ponds, and wetlands for centuries by obstructing stream flows, altering patterns and volumes of surface water runoff, increasing soil erosion and siltation of streams, altering surface water temperatures, reducing groundwater infiltration, and contaminating surface water and groundwater. These threats continue today, and climate change is exacerbating the stresses and adding new ones.

Groundwater

Groundwater can be depleted by reducing recharge from the ground surface (e.g., by expansion of impervious surfaces such as pavement and roofs) and by excessive groundwater withdrawals (e.g., from crowded wells in residential areas). That could become a more common problem in the more densely-settled areas with the increasing frequency and severity of droughts predicted by climate scientists.

Most Milan residents obtain their drinking water from groundwater wells, so the quality and quantity of groundwater should be of great conservation concern to the town.

Groundwater is most vulnerable to non-point source pollution such as applications of fertilizers and pesticides to lawns, gardens, and farm fields; nitrates, phosphates, and bacteria from septic systems; de-icing salts from roads and driveways; and volatile polluting substances, such as organic compounds from leaks and improper disposal of petroleum and other fluids. Groundwater is especially vulnerable to pollution in areas of coarse-textured soils (sand, gravel) or carbonate bedrock (limestone, dolostone).

The most significant potential sources of groundwater contamination may be from agricultural or lawn applications of fertilizers and pesticides, leaking fuel storage tanks, and storage and applications of road salt. Other possible sources are from wastewater discharges (e.g., from crowded or failing septic systems) and from active or inactive landfills or hazardous waste disposal sites. Unfortunately, a small volume of a

harmful substance can contaminate a large volume of groundwater and, once contaminated, groundwater can be very difficult and costly to clean up.[110] Most Milan residents obtain their drinking water from groundwater wells, so the quality and quantity of groundwater should be of great conservation concern to the town.

Surface Water

Adding impervious surfaces (roads, driveways, parking lots, and roofs) usually increases surface runoff and reduces groundwater infiltration, leading to erosion of stream banks and siltation of stream bottoms, degrading stream habitat quality and water quality, and reducing the base flows of streams. Runoff from impervious surfaces can also raise the water temperature of streams, leading to reduced levels of dissolved oxygen and degraded habitat for sensitive stream organisms. Clearing vegetation and disturbing soils on steep slopes or in areas of shallow soils (e.g., during construction of roads, driveways, or houses) often increase the surface runoff of precipitation and snowmelt, erosion of soils, and destabilization and siltation of nearby streams. The consequences are reduced groundwater recharge, loss of soils, and degradation of stream habitats. Stormwater management measures employed at development sites are often inadequate to restore and maintain the patterns, volumes, and quality of surface runoff and groundwater recharge that occurred prior to development.

Roadside ditches often carry contaminants such as motor oil, heavy metals, road salt and other chemicals, sand, and silt into nearby streams and wetlands. Applications of fertilizers and pesticides to agricultural fields, golf courses, lawns, and gardens can degrade the water quality of groundwater and streams and alter the biological communities of streams, wetlands, and ponds. Leachate from failing septic systems often introduces elevated levels of nutrients, especially phosphorus and nitrogen compounds, into streams, lakes, and ponds, leading to a cascade of effects on water chemistry, biota, and whole aquatic ecosystems. A Vassar College study found that the amount of nutrients and sediments entering a stream is most affected by the amount of development within 300 ft of the stream.[111] Streams, lakes, and ponds are also subject to atmospheric deposition of substances such as sulfur dioxide, mercury, and nitrogen from fossil-fuel-burning power plants in the Midwest, de-icing as well as nitrogen compounds from distant agriculture.[112]

The amount of nutrients and sediments entering a stream is most affected by the amount of development within 300 ft of the stream.

Removal of shade-providing vegetation along a stream or pond shore for landscaping or other purposes can lead to elevated water temperatures and severely impact the aquatic invertebrate, amphibian, and fish communities that depend on cool environments. Clearing of vegetation and conversion of riparian areas to developed uses can also reduce the important exchange of nutrients and organic materials between the stream and the floodplain, diminish the capacity for flood attenuation, and increase downstream flooding.

Forested land is very effective at facilitating the infiltration of rainwater and snowmelt to the soils, thus making it available for uptake by vegetation, for recharging the groundwater, and for slowly feeding streams, lakes, and ponds. Clearing of forests can greatly reduce infiltration to the soils and greatly increase the rapid runoff of surface water. This leads to "flashy" streams that run at high volumes during runoff events and then dry up at other times because groundwater is unavailable to feed the base flow.

Climate Change and Water

A warming climate is expected to affect both the quantity and quality of Milan's groundwater and surface water resources, as well as the habitat quality of streams and ponds. Both total annual rainfall and rainstorm intensity are predicted to increase in New York in the coming years, with multiple consequences to the land, water resources, and agriculture.

Flooding hazards may increase due to the increasing intensity of large rainstorms. The areas within the 100-year flood zones illustrated in Figure 8 will be particularly at risk, but additional areas may also be affected. The magnitude of flooding at any location will depend on the timing and intensity of large storms and the condition of the land—the ability to absorb large water volumes at the time of the storm—as well as the structures or other obstacles in the flood zone that may act to divert, concentrate, and accelerate flood flows.

The "100-year flood zone" shown on maps created by the Federal Emergency Management Agency (FEMA) is the area that, based on historical flood data, has a 1% chance of flooding in any given year. The "500-year flood zone" is the area believed to have a 0.2% chance of flooding in any given year. (Data for the 500-year flood zone for Milan were not available at the time of this *NRI* preparation.) The FEMA flood zone map data (Figure 8) are from a historical baseline and do not take into account the future storms and runoff events that could be larger.

Large floods can damage roads, bridges, and other infrastructure, destroy agricultural crops, wash away farmland soil, carry pollutants and large volumes of sediments into streams, and damage or destroy buildings and other structures in the flood zone. Much of the water volume from large rainfall or snowmelt events will run off quickly into streams and be unavailable for recharging groundwater. More extended and more frequent droughts are also predicted[113] and are likely to affect drinking water wells and farm ponds for watering livestock, as well as streams, other natural habitats, and native plants and animals. More extreme floods and droughts, as well as increases in water temperatures, are likely to adversely impact populations of trout and other sensitive stream organisms that rely on cool, clear streams and unsilted stream substrates. (See the **Threats to Natural Resources** section.)

Rainbow over Woody Row Road.

Photo © Glenn Butler

Threats to Biological Resources

Due to the great interdependence of aquatic and upland habitats, many of the threats to water resources outlined above also threaten the plants and animals of upland forests, meadows, shrublands, and other habitats. Additional threats include habitat loss and degradation of habitats, over-harvesting, non-native pests, and diseases, and the numerous effects of global warming.

Habitat Loss and Degradation

Loss of habitat occurs when new roads or residential, commercial, or industrial development eliminates former meadow or forest habitat, for example, or when unprotected wetlands are drained, filled, or converted to ornamental ponds. Local, state, and federal laws provide limited protection to certain wetlands and streams and the habitats of listed rare animal species, but most upland (i.e., non-wetland) habitats and many small wetlands and streams lack any legal protections and are especially susceptible to loss. The local or regional disappearance of a habitat can lead to the local or regional extirpation of plants and animals that depend on that habitat.

Most upland habitats and many small wetlands and streams lack any legal protections.

The full consequences of the loss of particular species or habitats are usually unknown, but we do know that each organism plays a particular role in maintaining its biological community, and the maintenance of each community at the regional scale enables ecosystems to withstand stresses and adapt to changing environmental conditions.

Less obvious but more insidious than direct loss of habitat, is the problem of habitat degradation, which can occur by many mechanisms and have consequences that are often invisible in the near term.

> Some species of plants and animals that are not prevalent or even existing any more are pheasant and quail and elderberry, all of which were abundant in previous years.
>
> –Jack Campisi, 2022

Habitats that are not lost to other uses can nonetheless be severely degraded by chemical or thermal pollution, sedimentation, and other direct and indirect disturbances such as trampling, cutting, nighttime lights, noise, invasive species, and fragmentation. These can severely alter the biological communities, ecological functions, and ecosystem services of the habitat and lead to local disappearance of sensitive species of plants and animals.

Habitat Fragmentation

Habitat degradation can lead to the loss of ecosystem services and local disappearance of sensitive species of plants and animals.

Habitat fragmentation occurs when an intact habitat area is split by a road, driveway, utility corridor, or other feature, dividing it into smaller segments. The subdivision of a large meadow or a large forest into residential lots, for example, divides it into smaller habitat blocks that may be unsuitable for the "area-sensitive wildlife" species that require large habitat areas and are sensitive to human contact or disturbances. Fragmentation of forests into smaller blocks increases the area of forest "edge" habitat where there are higher light and noise levels and drier conditions, and where invasion by non-native plant species and by predators such as raccoons and domestic cats is more likely. Fragmentation makes the formerly deep interior forest areas newly accessible to songbird nest predators and brood parasites (such as the brown-headed cowbird) whose activities are ordinarily confined to open areas and forest edges. Roads and other developed areas dividing forests can also act as significant barriers and hazards to wildlife movement, and many animals avoid breeding near human activities.

The "edge effects" of human disturbance (from roads, residential areas, and other development) can reach well over 300 feet into forest patches.[114] A road or driveway through a large meadow can similarly reduce the habitat values of the meadow for grassland breeding birds, making the formerly deep interior meadow areas newly accessible to nest predators and other disturbance.

Many species of wildlife require more than one habitat to fulfill their life history needs, and some species are far ranging, with territories or movement areas spanning hundreds or thousands of acres. The fragmentation of habitats inhibits the ability of wildlife to move across the landscape. For some wildlife, the fragmenting features can disrupt their travelways and render critical parts of their habitats inaccessible or expose them to mortality from vehicles, predation, or dessication.

Hardwood forest near Spring Lake. Photo © Phil Zemke

Another kind of habitat fragmentation occurs along streams where dams, culverts, or bridges interrupt the continuity of stream habitats. From headwaters to mouth, a stream is a continuous ecosystem dependent on free movement of nutrients, organic detritus, sediments, and animals. Many of our fishes need different parts of a stream for feeding, spawning, nursery areas, drought refuge, shelter from predators, and overwintering. They need access to cool pools in summer, deep pools in winter, suitable substrates for spawning, and shallow nursery areas inaccessible to predators. Invertebrate drift from upstream reaches can also be essential to maintaining fish populations. Similarly, invertebrates, amphibians, reptiles, and other animals also need to move freely to take advantage of various stream habitats and materials in different life history stages, seasons, and stream conditions.

Culverts suspended above the stream bottom obstruct the movement of stream organisms to upstream and downstream habitats.

Dams are an obvious impediment to these movements, but bridges and culverts, if improperly sized, designed, and installed, can also act as partial or total barriers, severely altering stream flows and disrupting the stream ecology. Culverts that are suspended above the stream bottom prevent the movement of organisms and materials. Undersized bridges or culverts disrupt natural flow patterns, causing upstream impoundment and increasing downstream velocities, often leading to stream-bed scouring and bank erosion, as well as damage to bridges, roads, and other infrastructure. These are widespread causes of degraded stream habitats that have led to the loss of whole populations of fish unable to navigate those barriers or tolerate the habitat alterations.

To accommodate floodflows and the movement of stream organisms, a culvert should be large enough so that stream flows are unimpeded, even during flood events, and the lower invert should be buried in the stream bottom so that water depth and substrate are similar within and outside the culvert. Additional information on sizing, design, and installation of culverts and bridges can be obtained at https://www.dec.ny.gov/permits/49060.html.

Over the last several years the North Atlantic Aquatic Connectivity Collaborative has partnered with state and county agencies to identify culverts that are too small to carry expected floodflows or are suspended above the stream-bed. The culvert survey results are provided to local, county, and state agencies to help them prioritize culverts for replacement or retrofitting so that stream continuity is restored and risk to infrastructure is reduced. Many of Milan's streams have not yet been assessed, but Figure 9 shows the locations of significant barriers identified so far on Milan streams.

Preserving habitat connectivity is critical for maintaining genetic exchange among distant populations and facilitating the migration of species under deteriorating environmental conditions or climate change. Populations of species that are unable to cross barriers such as roads, walls, dams, or culverts, and thus are restricted to fragmented habitat patches, may become genetically isolated and face local extinction. Also, some species that *are* able to cross human-created barriers (such as roads) face greater mortality risk from

vehicles and predators. Maintaining broad connections between habitat areas can ensure that the habitat, migration, and behavior requirements of many native plant and animal species are conserved across the landscape.

Low-density development is a major cause of habitat fragmentation.

These days, a primary cause of ongoing habitat fragmentation in the region is rural sprawl—low-density development that occurs outside of population centers such as hamlets or villages. Rural sprawl is the incremental, house-by-house, development that over time can unintentionally transform a landscape from rural to suburban. Milan has few recent instances of large residential subdivisions where a property is broken up into 20 or more house lots. Instead, the main pattern of new development is a single house on an approved lot, and subdivisions of 2-4 residential lots in a rural setting, the widespread mechanism of rural sprawl. The fragmentation of habitats is most severe when each lot is designed with the house located at the end of a long driveway. Utility corridors, roads, and even walking trails can have a similar fragmenting effect when located in an otherwise intact habitat area. Affluence, contemporary tastes, and today's engineering capabilities have led to more houses being built in places that were previously inaccessible or deemed unsuitable—such as hilltops, steep areas, and areas with shallow soils, where environmental damage is often greater.

Other Threats to Habitats

Forest habitats can be degraded in many ways besides fragmentation. Clearing the forest understory to create an appealing, park-like landscape destroys habitat for birds such as wood thrush,† which nests in dense understory vegetation, and hermit thrush, black-and-white warbler† and ovenbird,† which nest on the forest floor. Removal of native shrubs can also be an invitation to non-native invasive shrubs and forbs. Removal of mature and especially large trees eliminates habitat for lichens, fungi, bryophytes, and many invertebrates, as well as the many other kinds of animals that use cavities and that forage in and around large and decaying trees. Soil compaction and removal of dead and downed wood and debris eliminates habitat for mosses, lichens, fungi, birds, amphibians, reptiles, small mammals, and insects. Logging can damage the forest understory and cause soil erosion, compaction, and rutting, and sedimentation of streams. The soil disturbance, opened canopy, and introduced propagules carried by skidders and other equipment often leads to establishment of non-native invasive plants in previously uninfested areas. Human habitation in fire-prone forests leads to the suppression of naturally occurring wildfires, thus eliminating an ecological process that is important for some forest species and the forest ecosystem as a whole. Threats from recreational uses of forests are described in the **Impacts of Recreation** section.

Crest, ledge, and talus habitats often occur in locations that are valued by humans for recreational uses, scenic vistas, communication towers, and these days even for house sites. Construction of trails, roads, and houses destroys crest, ledge, and talus habitats directly, and causes fragmentation of these habitats and the forested areas of which they are often a part. Rare plants of crests are vulnerable to trampling and

collecting; rare snakes are susceptible to road mortality, intentional killing, and collecting; and rare breeding birds of crests are easily disturbed by human activities nearby. The shallow soils of these habitats are extremely fragile and susceptible to erosion from construction and logging activities and from foot and ATV traffic. The specialized biological communities of rocky crests are maintained in part by occasional wildfires (and by exposure to weather, and droughty nutrient-poor soils, etc.) but such fires are suppressed where they occur near houses, barns, and other vulnerable structures. The scarcity of fires enables other, less-specialized forest species to colonize these areas and leads to the loss of the unusual plants and animals especially adapted to the rare rocky habitats.

Mowing of large upland meadows during the bird nesting season can cause extensive mortality of eggs, nestlings, and fledglings of ground-nesting grassland birds. Another threat to upland meadow habitats is the soil compaction and erosion caused by use of ATVs, farm equipment, and other vehicles, which can harm the soil structure and reduce the habitat value for invertebrates, small mammals, nesting birds, and nesting turtles.

Outdoor lighting often accompanies existing and new residences, but lights are very disruptive to insects and to the kinds of wildlife that depend on darkness for hunting and shelter, and those for whom lights trigger certain metabolic or behavioral reactions.[115] Outdoor lights also disrupt the activities of predators that depend on darkness for hunting, and prey that depend on darkness for protection. Lights are a fatal attraction for many species of insects, including some whose populations are declining drastically due to a barrage of human-caused hazards. Loss of insects leads to further losses of birds, amphibians, and the many other kinds of wildlife that depend on them. Many bird species rely on the moon and stars to help them navigate during spring and late summer-fall migrations. Birds that become disoriented by artificial lights often collide with windows, walls, floodlights, and the ground. The US Department of Agriculture estimates that outdoor lighting leads to the deaths of 500 million to one billion birds annually.[116] Light pollution has been associated with huge reductions in local insect populations, and is a significant contributor to worldwide insect declines.[117,118]

Where outdoor lights are needed, their impacts on wildlife will be reduced if the lights are motion-activated, shielded and directed downward (instead of outward or upward), and they use insect-friendly light technology. LED lights that are filtered to be yellow or amber attract many fewer flying insects than blue or ultraviolet lights. The website of the International Dark Sky Association provides other information and tips for preventing or minimizing light pollution.

Lawns and other landscaped areas pose numerous threats to insects, other invertebrates, and the ecosystems that depend on them. Fertilizers applied to lawns and gardens are often carried in surface runoff into streams, ponds, and wetlands, where the excessive nutrients disrupt biological communities. Pesticides (including herbicides, insecticides, fungicides, algicides, and rodenticides) applied to lawns, gardens, and structures are toxic to many non-target organisms (including humans and pets), and often drift to non-target areas, are carried offsite, and contaminate the soil. Non-native trees, shrubs, and forbs in yards are likely to support many fewer insects than native plants and, consequently, support fewer birds

and other insectivorous wildlife.[119] More than one-third of our bird species are insectivores, and local depletion of insects can directly affect our bird populations.

Utility-scale renewable energy facilities, especially solar and wind, are often proposed for large areas of farmland (for solar arrays), or large areas of forest (for wind turbines on ridgetops). With today's technology, utility-scale wind energy development is unlikely in Milan because the wind speeds here are inadequate for efficient power production, although small-scale wind energy production for residential, farm, or institutional uses might be quite viable.

Meadows are often the chosen sites for community solar or utility-scale solar arrays, creating conflicts between competing interests in farmland and biodiversity, and much-needed renewable energy sources. Should such proposals come to Milan, they may conflict with Milan's desires for conservation of farmland, scenic vistas, and biodiversity. At the same time, the urgent need to move away from fossil-fuel-derived energy seems to mandate the harnessing of solar power at all scales, from utility-scale installations covering hundreds of acres, to community-scale projects covering a few acres, to solar panels installed on individual buildings and lawns. Although the large installations will usually require sacrificing some areas of active or recently-active farmland and oldfield habitats, careful attention to the siting and design of solar facilities can reduce the potential local harms. As for other development projects, conducting biodiversity surveys prior to siting a new project can direct the solar developer away from the most sensitive areas, and can help avoid or minimize many environmental problems, such as impacts to rare species, sensitive habitats, important farmland, or historic resources.[120] Avoiding disturbance of forests and wetlands can help to minimize the carbon footprint and biodiversity impacts of the project.

Woodpeckers strip the outer bark of ash trees to feed on the emerald ash borer larvae. The resulting "blonding" of the trees, shown here, is a prominent indicator of an EAB infestation.

Photo © Erik Kiviat

Invasive Species, Insect Pests, and Diseases

Disturbances to soils from forest clearing, mining, and the construction of new houses and roadways, as well as domestic plantings in yards and gardens, often result in the spread of non-native invasive plant species. Non-native plant species such as common reed, reed canary-grass, Japanese stiltgrass, Japanese knotweed, purple loosestrife, multiflora rose, Bell's honeysuckle, Japanese barberry, and tree-of-heaven are now widespread in Dutchess County and Milan but are most concentrated in

areas in and near developed or disturbed land. Establishment of many of these plants is favored by soil disturbance and unshaded conditions. Seeds and vegetative propagules of invasives are often transported by vehicles and earth-moving machinery from one site to another. Land development has the potential to promote the spread of these species into many high quality habitats and reduce the overall value of those habitats to native biodiversity.

Non-native invasive species often lack significant consumers or diseases in their new environments and can outcompete native species for limited resources or space, resulting in the decline of native biological diversity. For example, the presence of non-native brown trout has been found to displace brook trout from the best habitats in a stream, reduce the feeding success and weights of brook trout, increase the susceptibility to fatal disease, and reduce the size of brook trout populations.[121,122,123]

Invasive plants such as mile-a-minute weed are expected to thrive under elevated atmospheric levels of carbon dioxide.[124] The changing climate conditions may allow some insect pests and insect disease vectors to complete more generations per season and allow greater winter survival.[125] Although the longer growing seasons may increase overall forest productivity,[126] increases in pests and pathogens may cancel out the potential benefits to the timber industry. Pathogens that are encouraged by less-severe winters will take advantage of the weakened condition of trees and other plants stressed by rising temperatures and droughts. Forest pests such as the hemlock woolly adelgid and the emerald ash borer are transforming our forest communities.

Only four species of earthworms are known to be native to the Northeast;[127] most of the worms we see in our lawns, gardens, meadows, and forests were imported, intentionally and not, from other places, starting with European settlers who brought plants (with soils) from home. European earthworms may also have been present in soils used as ship ballast. Introductions of worms continues through the present with the importation of horticultural plants from around the world and from other parts of North America, the transport and sale of worms for vermiculture and fishing bait, and probably in vehicle treads and by other inadvertent means.

While non-native earthworms have been highly valued by farmers and gardeners because of their ability to aerate soils and speed up nutrient cycling, those same actions can damage the soils, soil life, and plant communities of forests. The biota of our forest soils have adapted to slow decomposition of organic matter and slow processing of nutrients, which allows the accumulation of a deep layer of organic duff—leaves, twigs, and other organic debris in various stages of decay—on the soil surface. The duff is an important habitat component for vertebrates, invertebrates, fungi, and microbes of the forest floor, and helps to prevent soil erosion and maintain soil moisture, and provide nutrients for woody and herbaceous plants, invertebrates, and fungi. When earthworms are introduced to forest soils, they rapidly consume the organic duff, leaving bare soil that is no longer suitable for many native wildflowers, tree seedlings, ferns, fungi, ground-nesting or foraging birds, and amphibians.[128] A Michigan study found that earthworm infestations were associated with crown die-back of sugar maples, perhaps because the loss of organic duff exposed these shallow-rooted trees to dessication.[129] A recent arrival in New York, the snake worm

(*Amynthas agrestis*), is especially large and voracious, and its parthenogenic reproduction allows a single adult to initiate a large local population. An infestation can remove the forest duff, alter the soil structure and chemistry, and create a forest floor habitat inviting to non-native plants such as garlic-mustard and Japanese stiltgrass.[130]

Human-Subsidized Wildlife

Human-caused changes to the landscape alter habitats and animal communities, favoring those species most adapted to open landscapes, small habitat patches, and human presence. For example, Canada goose, white-tailed deer, raccoon, and gray squirrel thrive in agricultural and residential areas and, when overabundant, cause cascades of ecological changes.

Human uses directly and unintentionally offer "resource subsidies" by providing food (such as household garbage, food or agricultural waste, stored feed, livestock, and pets) and winter shelter or den sites (such as attics, barns, sheds, and other structures), as well as intentionally by feeding birds and other wild animals. Native mammals that benefit from these subsidies include white-footed mouse, squirrels, raccoon, Virginia opossum, striped skunk, and white-tailed deer. Populations of these mammals are often large around human habitation, and can have negative effects on populations of other wildlife and on humans.

Raccoon is a native species that thrives in human-settled landscapes.
Photo © Phil Zemke

Eastern coyote successfully and rapidly colonized eastern North America starting in the early 1900s, due to the expansion of its preferred habitat (a mosaic of open, shrubby, and forested land), the extirpation of its main competitor, the eastern wolf, a growing population of white-tailed deer, and human-provided resource subsidies. Coyotes may cause declines in bobcat and red fox populations, and sometimes prey on livestock. But they are also valuable as the only non-human predator that regularly preys on deer, and they help control deer populations where winter weather is severe.[131]

Raccoon populations have expanded rapidly in the Northeast since the 1930s, and often achieve the highest densities in urban and suburban areas, but they also thrive in rural residential and agricultural settings. They cause considerable agricultural damage, are a commonly reported nuisance in residential areas, spread disease, and depredate waterfowl, songbirds, other birds, and turtles. Striped

skunk and Virginia opossum are also numerous in rural and urban areas, although less so than raccoons, and all three species use similar food resources and den sites. These mesopredators are vectors for numerous viruses (including rabies and canine distemper) and parasites, which affect other wildlife, pets, and humans. They also have large ecological influences on populations of their various prey species and of other carnivores.[132]

Many of the wildlife species that have become abundant in our residential and agricultural landscapes are "generalist scavengers" that also prey on songbirds. Some of these nest predators are American crow, blue jay, common grackle, raccoon, eastern gray squirrel, red squirrel, eastern chipmunk, white-footed mouse, and Virginia opossum—as well as hawks and owls. In rural landscapes, songbird nest failure has been shown to increase with the abundance of potential nest predators.[133]

The brown-headed cowbird is a native blackbird that originally occurred only in the open grasslands of the central and western US and Canada but moved east as the forested land was cleared by European settlers; it now inhabits most of North America. The brown-headed cowbird makes no nest of its own, but lays its eggs in the nests of other species. The eggs are early to hatch and the nestlings quick to develop, outcompeting the young of the host species for food. The cowbird benefits from forest fragmentation and has been implicated in the decline of certain songbird species in the Northeast.[134]

Feeding birds has been shown to increase local population sizes in some of the songbirds that consume birdseed, although the effect may be due to immigration, leaving the overall population unchanged. Provisioning may either increase or reduce the breeding success of these birds, depending on the species and situation. Feeding birds can increase nest predation on songbirds by increasing populations of the nest predators mentioned above.

Feeding large animals such as deer and bear leads to more frequent aggressive encounters with humans and the need to remove problem individuals.[135] Domesticated cats and dogs, whether feral or pets with access to the outdoors, pose serious threats to wildlife. Cats kill up to 4 billion birds and 22 billion mammals annually in the US. Free-ranging dogs kill fewer individuals but often chase or injure other animals. The presence of cats or dogs can cause wild species to shift their ranges, exhibit physiological or behavioral changes, or have reduced reproductive success. Rabies, canine distemper, and other viruses and parasites are regularly transmitted from pets to wildlife via contact or feces.[136]

White-tailed deer have been transforming our forests by their preferential overbrowsing. Photo © Glenn Butler

The white-tailed deer is native to this region and has been a part of our forest ecosystems since long before European arrival on this continent. The present-day over-population of deer, however, has severely affected our forest communities. The reasons for the large population are many: for example, extirpation of major predators—eastern wolf and eastern cougar; abundant food sources in our cropfields, roadsides, lawns, and gardens; decline of recreational and subsistence deer hunting; and expansion of human-settled areas where deer are partially shielded from hunters and predators.

Selective browsing by deer prevents the regeneration of many of our forest tree, shrub, and wildflower species, and encourages infestations of non-native plants.[137] Deer herbivory on native understory herbs and shrubs (and perhaps non-browsing effects from deer, such as litter disturbance, soil compaction, and changes in soil chemistry) also promotes the invasion and spread of some non-native plants such as garlic-mustard and Japanese barberry, although deer may keep palatable non-natives such as multiflora rose and Eurasian honeysuckles in check in some situations.[138,139]

Excessive deer herbivory also affects breeding bird communities, invertebrates that depend on understory plants, squirrel populations (which in turn affect bird nesting success), and tick abundance and the prevalence of tick-borne diseases.[140] For example, where deer are more abundant, songbirds that use understory foliage (such as white-eyed vireo, hooded warbler, and prairie warbler) are less abundant.[141] Deer also cause agricultural losses ($59 million in New York in 2002), collisions with vehicles (over 70,000 in New York in 2011), and damage to home gardens and landscaping.[142]

Today the population of white-tailed deer is at a destructive level in Dutchess County and much of southeastern New York, but reducing the population to a reasonable size has been an intractable problem. Should successful control measures eventually be discovered, a prudent goal would be to foster and maintain a modest, self-sustaining deer population that matches the carrying capacity of the land.

Unsustainable Harvest

The region has a long history of overfishing, overhunting, and over-gathering, which, at times, has imperiled or extinguished regional populations of certain species and has dramatically altered the ecology of the region.

Hudson Valley beaver were trapped to extinction by the mid-1700s to supply the fur trade with Europe, even before the widespread settlement of European colonists. The eastern wolf and eastern cougar were hunted to extinction throughout the Northeast by the 1890s. Wild turkey was also eliminated by over-hunting throughout much of the state in that period, and white-tailed deer was extinguished or nearly so in the Hudson Valley and nearby areas. The deer population has since recovered. Some of the wild turkeys from Pennsylvania that later repopulated areas of western New York were captured and transplanted in the 1950s-60s by NYSDEC to restore populations throughout the state. The wild turkey population in Dutchess County is now large and apparently thriving. Beaver have since returned and the regional population may be secure for the time being, although their ecological roles are somewhat curtailed due to

widespread human interventions to limit flooding from beaver dams. The permanent loss of the wolf and cougar—top predators here for thousands of years—has had devastating effects on the ecology of northeastern landscapes, affecting, for example, deer populations, forest regeneration, spread of tick-borne diseases, and invasive forest plant infestations.

Over-collection of certain wildflowers led to statewide restrictions on collecting "Exploitably Vulnerable" plants without landowner permission. Overharvesting of ramps (wild leek) continues to deplete local populations, however, and overharvesting of edible mushrooms and fiddleheads may have similar local effects.

Collecting of rare species of plants and animals has long been of concern to NYSDEC and the New York Natural Heritage Program. It is illegal to collect or harm NY state-listed Endangered or Threatened plants without the landowner's permission and to collect or harm any NY state-listed Endangered or Threatened animals. An international black market for some rare species, especially rare reptiles, amphibians, and orchids, continues to thrive.

Impacts of Recreation

Outdoor recreation can increase our understanding and appreciation of the natural world; improve our physical and mental health; promote family and social bonding; increase our productivity; and contribute to the local economy. Outdoor recreation is of great value to Milan residents and visitors, but the use of natural areas for recreation inevitably comes with environmental costs. These can be anticipated by land managers and mitigated by appropriate planning, design, and management techniques applied to privately-owned and public lands alike.

Trails for biking, ATVs, snowmobiling, and even walking can be disruptive to habitats and wildlife. Noise and pollution from motorized vehicles can disturb wildlife and harm forest habitats. Trampling and vehicle use cause damage to vegetation, reduced organic duff, and compaction and other changes to soils. These in turn can change plant communities along trails and other trampled areas, promote the introduction and spread of non-native plants, and alter patterns of surface runoff in ways that increase erosion and stream sedimentation. Trails provide an avenue into forests for non-native invasive plants. Trails that create an open canopy over the trail can invite nest predators and brood parasites into the forest interior. Even quiet, non-consumptive recreation such as hiking or birdwatching during the breeding and nesting season can disrupt the courtship behavior of adult birds and lead to abandonment of eggs or nestlings (e.g., for grassland and forest birds near heavily used trails), eventually skewing natural communities in favor of disturbance-tolerant species.[143] Foot trails located near a habitat edge instead of the interior would cause less disturbance to the sensitive interior wildlife species.

Campsites cause similar disturbances, in addition to the effects of firewood collection, campfires, and improper waste disposal. Intentional or unintentional feeding of wildlife contributes to the dominance of

subsidized species at the expense of others, changes ecological relationships, facilitates the spread of diseases, and increases the likelihood of nuisance behavior or attacks on people.

Trails and campsites may be especially damaging when located in riparian zones, contributing to sedimentation, phosphates, and *E. coli* in streams; on rocky ridges or other places with shallow soils; and near other fragile habitats (e.g., acidic bogs) or easily-disturbed species of conservation concern (e.g., nesting raptors or great blue heron). In general, a trail represents a linear corridor of disturbance. The "area of influence" in the vicinity of the trail may extend 300-1000 ft or more from trails in open areas and shorter distances in forest.[144] Motorized vehicle use on trails and access roads usually has larger impacts than other uses in terms of soil disturbance, vegetation damage, noise, air and water pollution, and disturbance of wildlife. For some animals such as raptors, however, a pedestrian can cause more disturbance than a vehicle.

Noise and light pollution associated with recreation activities have greater ecological effects than most people realize. Artificial night lighting can disorient, repel, attract, entrap, or kill a wide range of organisms including moths, other insects, birds, frogs, and fish, and can reduce reproductive success (birds, amphibians) and disrupt communication (fireflies, coyote), bird migration, and predator-prey relationships.[145]

Anthropogenic noise alters behavior, reduces habitat quality, and causes physiological impacts across a range of species. Noise levels that are annoying to humans (40-100 decibels [dB]) also disturb wildlife, and negative health effects occur in both humans and wildlife when levels exceed 52-80 dB. (For comparison, a floor fan can produce about 50 dB, an air conditioning unit 60, conversation 65, a lawn mower 90 dB.) At these levels (well below ATV/motorboat noise), birds, bats, and frogs have been found to suffer effects such as changed vocalization patterns, difficulty locating mates, reduced reproductive success, and altered abundance, distribution, physiology, and development.[146]

Spent bullets and shot pellets and lost fishing tackle are significant sources of lead released to the environment. Water birds often eat lead tackle, and this is the cause of 49% of known common loon deaths in New Hampshire, for example. Lead bullets fragment on impact, resulting in an average of 235 fragments in an animal carcass and 170 in the viscera. Scavenging birds such as eagles, vultures, and ravens can accumulate sufficient lead during the hunting season to suffer neurological effects and mortality, although it is not known to what extent populations of these species are affected. Lead-free bullets and fishing tackle are available but still not widely used in most parts of the US.[147] In New York State, non-toxic shot (such as steel) is required for hunting waterfowl.

Additional effects on aquatic systems are associated with water-based recreation. Non-motorized boating may have the least impact on aquatic communities, but even canoeing can cause stress responses in fish and declines in aquatic plant richness. Swimming can introduce chemicals from sunscreens, soaps, and cosmetics, affecting invertebrates; and swimmer presence may change the behavior and physiology of turtles and fishes. Recreational fishing and stocking of non-native fish can severely affect native fish

populations as well as those of their prey and predators, lowering overall diversity, transmitting fish diseases, and introducing excess nutrients and invasive aquatic species and earthworms (from bait).[148]

Motorized watercraft use and shoreline development cause by far the greatest problems for the water quality and ecological integrity of rivers and lakes. Engine noise, wave action, suspension of sediment, spilled fuel and engine oil, and destruction of aquatic vegetation can pollute water, change behavior and communication in fishes, kill fishes and turtles, disrupt bird nesting, and disperse invasive species—resulting in the disruption of food webs and a decline in diversity of plants and animals. Land development or other significant disturbance to the riparian or shoreline buffer vegetation can have similar effects.[149]

Many of the effects of recreation can be avoided or minimized by public education, good design of recreation amenities, good planning and land management, and monitoring and prompt remediation of problems when they arise. Some mitigating measures are described in the **Conservation Principles and Measures** section.

Climate Change and Ecosystems

Global warming is predicted to affect Dutchess County ecosystems in numerous ways, but the timing and magnitude of effects will depend in part on worldwide levels of greenhouse gas emissions to the atmosphere. Mentioned below are just a few of the expected changes, many of which are already occurring in the region.

Climate change has resulted in many plant species blooming earlier, potentially falling out of sync with the life cycles of their insect pollinators.

Warmer summer and winter temperatures, longer growing seasons, and elevated levels of atmospheric carbon dioxide will favor certain plants and disfavor others, and are thus likely to alter the composition of plant communities. Many of our native plants and animals have adapted over thousands of years to the seasonal temperature ranges of the Northeast and are ill-equipped to adapt quickly to the present-day pace of warming—several orders of magnitude faster than the temperature changes experienced during the most recent ice age.[150] The widespread fragmentation of today's landscape by roads and land development poses additional obstacles to adaptation and migration in response to climate change.

While floods and droughts are normal and expected events in this region, extreme floods and droughts can add to the multiple stresses on ecosystems from human activities. Warming in the region is predicted to significantly affect the composition and distribution of habitats and wildlife, and will force many species to migrate to cooler microclimates, higher elevations, or higher latitudes as former habitats become unsuitable. Cold-adapted species such as sugar maple, brook trout, and fisher are especially at risk. Together with non-climate stressors such as habitat fragmentation, water pollution, invasive species, and overharvesting, climate change will have synergistic effects that magnify the stresses and hazards to wildlife.[151]

Already, many plant species now bloom 4-8 days earlier on average than in the early 1970s[152] and 2-3 weeks earlier than they did a century ago[153]—an effect that may have far-reaching ecological consequences. For example, insect pollinators whose activity periods are closely tied to the historical flowering periods of their food plants may find that their pollen and nectar foods are unavailable at critical times in the pollinators' life cycles. This would add to the existing stresses from more frequent and more severe weather events and could severely harm regional populations of these insects.

Heat stress effects on native plants and animals may eliminate some of the cold-adapted species and communities from our landscapes. Warmer, shorter winters and prolonged winter thaws may make some perennial plants more vulnerable to mid-winter freeze damage by disrupting their accustomed dormancy period, and may subject the early leaves and flower buds to frost damage.[154] Reduced snow cover will harm small mammals and other animals that depend on snow for insulation and protection from predators, but it may favor their predators, such as foxes and eastern coyote, and may also favor white-tailed deer—already over-abundant—whose intense grazing pressure has been transforming our forests for several decades.

Surface water temperatures will rise along with air temperatures. Higher water temperatures reduce the concentrations of dissolved oxygen—a key habitat component for fish and other aquatic organisms—in streams, lakes, and ponds. The life cycles of many stream invertebrates are closely tied to water temperatures and the seasonal patterns of water temperature fluctuations. Alterations to water temperatures will have large effects on the fish, salamanders, and other biota of streams and ponds—organisms that are already stressed by water pollution, siltation, and competition from non-native fish.

Great blue heron, Spring Lake. Photo © Phil Zemke

In general, most at risk will be the plants, animals, and communities with more specialized habitat or food requirements or specialized interactions with other species (e.g., butterflies and their larval host plants) that are likely to be disrupted by climate change, those with poor dispersal ability (i.e., with limited ability to move from a degraded habitat to a more suitable one), and those with already-low population levels, including Endangered, Threatened, and special concern species. Plants and animals likely to benefit from climate change are those that are habitat- and food-generalists, such as white-tailed deer, warmwater fishes (e.g., bass, pickerel, sunfish, white perch), adaptable songbirds (e.g., northern cardinal, American robin, gray catbird, house sparrow, and European starling), and non-native invasive plant species.[155]

The bark of mature shagbark hickory provides summer roosting microhabitat for bats. Photo © Erik Kiviat

THREATS TO AGRICULTURE, FARMS, AND FARMLAND

Farmland is sometimes abandoned by farmers and non-farming landowners for a variety of reasons and then, if left undeveloped and unmanaged, it usually reverts to oldfield, shrubland, and eventually forest. All of those stages offer valuable habitat for native plants and animals, and the land can be returned to agricultural uses at any time, although reclearing a shrubland or forest is labor-intensive. Farmland is lost permanently, however, if the soils are excavated or contaminated, or if the land is developed with structures, pavement, roads, and driveways.

Farmland can be lost permanently if the soils are excavated or contaminated, or if the land is developed.

Soils can be easily damaged by poor farming practices, compaction, toxic contamination, and other disturbances and can be easily lost to erosion where unvegetated cropfields are exposed to large rainstorms or snowmelt events or to the forces of floodwaters. Protecting areas with good farmland soils is a fundamental requirement for maintaining the potential for viable local agriculture and its benefits for the town's economy, local and regional food security, the scenic character of the landscape, and the culture of the human community.

Agricultural land is often lost to developed uses both because of the financial needs of retiring farmers and because the open farmland is easy to convert to non-agricultural uses.

The growth in demand for high quality local and organic food in the Hudson Valley and the greater New York metropolitan region during the last several decades comes at a time when escalating property values have made maintaining large farm properties unaffordable to many multi-generational farming families. New farmers also face a critical shortage of accessible and affordable farmland. Partly due to the high costs of real estate in the region, some land that is farmed today is leased by farmers from non-farmer landowners. The short-term economic benefits of leased land arrangements are limited by farmers' needs for permanence, housing, and equity. A lease arrangement allows farmers to avoid some of the costs of land ownership but usually does not permit them to develop equity in the land or important infrastructure, and leaves them vulnerable to the whims of the landowner. Leased land usually lacks housing for the farmer or farm workers, and nearby affordable housing is often hard to find.

Subdivision of large farmland parcels into smaller lots poses another threat to the viability of land for farming. While some types of farming, such as commercial flower- or herb- growing, are practical on small acreages, many types of farm operations need large areas, so subdivision of a property can mean the end of farming there.

Protection must go beyond open space conservation to address access and affordability of farmland.

Establishment of conservation easements can protect the land itself from subdivision or development, but easements are expensive, and beyond the financial reach of many landowners. Even where conservation easements have been established or where development rights have been acquired by a conservation organization on important farmland parcels, keeping land in active agriculture can be a major challenge. Farmland protection must go beyond open space protection to address access and affordability of farmland, and maintaining opportunities for farming on protected agricultural lands.

The development of community- or utility-scale solar energy facilities is often in conflict with farmland and agriculture. Although farmers sometimes welcome such projects because of the additional income from a part of their land, solar arrays can alter or destroy the prospects for future farming of the land, temporarily or permanently. But solar facilities can also be designed to allow livestock grazing or crop production between the solar arrays. The combination of agricultural and solar energy production, called "agrivoltaics," has been very successful in Europe and is beginning to catch on here.

Branchwater Farm. Photo © Kevin Pike

Dutchess County Agricultural Survey

At a public meeting held in 2013 by the Dutchess County Agriculture and Farmland Protection Board, **farmers** were asked "**What are the issues facing agriculture in Dutchess County?**" Property taxes, high land prices, low profitability, and production costs were the issues noted by the greatest number of respondents. Some of the other issues noted were:

- Regulations: EPA and state environmental laws are restrictive, and impose many of the same burdens on small farms as on large operations. Compliance can be time consuming, and overly burdensome for small farmers.
- High costs: High land rental prices and purchase prices, high cost of agricultural services, etc.
- Lack of education and awareness about agriculture.
- Lack of transportation: No good access to New York City.
- Lack of grain mills, processing plants, and slaughterhouses.
- Labor issues: Difficult to find labor; immigration laws are difficult to navigate and discouraging to workers.
- Lack of communication: Need an organization where agricultural interests can interact. Need better non-farmer landowner/farmer relationships.
- Difficult access to grant funding: It is hard to find, access, or know how to obtain grant monies. There is no central clearinghouse of that information.
- Lack of access to land: The county has not done enough to protect farmland. Farmers should be prioritized to purchase farmland.

Responses to a survey issued by the AFPB of Dutchess County **residents** were as follows:

- 94% said local agriculture and farmland is very important to them.
- 94% said that the loss in farms & farmland over the past few decades is very important.
- 98% believe agriculture is important to the overall economy of the county.
- 89% said open spaces maintained by farms (including scenic views of farmland) are very important (9% somewhat important and 1% not important).
- The two most important factors in food buying were freshness/quality and if it's locally grown/produced.
- 55% would be willing to pay higher price for locally grown foods (but not if prices are substantially higher).
- 90% would support agricultural classes and Future Farmers of America (FFA) programs in high schools and BOCES.
- There was a high level of support for tax incentives to preserve farmland, helping farmers obtain grants, and organizing activities to promote locally-grown farm products.

The 230 respondents represented all towns in the county, but most of the responses were from residents of Hyde Park, Milan, Pine Plains, Pleasant Valley, Poughkeepsie, Red Hook, Stanfordville, and Washington.

(Dutchess County Agricultural and Farmland Protection Plan 2015)

Climate Change and Agriculture

Climate change is likely to affect agriculture in a variety of ways—some even beneficial; for example, warmer summers, warmer winters, longer growing seasons, and higher atmospheric carbon dioxide (CO_2) levels will favor some crops. But the mechanisms will be complex, with differential effects on crop growth, weeds, invertebrates, and pathogens. For example, higher CO_2 levels may benefit aggressive weeds even more than the crops and may increase their resistance to herbicides.[156] Warmer temperatures will be harmful to many existing crops and livestock—especially dairy cows—adapted to cool climates, and will require adjustments to longstanding farm practices. For dairy cows heat stress can lead to lower milk production, reduced calving, and increased risk for health disorders. Heat stress similarly affects the well-being and productivity of other livestock, including beef cattle, pigs, and chickens.[157]

Sugar maples may be entirely lost from the region by 2100.

Increased frequency of summer droughts will stress many crops, and more frequent large rainstorms and flood events will lead to direct losses of crops, soils, and nutrients, as well as costly delays in field access for farm equipment due to wet soils. Some insect pests, pathogens, and weeds will be favored by less severe winters. Rising winter temperatures are already allowing the northward expansion of agricultural pests that reduce crop production. Disruption of heat/thaw patterns may be especially harmful to woody plants (e.g., fruit trees) and perennial herbs.[158] Warming temperatures may have the effect of uncoupling the activity periods of insect pollinators from the flowering periods of both crop plants and native plants that rely on those pollinators.

Perennial fruit crops are affected by the climate year-round, and the stresses experienced in one growing season may affect growth and productivity for two or more years afterward. While apple trees may benefit from longer growing seasons and increased atmospheric carbon dioxide, warm winters may reduce fruit production the following summer, especially for the cold-adapted varieties, and summer heat stress and drought may harm the fruit quality. Greater variation in springtime temperatures can be especially harmful to fruit crops; when warm springs are punctuated by hard frosts, fruit damage becomes more likely. Transitioning to warm-climate fruit varieties is an appropriate response, but will nonetheless be costly to farmers. These kinds of effects will put additional financial strain on farm operations whose profitability is already marginal.

Disruption of the late winter/early spring freeze-thaw cycles will reduce the quality and quantity of maple syrup production. Indeed, sugar maples may be entirely displaced from the region by 2100, with suitable cool, moist habitat remaining only on the highest peaks in the Adirondacks.[159]

Threats to Scenic Resources

Many—probably most—of the scenic areas in Milan encompass privately-owned land with no legal protections for the scenic features. Piecemeal land development, one house at a time, can incrementally chip away at the scenic landscapes that are so valued here. New clearings and buildings on or near hill summits or on high-elevation hillsides often have the greatest impact on the largest viewsheds, but houses in a former expanse of farmland or other meadows can be similarly disruptive. Not only the daytime views, but the visibility of lights at night degrade the scenic quality. "Burglar lights" and other outdoor lights that stay on through the night are a particular eyesore, but even indoor lights can be visible across a large viewshed. See above (Threats to Biological Resources) for a discussion of the effects of light pollution on wildlife.

In recent years, communities in the region have been presented with proposals for utility-scale solar facilities covering, sometimes, hundreds of acres of active or recently-active farmland. While communities are often reluctant to lose the potential for farming and the scenic values of those lands, they may also feel the urgent responsibility to contribute to the transition from fossil-fuel-based energy production to renewable energy sources. Sometimes compromises can be made between municipalities and the solar developer that reduce the area used for the solar arrays, or allow for "agrivoltaics"—that is, the use of land for both agriculture and solar photovoltaic energy generation. Using solar fields for livestock pasture, for example, can eliminate or reduce the need for mowing around the arrays. Solar fields have also been used for growing commercial blueberries, ornamental flowers, and vegetables. The scenic value of sheep or flowers among the solar arrays may partially compensate for the loss of the traditional scenic farmscape.

View of the Catskills from Milan. Photo © Glenn Butler

Stewardship and Conservation of Natural Resources

Conservation Principles and Measures

This section outlines some basic principles and measures for uses and effective conservation of resources of concern, including measures that will help to address anticipated impacts of climate change. Examples of local policies, procedures, and legislation to implement these measures are in the **Regulatory Protections** section below.

Conservation of Mineral Resources

Milan has no active hard rock mines, and just one active sand and gravel mine. The current zoning ordinance prohibits new mining enterprises, so there is little risk of overexploitation of those resources.

Soils are a critical resource for ecological communities and for most kinds of agriculture and are capable of storing large amounts of carbon. Soils are regularly lost due to erosion on construction sites and agricultural fields, and inadequate stormwater management in developed areas, and they are damaged by contamination, depletion, and compaction. Eroded sediments that are washed into wetlands and streams degrade the quality of the water and aquatic habitats.

Measures for soil conservation on construction sites include practices such as preserving topsoil; minimizing cutting and filling; minimizing areas of exposed (unvegetated) soils at all times; and stabilizing, seeding, and planting exposed soils immediately upon final grading. Soil conservation on agricultural lands includes practices such as crop rotation, reduced tillage, cross-slope tillage, mulching, cover cropping, minimizing disturbance of wet soils (including from livestock or equipment), and minimizing applications of fertilizers and pesticides. Additional measures are mentioned in the **Conservation of Farmland Resources** section, below.

Forested ledge, Old Knob Road. Photo © Glenn Butler

Conservation of Water Resources

Forested landscapes are the best insurance for sustaining groundwater supplies, ample water in lakes and ponds, and cool, clean streams with stable banks. Forests with intact canopy, understory, ground vegetation, and floors are very effective at promoting infiltration of precipitation to the soils and preventing rapid runoff of rainwater and snowmelt and the consequent damage to streams, ponds, and wetlands.

Groundwater throughout the town is of conservation concern because it is the only source of drinking water for Milan residents, and is essential to the town's ecosystems. The unconsolidated aquifers deserve particular attention, as they are important groundwater recharge areas and are the most accessible potential sources for well withdrawals, but are also the most vulnerable to contamination. They are located in permeable glacial deposits (sands and gravels) that can be efficient conduits for contaminants introduced by above-ground human activities. Avoiding both impervious surfaces and potential contamination in these most vulnerable land areas will help to preserve groundwater quality and quantities.

The water quality, flow volumes, and flow patterns of a stream depend to a large extent on characteristics of the stream's watershed—the entire land area that drains into the stream. The condition of the soils and land cover in the watershed determine the quality and quantity of water available to a stream throughout the year. Both surface water and groundwater will best be protected by maintaining forested landscapes wherever possible, minimizing use of agricultural fertilizers, minimizing applications of de-icing salts on roads and driveways, minimizing use of pesticides and other toxins as much as possible, and carefully designing stormwater management systems to reduce surface runoff and promote infiltration of precipitation and snowmelt to the soils.

Maintaining dense vegetation cover in roadside ditches will reduce soil erosion and reduce sediments carried into streams. Directing ditch flow into vegetated swales or detention basins will further reduce harm to streams from large runoff events.

Conserving intact habitats in and near flood-prone areas can help reduce local and downstream flood damage while promoting groundwater recharge.

Maintaining "soft" stream banks (i.e., not hardened with riprap, concrete, or other artificial structures) and full connectivity between streams and their floodplains allows floodwaters to spread out, thus dampening downstream floodflows, and reducing downstream bank erosion and potential flood damage to property and infrastructure. It also allows movement of organisms and exchange of organic materials and sediments between the stream and floodplain, thus benefiting the habitats of both. Conserving intact habitats in and near flood-prone areas, and removing engineered features, buildings, and other structures, can help reduce local and downstream flood damage while promoting groundwater recharge, improving stream health, and providing valuable wildlife habitats.

Impervious surfaces such as roads, driveways, parking lots, and roofs impede water infiltration to the soils, reduce groundwater recharge, and promote rapid runoff of rainwater and snowmelt into ditches, streams, and wetlands. These effects create "flashy" streams with brief periods of high flow volumes during runoff events followed by prolonged periods of low flow or no flow. The reduced volumes of groundwater recharge reduce the capability of groundwater to support the base flow of streams during dry periods.

The town could conduct a groundwater study to identify and describe the bedrock aquifers and unconsolidated aquifers, their vulnerability to contamination and over-extraction, and their capability for supporting residential drinking water wells. In anticipation of prolonged droughts, the town could establish water conservation programs to harvest rainwater for domestic and agricultural use, increase water usage efficiency, and adopt local legislation and other measures for water source protection. These could include a water source overlay zone (e.g., to protect the watersheds of important aquifers and headwater streams), acquisition of key land parcels in the vicinity of unconsolidated aquifers, use of green infrastructure where appropriate, minimization of impervious surfaces, and strict stormwater management requirements to promote onsite infiltration of rainwater and snowmelt.

The Saw Kill at Route 199 and Milan Hill Road. Photo © Phil Zemke

Conservation of Biological Resources

Most of the land in Milan is held by private landowners in thousands of parcels of all sizes, from less than ½ acre to hundreds of acres. This is typical of rural areas of the region, but it creates special challenges for maintaining connected landscapes and wildlife travel corridors that must cross multiple property boundaries. The connectivity of habitat areas and the persistence of much of the town's biological diversity depend on the land uses and land management choices of many individual property owners. Educating landowners about the roles their land plays in the larger ecosystem is thus an important component of local conservation. Finding ways to protect (formally and informally) the most important and sensitive areas and to maintain intact connections between protected areas will help to ensure that intact ecosystems and the native biological diversity will persist long into the future.

The persistence of the town's biological diversity depends on the land uses and land management choices of many individual property owners.

For example, maintaining large contiguous areas of intact habitats will help to ensure the persistence of area-sensitive wildlife species that require large habitat patches to fulfill their life history needs, and will also protect the array of natural communities, even those communities of which we are yet unaware. Protecting high-quality representatives of all ecologically significant habitats or communities (such as calcareous and acidic ledges, upland deciduous forests, conifer swamps, woodland pools, bogs, intermittent streams) and areas with concentrations of unusual and rare habitats will help ensure that the most imperiled biological communities will not disappear.

Many of the basic principles for biological resource conservation, mentioned or hinted at in foregoing discussions, can be summarized as follows (adapted from the *Biodiversity Assessment Manual for the Hudson River Estuary Corridor*[160]):

- Large tracts of undeveloped land and connectivity among diverse habitats are important to many species of rare, declining, and vulnerable plants and animals of Milan.
- Broad corridors for seasonal or annual migrations and for population dispersal can be just as important to populations of certain mobile species as their primary breeding, foraging, or overwintering habitats.
- Natural disturbances (e.g., wildfires, floods, wind, ice scour, landslides) are essential features of certain habitats and help to create the environmental conditions that allow some species and communities to persist.
- Broad buffer zones of undisturbed vegetation adjacent to streams, woodland pools, other wetlands, lakes, and ponds are important for preserving the integrity of the aquatic, wetland, and upland habitats required by sensitive species of those habitats.

- Old systems, such as mature forests or wetlands with deep organic soils, are less common in the region than young counterparts of those systems (e.g., young forests or recently created marshes) and provide habitat values for biodiversity not duplicated by the younger habitats.

Protecting habitats and habitat complexes critical to particular plant and animal species of conservation concern will provide an umbrella for many other species using the same habitats and landscapes. For example, for the wood turtle, a broad (e.g., 1,600-ft wide) zone centered on low-gradient perennial streams with undeveloped riparian habitats would encompass most of the turtle's foraging and nesting migrations, as well as habitat areas for a wide range of other wildlife species of riparian corridors, such as river otter, American mink, and Louisiana waterthrush. For pool-breeding amphibians such as wood frog and Jefferson/blue-spotted salamander, maintaining intact forested connections between clusters of intermittent woodland pools or similar pool-like swamps (within 1,500 ft of each other) would protect critical breeding, nursery, foraging, and overwintering habitat and the broad corridors between pools that facilitate population dispersal and genetic exchange. It would also maintain habitat and travelways for the spotted turtle and other animals that use both the pools and forest. For ledge-associated snakes of conservation concern, large contiguous habitat areas around ledgy habitats will encompass the snakes' denning, basking, and breeding areas, as well as critical areas for foraging and migrations. While land development is expected to proceed within those zones, siting and designing new development with an eye to the habitat needs and migration corridors of those snakes will help to ensure that they can continue to thrive in these landscapes.

Below are examples of habitat-specific measures that will help to protect plants and animals of forests and meadows. Many of these measures can be employed voluntarily by individual landowners of small or large parcels.

Conservation of Forests

In forests of any size, maintaining an undisturbed forest floor and retaining understory and ground vegetation, standing snags, and downwood and other organic debris will help to support the forest ecosystem and maintain the resources and microhabitats needed by forest plants and animals. Restoring and maintaining broad landscape

Logging

Adherence to Best Management Practices can help avoid some of the adverse ecological impacts of logging. For example:

- Begin with identifying sensitive features—such as steep slopes, streams, wetlands, seeps, highly erodible soils, and known habitats for rare species—and plan the tree harvest to avoid those areas.
- Maintain broad undisturbed forested zones along streams and around wetlands.
- Conduct logging operations when soils are dry, or in winter when soils are deeply frozen and some wildlife are dormant or absent.
- Leave some large trees in place, and maintain trees of diverse ages and species composition.
- Employ temporary soil stabilization measures during logging operations and install permanent measures as soon as work in each area is completed. Grade and seed logging roads and staging areas when no longer in use.

(Voluntary Best Management Practices for Water Quality, NYSDEC 2018.)

connections between forested areas, and between forests and other intact habitat areas, will help to ensure that important ecological interactions can continue to occur, and will help the plants and animals of forests adapt to the many effects of climate change.

Where new development is proposed in large forest areas, the forest habitats will be best protected if the developed uses do not encroach on forest interiors but are instead confined to the edges and near existing roads and other development so that forest fragmentation is minimized. A utility corridor, a road, and even a single driveway to a house site deep in the forest interior can be a significant fragmenting feature, disturbing wildlife and inviting invasive plant species, nest predators, and brood parasites.

In addition to fragmentation and the extensive edge effects of land development, forests are subject to multiple other stresses such as excessive deer herbivory; invasive plants, insect pests, earthworms, and pathogens; acid rain; nitrogen deposition; and ozone pollution. Forest resilience to the effects of climate change will be improved by reducing these non-climate stressors to plants, animals, and habitats as much as possible.

The large deer population is a regional problem needing regional solutions. Site-specific efforts to control deer or reduce their forest impacts are likely to have only minor, local, and temporary effects (see sidebar).

Deer Management

Many interests collide around questions of deer management. Some hunters favor large deer populations, while many landowners, farmers, and ecologists favor lower populations, and many animal rights advocates oppose sport hunting.

Recreational hunting is the primary management method for deer in New York, but the number of hunters and access to land for hunting continue to decline in New York, and deer damage to forests, especially in southeastern New York, continues to be severe (Shirer and Zimmerman 2010, Russell et al. 2017).

NYSDEC regulates the timing and length of the deer hunting season, the techniques and weapons permitted, and the allowable take per hunter. Nuisance Permits for hunting outside the regular deer season are issued for special situations. Exclusion fences, repellents, habitat modification, birth control, and frightening devices are also used to reduce deer impacts in some situations, but are impractical for treating large areas. A regulated commercial deer harvest, in which hunters could profit by selling venison, might be an effective control, but would contradict long-standing state and federal laws against buying and selling wildlife (Vercauteren et al. 2011).

Even if control efforts (such as intensive hunting) are temporarily successful at reducing the herd on a single site—say, a 10-acre or 500-acre property—deer mobility and the permeable landscape ensure that deer will quickly repopulate the site once those efforts cease. Programs to reduce the regional deer population will be successful only if implemented region-wide, but practical, ecologically sound, humane, and politically feasible control methods have yet to be discovered.

Invasive plant species are best managed in the early stages of an infestation, when just a few individuals can be successfully removed. Once an infestation has taken hold, removal efforts may be futile and may cause unjustifiable disruption of other biota and the forest soils. Fact sheets on the ecology and management of some of our most widespread non-native plants are available on the Hudsonia website.

Conservation of Meadows

Meadows of any size can provide valuable habitat for butterflies, moths, bees, hover flies, ants, beetles, spiders, and a host of other important invertebrates of above-ground and below-ground meadow microhabitats. While different species and groups have their own particular habitat requirements, many will be served by some general management measures.

Farmers often need to mow hayfields several times per year for economic reasons, but non-farmer landowners have more flexibility in their mowing schedules. Maintaining meadow areas with diverse plant species, diverse vegetation structure, and uncompacted soils, and delaying mowing until late fall will accommodate the needs of a wide array of insects and other animals. The undisturbed vegetation and soils will provide resting and ground-nest habitat for native bees, ground beetles, and ants, as well as habitats for egg-deposition, pupation, and overwintering of butterflies and moths. Leaving cut vegetation in place provides the thatch ground cover that is important to small mammals and ultimately becomes part of the meadow food web. Avoiding use of broad-spectrum pesticides (herbicides, insecticides, fungicides, algicides, rodenticides) in or near meadows will help to protect the plants and animals of these habitats. Pesticides contaminate the vegetation, pollen, and nectar foods of pollinators and can harm whole populations in the localities where they are used. Promoting the larval host plants for butterfly species of conservation concern, such as milkweeds for monarch and grasses for skippers, and plenty of nectar plants for those and other pollinators will give an extra boost to those groups.

Delaying mowing until mid- or late summer can significantly improve grassland breeding bird survival rates.

Large meadows (e.g., 10+ acres) have particular value for grassland breeding birds, which are of significant conservation concern in the Northeast. Because many grassland birds nest in the spring and the young do not fledge until late spring or summer, mowing or intensive grazing of meadows in the spring or early summer is likely to be fatal to eggs and nestlings. If nests are destroyed or depredated, some birds will nest again, and the young may not fledge until August, or even later. Delaying mowing until mid- or late summer can significantly improve bird survival rates, as many of the young will have fledged by mid-July and most will have fledged by mid-August.[161] Sedge wren,† however, commonly nests in August or September, so might be harmed by late mowing. (The species is very rare in the Hudson Valley but has been recorded in northern Dutchess, Ulster, and Albany counties as a "probable" nester.). Similarly, rotational grazing that allows for sufficient regeneration of vegetation between grazing periods also improves the survival rates of bird eggs and nestlings. For farmers who must mow at least twice for economic reasons, a recommended schedule is to

mow as early in May as feasible, and then wait 65 days to mow again. This allows bobolinks to renest successfully.[162]

For hayfields, multiple cuttings are essential to the economies of some farm operations, so delayed cutting is not a practical option in those cases. Also, the nutritional quality of forage and hay decreases over the season; hay cut later in the season will tend to have lower protein content. Late-cut hay may therefore be less suitable for livestock with high protein requirements, such as milking dairy cows.[163]

For farm operations that cannot afford to reduce the intensity of mowing or grazing, other alternatives are to raise the cutter bar to six inches or higher, which will likely protect some nests, or to simply set aside certain areas—perhaps those with poorer soils or wetter soils—to accommodate bird nesting, while maintaining more intensive operations elsewhere. There are other good reasons to delay cutting and grazing of wet areas until late summer when soils may be drier. Compaction of wet soils by farm equipment or grazing livestock can harm the soil structure, impede the root growth of plants, impair plants' ability to take up nutrients and water, and reduce productivity long into the future.[164] Delayed cutting and grazing in wet meadow areas will help to maintain soil health in addition to maintaining safe bird nesting habitat and supporting pollinators of these habitats.

Another consideration is that some grassland birds return year after year to the same fields for nesting, so it is best to maintain a late-cut schedule in the same general areas over time. Ideally, those areas should be located away from hedgerows and forest edges, which can harbor nest predators such as skunks, raccoons, and black rat snakes, and brood parasites such as the brown-headed cowbird. Best Management Practices for maintaining grassland habitat for nesting birds are described by Mass Audubon.[165]

Wetlands and Waterbodies

The ecosystems of wetlands, ponds, and lakes depend not only on the internal processes and interactions among organisms, and between organisms and their physical and chemical environment, but also on interactions with surrounding habitats. The condition of the surrounding landscape, the quality of the surface runoff, and the exchange of organisms and materials between the wetland and the adjacent or nearby habitats has a large influence on the habitat quality and water quality of the wetland. For those reasons, in addition to preventing direct disturbance or point-source pollution, maintaining broad, undisturbed buffer zones bordering wetlands, ponds, and streams is among the best ways to preserve the integrity of those habitats. Avoiding disruptions to the seasonal patterns and volumes of surface water and groundwater inputs to the wetland, pond, or stream will also help to maintain those habitats.

Maintaining forested shorelines and watersheds as much as possible will help to maintain cool temperatures in wetlands and waterbodies, and also provide high-quality organic detritus that contributes to the structure and food webs of those habitats.

Ecosystem Resilience

Many species of plants and animals need to move to adjust to new habitat conditions imposed by climate change. Ecologists and conservationists are seeking ways to identify the most important parts of the landscape to allow safe migrations and to maintain intact habitat areas in the changing environment.

The Nature Conservancy undertook a study to identify key areas for conservation based on landscape characteristics associated with diversity and the ability to buffer against climate effects.[166] Their aim was to identify places that encompass the full spectrum of landscapes and habitats needed to accommodate the safe movements and survival of species, so that conservation efforts can be focused where they will be most effective.

One assumption of the study—based on empirical evidence—is that complex and unfragmented landscapes are most likely to provide the array of habitats and microhabitats needed to support species in a changing climate. "Complex" in this context refers to complexity of landforms, elevation ranges, habitat diversity, and wetland density. The Nature Conservancy uses the term "resilience" to refer to "the capacity of a system to adapt to climate change while still maintaining diversity." The researchers created maps showing areas with high or low predicted resilience (Figure 20).[167] The high-resilience areas shown in Figure 20 are mostly forested, have few large roads, and have a high degree of topographic complexity.

This analysis provides only a coarse filter for conservation planning. The notion of resilience is not intended to supersede or outweigh applications of basic conservation principles or the protection of features of local concern—such as riparian corridors, rare or high-quality habitats, or known areas of importance for rare species. But the resilience map provides an additional perspective on connectedness and landscape complexity that can help with identifying regional conservation priorities.

Ice-covered trees on the southbound Taconic State Parkway. Photo © Phil Zemke

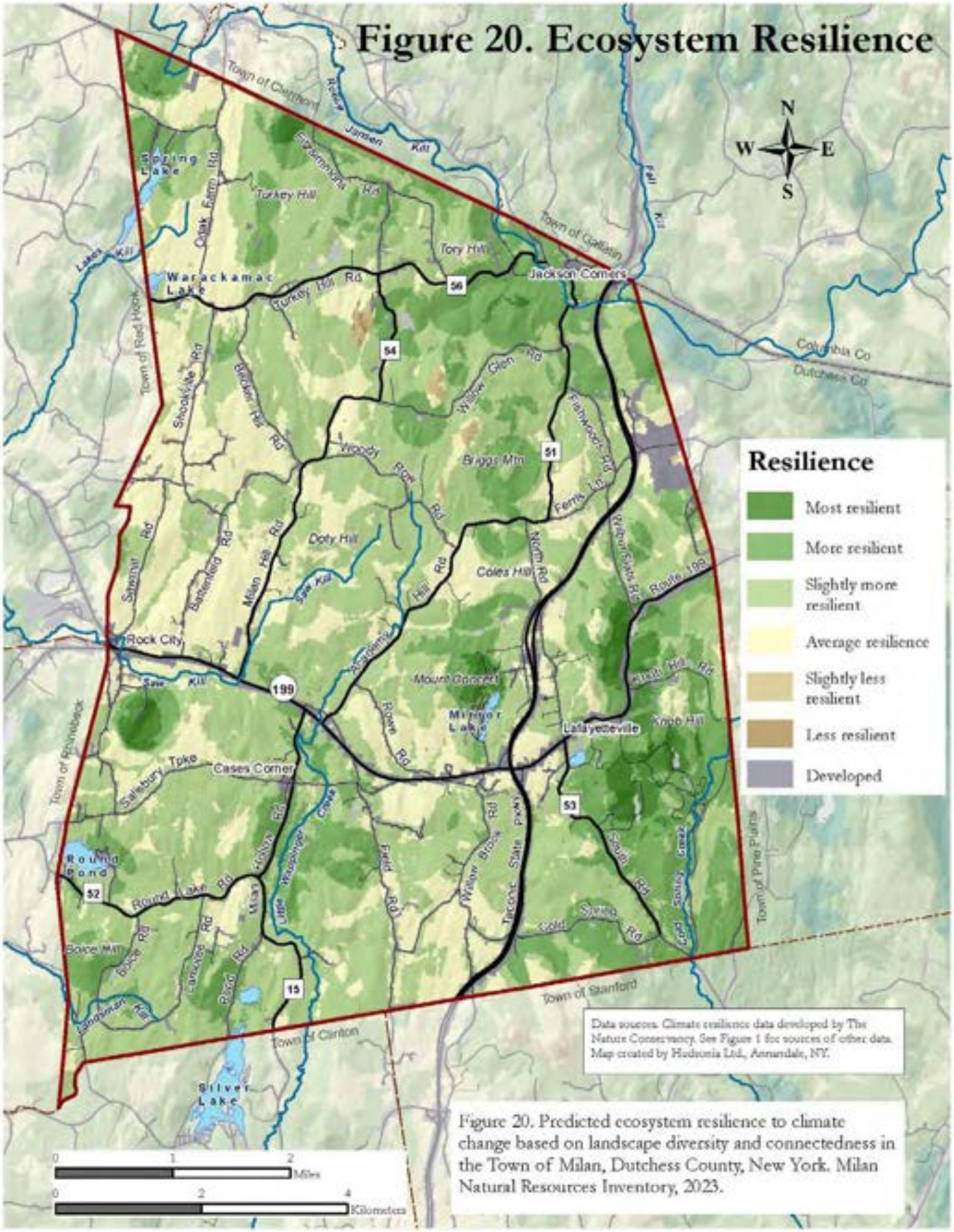


Figure 20. Predicted ecosystem resilience to climate change based on landscape diversity and connectedness in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

Conservation of Farmland Resources

Maintaining viable local agriculture has obvious large benefits for the local economy, local food security, the scenic character of the landscape, and the culture of the human community. Active and abandoned farmland can also contribute significantly to native biodiversity, and intact habitats in the vicinity of farms can, in turn, provide critical and irreplaceable services and resources to farm enterprises—for example, climate moderation, clean and abundant water, flood attenuation, and habitat for pollinators and other beneficial invertebrates.

A strong message from the 2022 United Nations Intergovernmental Panel on Climate Change[168] is that the world's food supply is at great risk from the warming climate. This magnifies the importance of maintaining and expanding the ability to produce food locally. Supporting active farms—for example, by means of reduced property assessments, allowing onsite farm-related businesses, or assistance with obtaining grants—and protecting the best farmland soils will help to keep present-day farming viable and preserve the potential for future farming in the town. Such local support may nevertheless be insufficient given the fragile economies of small farms and the difficulties of withstanding variable and unpredictable weather, markets, and commodity prices. To ensure the continuing viability of farming in the town, other measures may be necessary to foster the economic success of existing and new farm operations and to pair farmers with available farmland.

Numerous studies have found that active farms lower taxes for everyone. Even though some farms receive lower tax assessments than non-farmed properties, they also demand fewer services from a municipality,

Hayfield, Odak Farm Road. Photo © Glenn Butler

and usually represent a significant net gain to municipal coffers. A 1995 study in Tompkins County, New York, found that agriculture typically requires 15¢ to 40¢ of town and school expenditures for every $1.00 in tax revenue it generates, whereas providing services to residential development costs $1.09 to $1.56 - $2.06 per $1.00 of taxes generated—a significant net loss.[169] Many other studies have similarly shown that residential development is typically a drain on municipal finances, while farmland is a net gain.[170]

Whatever means are used to promote agriculture in Milan, a fundamental need is the protection of high quality farmland and its continued availability for agricultural production. With limited financial resources for conservation, protection efforts should be directed toward working farms and lands that have the greatest potential for successful agriculture over the long term.

The American Farmland Trust published *Planning for Agriculture in New York: A Toolkit for Towns and Counties*,[171] which describes the many regulatory and non-regulatory means available to municipalities to support and promote agriculture.

Conservation of Scenic Resources

The scenic beauty of Milan landscapes is inextricably tied to the other natural resources described in this *NRI*—the hills, valleys, ledges, streams, lakes, ponds, wetlands, forests, and farmland. Protection of many of those features will help to protect the scenic areas that are so highly valued by the people of the town. Many of the most scenic areas are on unprotected privately-held land, so recruiting landowners as stewards of scenic areas would be an important component of a scenic areas conservation initiative.

View from Becker Hill. Photo © Debra Blalock

Identifying the scenic areas of greatest importance is an essential first step toward protection. Then, developing local legislation or revising environmental review procedures and standards for decision-making would help the Planning Board and applicants locate and design projects that meet the applicants' needs while preserving the scenic values of the town.

Conservation of Public Recreation Resources

Outdoor public recreation opportunities improve the daily lives of residents, attract visitors, benefit businesses, and strengthen people's connections to and appreciation for the land. If designed carefully, monitored, and remediated, recreation tied to the natural landscape can have relatively minor environmental impacts while immeasurably enriching the lives of those who take advantage of it. The main areas for public recreation in Milan are Wilcox Park, the Milan Recreation Park, and the three state-owned Multiple Use Areas. In addition to the public-access lands for recreation, of course many Milan residents use private lands—either their own or others' with landowner permission—for walking, skiing, bicycling, birdwatching, hunting, fishing, and other uses.

Expanding some kinds of public recreation do not require acquisition or development of additional land. One way to expand recreation opportunities without setting aside more land for that purpose is the adoption and implementation of Complete Streets principles, which can transform existing roads into safe and attractive corridors for walking and biking, in addition to their use by motorized vehicles. Additional ideas for modifying existing roadways for those purposes and for other kinds of trail planning are in the Greenway Guides of the Dutchess County Greenway Connections program.

When establishing trails and other features for private or public uses of outdoor spaces, certain practices can help to minimize the adverse effects on plants, animals, and habitats. Trails and access areas located at habitat edges instead of interiors, and designed to avoid rare and sensitive habitats, wildlife travel corridors, and breeding areas for sensitive species will have fewer impacts on biological resources. Minimizing noise and artificial lights will cause less disruption of wildlife. Managers who identify acceptable and unacceptable levels of impact, and monitor uses and conditions, can take steps to reduce impacts when the resource is threatened by over-use. Trails can be closed and re-routed when necessary, and trail features can be installed to minimize erosion, bridge streams and wetlands, and mitigate other harms.

The potential for ecological harm is often related more to the spatial extent of human uses than the timing or intensity of use. A spatially extensive network of "social" trails and campsites has a greater negative impact on wildlife and plants than a few clearly-marked and well-maintained formal trails and campsites, even with more annual visitors.[172] Predictable disturbances, such as human presence on an established trail, are better tolerated by wildlife than unpredictable ones.[173] Even low levels of foot traffic or only a few nights of camping in one site can cause lasting changes to soils and vegetation. Visitor education—about wildlife sensitivity to disturbance, the value of staying on trails and using established campsites, proper waste disposal, and other "Leave No Trace" principles—can be very helpful, because many visitor impacts are unintentional and avoidable.

For managers of conservation lands, the different goals of recreation and resource protection should not be confused with each other; they are sometimes but not always compatible. Some areas of conserved land may be inappropriate for recreational uses, due to the sensitivity of habitats, plants, wildlife, or water, while other areas may be more resilient. Even non-motorized boating, for example, can damage the rare

vegetation on floating mats in a circumneutral bog lake, and even low levels of foot traffic on a rocky crest can destroy its plant community or interfere with the nesting of a sensitive songbird. But good planning and design of infrastructure, trails, and other use areas, along with education about and observance of outdoor etiquette, can improve the compatibility of human recreation and intact habitats and help to protect the natural areas that are so widely valued in Milan.

Mitigating and Responding to Climate Change

The effects of global warming are now apparent worldwide in storms of record-breaking intensity, hotter and more prolonged heat waves, warmer winters, massive wildfires, and rising sea levels that are inundating coastal areas and islands. The juggernaut of global warming cannot be easily slowed or turned around, but local, regional, national, and worldwide efforts to reduce greenhouse gas emissions to the atmosphere are essential if we are to head off increasingly greater catastrophic events.

These reductions are achievable only if individuals as well as municipalities, states, and nations take concerted steps to significantly reduce emissions. Individual actions might take the forms of driving less, switching to renewable energy sources and more energy-efficient appliances and vehicles, and reducing purchases of plastics and other petroleum-based products. The town government could switch to renewable energy sources and more efficient equipment for municipal operations, promote local production of renewable energy, educate the public about reducing our carbon footprint, and enact local legislation to protect forests and wetlands for their carbon sequestration services (in addition to their biodiversity and water resource services).

The town could also adopt a Climate Sustainability Checklist for new building projects to encourage energy-efficiency in building design, use of renewable energy sources, and other measures to reduce the carbon footprint of new construction. For example, the Town of Chelmsford, Massachusetts, has developed a model for such a checklist to be used during site plan review.

The town could also take part in the New York State Climate Smart Communities program which guides municipalities through the process of increasing energy efficiency, reducing GHG emissions, and increasing resiliency to climate change, and makes grants available to assist communities with those efforts.

Slowing the advance of global warming is one important goal, but finding the best ways to respond to the present-day and future stresses of the changing climate is another. The more frequent and larger storms and the prolonged heat waves and droughts are likely to make groundwater and surface water supplies less reliable, disrupt agriculture, degrade habitats for many kinds of wildlife of conservation concern, pose new hazards to human health, and harm humans and wildlife in many other ways.

Maintaining and restoring forests may be the best way to ensure that precipitation and snowmelt feed the soils and groundwater instead of running rapidly off the ground surface. Forests also hold soils in place, store large amounts of carbon in above-ground and below-ground biomass and soils, moderate local air

temperatures, and provide foraging, breeding, and overwintering habitat as well as safe travel corridors for many kinds of wildlife. Maintaining large, well-connected habitat areas (habitats of all kinds) will ensure that wildlife can move safely between the habitats that support their various life needs. Maintaining and restoring broad buffer zones of undisturbed soils and vegetation around streams, wetlands, ponds, lakes, and other sensitive habitats will help to protect those places from pollution and other disturbances from human activities. Undisturbed buffer zones that encompass stream floodplains will accommodate floodwaters from large storm events, reduce hazards to infrastructure, and reduce downstream flooding.

To help ensure resiliency in the face of existing and new environmental stresses brought on by climate change, the best townwide approach may be to seek protection of large areas representing all elevational gradients and significant landforms (such as hill summits, side slopes, ravines, valleys), bedrock types, and hydrological conditions, and to maximize the connectivity of intact habitat areas. This approach will help to maintain and protect important biodiversity and water resource elements in the present, and will provide the greatest opportunities for adaptations and safe migration of wildlife and plants to suitable habitats in a rapidly changing environment.

Protected Lands

Approximately 2,450 acres of land in Milan has some kind of formal protected status—either owned and managed by a public agency for conservation purposes, or owned privately but with a conservation easement held by a land trust (Figures 19 and 21).

Conservation easements (see explanation below) are perhaps the best way for a private landowner to ensure permanent protection of their land while maintaining ownership and use. Landowners can work with local land trusts to ensure that the easement provisions reflect their conservation vision while allowing reasonable land uses to continue.

Regulatory Protections for Natural Resources

Federal and state laws provide some protections for certain kinds of resources, but many important resources have no protection except for those provided by local legislation or offered voluntarily by landowners.

Below are outlined some of the existing protections for land areas and species in federal, state, and local laws. See the **Achieving Conservation Goals** section for ideas for local measures that can extend protections to other areas and resources of concern.

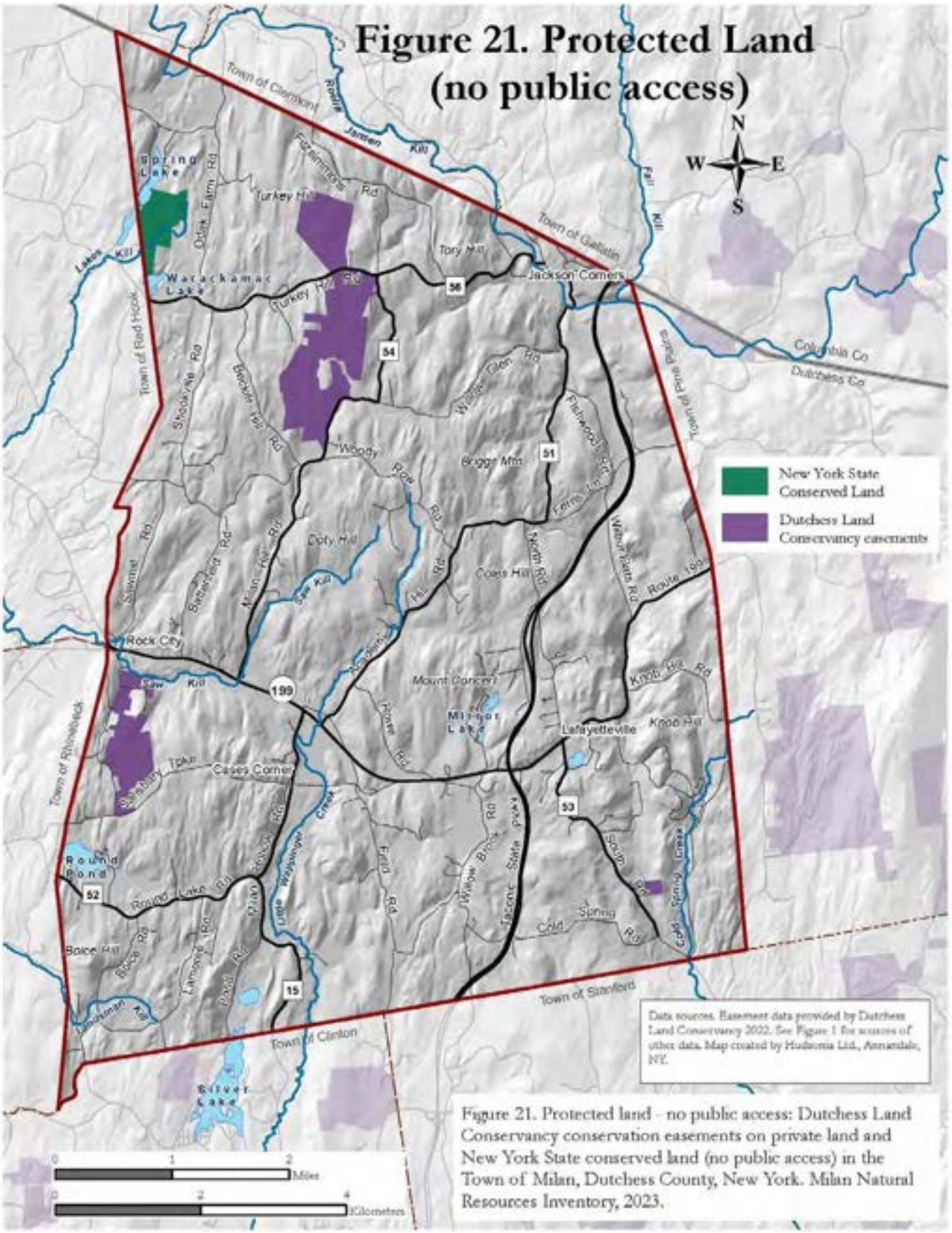


Figure 21. Protected land - no public access: Dutchess Land Conservancy conservation easements on private land and New York State conserved land (no public access) in the Town of Milan, Dutchess County, New York. Milan Natural Resources Inventory, 2023.

Mining

The Milan local code prohibits the establishment of new mines in the town, but one sand and gravel mine—Red Wing—still operates. A permit from NYSDEC is required for commercial mining in New York, and mining wastes must be disposed of properly, erosion on mine sites must be controlled, and mined lands must be reclaimed and returned to productive condition according to the mined land reclamation law (Article 23, Title 27 of the Environmental Conservation Law). Regulations (6NYCRR Parts 420-425) and a permitting program designed to achieve these goals have been established by NYSDEC. Mines wishing to continue operating must renew their state permits on a five year (or shorter) schedule. Exempted from the permit requirements are excavations of less than 1,000 tons or 750 cubic yards (whichever is less); or less than 100 cubic yards in or adjacent to any body of water not subject to permitting under the Protection of Waters Program (ECL Article 15); or excavation associated with onsite construction or farming.

Wetlands

Unlike most other parts of the landscape, certain wetlands and streams receive some protections from the federal government and New York State.

Federal Wetland Regulatory Program

Section 404 of the federal Clean Water Act (CWA) is the basis for the federal wetland regulatory program, which is administered by the US Army Corps of Engineers (ACOE), sometimes in consultation with the US Environmental Protection Agency (USEPA) and other federal agencies. The federal government regulates activities in "navigable waters" and wetlands of any size that are connected to those waters.

The Clean Water Act prohibits certain kinds of activities (especially filling) in jurisdictional wetlands without a permit. It imposes no standard setback or buffer zone around wetlands or along streams, although those may be imposed on a case-by-case basis at the discretion of the ACOE.

Navigable Waters

As defined in Section 404 of the federal Clean Water Act, "navigable waters are…those waters that are subject to the ebb and flow of the tide and/or are presently used or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce."

The interpretations of criteria for navigability and connectivity under the CWA have been in flux in recent decades. At the time of the publication of this *NRI,* we are governed by a May 2023 decision by the US Supreme Court, which holds that only streams and wetlands with a more-or-less permanent surface water connection to navigable waters are jurisdictional under the CWA. This is a huge departure from long-

standing interpretations of the CWA by federal agencies and the courts, and effectively eliminates federal protections from most streams and wetlands.

Most of Milan's streams and wetlands are unprotected under the current interpretation of the Clean Water Act.

Figure 15 shows (in dark purple) the wetlands in Milan mapped in the National Wetland Inventory (NWI) by the US Fish and Wildlife Service. The map includes many wetlands that do not fall under federal jurisdiction, and excludes many that do. The ACOE does not use the NWI maps to determine federal jurisdiction or to determine wetland boundaries.

Under the ACOE's "Nationwide Permit" program, some kinds of activities in jurisdictional wetlands and streams are allowed if the anticipated impacts fall beneath certain thresholds. There are 54 Nationwide Permits described for the New York City ACOE district (which includes Dutchess County), each for a different kind of activity and with different thresholds of impacts allowed. For example, Nationwide Permit 29, for residential developments, allows filling of up to ½ acre of non-tidal wetland as long as General Permit Conditions are adhered to and "the project is designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable." The permittee must submit a Pre-Construction Notification to the ACOE, which may impose additional conditions on the project. Nationwide Permits for the New York City district are described at https://www.nan.usace.army.mil/Missions/Regulatory/Nationwide-Permits/.

New York State Wetland Regulatory Program

The New York State Freshwater Wetlands Act (Article 24 of the New York Conservation Law) specifies the kinds of activities that can and cannot legally occur in and near large wetlands (12.4 acres and larger) and in a few smaller wetlands "of unusual local importance." The most typical instances of the latter are wetlands connected to a public drinking water supply, or wetlands known to support a state-listed Threatened or Endangered animal. The law also regulates activities in a 100-foot-wide "adjacent zone" around the perimeter of any state-jurisdictional wetland. Most wetlands in New York do not fall under state jurisdiction, however, because they meet neither the size nor the "unusual local importance" criteria.

Thus, due to their small size or hydrological isolation, most of our intermittent woodland pools (vernal pools), isolated swamps, and isolated wet meadows receive no protection in federal or state law. Small, isolated wetlands can have great value for biodiversity and for water management, however, and it is often the very isolation that imparts their special value to certain plants or animals. In the case of vernal pools, for example, the isolation from streams and other wetlands helps to maintain the fish-free environment that is a critical factor for the pool-breeding amphibians of conservation concern. (See discussion of these pools in the **Biological Resources** section, above.)

The New York State Freshwater Wetland Maps show the wetlands that are protected under the NYS Environmental Conservation Law. Like the federal NWI maps, the state wetland maps show inaccurate

wetland boundaries and exclude some wetlands that would otherwise meet the jurisdictional criteria. Although NYSDEC uses the maps to determine which wetlands are jurisdictional, it does not rely on those maps to determine the actual extent of jurisdiction, but instead requires on-the-ground delineations.

In 2022, the New York State Assembly passed significant reforms to the freshwater wetland regulatory program. For example, the reforms will:

- eliminate the jurisdictional use of the existing state freshwater wetlands maps in 2025;
- lower the minimum size for jurisdictional wetlands from 12.4 to 7.4 acres in 2028;
- include additional criteria for identifying smaller wetlands of "unusual local importance," such as wetlands that attenuate significant flooding, filter drinking water, provide habitat for rare species, increase climate resiliency, sequester carbon, or are located in an urban area; and
- provide funding for wetlands management and local mapping of freshwater wetlands through the Climate Smart Communities Program in the NYS Environmental Protection Fund (Part QQ of Chapter 58 of the Laws of 2022).

A fuller description of the history of NYS wetlands regulations and the 2022 reforms is in an article in the *New York Law Journal*.[174] Until some of the new provisions take effect in 2025 and 2028, however, the 12.4-acre size threshold and other features of the existing law remain in force. NYSDEC is preparing new freshwater wetland maps that will show many of the wetlands that meet the revised criteria, but the maps will be for informational purposes only, and will not eliminate the need for on-the-ground identification, delineation, and mapping when new development projects are proposed in the vicinity.

Town of Milan Wetland Protections

The Town of Milan local code defers to the definitions and protections in the New York State and federal wetlands regulatory programs. It extends no jurisdiction to the wetlands excluded from those programs, and imposes no additional regulatory buffer zones or other protections. It does require that wetlands be shown on subdivision plats and other submissions for review by the Planning Board, and urges that new development features generally avoid wetlands, but sets forth no independent standards for avoidance, setbacks, or other protective measures.

Streams

Federal Protection of Streams

Under Section 404 of the federal Clean Water Act (CWA), the federal government regulates activities in "waters of the United States" which include tidal wetlands and streams, and non-tidal streams that are considered to be "navigable waters." The CWA interpretation has been in flux for many years—see the sidebar and discussion in the previous **Wetlands** subsection.

As of the May 2023 US Supreme Court decision (Sackett vs. Environmental Protection Agency), only perennial streams—those that run all year—are "navigable" and thus jurisdictional.

As with wetlands, some kinds of stream disturbance may fall under a Nationwide Permit (see above) and thus not require the lengthier "individual permit" process with the ACOE. For residential projects, for example, Nationwide Permit 29 applies to disturbances affecting up to 300 linear feet of a stream bed or banks. The federal government imposes no standard buffer zones along streams but can require a buffer zone on a case-by-case basis.

Among the General Conditions that apply to all Nationwide Permits is a requirement to maintain aquatic connectivity: "[no] activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species. If a bottomless culvert cannot be used, then the crossing should be designed and constructed to minimize adverse effects to aquatic life movements."[175]

New York State Protection of Streams

A NYS Protection of Waters Permit from NYSDEC is required for disturbing the bed or banks of a stream with a classification of AA, A or B, or with a classification of C with a standard of (T) or (TS) (see the **Surface Water: Water Use Classification** subsection for explanation of these classes), whether the disturbance is temporary or permanent. The state law has no setback or buffer zone requirement. No permit is required for disturbance of streams of other classes or for unclassified streams. Small ponds or lakes of ten acres or smaller and located within the course of a stream are considered to be part of the stream and are subject to the same regulations as that reach of the stream.

A Protection of Waters permit is also required for excavating or filling in "navigable waters" of the state and adjacent wetlands. In this case, "navigable waters" include any rivers, lakes, ponds, and streams that can float a watercraft holding one or more persons. Exempted from this requirement are any waterbodies that are entirely surrounded by land held in a single private ownership.[176]

Town of Milan Protection of Streams

Although the Milan code includes protection of streams from pollution among the purposes of the zoning ordinance (§200-3F), and requires that streams be shown on subdivision plats and site plans for review by the Planning Board, it imposes no specific protective requirements such as avoidance or setbacks. Moreover, the code includes no specific definition of streams or of the umbrella term "watercourses."

Water Quality

Certain activities that affect the water quality of streams and lakes require a permit from New York State; for example, constructing or using an outlet pipe for wastewater, a sewage treatment plant, or a concentrated animal feeding operation; construction activities disturbing one or more acres of soil; or stormwater runoff from industry or municipal storm sewers. Siting and design of residential septic systems are subject to review and approval by the Dutchess County Department of Behavioral and Community Health. Pesticides applied to surface waters require a NYSDEC permit and, for waterbodies that straddle more than one property, or are one acre or larger, or have a surface water outlet, may only be applied by a certified pesticide applicator.

Rare Species

The federal and New York State governments maintain lists of protected rare species and have laws intended to prevent harm to individuals and populations of those species. Most places in New York, however, have never been surveyed for rare species, so many of the locations where rare species occur are unknown. Hence, most land disturbance and land development takes place without anyone knowing whether or not rare species occur in the vicinity and could be harmed by the project. Many rare species are also difficult to detect, and determining their presence or absence often requires lengthy surveys conducted by experts during specific seasons.

Most species are associated with particular kinds of habitats, so information on habitats can help determine where particular species are likely to occur. For example, a spotted turtle may use a marsh for foraging and a nearby gravel bank for nesting, but is unlikely to be found on a high-elevation ledge. An eastern meadowlark is likely to nest in a large upland meadow but not in a marsh. In these ways, understanding the kinds of habitats that a rare species uses will help to predict the places where the species might occur in Milan.

Unfortunately, there is no comprehensive habitat map for the town. Figure 10 gives a rough picture of some of the habitats, based largely on automated remote interpretation of satellite imagery by the US Geological Survey, but the map cannot be relied on for accurate or detailed identification of habitats at a specific location. Thus, an onsite assessment is necessary to identify habitats of conservation concern during reviews of new development projects.

Below are brief descriptions of some of the federal, state, and local laws, policies, and procedures that can help to protect rare species and their habitats.

Federal Endangered Species Act

The Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884) prohibits unauthorized taking, possession, sale, and transport of federally-listed Endangered or Threatened species of plants and animals. The US Fish and Wildlife Service maintains and revises the list of plant and animal species deemed to be rare nationwide under the law, and assigns a rank of "Endangered" or "Threatened" to each. Only a few species in New York are on the federal list. In Milan those are Indiana bat† and northern long-eared bat.† Land development projects that may interfere with known locations of federally-listed Threatened or Endangered species must be reviewed by the US Fish and Wildlife Service.

New York State Environmental Conservation Law

Animals ranked as Endangered, Threatened, and Special Concern New York are listed under 6 NYCRR Part 182 of the New York Environmental Conservation Law (ECL) 11-0535. The regulations prohibit the taking of (or engaging in any activity likely to result in the taking of) any species listed as Endangered or Threatened in New York. The regulations also prohibit importing, transporting, possessing, or selling "any Endangered or Threatened species of fish or wildlife, or any hide or part thereof...."

Plants ranked as Endangered, Threatened, Rare, or Exploitably Vulnerable are listed and regulated under Environmental Conservation Law section 9-1503 Part (f): "It is a violation for any person, anywhere in the state to pick, pluck, sever, remove, damage by the application of herbicides or defoliants, or carry away, without the consent of the owner, any protected plant." ("Exploitably Vulnerable" plants are not rare but are vulnerable to collecting for commercial and personal purposes.) Thus, plants are considered the property of the landowner and are protected only to the degree that the landowner wishes. Under NYS law, any landowner can lawfully remove, damage, or destroy (or grant permission for others to destroy) state-listed rare plants on their own property, but others are not permitted to harm those plants without the landowner's permission.

Town of Milan Protection of Rare Species

The State of New York grants considerable authority to municipalities to adopt zoning and other laws governing land use. For any resource, municipalities may adopt regulations that are equally or more protective than the state regulations of those resources. There are no provisions in the Milan local code for protection of rare species.

ACHIEVING NATURAL RESOURCE CONSERVATION GOALS

Conservation of natural resources can happen on every land parcel in the town, whether it is a half-acre residential lot, a 50-acre woodlot, or a 200-acre farm. It can happen through a variety of means, including voluntary land management efforts of individual landowners, conservation-minded designs of new development projects, land trust acquisition of land or establishment of conservation easements with willing landowners, or restrictions imposed by governmental policy or legislation.

Landowner Stewardship

> This town is small yet diverse, like a family. I have only been here fifty years. The lineage of other families extends millennia. The most recent immigrants to Milan are drawn to a great extent to our natural resources. Most residents share values of conservation. -Tom Foote, 2022

Educating landowners about their potential stewardship roles can inspire voluntary action and help raise awareness and support for other conservation activities. For example, management of forests, meadows, and residential yards can be designed to support native biodiversity and water resources, and the siting, construction, and maintenance of woods roads and foot trails can be designed to protect sensitive areas. Use of alternatives to broad-spectrum pesticides and chemical fertilizers can create safer habitats for native plants and animals, including pollinators.

Education can occur through outreach at community events, through lectures and workshops, through distribution of educational materials, and through referrals to programs of state and county agencies and conservation organizations. Programs of NYSDEC, the Cornell Cooperative Extension-Dutchess County, and the Dutchess County Soil and Water District, for example, address aspects of agriculture and gardening, protection of water resources, management of invasive species, flood resiliency, and other topics related to land management and conservation. The Women Owning Woodlands website provides a wealth of information on owning and managing land (for people of any gender). Programs of the Dutchess Land Conservancy assist landowners with many aspects of land stewardship for conservation. Since most of the land in Milan is and will remain in private ownership, educating landowners about the special natural features of their land, and recruiting landowners as long-term land stewards and conservation partners is essential for conserving the ecologically significant features of the Milan landscapes.

Formal Land Protection

Landowners, conservation organizations, municipal agencies, and state or federal agencies may be involved in formally protecting land. Most often, land protection is undertaken using one of two approaches: land acquisition or perpetual conservation easements. Other legal instruments can confer conservation status for a period of time, such as deed restrictions or term easements (easements that cover a specified period of time).

Land Acquisition

Milan may rarely have funds available for acquiring lands for conservation purposes but can nonetheless collaborate with other public and private entities to help with acquisition efforts for lands with special environmental, historic, agricultural, recreational, or scenic importance or lands that are threatened by inappropriate development.

A decision to purchase a property for conservation purposes should be preceded by an assessment of the conservation values of the property in relation to the buyer's goals and priorities, and a determination of the long-term capacity for stewardship of the property. Financial and other forms of collaboration with other agencies, organizations, and landowners can expand the opportunities for and success of land acquisition projects.

Land acquisition is only one of many tools for land conservation, however. Other methods for protecting important resources on privately-owned lands without formal conservation status are outlined below.

Conservation Easements

A conservation easement is a legal agreement between a landowner and an entity such as a municipality or a land trust. The easement is developed by the landowner and the receiving agency (such as the land trust), and it restricts the type, location, and amount of development and specifies the types of land uses that can occur on the property so that conservation values—such as wildlife habitat, scenic views, agricultural value, and water resources—are protected. An easement may be in force for a certain amount of time (term easement) or forever. An easement may be donated by the landowner to the receiving agency or may be purchased from the landowner by the receiving agency. Conservation easements may be required under some municipal rules, such as conservation subdivisions.

Easement lands remain in private ownership and on local tax rolls. The landowner retains full title to the land and is free to sell, lease, or mortgage the property or pass it on to heirs. The conservation easement, however, "runs with the land;" that is, the restrictions and responsibilities of the easement are conveyed to all future owners of the property. In this way a conservation easement allows the current landowner to maintain ownership and use of the property, while securing a conservation legacy for future generations.

Conservation easement agreements with a land trust such as the Winnakee Land Trust, the Dutchess Land Conservancy, or Scenic Hudson are completely voluntary, are developed on the landowner's initiative, and are designed to meet the wishes and long-term needs of landowners while adhering to the conservation principles of the land trust and the rules of the funding program (if state or federal funding is involved). Easements require regular (annual) monitoring by the easement holder to ensure that the terms of the land use agreement continue to be met.

Natural Resources and SEQR

Municipalities may require that certain kinds of natural resource information be part of an application to the planning board or building department.

Including natural resource information early in project planning helps the applicant accommodate the important features in the project design right from the start, and helps avoid the expenses of redesign.

Municipalities can recommend or require that land use applicants refer to this *NRI* to bring natural resource information into project design and review, and can require that a **habitat assessment** be prepared by a qualified professional as part of an application for a subdivision or site plan approval.

Model guidelines for such an assessment are available on the Hudsonia website.

State Environmental Quality Review (SEQR)

Many projects proposed by a state agency or a municipality, and all permits from a state agency or unit of local government, require an environmental impact assessment (6 NYCRR Part 617 State Environmental Quality Review). The basic document for this assessment, to be completed in the early stages of the SEQR process, is the Environmental Assessment Form (EAF), designed to help the project applicant and the reviewing agencies gather and assess basic information about the proposed project, the natural and cultural features of the project site, and the potential impacts of the project on resources of concern. SEQR requires the sponsoring or permitting agency (such as a municipal planning board) to identify potentially significant environmental impacts of the activity it is proposing or permitting, and to avoid, minimize, or mitigate those impacts.

As with many such bureaucratic forms, the EAF is often completed in a perfunctory way by the applicant and the lead agency in the environmental review, providing only scant and superficial information about resources at risk and potential impacts to those resources. But applicants, planning boards, and town or village boards that use the EAF and the SEQR process to their fullest potential will find them powerful tools for protecting important resources and sensitive areas. This starts with thorough and informative answers to the EAF questions and analysis of potential impacts.

NYSDEC hosts an online EAF Mapper designed to answer the place-based questions in Part 1 of the EAF forms. Using the Mapper can greatly hasten and simplify the work of completing the EAF. However, the Mapper uses only existing data in the public domain and thus relies on the state and federal wetland map data (with all their known inaccuracies and omissions), existing rare species data (which are incomplete), and existing flood zone data (which are outdated and cover only the larger streams). A thorough approach to completing the EAF would include onsite identification and mapping of wetlands

and floodplains, and a habitat assessment to determine the potential for species of conservation concern. A fact sheet on using the EAF short form to its fullest potential for identifying sensitive natural resources is available on the Hudsonia website.

Land Use Legislation & Other Local Measures

Landowners have much autonomy in the uses and care of their own land, but municipalities regulate some aspects of land uses and development with potential to affect resources important to the public welfare by means of zoning, subdivision, site plan review regulations, and other mechanisms in the local code. Citizens can make their concerns known to town agencies by attending agency meetings and becoming involved in comprehensive planning, open space planning, and zoning revisions, and can even put their names up for election or appointment to town boards and committees.

> If the town implements the actionable intelligence from the 2007 [Comprehensive] Plan and the *NRI* conservation goals, we will leave this land a better place for our children. -Tom Foote, 2022

Comprehensive Planning

In New York, municipal land-use regulations must be adopted in accordance with a Comprehensive Plan (e.g., NYS Consolidated Laws, Town Law, § 272-a). The comprehensive plan, based on the needs, values, and vision of the community, is intended to guide long term growth and development and serve as a foundation for all land-use regulations (such as zoning, subdivision, right-to-farm, and flood damage prevention laws). Comprehensive plans are most useful when they include descriptions, locations, and values of local natural resources, along with goals and priorities for resource use and conservation and strategies for furthering those goals.

The municipal Comprehensive Plan sets forth the interests, purposes, and intents of the community for development and conservation; the zoning law establishes rules and procedures to carry out those intents; and municipal agencies (e.g., town board, planning board, zoning board of appeals) implement the local laws when reviewing and ruling on land development projects. Periodic updates of the Comprehensive Plan will help the town keep up with development trends, conservation ideas, concerns of townspeople, and emerging threats, including those posed by climate change.

Zoning, Site Plan Review, and Subdivision Regulations

Zoning and other local laws provide legal standards for land development projects and usually strive to balance private property rights with community environmental, health, and safety concerns. Carefully designed legislation and project reviews help to ensure that land use restrictions are applied consistently and fairly, and that resources important to town interests and public welfare are protected.

MILAN COMPREHENSIVE PLAN

The 2007 *Milan Comprehensive Plan* offers many recommendations for improving stewardship and conservation of natural resources. For example:

- Integrate *Habitat Assessment Guidelines* into subdivision and site plan review procedures
- Complete a *Natural Resources Inventory*, and adopt for planning purposes
- Prepare a townwide habitat map
- Establish environmental overlay districts or Critical Environmental Areas for areas of special sensitivity, such as ridgelines, steep slopes, scenic roads, scenic vistas, farmland soils, habitats for rare species, and important water resources
- Encourage conservation easements on privately-owned lands
- Promote conservation subdivision designs
- Adopt ordinances for protection of water resources
- Replace the Land Conservation Zone with more targeted environmental regulations
- Establish regulations for logging and excavation
- Apply "Dark Skies" measures to all development projects

The Recommendations section in this *NRI* outlines specific actions to advance those goals.

Good land use policies and decisions depend on having good information. This *NRI* provides information on natural resources throughout the town, including resources of conservation concern and particular sensitivity, but does not show site-specific details. While the *NRI* can alert users to the presence of some important resources, on-the-ground observations are still essential to adequately assess the features of concern on any site where new land development is proposed.

The statement of purpose in a local zoning law clearly spells out the public interests to be served by the law and thus the underpinning for regulatory decisions. Below are described some specific regulatory tools that can be employed at the town level to govern the uses and conservation of natural resources.

Overlay zoning –Some municipalities have designated "conservation overlay zones" pertaining to certain resources and places of particular conservation concern such as agricultural areas, scenic corridors, ridgelines, steep slopes, stream corridors, and aquifer protection districts. Overlay zones often overlap two or more underlying zones; the existing rules and exemptions for the underlying zones still apply, but additional restrictions may be imposed to protect the sensitive environmental features of the overlay zone.

Performance standard zoning – This zoning establishes restrictions on environmental impacts regardless of use; for example, requiring naturally vegetated buffers of a certain width around waterbodies, wetlands, or streams.

Wetland protection – Local legislation is the only means for legal protection of the many wetlands and streams that do not fall under state or federal jurisdiction. Wetland protections are typically part of the zoning code and the subdivision regulations. While the Milan Comprehensive Plan and local code express an intent to protect wetlands and streams, the code refers only to existing state and federal regulations, leaving many important wetlands and streams entirely unprotected. Local legislation can establish land use restrictions, buffer zones, and other measures for protecting wetlands and streams of any size or in any landscape position. Other Hudson Valley municipalities have adopted local laws to protect ecologically important wetlands and streams. A guidance document from the NYS Department of State offers a model local law.

Incentive zoning – In return for maximizing open space or another environmental benefit, a subdivision developer is given an incentive such as permission to subdivide at a higher density.

Special use permit requirement – The town may legislate to set standards or impose requirements (furthering natural resource conservation) to avoid or minimize the risks of certain types of uses. For example, the town could require special use permits for gas stations in areas of sensitivity for groundwater, making it a condition of approval that fuel storage be above ground.

Conservation subdivision regulations – A "conservation subdivision" is a special kind of "cluster" subdivision with the explicit purpose of permanently protecting the most important natural resources and open spaces on a site.[177] The Milan local code includes provisions for cluster subdivision design (§200-22), but not for conservation subdivision design. The code also states that the Planning Board "may require" a cluster subdivision design if a site meets certain criteria, but there is no obligation to require it.

Ted Fink (the principal of GREENPLAN, Inc.) has developed Conservation Subdivision legislation for the towns of Rhinebeck and Warwick that specifically require a) identifying the most important natural resources on the site, and delineating buffer zones around those resources; b) a Planning Board visit to the site; c) identifying the portions of the site best suited to new development (and most protective of the sensitive areas); and d) locating roads and driveways to minimize roadway lengths and habitat fragmentation.

One limitation of "conservation subdivision" laws and similar local laws is that they are usually invoked only for "major" projects (e.g., those involving five or more subdivided lots; the exact threshold is set in the local code). Thus, project sponsors often design smaller projects (e.g., four subdivided lots) to avoid the requirements of a conservation subdivision design. The consequence is that subdivision projects are designed without regard to the habitat fragmentation effects of conventional subdivisions, and rural sprawl proceeds unabated.

Site plan review – A site plan is a scale drawing and description of existing features and the layout and design of a proposed development project or use on a single parcel of land. Milan's zoning ordinance (at Article IX) describes when a site plan review may be required, the procedure for the review, a checklist of elements that must be included on a site plan, and the matters that must be considered by the Planning Board. The Planning Board may impose reasonable conditions or restrictions as part of site plan approval. The law could be amended to show additional features on the site plan, such as the 500-year flood zone, Prime and Statewide Important Farmland Soils, Areas of Known Importance, intermittent streams (delineated onsite), exposed ledges, large forests, large meadows, and unusual habitats, to illuminate additional areas of sensitivity.

Solar facilities legislation – Utility-scale and community-scale solar facilities are an essential part of the transition from fossil-fuel-derived energy to renewable energy sources, but often conflict with resources that are highly valued by the community, such as farmland, biodiversity, and scenic vistas. The NYS Energy Research and Development Authority has developed a model local law for siting solar facilities that can be adapted to accommodate local needs and values.

Watershed Planning

Because streams, watersheds, and aquifers cross political boundaries, cooperation between neighboring communities is often essential for protection of water resources. Through watershed planning, public agencies, conservation NGOs, private landowners, and others can identify threats to water resources and specific actions for watershed management. The *Watershed Plans Guidebook*[178] from the NYS Department of State provides step-by-step guidance on the watershed planning process. Collaborating with existing watershed conservation groups—the Roe Jan Watershed Community, the Saw Kill Watershed Community, and the Wappinger Creek Watershed Planning Committee—can advance the work of all.

Open Space Planning

Under the broadest definition, "open space" includes all the undeveloped land—both publicly- and privately-owned—in a municipality or other area of interest. The NYS General Municipal Law, Section 247, defines open space as "any space or area characterized by (1) natural scenic beauty or, (2) whose existing openness, natural condition, or present state of use, if retained, would enhance the present or potential value of abutting or surrounding urban development, or would maintain or enhance the conservation of natural or scenic resources." An open space "inventory" simply catalogs and maps the important open space resources in a municipality or other area of interest, and the land parcels that are involved. An open space "plan" prioritizes areas for open space conservation and outlines ways to accomplish the conservation goals. Preparation of an Open Space Plan or Inventory is a natural follow-up project to a Natural Resources Inventory.

Floodplain Protection

The Floodplain Management Regulations of the Federal Emergency Management and Assistance Law set forth minimum standards for flood protection but encourage communities to adopt more restrictive floodplain management regulations when warranted to better protect people and property from local flood hazards (44 CFR 60.1[d]).

Under the Community Rating System, insurance premium discounts are available to policy-holders in communities that have enacted floodplain management programs that exceed the standards of the Federal Emergency Management Agency (FEMA). To minimize public hazards and stream degradation, Milan may want to adopt improved standards for floodplain protections, including prohibition of new structures, septic systems, storage of hazardous materials or manure, or placement of fill. A model local law provided by NYSDEC is in section 4.4 of Model Local Laws to Increase Resilience.

Critical Environmental Areas

Another means of drawing attention to significant natural resources is by establishing a Critical Environmental Area (CEA). A CEA is a geographical area with exceptional character with respect to one or more of the following:

- a benefit or threat to human health;
- a natural setting (e.g., fish and wildlife habitat, forest and vegetation, open space and areas of important aesthetic or scenic quality);
- agricultural, social, cultural, historic, archaeological, recreational, or educational values; or
- inherent ecological, geological or hydrological sensitivity that may be adversely affected by any change in land use.[179]

A CEA is a formally-designated area, adopted by the municipality and registered with the state, with the purpose of raising awareness of the unusual resource values (or hazards) that deserve special attention during environmental reviews and land use decisions. Once a CEA has been designated, potential impacts on the special characteristics of that CEA must be addressed by the lead agency when determining the significance of any Type I or Unlisted actions (in the SEQR process) that may affect the CEA. Many Dutchess County towns have adopted CEAs.[180]

Habitat Assessment

A "habitat assessment" can be adopted as a standard requirement in the early stages of planning and municipal review of new projects. The purpose is to ensure that the applicant, the planning board, and other reviewing agencies have the information they need to assess potential impacts to habitats and species of concern prior to approval of new projects. Guidelines for conducting a habitat assessment, which Milan developed years ago, could be revived. Another template for habitat assessments is available on the Hudsonia website.

Community Preservation Fund

A Community Preservation Fund can be established by a municipality only after special authorization from the NYS Assembly, and only after adoption of a Community Preservation Plan (CPP) that identifies the important areas for preservation. Once such authorization is obtained and a CPP is in place, the governing body of the municipality can initiate a Community Preservation Fund to be used for establishing parks or preserves, protecting open space, scenic areas, significant habitats, water resources, agricultural land, historic places, and other places that help to preserve the community character. The fund is supported by a

real estate transfer tax of up to two percent of the purchase price of properties. The tax is typically levied only on real estate transactions that exceed a certain minimum value, such as the median price in the community, so modest transactions are unaffected.

Scenic Byways

Scenic Byways are transportation corridors recognized by the NYS Department of Transportation for exceptional scenic, recreational, natural, or cultural features. They are managed to protect those characteristics and to encourage economic development through tourism and recreation. Scenic Byways are typically nominated at the local level. The nomination, accompanied by a Corridor Management Plan (CMP), is submitted to the New York State Scenic Byways Advisory Board. The Advisory Board must approve the CMP before recommending the Scenic Byway designation to the Commissioner of Transportation who makes the final decision. Once a Scenic Byway has been formally designated, the Commissioner is authorized to review projects occurring along the roadway; construct facilities for the use of pedestrians and bicyclists, rest areas, turnouts, highway shoulder improvements, passing lanes, overlooks, and interpretive facilities; make improvements that enhance access for purposes of recreation; and protect historical and cultural resources in adjacent areas.

Katydid on Japanese knotweed. Photo © Erik Kiviat

RECOMMENDATIONS FOR NATURAL RESOURCE CONSERVATION

The *NRI* Advisory Committee has brought local knowledge and historical data to this project, and has studied the natural resource information in the *NRI*. We believe that preserving our natural resources and their roles in local ecosystems are of paramount importance to retaining the character and quality of life in our town. To advance the vision and goals set forth in the town's comprehensive plan, and to help ensure that our drinking water, farmland, wetlands, streams, soils, forests, meadows and other natural resources will continue to support the Milan community long into the future, we present the following recommendations for actions that can be taken by landowners and town leadership.

The Town of Milan is a Greenway Compact community committed to pursuing the policies, principles, and guidelines of the *Greenway Connections: Greenway Compact Program and Guides for Dutchess County Communities*. The recommendations below are consistent with the goals and approaches set forth in the Greenway Guides for protecting natural areas, farmland, aquifers, and other natural resources, preserving habitat connectivity, increasing public access to natural areas, enhancing outdoor recreational uses, and designing new development to minimize environmental harms and improve the human experience.

(Page numbers in parentheses in the lists below refer to places in this *NRI* where each topic is discussed.)

Town Legislation

- Adopt design standards for all land development projects to ensure that harm to sensitive areas is minimized. Standards could address, for example:
    - habitat fragmentation and landscape connectivity
    - design, sizing, and installation of culverts
    - curb specifications (to allow passage of small animals)
    - exterior lighting (to reduce ecological and scenic impacts)
    - soil erosion (to reduce soil loss and sedimentation of streams, ponds, and wetlands)
    - stormwater management
    - biodiversity assessment protocols for environmental reviews
    - scenic resource and ridgeline protection protocols
- Adopt local legislation to extend protection to the small streams, riparian buffer zones, and small, isolated wetlands (and buffer zones) that are not protected by state or federal laws. Milan could revive its former Wetland and Watercourse Protection Law, or adapt some version of the model legislation offered by the NYS Department of State for protecting wetlands and streams. (Pages 158, 160)

- Add a "Conservation Subdivision" option to the Cluster Development section (§177-27), and make cluster subdivision design a requirement for subdivision proposals on all parcels of ten acres and larger. (Page 160)
- Strengthen steep slope regulations in the local code to better address soil erosion, stormwater management, and protection of streams; for example, prohibit soil disturbance or tree-cutting on slopes of 25% or greater. (Pages 110, 159)
- Upon completion of a townwide groundwater study, establish an Aquifer Overlay District with regulations to protect the areas most important for aquifer recharge and most vulnerable to groundwater contamination. (Pages 25, 109-110, 134, 159)
- Revise the Flood Damage Prevention section of the local code (Ch. 127) to prohibit construction of new buildings, roads, driveways, and other structures in the 100-year flood zones of Milan streams, and encourage the removal of structures, equipment, and materials that could interfere with natural flood dynamics, or create local or downstream hazards if flooded. (Expand this to the 500-year flood zone when FEMA data is available.) (Pages 28-29, 67, 108, 134-135)
- Adopt "Dark Skies" legislation to minimize light pollution from new and existing development sites. (Pages 117, 124, 132)
- Create local funding for land acquisition, purchase of development rights, and other measures that the town deems important for natural resource conservation (for example, through a Community Preservation Fund, described in the **Conservation Tools** section). (Pages 155-156, 162)
- Consider establishing Conservation Overlay Zones or Critical Environmental Areas for places of special concern such as unconsolidated aquifers, streams and riparian corridors, large forests, large meadows, steep slopes, ridgelines and other scenic areas, and special biodiversity areas. (Pages 135, 159, 160, 162, 163)

Town Procedures, Additional Studies, and Other Measures

Town Board

- Find grants or other funding to support:
    - a townwide groundwater study (Page 135)
    - an Open Space Inventory (Page 161)
    - a scenic areas survey (Page 144)
    - establishment of one or more Critical Environmental Areas
- Develop a drought emergency ordinance with proactive measures and instructions for residents to prepare for and respond to short- and long-term drought conditions. (Page 135)
- Collaborate with the Roe Jan Watershed Community, the Saw Kill Watershed Community, and the Wappinger Creek Watershed Planning Committee on developing local policies for stream protection. (Page 161)

- Update the Comprehensive Plan to incorporate ideas for mitigating and responding to climate change, including recommendations for local legislation. (Page 158)
- Appoint an Open Space Committee to develop an Open Space Inventory and Plan that identifies and prioritizes the most important land areas for formal or informal protection. (Page 161)
- Apply lower tax assessment values to parcels with conservation easements. (Page 156)
- Develop a program to collaborate with farmers in their efforts to reduce pollution of surface water and groundwater, and to assist with obtaining grants and other support to defray the costs of those efforts.
- Consider nominating Route 199 and possibly other roads as Scenic Byways. (Page 163)
- Manage town-owned lands in ways that exemplify sound conservation principles (e.g., buffer zones along streams, bioretention installations to manage stormwater, reduced use of de-icing substances on roads, and reduced use of herbicides) (Pages 29, 75, 110, 134-135, 139)
- Contact businesses and homeowners in floodplains regarding restricted activities and structural requirements for participation in the National Flood Insurance Program. (Pages 110, 161-162)

Planning Board, ZBA, Code Enforcement Officer

- Adopt habitat assessment guidelines for applicants, to help ensure that adequate natural resource information is provided to the Planning Board and Zoning Board of Appeals with land use proposals. Milan could revive guidelines that were in use here in the 2000s, use Hudsonia's template, or adapt guidelines in use by other Hudson Valley towns. (Pages 92-93, 157-158, 162)
- Consider impacts to water resources, sensitive habitats, good farmland soils, and important scenic resources at the earliest stage of reviewing land development projects, and help applicants design their projects to minimize those impacts. (Pages 109-112, 113-127, 128-131, 132)
- Hold erosion control and stormwater management plans to a high standard, to ensure that soils are not lost, stormwater is conserved, groundwater is replenished, and streams are protected. (Pages 27, 110, 133-135)
- Discourage disturbance of floodplain forests and other floodplain habitats. (Pages 29-31, 42)
- Take advantage of the training programs for municipal agencies offered by the NYSDEC Hudson River Estuary Program.

Highway Department

- Use the NAACC stream barrier data to prioritize repairs to culverts and bridges, and identify state-funded grants to make necessary upgrades. (Pages 36, 115)

- Reduce applications of de-icing salts on town roads, and town-owned parking areas and driveways, and manage stormwater runoff from such areas in ways that promote infiltration of water to the soils. (Page 134)

Landowner, Farmer, Resident Actions

- Apply the general conservation measures (in the NRI **Summary**) to land and water throughout the town, where applicable. (Pages xii-xv)
- Remove structures and hazardous substances from floodplains, and shift to flood-resilient land uses to minimize economic losses from flood damage, flood hazards to downstream areas, soil loss, and stream contamination. Some appropriate land uses are forests, hayfields, and pastures. (Pages 28-29, 67, 108, 134-135)
- Maintain floodplain forests intact wherever possible, and plant woody vegetation in unforested areas along streams to provide shade and organic detritus to the stream, improve streambank stability, and improve wildlife habitat. See the Buffer in a Bag program for free tree and shrub seedlings for streamside planting. (Pages 29-31, 42)
- Adopt wildlife-friendly agricultural practices that protect water supplies, build living soils, support native pollinators, and accommodate ground-nesting birds where possible. (Pages 95-97)
- Avoid or minimize applications of polluting substances to the land, such as de-icing salts to driveways and walkways, and pesticides and fertilizers to lawns, gardens, and cropfields. (Page 134)

Other

- Organize and conduct a townwide survey of scenic locations throughout the town, so that those areas can be considered in land use planning and environmental reviews of land development projects. (Page 101)
- Develop educational programs and materials for landowners, business owners, farmers, and residents on topics related to natural resource conservation.
- Educate residents who live along streams about the benefits of riparian borders, broad buffer zones and best practices for stream stewardship (see " Life at the Water's Edge: Living in Harmony with Your Backyard Stream."[181] (Page 29)

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Appendices

Appendix A

Interviews with and writings from town residents

In the following pages are transcripts and notes from interviews with Milan residents, past and present, and excerpts of written accounts, recollections, and musings about people and the land. Oral history videos are at https://www.youtube.com/c/milanNYhistory1818.

Trail's End

(from interview with Esther Rider and Bessie Coon, 8 April 1971)

In 1843 the buildings were in a state of disrepair, most of the land was still uncleared. The land was either in woodland or undeveloped cleared land; timber was down, and fields were unmarked and full of rock. The rock walls that lace the farm and the land and the foundations to the barn are testament to the labor and time that went into building a farm.

From *"This Place Called Milan"*

(notes from Bill Jeffway, 2018)

Milan roads were shaped by lot lines and the many hill and hollows. With a few exceptions, the goal was to stay flatter [i.e., locate roads, residences and farms on flatter terrain], even if it meant going farther. Around 1850, the "Barge Milan" [carried] loads of products from Milan farms that would include livestock and milled goods leaving from Rhinebeck's "Slate Dock" at Rhinecliff. The milled goods included rye, wheat, bran, cornmeal, and rye flour among others. Internal railroad lines were constructed 1869-1875. There was a railroad station at Jackson Corners and another in Cokertown (Spring Lake) on the border between Milan and Red Hook. Greenhouses abounded. In 1924 approximately 100 families were involved in growing violets. [See a video about the violet boom at https://vimeo.com/ondemand/sweetviolets.] [Today] the Battenfelds have some of the few that remain and are now growing anemones in greenhouses and Christmas trees in the fields.

There were a total of ten school districts and one-room school houses before the [school] consolidation in the 1930s: Cokertown, Rock City, Lafayetteville, Jackson Corners, Milan Hill Road, Academy Hill/North Road, Academy Hill/Morehouse, Milan Hollow, Round Lake Road, and Cold Spring/Eagle Lane. Many children walked to school so it was important for the schools to be located close to where people lived.

Jackson Corners

(from interview with Walt Hermans, 4 April 1993)

The railroad had a passenger and freight stop at Jackson Corners. The station agent used to board with Walt Hermans' parents. He had old Elgin car. When he started it to come back to the house, Mrs. Hermans could hear it and had dinner on the table by the time he came in. Enos Seifert use to carry the mail on his back from the railroad station to the post office at the General Store. The mail came on the passenger trains and sometimes came in twice a day. Inhabitants had to go to the store to get their mail.

Sawmill on Academy Hill Road

(Harold Coon)

[The mill] usually operated only in the springtime when the water was high. The farmers would bring the logs in during the winter [onto] the level place about 200 feet long above the site of the mill; [that's] where they would hold the logs until the mill opened….There was a dam that went all the way across the stream. The wheel was an undershot providing the power for the saw. There was an 18-inch pipe which directed the water onto the wheel. When the gate was opened the water flowed through the pipe and turned the wheel. The main portion of the work done was to provide planking for the bridges in town. Beams, shingles for houses, and barns were usually hand-hewn; they were cut and shaped with an adze. Many times in the old houses, beams can be seen that are flat only on one side to support the flooring, while the underpart of the beam is still round and in many cases still has the bark on it.

Brief History of Rock City and Grange

(Lucille Battenfeld)

Without a doubt, these first settlers saw an opportunity and had visualized what the future might be if some of the unharnessed water power was harnessed to manpower. They set foot, used a great deal of time, thought, and energy, and created a sawmill. This was the first industry to be attempted….After a few years of successful labors, a new industry was conceived and the second floor of the sawmill was equipped for making wheels, spokes and hubs for wagon….One industry led to another. The results were a carpet and woolen mill....Other mills such as a grist mill, cider mill, harness shop and shoemakers shop were the few industries Rock City in the past could be proud of having.

From "*Up to Milan*"

(Barbara Thompson)

George Zitz wins the honor of being the first of Milan's immigrants to arrive. It was not dairying but growing all kinds of fruit - apples, peaches, plums, pears and grapes - that first attracted George to farm life, probably as his family had done in the Old World. He kept a few cows and pigs and she (his wife Frances) raised chickens and sold the eggs to neighbors. The fruit was taken to Rhinecliff and from there to the City on the New York Central Railroad. As was the custom for the Croat and Slovenian neighbors of their time in New York, they also took in boarders. Although they were escaping the heat of the city, these were not indolent vacationers but additional hands expected to help with the chores.

Jesse Langdon

(notes from Bonnie Wood)

Milan listened when a cowboy born in Fargo, North Dakota, arrived in Lafayetteville with tales of his teenage years riding broncos and joining Teddy Roosevelt's "Rough Riders." With a reputed handshake that engulfed the hands of other men, and memories that rivaled those on any movie screen, Milan soon believed, and can recall hearing him speak his mind at meetings in the Milan Town Hall.

In Theodore Roosevelt's *The Rough Riders*, a history of the First United States Volunteer Cavalry in the 1898 Spanish-American War, Jesse Langdon is listed on the Muster-Out Roll as a Trooper from Fargo. According to a June 1975 Poughkeepsie Journal article, Jesse D. Langdon and his first wife Marie Story founded the Story-Langdon Foundation in 1947. The foundation owned 272 acres in Lafayetteville. Marie Story came from an old Milan family. They lived on the Story farm where Marie grew up. Her father Roland worked for the US Customs in New York City and operated a dairy on South Road. According to a March 1971 Poughkeepsie Journal article by Christopher Klose, Jesse offered his 272 acres to Dutchess County for $54,600. Land should be "conveyed for the use and for the benefit of the general public."

America's hero Jesse Langdon and "[his] beloved wife Marie in eternity" and her parents are interred on a hill in the Milan Union Cemetery. May the spirit of this American cowboy remain in the hills of Milan, NY and in its history books.

Irene Wilcox

(from interview, May 24, 1972)

There were two grades of soap. The soft soap was the poorer and made from the poorer type grease from frying pans and the like. It was good enough for mens overalls. They used to put it and some water in a barrel and stomp on it or poke with stick and let it soak for a long time. The hard soap was odorless and almost white this was made from the innards and better grease. They used to put the grease in a big "kittle" and add boiling water to it and then when it cooled the good stuff would be at the top and poor down at the bottom. Used to do it two or three times a year.

Tom Odak

(from interview with Audrey Cole)

Tom's father purchased the farm in 1919, and renamed it from Hilly Acres to Shadblow Farm, named after the first flowers to bloom in the spring—small white flowers that filled the field across the street from the farm. They raised dairy cows and nearly everything the family needed to live. They had 15 cows, 200 chickens, and grew corn, oats, and hay. They kept hogs that were butchered for ham, bacon, and fat that was used for cooking and soap. They grew apples, peaches, and grapes on an additional 25 acres. Eggs were often exchanged in Red Hook for groceries. They didn't drink milk, as that was income.

Milk was cooled in a wellhouse next to the pond; the water stayed nearly ice cold year round. Tom recalls cutting ice from Spring Lake in January in most years, which kept the icehouse (lined with zinc and covered with sawdust), and lasted through September. He recalls particularly tough and long winters when the "snow would set in around Election Day and never left the ground until the first of March." He remembers the slow mechanization of farming practices—from the horse-drawn hay rake to the tractor; the process of reaping and threshing oats and hay; and the communal nature of the work. "Whether it was haying, ice-harvesting, or barn-raising, additional help was needed….No matter what one had to do at his own place, that had to be done beforehand. A commitment to help was as important as were the hours of daylight to a farmer.

Tom started milking cows when he was eleven. He would go to the barn in the early morning, return to the house to find a nice warm breakfast that his mom made, and walk to the schoolhouse at the corner of Turkey Hill Road and Salisbury (now Odak Farm Road). He would walk home for lunch, back to school, and then home for chores before supper. There were no electric lights then, of course. "We'd walk to the barn with lamps and do milking by hand."

His father kept plowing with a horse long after they purchased a tractor, feeling that the tractor compacted the soil too much. They purchased very little for heating the home. They cut their own firewood from logs brought home on a wagon and cut into chunks. They kept around a year's supply of seasoned firewood on hand.

Odak farm, like much of Milan, is extremely rocky. Tom got used to knowing the terrain and adjusting his plowing to avoid stones. He notes that the soil has a lot of limestone; he never had to buy lime and believes the limestone contributed to a good harvest from the garden and crop fields annually. Crops were rotated annually: "Corn was planted one year, then oats and grass. Then we would take hay off that field for three years after that, and then start the cycle over again."

They rotated cows through difference pastures with electric fencing and would take chopped hay and silage to the cows in the field; felt this ensured healthier cows and fields. They raised fruit with very different practices than today. They sprayed trees just twice in a season, and "the apples were always perfect."

Linda Ahlin/Jacoby

(interview with Marty Clarke and Bill Gallagher, May 12, 2022)

Linda tells of her father, Lee Jacoby, and the family's life on the farm on Link's Corners Road (re-named Field Road after Cyrus Field?).

At first it is a story of subsistence and diversified farming seemingly dating from another age...they were "pioneers" in Milan. A story of limitless hours of tedious, manual labor, a cold house heated by wood stoves, no indoor plumbing, sleeping on cloth mattresses filled with straw or corn husks, living with cracks in the roof allowing rain or snow to leak in, keeping a bucket of water on the second floor to throw down the chimney if it caught on fire, and walking several miles to attend the one-room schoolhouse on Academy Hill Road.

The specialty crops were sweet corn and apples, and Linda's mother canned all the fruit grown. They had a small number of cows starting in the 1950s, and they raised hogs, oats, and hay. The farm totaled 187 acres, and approximately 60 acres were usable for agriculture.

The family had to be quite self-sufficient, growing most of its own food and supplementing it by hunting, repairing farm machinery and buildings, creatively recycling materials. Members of the family worked together. Each one contributed to the success of the farm by doing chores such as feeding the animals, collecting eggs, working in the vegetable garden, milking cows, unloading hay, cooking, cleaning, sewing clothing, or frugally altering "hand-me-downs" for further use. All the brothers and sisters worked together and were expected to do the same work—no discrimination; for example: 300 bales of hay had to be unloaded and stacked weekly. The family had target practice Sunday afternoons so they knew how to handle a gun. The Jacoby's had one hired hand and managed to put four children through college.

After WWII, Lee focused his attention on dairy farming and eliminated the orchard aspect of the farm. Since only "37% of the farm acreage was usable, the rest being rocky hills and swampland, my father rented or purchased additional acreage from several neighbors in order to support his growing dairy herd. Tractors and new equipment replaced horses and horse-drawn equipment making it more practical and efficient to farm the new acreage.

“Throughout the expansion and modernization of the farm in the 1950's and 60's, my father remained hardworking, frugal, and as self-sufficient as possible while managing to successfully produce one of the top dairy farms in Dutchess County.”

From Marty Clarke: "One afternoon Linda's brother Stanley Jacoby, showed me a place on the farm where charcoalers from yet another age made charcoal. The burned ring, where nothing will grow due to the super-heating of organic material in the soil, is still visible there".

* Some facts taken from the Milan Community Assoc. Newsletter - May, 1974 - Vol VI No. VII.

Janet and Gene Ohlson

(interview with Bill Gallagher and Marty Clarke, 2022)

Gene came to Academy Hill Road in 1936 or 1937 with his family from New York when they purchased the property for $5000. It had been a dairy farm with barns, a house and 140 acres. Though they never really farmed it, they spent weekends and summers, moving up full time in 1941.

He recalls that the road was dirt and electricity had just come through in 1936 (or 1937). When they went up to swim in the Roe Jan creek, they used to sit on the railroad trestle and wait for the train to come through to feel it shake!

During the polio outbreak, he had to attend the upper one-room schoolhouse on Academy Hill, but later graduated from Pine Plains High School in 1941. He also told stories of several impoverished families living in shacks without services—seemingly from another era!

He sadly told the story of losing his friend, Junior Wilcox, the son of Irene Wilcox, benefactor for the Town of Milan, in a plane crash.

Gene's wife, Janet Van Wagner of a Pine Plains farming family, remembers the olden days fondly, especially the friendliness and helpfulness of neighbors. They have been married for over 70 years!

A pleasant hour spent with Gene and Janet.

Fred Battenfeld

(interview with Bill Gallagher, June 23, 2022)

In 1932 during the Great Depression, grandfather Fred Battenfeld bought 105 acres. The farm was supported by violets, hops, and grapes, and by renters in the summers.

Dutchess County was the grain belt for New York State. Grain was shipped down to New York City on boats and trains along the Hudson.

Dick Battenfeld started growing anemones in the 1950s. Area fruit growers shrank down to a handful. Although Dutchess County was a strong agricultural area in the 1950s, farming is now almost extinct.

The Christmas tree part of the business was started in 1948, and the first Christmas tree was sold in 1956. Fred Battenfeld got started in the business in the early to mid-1960s. Eight wooden greenhouses were replaced by modern aluminum construction. The work goes on in greenhouses in the winter, and outside tending Christmas trees in the summer. Fred’s two kids are working and learning to eventually take over the business.

Burton Coon

[…]Shookville had no water power. It was a farming community. Many of the dwellings were small, with a garden and yard attached and occupied by a laborer and his family. In those days, everything was done by hand, even mowing and raking, and grain harvesting, and there was need of many laborers. Also, much more hay and grain was raised then than now. Every farmer had a man, by the month or season, and a man by the day, and often extra help in harvest. But with the invention of machinery, not so much help was needed so the laborer had to seek employment elsewhere. At the same time, the cities and manufacturing centers were offering larger opportunities to young men and so the boys left the country home and went to the city or village. And when the old folks died, the place was abandoned and now there are only the "old house places" as we call them, that can be distinguished only by a fragment of a cellar wall or a lilac or a currant bush standing like a wayfarer left behind in the march of civilization.

I imagine many of these little homesteads were acquired as the early settlers in the west did theirs. A young man and his wife who wanted a home would pick them out a place along a stream where water was handy and they thought potatoes and a garden would grow and there they would put up a house and raise a family. "Squatters," you say. Probably they were to begin with, but by long and undisturbed residence there they would acquire legal title to the land. These little houses would often be away back from the road with only a footpath leading to them. Some of them, I think, were the homes of the charcoal burners. All about here in the fields are dark circular patches of soil about ten or twelve feet in diameter where charcoal was burned when the virgin forest was cleared off. And I have often stood and wondered who he was that tended that pit—his name, his character, his family, where he lived, and where he was buried. But all now is forgotten and the place that once knew him will know him forever. I often wish I might have photographs of some of the old inhabitants and so see them at their work or in their hours of leisure.

Jack Campisi

(Interview with Debra Blalock, December 2022)

Jack was born October 7th 1931 in Brooklyn, NY, and recently enjoyed his 91st birthday. He is a past Milan supervisor, is the town's current deputy supervisor and spends a good amount of his time working with the town officials and staff on the issues that confront the town on a daily basis.

His father Jules bought property on what is now Willow Glen Road in 1936. It had been used by a bootlegging business out of Brooklyn to produce and run liquor. Jules had known of the bootlegger and through that connection eventually purchased the property. Upon moving here Jack started third grade in the Red Hook Central School. The Red Hook schools were centralized in 1937 absorbing the students of four one-room schoolhouses in Milan. Pine Plains had centralized in 1931 absorbing five other Milan schoolhouses and Rhinebeck took the last one when its schools were centralized in 1941.

There were no paved roads in Milan until the 1960s when CHIPS (Consolidated Local Street and Highway Improvement Program) was passed by the state legislature. In the winter Willow Glen Road was not plowed past Jack's family home.

Dick Campbell and his Swedish wife Ingaborg Nelson moved next door in the 1940s. Dick and Ingaborg raised pheasants and three daughters there—Marjorie, Carol, and Barbara.

Jack's father spent a lot of his time working on the house when the family moved to Milan. One big project was a huge fireplace and its chimney that was the only source of heat. They did get electricity in the 1930s and there was an indoor water hand pump in the kitchen.

One of the most astonishing changes Jack has seen over his years of living here is the reforestation of the town. When he moved here most hills were bare of trees from all the agricultural activity and of course the use of timber for building and heating. The main kind of agriculture when he was young was dairy farming and fruit orchards. The decline in agriculture led to reforestation of much of the cleared land, and today Milan is one of the most densely forested towns in the county.

Other changes that Jack noted were how much less snow there has been in the winters over time and the increase in temperatures during winter over the years. In the 1940s and 1950s, plowed snow banks along the roads at times were higher than the vehicles. Some species of plants and animals that are uncommon or even absent now are pheasant and quail and elderberries, all of which were abundant in previous years. The one species that he rarely saw when he was growing up but has exploded recently is deer.

(continued)

Jack Campisi (cont.)

Jack remembers getting lumber sawed at Hubert Gay's sawmill on Sawmill Road in Rock City. In high school he and friends spent time at the Lafayette House in Lafayetteville. He had no problem with walking to Red Hook to play pick-up baseball. Because of World War II, gas was rationed and walking was often the only option.

He talked about racing cars on the Taconic State Parkway before it opened in the 1950s. One of the people who settled in Milan as a result of working on the Parkway was Dick Chrisjohn of Oneida peoples descent. Henry Wyant gave Chrisjohn property on what is now Indian Road. Tina Chrisjohn married a Wyant and currently lives in Lafayetteville.

Television and a waning interest in organized religious activities may have led to less social interaction over the years and there aren't nearly the number of community social events held here now as there were years ago. At one time the Fire Department and the Town held various get-togethers for Halloween, Christmas, and Easter, decorating for the festivities, but that is rare today.

Jack noted that, while farming was the primary occupation for many of Milan's citizens years ago, they often supplemented with income from other jobs as construction workers, plumbers, and such. Farmers have long had to be jacks-of-all-trades. Their days revolved around the farm chores. Even when the very long movie "Gone with the Wind" was playing here, the movie had an intermission so that the farmers could go home at milking time.

Jack remembers there being a lot of boarding houses and several summer camps in Milan years ago. Tom Juranic had a boarding house on Battenfeld Road and there were others on Brooklyn Heights Road, named so because so many boarders came from Brooklyn. Where the Steels live now was formerly owned by Tom Udiljack, and many Yugoslavians stayed there in the summer. There were summer camps on Milan Hill Road, Salisbury Turnpike, and Tribune Lane.

Jack stayed in Milan because he likes the quiet; it's an easy place to live, and a good place for raising kids.

Tom Foote

(interview with Debra Blalock, May 20, 2022)

I met with Tom Foote and his wife Luzia and was treated with backyard foraged edibles such as chickweed salad and garlic-mustard. They also forage for mushrooms and have found morels, black trumpets, bolete, hen of the woods, jelly mushrooms, chicken mushrooms, and oyster mushrooms. I was surprised to learn that we have so many here in Milan. Tom has wandered over a good amount of the territory in Milan and has noted changes over the years. He has lived here since 1973. He has tracked the elusive fisher (also called fisher cat) to get photos and has a huge library of photos of various species of plants and animals that live here. He spoke about species that he rarely sees such as the snowshoe hare. He also observes invasive species that are taking hold in Milan. One such species is *Ailanthus* (tree of heaven) which is indigenous to China and is classified as invasive. When loggers clear cut, *Ailanthus* often quickly takes hold and dominates the area. He encouraged me as a Town Board member to require remediation by reseeding, replanting, or selectively cutting any areas that are to be commercially logged in the future. He also encouraged us to include map(s) of invasive species of plants, animals and insects in our NRI. I think this is a good idea.

Tom Foote - "This town is small yet diverse, like a family. I have only been here fifty years. The lineage of other families extends millennia. The most recent immigrants to Milan are drawn to great extent by our natural resources. Most residents share core values of conservation. If the town implements the actionable Intelligence from the 2007 Plan and the NRI conservation goals, we will leave this land a better place for our children."

Bob Bard

(interview with Bill Gallagher, May 25, 2022)

Though Bob Bard was raised in Annandale with deep family roots in Tivoli, he moved to Milan in 1968. He purchased his old farm on Field Road, a former Jacoby farm, in 1968, and resides there still. He early established himself as a Milan country person with close ties to local farmer and neighbor Lee Jacoby (see interview with Linda Jacoby Ahlin) helping Lee with farming, and joining him in hunting, hog butchering, and all things rural Milan. He recalled many things about farm life, like the names that all farms had for their fields, for the characteristics at that field (Vlie, Mire, Continental, Thistle)—names often lost to the history of the farm.

He worked for the DEC until he purchased an old wooden sawmill from another older Milan character, John MacIntosh, for the huge sum of $400, later replaced with a steel unit for $14,000 which, sadly, was later destroyed by fire. After this he worked as a builder and contractor for many years. He is known as an outdoorsman, canoe builder and waterman, boater, and trainer of birds of prey. He always seemed to have a hawk to train and hunt with. He has a deep interest in vintage and WWI aircraft and is still working at the Old Rhinebeck Aerodrome.

It was a pleasure to know such an old time Milan resident with a long history here and such diverse interests, clearly recognizing the importance of ties to Milan’s rural past.

Albrecht Pichler

(interview with Debra Blalock, 2022)

Albrecht Pichler settled in Milan with his wife, Margrit, in 1977 after living and working in NYC as an architect since 1967. This was the year he moved to the US from his home country, Austria. He still works as an architect and has been involved in many notable projects throughout his career, including as chief designer for the main airport terminal in Nashville, Tennessee and many houses and resorts.

Albrecht met Margrit in 1976 while they both lived in New York City. They shared many interests, including a love of animals, and thought about having a farm someday. The two searched for properties up here and almost immediately found the perfect one on Milan Hill, with its lovely old farmhouse surrounded by lots of acreage and barns. They realized what an amazing place it was, uniquely suited to their needs as potential farmers.

Margrit, a graphic designer and an expert and prolific knitter, wanted to start a knitting business to sell yarn and her knitting patterns and kits. With this in mind, they decided to raise sheep, picking Merinos as the breed with the finest wool. Hoping to find some hearty sheep to start the flock, they traveled to the 1983 National Merino Sheep Show in Harrisburg, PA, and drove home in a rented U-Haul holding the ram and three ewes that had won first prizes in the show. To create pastures, the couple cleared land around the house and under the property's power lines and also rented the pastures of nearby neighbors. The business would ultimately grow into a flock of 600 sheep, a retail store in nearby Rock City and a successful online yarn business that continues to grow.

After they imported two superfine Merino rams from Australia, they began breeding Merinos themselves and showed their prized animals in many contests throughout the country, traveling by livestock trailer with living quarters. They won many top awards, including that of the National Ram Show in Salt Lake City, Utah. Through the years, demand increased for their wool and sheep. For decades they exhibited and sold sheep at the annual Sheep and Wool Festival in Rhinebeck, which hosts hundreds of vendors and thousands of visitors. One year, they started an annual tradition of holding an open house the day before the festival begins, which continues to draw many enthusiastic knitters and buyers.

The history of their house itself is interesting. The Pichlers had bought the place from longtime Milan residents Susie and Barry Van Kleeck. The early section was built in the late 1700s; the later one was added in the early 1800s; and several architectural changes were made in the following years. Albrecht himself designed a new section in 1997. At some point in its early history, according to legend, the house had been owned by a man named Morehouse who was a not-well-liked sheriff.

The yarn/knitting business was started in their house. But when it grew, they moved it to one of the enclosed barns on the property. They eventually opened the store in Rock City and enjoyed success there, and later through their burgeoning online business, until Margrit became ill and passed away.

(continued)

Albrecht Pichler (cont.)

These days the flock is much smaller, with 60 sheep. Albrecht is happily married to Lisa, a former editor, but still works as an architect at age 82. He particularly enjoys going to local music venues, hiking, and playing pickleball with Lisa. And he oversees the knitting business's continued success under the expert hand of a longtime employee and friend, Erin Pirro. He considers his life well lived and cherishes his place here in Milan. When asked for a quote about Milan, he offered, "I love Milan's beautiful rural character (here you can actually see the stars at night!) with its rolling hills and open farmland—perfect for grazing animals, especially my beloved sheep."

Victoria and Alfred Lo Brutto

(interview with Debra Blalock, 30 January 2023)

Before Carvel [the Carvel golf course] was built and the property later bought by the Durst Corporation, the area had a boarding house. People tended to board in enclaves according to their nationality. Aldo Tambini, Vicky's father, and his friend Bil Hromada would come up from the city and stay in the boarding house and hunt on Walt Hermans' property on Academy Hill Road. Eventually they bought ten acres from Walt and started building bungalows for their families. During the construction the families stayed in a large overseas shipping crate. Vicky was about 8 years old then. The first structures were rudimentary cabins with no electricity and no plumbing. Their beds were army cots and the cabins were not heated. The families would come up for weeks with the men going back to their jobs in or near New York City, leaving the wives and kids on their own without any transportation. The kids were pretty much on their own playing games but also doing chores. They would get on their bikes and ride to the Roeliff Jansen Kill on Academy Hill Road which had been paved by that time. It was only about a mile away and great for exploring or swimming. The Roe Jan has been a favorite swimming spot for many years and is today as well. On their way to the Kill, Vicky remembers seeing many blackcap raspberries and orange lilies along the roadside. Her great uncle (Zio) John Bazzani had a huge garden which fed them and others quite well.

Vicky and Al married in 1969 and decided to see the country and go to California for a year. They settled down in San Francisco and while there took trips to both Canada and Mexico. Al worked at temporary computer jobs before getting a job as a service operator, and eventually became a foreman for Bay Area Rapid Transit. Vicky worked temporary, secretarial jobs using her skills and teacher education knowledge gained through her Bachelor of Arts in Business Education. They also became parents during that time. While raising their four children, Vicky earned a Masters in Education and a Masters in Library Science.

Their time in California extended past their original intent of a year but in 1973 they returned to Milan and moved into the Tambini bungalow. Al found a job as a carpenter and, after gaining experience, decided to build a house on ten acres that he and Vicky had bought on Academy Hill Rd. Unfortunately

(continued)

Victoria and Alfred LoBrutto (cont.)

they had little money and his solution was to scavenge lumber, and he placed an ad in the local paper offering to take down unwanted buildings. He got a response to tear down a barn on Academy Hill Road and a church in Rhinecliff. With the help of neighbors, he began building the house where they now live on Academy Hill Road using the lumber he had salvaged. It took years but they finally moved there in 1985 after years of the family of six living in the small four room 25-ft x 25-ft cabin.

Al got into politics when there were several efforts to put up coal and nuclear power plants in the area along with high capacity transmission lines by joining the Citizens for Safe Power Transmission (CSPT), which came to the town board asking for a non- binding referendum which was granted. The referendum revealed that 98 percent of the respondents were against the power plants and the transmission line. The Dysons and other affluent families got in on the movement as did then-Congressman Maurice Hinchey. After seven years of activism the Public Service Commission) deemed that the need was not nearly as great as originally determined and halted the plans for the power plants and transmission line. The CSPT joined with other activist groups to form Hudson Valley GREEN (Grass Roots Energy Environmental Network) which focused on protecting the environment of this area. Future Milan supervisor Van Talmage was a member and often a spokesperson for the group.

Al was asked to join the town Zoning Board of Appeals (ZBA) by Town Board member Bernie Center. Zoning had been instituted in 1969, challenged and overturned but reinstated in 1975. Getting a variance from the ZBA was very difficult at that time as the members were sticklers for interpreting the code. Al was on the board for ten years and chaired it as well. He went on from the ZBA to become the town Building Inspector offering to temporarily take that on when the former inspector left the position unexpectedly. He stayed in that position for almost two years and became the chair of the town Democratic Party. While chair the party got the first woman (Joanie Wyant) elected to the town board and the first and only woman justice elected. Elections were often very competitive but, once over, the townspeople pulled together and worked to benefit the town. Al served on the Milan Town Board from 2004-2008 and then became the chair of the Planning Board and ran for Assessor, a position he held for six years before running (successfully) for Supervisor.

Vicky has remained active in the town volunteering for the town's Bicentennial Committee which worked for three years on the celebration and commemoration of the Town of Milan's 200th birthday. She is now the Town Historian and is interested in preserving historic properties and cemeteries. She is very busy collecting and reviewing historical information about Milan. She provided many of the historical interviews with citizens that we have included in this NRI.

Some of the challenges that Al and Vicky see that need to be addressed are 1) keeping Milan rural versus the push for development; 2) protecting the town from outside interests that seek to exploit the town's natural resources while providing no benefit to the town; 3) affordable housing; 4) accessing effective and economical avenues for communicating with citizens; 5) public transportation; and 6) encouraging and assisting homeowners who want to age in place.

Larry Longo

(interview with Debra Blalock, April 2023)

Larry Longo has been farming on Willow Brook Road for 21 years and prior to that in the Town of Clinton for 20 years. The Longo farm was part of the original Little Nine Partners Patent designated as Farm 26 on Lot 23. The first inhabitant was Isaac Vail who moved here from Fishkill. The subsequent owners were NY Governor Clarke's son who lost it to a mortgage foreclosure, and it was bought by Mr. Palmer in 1888. Palmer's son Benjamin inherited the farm and lived there with Ida Case (same family as Cases Corners Road) until 1925. In 1925 John Ronner bought the farm. His daughter Susan still lives up the road. Ronner had 1000 chickens and a dairy herd of 40 cows. Selling eggs and milk during that period under Ronner's ownership was probably the most active and productive period of the farm's existence as far as animal agriculture. The state bought 20 acres for $50 an acre in1932 for the construction of the Taconic Parkway which was completed in 1948. In 1965 the farm was sold to Harold O'Callahan and tended by tenant farmers who it turns out were not as diligent and caring as Mr. Ronner and much of the place fell into disrepair.

Larry purchased the 161.9 acres farm in 2002. He cleared acres to increase the productive farmland and has a couple of enterprises that generate income through the year. He is a "backgrounder" for grazing others' cattle from the first of May until about the first of November. He farms 53 acres, generally has between 8 and 25 head grazing, cuts hay for sale, and grows some vegetables for market as well. Along with those endeavors, Larry has a 52" circular hand set saw mill which provides extra income in the winter and spring and I saw some fine carpentry skills on display. There's a couple of buildings he put up and lots of fencing. They are a testament to his good technique and industriousness. He cuts wood from the farm to feed the two stoves that heat the house in the winter. Larry sawed a lot of ash trees in the past and laments what has happened to that species since the emerald ash borer arrived in Michigan in shipping crates from Asia. He has lost over a 1000 trees to the invasive pest.

Larry went into solely farming after retiring from his law enforcement career and years of farming in the daytime and going to 2nd or 3rd shifts in law enforcement later in the day, seldom ever getting much rest. Many farmers are familiar with the concept of working two full-time jobs. Even though he has put in long hours on the farm the income from agriculture never equaled as much as his other career. He is glad to see a resurgence in farming but thinks this area's heyday of farming is in the past. Most of today's farms are scaled-down operations.

Larry is also an accomplished banjo player performing bluegrass music for many years.

Craig Fitzsimmons

(interview with Debra Blalock, April 2023)

Craig moved to Milan in 2019 when he bought a 10-acre farm on Willow Brook Road. He had spent a good portion of his youth working with his Dad and the cattle on a large ranch in Wyoming. In college he started flying, got his pilot's license and became a crop duster at the age of 24. He went on from that beginning to become a corporate pilot and today continues in that career for a portion of each month. Being in a management position at this point he can work a good portion of the month remotely.

Tucked away on his charming farm is a lifestyle he enjoys. Since he bought the place he has personally put in a lot of fencing for his cattle operation. He mentioned the difficulty of putting in the fence posts because of the abundance of rocks which has been an often recounted issue for farmers throughout the years here. The farm has a barn from the 1800s which was a milking barn in the past complete with a hayloft and chutes for sending the hay down to feed the cows. It now houses his tractor, hay bales and other gear but down below there are still the head locks and troughs from the milking days. Craig has kept portions of this place's history intact. The farm no longer has dairy cows but concentrates on producing delectable beef for an eager market that he has developed. His cows are from superior stock and he uses artificial insemination or embryo implantation from quality sources to assure that the products he sells are top notch. For most of their lives the cattle are grazing on the pastures and are grain finished before slaughter. He is doing many things right as his very pleased customers assure him that they will continue to buy year after year. In fact he always has more requests than he has beef. Craig is busy creating a place that can support grazing but also provides shade and other benefits by clearing out the underbrush and sowing grass there. It is a method known as silvopasture and has been used for centuries. Properly managed silvopasture (grazed woodland) can increase overall productivity and long-term income due to the simultaneous production of tree crops, forage, and livestock, and can provide environmental benefits such as carbon sequestration. Craig's enterprising nature and attention to detail keep him very busy and his product superior.

Anonymous hunter and hiker

(interview with Debra Blalock, 2023)

Because of the steep slopes and other geological features, such as large rock outcroppings, Milan has remained rural and pretty much undeveloped, unlike the flatter areas to the west, closer to the Hudson River. It now hosts one of the largest contiguous forested areas in northern Dutchess County which has matured over the years since sheep farms were abandoned and trees once again populated pasture areas. Numerous species live here because of the availability of contiguous forested areas and the diversity of habitats. Some of the animals he has seen over the years are: owls which thrive in larger forested areas, fisher cats on Milan Hill Road, bears, red foxes, occasionally a gray fox, recently bald eagles, bobcats, river otters, American woodcock, box and snapping turtles, and coyotes. There are trout that anglers fish for in some of the streams along with various amphibians. Steep slopes and higher elevations have provided habitat for a diversity of birds such as bald eagles, owls, and several varieties of hawks such as sharp-shinned, Cooper's, and red-tailed. The natural complexity of Milan's landscape provides a relatively large diversity of habitats which, in turn, supports a large diversity of plants and animals.

He believes that there is a watershed divide near Milan Hill Rd with the Roe Jan heading to the north and the Saw Kill heading south. He has read a bit of literature written by the geologist Robert Titus describing the unique geology of Milan. He cautions that development may threaten the substantial forest area and the species that now flourish.

Appendix B

Glossary

Appendix B

Glossary

alluvium Material, such as sand, silt, clay, and gravel, deposited on land by moving water. "Recent alluvium" is on floodplains of streams or river. Older alluvium is on alluvial terraces that are no longer flooded (or very infrequently flooded).

amphibolite A coarse-grained metamorphic rock composed mainly of green, brown, or black crystalline (amphibole) minerals and plagioclase feldspar.

argillite A fine-grained compact rock derived from mudstone or shale.

aquifer A water-bearing formation, e.g., in bedrock fractures or solution cavities, or in unconsolidated surficial material such as sands and gravels.

area-sensitive wildlife Wildlife species that require large contiguous habitat areas to meet their life history needs and maintain local populations. Some of these species have large home ranges; some require a complex of habitats distributed over the landscape; some are especially sensitive to human disturbance or are vulnerable to predators or nest parasites that frequent habitat edges.

asl Above sea level.

base flow (of a stream) The sustained flow of a stream in the absence of direct, recent precipitation or surface runoff. Natural base flow is sustained largely by groundwater discharges (https://water.usgs.gov/edu/dictionary.html).

bedrock The solid rock either exposed or underlying soil, rock fragments, or other unconsolidated materials.

biodiversity All the variety of plants, animals, and other living things. The term encompasses diversity at all scales, including landscapes, ecosystems, ecological communities, species, and their genes. From a conservation standpoint, ecologists are mainly concerned about native biodiversity—the biota that have established and developed in the region over millennia, but not the recent introductions since European settlement.

bog A wetland with permanently saturated soils, and that receives most of its water from precipitation instead of groundwater, and that accumulates a deep layer of peat.

calcareous Calcium-rich; containing high concentrations of calcium salts. The term is generally applied to water, soils, and bedrock. The source of calcium in this region is usually calcium carbonate (e.g., limestone), and thus calcareous environments are generally circumneutral or alkaline.

calcicoles A plant species that does best in calcium-rich environments (i.e., calcareous rock, soil, or water).

carbon sequestration Capture and long-term storage of atmospheric carbon dioxide or other forms of carbon. Carbon sequestration, whether occurring artificially or by natural biological, chemical, and physical processes (such as the growth of a tree, or the accumulation of peat in a wetland), is a means of mitigating or deferring global warming.

catadromous Migrating from freshwater streams to the ocean to spawn.

chert A sedimentary rock of micro- or cryptocrystalline quartz (silicon dioxide, SiO_2). Broken chert has very sharp edges, and was used by indigenous people for cutting tools and weapons. "Flint" is an alternate name for chert.

circumneutral Having a pH at or near 7.0 (approximately 6.6–7.3).

clay Soil material with particles <0.002 millimeter in diameter.

conglomerate A sedimentary rock made up of rounded fragments of pre-existing rock greater than 2 mm in diameter. The intervening spaces are usually filled with sand- and clay-size particles, and all is cemented together with calcite or quartz.

conifer forest A forest dominated by conifer trees; i.e., where conifer tree species constitute ≥75% of the forest canopy. Conifers are cone-bearing trees such as white pine, eastern hemlock, tamarack, and eastern red cedar. The native conifers in this region have needle-like or scale-like leaves and are evergreen—that is, they maintain their leaves year-round. An exception is tamarack, which sheds its leaves in the fall. See "deciduous forest" for comparison.

conservation easement A legal agreement drawn up by a landowner and a qualified public or private agency (such as a land trust) that ensures permanent protection of the land. The landowner retains ownership with many of its rights and responsibilities (including property taxes), and can live on, use, or sell the land or pass it on to heirs, but the conservation easement remains attached to the land in perpetuity. The easement is designed to serve the conservation goals of the landowner and easement holder (e.g., the land trust), and describes permissible and impermissible land uses and land management.

Critical Environmental Area A geographical area with exceptional character with respect to a benefit or threat to human health; a natural setting; agricultural, social, cultural, historic, archaeological, recreational, or educational values; or inherent ecological, geological or hydrological sensitivity that may be adversely affected by any change in land use. A CEA is formally delineated, mapped, described, and adopted by the municipal legislative body, and registered with the NYS Department of Environmental Conservation (http://www.dec.ny.gov/permits/45500.html). The purpose of establishing a CEA is to raise awareness of the unusual resource values (or hazards) that deserve special attention during environmental reviews and land use decisions.

deciduous forest (Also called "hardwood forest.") A forest dominated by deciduous trees; i.e., where deciduous tree species constitute ≥75% of the forest canopy. Deciduous trees are those that shed their leaves annually. In this region, deciduous trees include oaks, maples, ashes, cherries, beech, and many others. See "conifer forest" for comparison. (Tamarack is the unusual case of a deciduous conifer.)

denitrification The microbial process of reducing nitrate and nitrite to gaseous forms of nitrogen, mainly nitrous oxide (N_2O) and nitrogen (N_2).

duff (or "organic duff") Dead plant material (leaves, twigs, bark) on the ground surface. Duff is a key component in soil development and fertility, and an important microhabitat in forests and other habitats.

ecosystem services The resources and services provided by the natural environment that benefit the human community, such as purification of water and air, cycling of nutrients, mitigation of floods, dispersal of seeds, pollination of agricultural crops, control of agricultural pests

and human disease organisms, and production of timber, fish, wild game, and other wild foods.

edge effects The influences of habitat edges on interior habitats and species. These may include the effects of noise, light (natural or artificial), wandering pets, accessibility to predators and nest parasites, and pollution introduced from human activities at the habitat edges. Certain edge effects occur at the edges between natural habitats as well as those between natural habitats and human-disturbed areas.

Farmland Soils of Statewide Importance A designation of the Natural Resource Conservation Service for soils that are nearly as productive as "Prime Farmland Soils" and that produce high yields of crops when properly managed.

fen As used in this *NRI*, an open, herb- and low shrub-dominated wetland fed by calcareous groundwater seepage. This habitat has a distinctive plant community that, in this region, often includes such species as shrubby cinquefoil (*Dasiphora fruticosa*), grass-of-parnassus (*Parnassia glauca*), bog goldenrod (*Solidago uliginosa*), and woolly-fruit sedge (*Carex lasiocarpa*).

flood attenuation The effects of storing and retaining floodwater and slowly releasing it to the groundwater, a stream, or other water body, thereby reducing the peak downstream flows.

floodplain The area bordering a stream that is subject to frequent or infrequent flooding.

forb A broad-leaved herbaceous (non-woody) plant. (Compare to "graminoid.")

garnet A semi-precious crystalline stone, usually dark red and translucent, used in jewelry and as an industrial abrasive.

habitat fragmentation Dividing (by roads, driveways, utility corridors, other developed features) large, continuous habitat areas into smaller, more isolated remnants.

gabion A wire-mesh container filled with rocks, broken concrete, or other coarse material used to fortify retaining walls and other structures.

glacial kettle (See "kettle, below.)

glacial outwash Mineral material (gravel, sand, and silt) deposited by the melting ice of a glacier.

glacial till Mixed mineral material (clay, silt, sand, rocks) transported and deposited by glacial ice, or by streams flowing from a melting glacier.

lacustrine deposits Sand, silt, and clay particles that settled on the bottom of an ancient lake.

loam Soil composed of a mixture of sand, silt, and clay in approximately 40-40-20% composition by mineral weight.

gradient As used in this *NRI*, the slope, or degree of slope (e.g., a steep or gentle gradient).

graminoid A grass-like plant. Graminoids includes grasses (Poaceae), sedges (Cyperaceae), and rushes (Juncaceae).

graywacke An impure gray sandstone.

green infrastructure An approach to water management that incorporates natural systems (and mimicry of natural systems), sometimes in combination with engineered systems to protect, restore, or maintain water resources and ecosystem functions. Some examples are protection or restoration of floodplains, wetlands, or forests, or use of urban rain gardens, permeable pavement, green roofs, rainwater barrels, graywater retrieval systems, and vegetated swales.

groundwater The water that resides beneath the soil surface in spaces between sediment particles and in rock fissures and cavities.

groundwater recharge The process by which water flows or percolates from the ground surface to an aquifer—an underground water-bearing formation in bedrock or in loose material such as sand or gravel.

habitat The place or environment where an organism normally spends all or part of its life. A habitat is defined by both the biological (e.g., plants and animals) and the non-biological (soil, bedrock, water, sunlight, temperatures, etc.) components.

habitat assessment As used in this NRI, an appraisal conducted by means of map analysis and field observations to identify and describe the character and condition of habitats and water features on a site, and the implications for land uses and conservation. A habitat assessment should be carried out by biologists familiar with habitats and biota of the region, and the life history needs of species of conservation concern.

habitat edge The boundary between two different kinds of habitats or biological communities or between other different landscape elements.

headwaters The upper reaches of a stream, near the stream's origin.

herbaceous Non-woody. Herbaceous plants include, for example, forbs, graminoids, mosses, and liverworts.

hydric soils Soils formed under conditions of saturation for long enough during the growing season to develop anaerobic (oxygen-free) conditions near the ground surface. The presence of hydric soils is one of the three features necessary (along with wetland hydrology and hydrophytic vegetation) for identifying an area as wetland.

hydrology As used in this NRI, the occurrence, distribution, movement, and properties of water.

hydroperiod The seasonal pattern of inundation or soil saturation.

impervious surface Surface such as roof, pavement, or compacted soils that impedes or prevents the local infiltration of water to the soils or underlying substrate.

intermittent stream A stream that typically flows for only part of the year.

intermittent woodland pool A vernal pool (see below) in a forested setting.

invertebrate An animal that lacks a spinal column. Invertebrates include insects, mollusks, crustaceans, nematodes, spiders, earthworms, centipedes, protozoans, and a host of other macroscopic and microscopic organisms.

kame An irregular hill or short ridge composed of mineral material deposited by a glacier.

kettle A depression in the ground surface formed by the melting of a stranded block of glacial ice that was buried or partially buried by outwash drift.

kettle wetland A wetland formed in a glacial kettle.

LiDAR Light Detection and Ranging—a method of remote sensing that uses pulsed laser to measure variable distances between the instrument (on an aircraft) and the Earth. Images produced by LiDAR depict details of the ground surface that are obscured by vegetation in aerial photographs.

limestone A fine-grained sedimentary rock composed of calcium carbonate.

loam Soil composed of a mixture of sand, silt, and clay, in the proportions of <52% sand, 28-50% silt, and 7-27% clay.

marl A mud or mudstone rich in calcium carbonate but also containing admixtures of clay and silt. It is chemically similar to limestone, and may occur as rock or in semi-liquid form. Marl forms from decaying plant and animal material in certain kinds of wetlands.

marsh A wetland that typically has standing water for a prolonged period during the growing season, and is dominated by herbaceous (non-woody) vegetation with species such as cattail, bur-reed, pond-lily, and arrowhead.

mesic As applied to soils, having moderate moisture content.

mesopredator A mid-ranking predator in a food web. Some examples in our habitats are foxes, raccoon, skunk, bobcat, and snakes.

microclimate The climate of a very localized area: for example, the hot, dry conditions on a rocky barren in summer, or the cool, moist conditions beneath a rotting log on the forest floor.

microhabitat A very localized habitat distinct from those of the larger surrounding habitat; for example, a tree cavity within a deciduous forest, or a woody hummock within a swamp.

muck Highly-decomposed organic soil material, also called "sapric" material, that accumulates under conditions of prolonged soil saturation.

native species A plant or animal species that is indigenous to the region; that is, a species that arrived here by natural dispersal processes and not by human agency.

NGO Non-governmental organization.

non-native species A plant or animal introduced to the region by human agency, intentionally or unintentionally. (See "native species" for comparison.)

non-point source pollution Pollution emanating from a diffuse source such as unchannelized runoff from a paved parking lot or an agricultural field. (Compare with point-source pollution.)

NYNHP New York Natural Heritage Program, an agency that serves as a repository and clearinghouse for information on the occurrence, distribution, and status of plants, animals, and natural communities in the state.

NYSDEC New York State Department of Environmental Conservation

old growth forest A forest ecosystem that has attained great age (e.g., 200+ years) without significant disturbance from human activities such as cutting, soil disturbance, or intentional burning. These systems are variable in appearance, structure, and development history, but are often distinguished by old trees, diverse vertical and horizontal vegetation structure, and accumulations of large standing snags and downwood.

organic duff The accumulation of organic matter on the forest floor, usually in many stages of decay.

parasitoids An insect whose larvae live as parasites and eventually kill their hosts,

peat Partially decomposed organic matter, also called "fibric" materials, that accumulates under conditions of prolonged water saturation.

perennial stream A stream that typically flows year-round.

phyllite A fine-grained metamorphic rock intermediate in grade between slate and schist (Fisher 2006).

pioneering plant species Plant species that are the first to colonize areas of stripped, disturbed, or damaged soils or other substrate.

point source pollution Pollution emanating from a singe point, such as an industrial chimney or a discharge pipe from a sewage treatment plant. (Compare with non-point source pollution.)

Prime Farmland Soils A designation of the Natural Resources Conservation Service for soils that have the best combination of physical and chemical characteristics for producing crops.

propagule A portion of a plant or fungus, such as a cutting, seed, tuber, or spore, from which a new individual may develop.

quartzite A hard and durable medium-grained metamorphic rock derived from sandstone.

reach (as in "stream reach") A segment of stream or river defined by geographic markers, such as river miles, natural features, or political boundaries.

remote sensing Detecting the physical characteristics of an area from a distance. Typically the term refers to interpretation of satellite or aerial photo imagery and map data to analyze the landscape.

resiliency As used in this NRI, the capacity to withstand, recover from, and adapt to stresses such as those imposed by floods or climate change.

riparian Within or adjacent to a stream or river.

riprap Layer of rock placed along a streambank or shoreline to prevent erosion.

sand Soil material with mineral fragments 0.05-2.0 millimeters diameter.

sandstone A sedimentary rock composed of sand-size grains of cemented mineral and rock particles.

schist A medium-grained, layered metamorphic rock derived from shale.

seep Diffuse groundwater discharge to the ground surface. (Compare with "spring.")

SGCN Species of Greatest Conservation Need: a list drawn up by NYSDEC that includes 1) species on the federal list of Endangered or Threatened species that occur in New York; 2) species listed as NYS Endangered, Threatened, or Special Concern; 3) species with 20 or fewer elemental occurrences in the New York Natural Heritage Program database; and 4) other species deemed by NYSDEC to be of greatest conservation need due to their status, distribution, and vulnerability.

shale A fine-grained thinly layered sedimentary rock derived from silt and clay.

sheetflow Flow of unchannelized water across the ground surface.

silt Soil material with mineral soil particles that are coarser than clay (i.e., >0.002 millimeter diameter) and finer than very fine sand (i.e., <0.05 millimeter diameter).

slate A fine-grained metamorphic rock derived from shale.

snag A standing dead tree.

soil Organic or unconsolidated mineral materials that has been acted on by weathering and organic processes.

spring Concentrated groundwater discharge to the ground surface (Compare with "seep.")

sub-basin The watershed of a tributary to a larger stream.

submergent aquatic vegetation Plants that grow beneath the surface in shallow water areas, but do not emerge above the water surface; "SAV."

substrate As used in this NRI, 1) the bottom of a stream or lake, or 2) the substance or surface on which an organism lives or is attached.

surficial deposits Loose material deposited over bedrock. Material may be transported by glaciers (e.g., glacial till, glacial outwash), by moving water (alluvium), or by wind (loess).

swamp A wetland dominated by woody vegetation (trees or shrubs).

talus Loose rock debris that accumulates below an exposed bedrock ledge.

thatch Undecomposed, dead plant material that accumulates on the soil surface of a meadow or lawn.

tributary A stream that flows into a larger stream, river, or lake.

trophic structure The organization of organisms in the food web.

unconsolidated aquifer Groundwater stored in saturated sand and gravel deposits.

upland As used in this *NRI,* "upland" is equivalent to "non-wetland." The term implies nothing about elevation; upland areas can be at any elevation, low or high or anywhere in between.

vegetation structure The arrangement of vertical layers and horizontal spacing of vegetation.

vernal pool A wetland—usually small—that is isolated from other wetlands or streams, and that typically holds water in winter and spring, but dries up at some time during the growing season. (See "intermittent woodland pool.")

viewshed The entire area visible from a specified location and the entire area from which that location is visible.

watershed The entire land area that drains to a particular place such as a stream, wetland, or pond.

wetland "[An area that is] inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances [does] support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (definition of wetlands regulated under the federal Clean Water Act: at 33 CFR 328.3[c][4]).

wet meadow A wetland dominated by herbaceous (non-woody) vegetation and that typically has little or no standing water for most of the growing season.

windthrow Uprooting and toppling of trees by wind.

Appendix C

Plants and Animals of Milan and Dutchess County

Appendix Table C-1. Common and scientific names of vascular plants mentioned in the Milan Natural Resources Inventory.

Scientific nomenclature follows the New York Flora Atlas (Werier et al. 2023).

Common Name	Scientific Name	Common Name	Scientific Name
alder	*Alnus*	blueberry	*Vaccinium*
alfalfa	*Medicago sativa*	blueberry, highbush	*Vaccinium corymbosum*
anemone	*Anemone*	blueberry, lowbush	*Vaccinium angustifolium*
apple	*Malus*	bluestem, little	*Schizachyrium scoparium* var. *scoparium*
arrow-arum	*Peltandra virginica*	buckthorn, common	*Rhamnus cathartica*
arrowhead	*Sagittaria*	bulrush, dark-green	*Scirpus atrovirens*
arrowhead, broad-leaved	*Sagittaria latifolia*	bur-reed	*Sparganium*
arrowwood, northern	*Viburnum dentatum* var. *lucidum*	butternut	*Juglans cinerea*
ash	*Fraxinus*	buttonbush	*Cephalanthus occidentalis*
ash, black	*Fraxinus nigra*	canary-grass, reed	*Phalaris arundinacea*
ash, green	*Fraxinus pensylvanica*	cattail	*Typha*
ash, white	*Fraxinus americana*	cedar, eastern red	*Juniperus virginiana* var. *virginiana*
aspen	*Populus*	cherry, black	*Prunus serotina*
aspen, quaking	*Populus tremuloides*	cherry/plum/peach	*Prunus*
aster	*Symphyotrichum*	chokeberry, black	*Aronia melanocarpa*
aster, flat-topped white	*Doelingeria umbellata* var. *umbellata*	cinquefoil, shrubby	*Dasiphora fruticosa*
autumn-olive	*Elaeagnus umbellate*	cliffbrake, purple	*Pellaea atropurpurea*
azalea, swamp	*Rhododendron viscosum*	cliffbrake, smooth	*Pellaea glabella* ssp. *glabella*
barberry, Japanese	*Berberis thunbergii*	clover	*Lespedeza/Trifolia/Desmodium,* etc.
basswood, American	*Tilia americana* var. *americana*	columbine, wild	*Aquilegia canadensis*
bee-balm	*Monarda*	cottonwood, eastern	*Populus deltoides* ssp. *deltoides*
beech, American	*Fagus grandifolia*	cranberry	*Vaccinium*
beechdrops	*Epifagus virginiana*	cress, rock	*Arabis/Arabidopsis/Borodinia*
betony, wood	*Pedicularis canadensis*	dock	*Rumex*
birch	*Betula*	dodder, field	*Cuscuta campestris*
birch, gray	*Betula populifolia*	dogwood, gray	*Cornus racemosa*
birch, swamp	*Betula pumila*	dogwood, silky	*Cornus amomum* ssp. *amomum*
bittersweet, oriental	*Celastrus orbiculatus*	duckweed	*Lemna* or *Spirodela*
blackberry, northern	*Rubus flagellaris*	elderberry	*Sambucus*
bladdernut	*Staphylea trifolia*	elm	*Ulmus*
bladderwort	*Utricularia*	elm, American	*Ulmus americana*
bloodroot	*Sanguinaria canadensis*	elm, slippery	*Ulmus rubra*

(continued)

Appendix Table C-1. (cont.)

Common Name	Scientific Name	Common Name	Scientific Name
fern, bracken	*Pteridium aquilinum* ssp. *latiusculum*	holly, winterberry	*Ilex verticillata*
fern, cinnamon	*Osmundastrum cinnamomeum* var. *cinnamomeum*	honeysuckle, Eurasian	*Lonicera morrow/tatarica/x bella*
fern, crested	*Dryopteris cristata*	honeysuckle, Bell's	*Lonicera* x *bella*
fern, fragile	*Cystopteris fragilis*	hornbeam, American	*Carpinus caroliniana* ssp. *virginiana*
fern, grape	Ophioglossaceae	horsetail, variegated	*Equisetum variegatum* ssp. *variegatum*
fern, maidenhair	*Adiantum pedatum*	huckleberry	*Gaylussacia*
fern, marsh	*Thelypteris palustris* var. *pubescens*	indigo, wild	*Baptisia tinctoria*
fern, ostrich	*Matteuccia struthiopteris* var. *pensylvanica*	iris, yellow	*Iris pseudacorus*
fern, royal	*Osmunda regalis* var. *spectabilis*	jewelweed, common	*Impatiens capensis*
fern, sensitive	*Onoclea sensibilis*	knotweed, Japanese	*Reynoutria japonica* var. *japonica*
fern, walking	*Asplenium rhizophyllum*	knotweed, slender	*Polygonum tenue*
garlic-mustard	*Alliaria petiolata*	lady's-slipper, pink	*Cypripedium acaule*
gentian, smaller fringed	*Gentianopsis virgata* ssp. *virgata*	lady's-slipper, yellow	*Cypripedium parviflorum*
ginseng, American	*Panax quinquefolius*	larch, American	*Larix laricina*
goldenrod	*Solidago*	larch, European	*Larix decidua*
goldenrod, bog	*Solidago uliginosa*	laurel, mountain	*Kalmia latifolia*
goldenrod, rough-leaved	*Solidago patula*	leatherleaf	*Chamaedaphne calyculata*
goldenrod, smooth	*Solidago gigantea*	leek, wild	*Allium tricoccum* var. *tricoccum*
goldenseal	*Hydrastis canadensis*	Legume	Fabaceae
gooseberry/currant	*Ribes*	lilac	*Syringa*
grape	*Vitis*	locust, black	*Robinia pseudoacacia*
grass	Poaceae	loosestrife, purple	*Lythrum salicaria*
grass, panic	*Panicum/Dichanthelium*	lupine	*Lupinus*
grass, purpletop	*Tridens flavus* var. *flavus*	mannagrass, fowl	*Glyceria striata*
grass-of-Parnassus	*Parnassia glauca*	maple	*Acer*
hackberry	*Celtis*	maple, red	*Acer rubrum*
hackberry, northern	*Celtis occidentalis*	maple, sugar	*Acer saccharum*
hairgrass, common	*Avenella flexuosa*	may-apple	*Podophyllum peltatum*
hawthorn	*Crataegus*	meadow-rue, early	*Thalictrum dioicum*
heath	Ericaceae	meadowsweet	*Spiraea alba* var. *latifolia*
hemlock, eastern	*Tsuga canadensis*	milkweed	*Asclepias*
hepatica	*Hepatica*	monkeyflower, winged	*Mimulus alatus*
hepatica, round-lobed	*Hepatica americana*	mustard	Brassicaceae
hickory, shagbark	*Carya ovata* var. *ovata*	naiad	*Najas*

(continued)

Appendix Table C-1. (cont.)

Common Name	Scientific Name	Common Name	Scientific Name
nannyberry	*Viburnum lentago*	rose	*Rosa*
nettle	*Urtica*	rue	*Thalictrum*
oak	*Quercus*	rush	Juncaceae
oak, chestnut	*Quercus montana*	rush, soft	*Juncus effusus* ssp. *solutus*
oak, pin	*Quercus palustris*	sarsaparilla, bristly	*Aralia hispida*
oak, red	*Quercus rubra*	saxifrage, golden	*Chrysosplenium americanum*
oak, scrub	*Quercus ilicifolia*	sedge	Cyperaceae
oak, swamp white	*Quercus bicolor*	sedge, cattail	*Carex typhina*
oak, white	*Quercus alba*	sedge, Davis's	*Carex davisii*
orchid	Orchidaceae	sedge, fox	*Carex vulpinoidea*
parsley/carrot/related plants	Apiaceae	sedge, golden-fruit	*Carex aurea*
pear	*Pyrus*	sedge, lakeside	*Carex lacustris*
pickerelweed	*Pontederia cordata*	sedge, Pennsylvania	*Carex pensylvanica*
pine	*Pinus*	sedge, tussock	*Carex stricta*
pine, eastern white	*Pinus strobus*	sedge, woolly-fruit	*Carex lasiocarpa* ssp. *americana*
pine, pitch	*Pinus rigida*	shadbush	*Amelanchier*
pine, red	*Pinus resinosa*	skunk-cabbage	*Symplocarpus foetidus*
pine, Scotch	*Pinus sylvestris*	spicebush	*Lindera benzoin*
pinweed, slender	*Lechea tenuifolia*	spikerush, ovate	*Eleocharis ovata*
pipevine	*Endodeca/Isotrema*	spleenwort, ebony	*Asplenium platyneuron*
pitcher-plant, purple	*Sarracenia purpurea*	spleenwort, maidenhair	*Asplenium trichomanes*
plantain, English	*Plantago lanceolata*	spruce, Norway	*Picea abies*
polypody, rock	*Polypodium virginianum*	St. Johnswort, Fraser’s	*Triadenum fraseri*
pond-lily, fragrant	*Nymphaea odorata* ssp. *odorata*	stiltgrass, Japanese	*Microstegium vimineum*
pond-lily, yellow	*Nuphar variegata*	sweetflag	*Acorus*
pondweed	*Potamogeton*	switchgrass	*Panicum virgatum*
prickly-ash, American	*Zanthoxylum americanum*	sycamore, eastern	*Platanus occidentalis*
primrose	*Primula*	tea, New Jersey	*Ceanothus americanus*
quarters, lamb's	*Chenopodium album*	timothy	*Phleum pratense* ssp. *pratense*
raspberry	*Rubus*	toothwort, two-leaved	*Cardamine diphylla*
rattlebox	*Crotalaria sagittalis*	top, purple	*Tridens flavus* var. *flavus*
reed, common	*Phragmites australis*	tree-of-heaven	*Ailanthus altissima*
rice-cutgrass	*Leersia oryzoides*	trefoil, tick	*Desmodium*
rose, multiflora	*Rosa multiflora*	turtlehead, white	*Chelone glabra*

(continued)

Appendix Table C-1. (cont.)

Common Name	**Scientific Name**
tulip-tree	*Liriodendron tulipifera*
vervain, blue	*Verbena hastata*
vetch	*Vicia*
viburnum, maple-leaf	*Viburnum acerifolium*
violet	*Viola*
wall-rue	*Asplenium ruta-muraria*
water-plantain	*Alisma*
watershield	*Brasenia schreberi*
water-willow	*Decodon verticillatus*
weed, Joe-Pye	*Eutrochium*
weed, mile-a-minute	*Persicaria perfoliata*
wild-raisin, northern	*Viburnum nudum* var. *cassinoides*
willow	*Salix*
witch-hazel	*Hamamelis virginiana*
zinnia	*Zinnia*

Werier, D., K. Webster, T. Weldy, A. Nelson, R. Mitchell, and R. Ingalls. 2023. New York flora atlas. [S.M. Landry and K. N. Campbell (original application development), USF Water Institute, University of South Florida.] New York Flora Association, Albany. https://newyork.plantatlas.usf.edu/

Appendix Table C-2. Prominent non-native invasive plants of the lower Hudson Valley.

Plants are listed and ranked for management priority (tiers) by the Lower Hudson Partnership for Invasive Species Management (LHPRISM). Updated lists of invasive species are at https://www.lhprism.org/species-information.

Common Name (*Scientific Name*)	**Tier 2**[1]	**Tier 3**[1]	**Tier 4**[1]	**Tier 5**[1]
alder, black (*Alnus glutinosa*)	X			
aralia, castor (*Kalopanax septemlobus*)	X			
archangel, yellow (*Lamium galeobdolon*)				X
arum, Italian (*Arum italicum*)	X			
autumn-olive (*Elaeagnus umbellata*)[2]			X	
baby's-breath, tall (*Gypsophila paniculata*)	X			
barberry, Beales (*Mahonia bealei*)				X
barberry, common (*Berberis vulgaris*)[2]			X	
barberry, Japanese (*Berberis thunbergii*)[2]			X	
beautybush (*Kolkwitzia amabilis*)				X
berry, porcelain (*Ampelopsis glandulosa*)		X		
bittercress, narrowleaf (*Cardamine impatiens*)		X		
bittersweet, Asian (*Celastrus orbiculatus*)[2]			X	
bluebells, Spanish (*Hyacinthoides hispanica*)				X
bower, Japanese virgin's (*Clematis terniflora*)		X		
brome, slender false (*Brachypodium sylvaticum*)	X			
broom, Scotch (*Cytisus scoparius*)	X			
buckthorn, common (*Rhamnus cathartica*)[2]			X	
buckthorn, glossy (*Frangula alnus*)[2]		X		
bush, burning (*Euonymus alatus*)[2]			X	
bush, false indigo (*Amorpha fruticosa*)				X
bush-clover, Chinese (*Lespedeza cuneata*)	X			
butterbur (*Petasites hybridus*)				X
butterbur (*Petasites japonicus*)				X
butterfly-bush, orange-eye (*Buddleja davidii*)				X
canary-grass, reed (*Phalaris arundinacea*)[2]			X	
carpetgrass, small (*Arthraxon hispidus*)	X			
celandine, lesser (*Ficaria verna*)		X		
cherry, bird (*Prunus avium*)[2]			X	
chervil, wild (*Anthriscus sylvestris*)[2]		X		
corktree, Amur (*Phellodendron amurense*)	X			
crabapple, tea (*Malus hupehensis*)	X			
crabapple, Toringo (*Malus toringo*)[2]	X			
creeper, winter (*Euonymus fortunei*)[2]		X		
cup-plant (*Silphium perfoliatum* var. *perfoliatum*)	X			

(continued)

Appendix Table C-2. (cont.)

Common Name (*Scientific Name*)	**Tier 2**[1]	**Tier 3**[1]	**Tier 4**[1]	**Tier 5**[1]
elm, Siberian (*Ulmus pumila*)		X		
elodea, Brazilian (*Egeria densa*)	X			
fanwort (*Cabomba caroliniana*)	X			
forget-me-not, true (*Myosotis scorpioides*)[2]			X	
foxglove, purple (*Digitalis purpurea*)				X
foxglove, yellow (*Digitalis grandiflora*)				X
frogbit, European (*Hydrocharis morsus-ranae*)[2]	X			
fumewort, incised (*Corydalis incisa*)	X			
fumewort, spring (*Corydalis solida*)				X
goutweed, Bishop's (*Aegopodium podagraria*)		X		
grass, Chinese silver (*Miscanthus sinensis*)		X		
hogweed, giant (*Heracleum mantegazzianum*)	X			
holly, Japanese (*Ilex crenata*)				X
honeysuckle, Amur (*Lonicera maackii*)[2]		X		
honeysuckle, Bell's (*Lonicera* x *bella*)[2]			X	
honeysuckle, Japanese (*Lonicera japonica*)[2]			X	
honeysuckle, Morrow's (*Lonicera morrowii*)[2]			X	
honeysuckle, Tartarian (*Lonicera tatarica*)[2]				X
hops, Japanese (*Humulus japonicus*)		X		
iris, yellow (*Iris pseudacorus*)[2]			X	
jetbead, black (*Rhodotypos scandens*)		X		
knapweed, black (*Centaurea nigra*)			X	
knapweed, brown (*Centaurea jacea*)[2]			X	
knapweed, spotted (*Centaurea stoebe* spp. *micranthos*)[2]			X	
knotweed, Bohemian (*Reynoutria* x *bohemica*)			X	
knotweed, giant (*Reynoutria sachalinensis*)			X	
knotweed, Japanese (*Reynoutria japonica* var. *japonica*)[2]			X	
kudzu (*Pueraria montana*)	X			
lace, Queen Anne's (*Daucus carota*)[2]				
lily, orange day (*Hemerocallis fulva*)[2]				
locust, black (*Robinia pseudoacacia*)[2]			X	
loosestrife, European wand (*Lythrum virgatum*)				X
loosestrife, purple (*Lythrum salicaria*)[2]			X	
loosestrife, spotted (*Lysimachia punctata*)				X
loosestrife, yellow garden (*Lysimachia vulgaris*)	X			
lovegrass, weeping (*Eragrostis curvula*)	X			
maple, Norway (*Acer platanoides*)[2]			X	
maple, sycamore (A*cer pseudoplatanus*)		X		
meadowsweet, Japanese (*Spiraea japonica*)				X

(continued)

Appendix Table C-2. (cont.)

Common Name (*Scientific Name*)	**Tier 2**[1]	**Tier 3**[1]	**Tier 4**[1]	**Tier 5**[1]
mint, crested late summer (*Elsholtzia ciliata*)	X			
mugwort (*Artemisia vulgaris* var. *vulgaris*)[2]			X	
mulberry, paper (*Broussonetia papyrifera*)	X			
mulberry, white (*Morus alba*)[2]			X	
naiad, brittle (*Najas minor*)		X		
oak, sawtooth (*Quercus acutissima*)				X
parsnip, wild (*Pastinaca sativa*)[2]			X	
pear, Bradford (*Pyrus calleryana*)		X		
peashrub, Siberian (*Caragana arborescens*)				X
periwinkle, common (*Vinca minor*)[2]				X
photinia, oriental (*Photinia villosa*)	X			
plant, beefsteak (*Perilla frutescens*)	X			
plant, chameleon (*Houttuynia cordata*)				X
pondweed, curly leaf (*Potamogeton crispus*)			X	
poplar, white (*Populus alba*)				X
poppy, plume (*Macleaya cordata*)				X
primrose, Japanese (*Primula japonica*)	X			
privet, border (*Ligustrum obtusifolium*)[2]		X		
privet, Chinese (*Ligustrum sinense*)	X			
reed, common (*Phragmites australis*)[2]			X	
reed, giant (*Arundo donax*)	X			
rose, multiflora (*Rosa multiflora*)[2]			X	
Russian-olive (*Elaeagnus angustifolia*)[2]	X			
sage, sticky (*Salvia glutinosa*)	X			
sapphireberry (*Symplocos paniculata*)	X			
snowball, Japanese (*Viburnum plicatum*)	X			
snowflake, summer (*Leucojum aestivum*)				X
spindle-tree, European (*Euonymus europaeus*)				X
spurge, caper (*Euphorbia lathyris*)				X
spurge, cypress (*Euphorbia cyparissias*)[2]		X		
spurge, leafy (*Euphorbia virgata*)		X		
star-of-Bethlehem, common (*Ornithogalum umbellatum*)				X
stiltgrass, Japanese (*Microstegium vimineum*)[2]			X	
swallow-wort, black (*Vincetoxicum nigrum*)[2]		X		
swallow-wort, pale (*Vincetoxicum rossicum*)			X	
teasel, cut-leaf (*Dipsacus laciniatus*)[2]	X			
teasel, fuller's (*Dipsacus fullonum*)[2]			X	
thistle, bull (*Cirsium vulgare*)[2]			X	
thistle, Canada (*Cirsium arvense*)[2]			X	

(continued)

Appendix Table C-2. (cont.)

Common Name (*Scientific Name*)	**Tier 2**[1]	**Tier 3**[1]	**Tier 4**[1]	**Tier 5**[1]
tree, Angelica (*Aralia elata*)		X		
tree, princess (*Paulownia tomentosa*)		X		
tree, wayfaring (*Viburnum lantana*)				X
tree-of-heaven (*Ailanthus altissima*)[2]			X	
viburnum, linden (*Viburnum dilatatum*)	X			
viburnum, Siebold's (*Viburnum sieboldii*)	X			
vine, chocolate (*Akebia quinata*)	X			
vine, mile-a-minute (*Persicaria perfoliata*)[2]		X		
vine, silver (*Actinidia polygama*)	X			
vine, tara (*Actinidia arguta*)	X			
water-chestnut (*Trapa natans*)[2]		X		
watermilfoil, Eurasian (*Myriophyllum spicatum*)[2]			X	
water-thyme (*Hydrilla verticillata*)	X			
willow, gray (*Salix atrocinerea*)	X			
wineberry (*Rubus phoenicolasius*)[2]			X	
wisteria, Chinese (*Wisteria sinensis*)[2]			X	
wisteria, Japanese (*Wisteria floribunda*)			X	
yam, Chinese (*Dioscorea polystachya*)	X			
yellow-loosestrife, gooseneck (*Lysimachia clethroides*)				X

[1] **Tier 2: Eradication is recommended**. High and very high impact species with low enough abundance to make eradication feasible within the Lower Hudson PRISM region. Highest level of response efforts.

Tier 3: Containment is recommended. High and very high impact species that are likely too widespread for eradication, but low enough abundance to think about regional containment. Target strategic management to slow the spread since many surrounding regions could be at risk if left unattended.

Tier 4: Local control is recommended. Well-established species with high and very high impacts. Eradication efforts not feasible; only localized management over time to contain, exclude, or suppress, if justified to meet local management goals.

Tier 5: More research is needed. Species in or surrounding the PRISM region that need more research, mapping, and monitoring to understand invasiveness and impacts.

[2] A species known or likely to occur in Milan at present.

Appendix Table C-3. Dragonflies and damselflies of Dutchess County.

Data are from the NYSDEC 2005-2009 statewide survey (White et al. 2010). Habitats are from Vispo (2017), Abbott (2006-2018), and Nikula et al (2003).

Common name	Scientific name	Habitat	Statewide Status[1]
AESHNIDAE			
darner, black-tipped	*Aeshna tuberculifera*	over fields & along edge of water	
darner, Canada	*Aeshna canadensis*	over fields & along shores of slow-moving water	
darner, comet	*Anax longipes*	around ponds or over fields	S2S3
darner, common green	*Anax junius*	over small ponds, skimming lake edges, or over fields	
darner, Cyrano	*Nasiaeschna pentacantha*	ponds, slow streams, & coves of lakes	S2S3
darner, fawn	*Boyeria vinosa*	in forested swamps & over shaded streams	
darner, green-striped	*Aeshna verticalis*	over fields	
darner, harlequin	*Gomphaeschna furcillata*	edges of forests	
darner, shadow	*Aeshna umbrosa*	along forest edges, shaded areas	
darner, spatterdock	*Rhionaeschna mutata*	ponds & pools, open marshes & bogs, often with spatterdock	S2
darner, springtime	*Basiaeschna janata*	rivers, streams, lakes, & ponds	
darner, swamp	*Epiaeschna heros*	wooded ponds & streams (incl. ephemeral pools & ponds)	S3
CALOPTERYGIDAE			
jewelwing, ebony	*Calopteryx maculata*	in shaded areas & along small streams	
jewelwing, river	*Calopteryx aequabilis*	around all types of rivers & streams	
COENAGRIONIDAE			
bluet, azure	*Enallagma aspersum*	near most slow-moving water	
bluet, big	*Enallagma durum*	around swampy ponds or slow-moving rivers	S3
bluet, familiar	*Enallagma civile*	around large, slow-moving water bodies	
bluet, Hagen's	*Enallagma hageni*	along edges of ponds	
bluet, marsh	*Enallagma ebrium*	around wetlands & open swamps	
bluet, northern	*Enallagma annexum*	around still water & nearby vegetation	
bluet, orange	*Enallagma signatum*	near all types of still water	
bluet, skimming	*Enallagma geminatum*	around edges of most types of water	
bluet, slender	*Enallagma traviatum*	marshy ponds & lakes	
bluet, stream	*Enallagma exsulans*	along sides of streams & lakes	
bluet, turquoise	*Enallagma divagans*	slow-moving streams, lakes	S3
bluet, vesper	*Enallagma vesperum*	around ponds & lakes	S4
damsel, aurora	*Chromagrion conditum*	near most water; esp. slow-moving or stagnant ponds	

(continued)

Appendix Table C-3. (cont.)

Common name	Scientific name	Habitat	Statewide Status[1]
COENAGRIONIDAE (cont.)			
damselfly, eastern red	*Amphiagrion saucium*	around ponds or other stationary water	
dancer, blue-fronted	*Argia apicalis*	rivers, large streams, esp. deep & muddy	S3
dancer, dusky	*Argia translata*	streams, lakes	S1
dancer, powdered	*Argia moesta*	around medium to large rivers, ponds, & lakes	
dancer, variable	*Argia fumipennis violacea*	around edges of most slow or still water	
forktail, eastern	*Ischnura verticalis*	wide variety incl. ponds, edges of slow-moving rivers, & fields	
forktail, lilypad	*Ischnura kellicotti*	ponds with lily pads	S3
forktail, fragile	*Ischnura posita*	wide variety incl. pond edges, forested swamps, streams, & fields	
sprite, sedge	*Nehalennia irene*	in wet, grassy, mostly open areas	
CORDULEGASTRIDAE			
spiketail, delta-spotted	*Cordulegaster diastatops*	unshaded seeps, small streams	
spiketail, twin-spotted	*Cordulegaster maculata*	around rocky, shaded streams & along field edges	
CORDULIIDAE			
baskettail, beaverpond	*Epitheca canis*	bog ponds, slow-moving streams, & marshy lakes	
baskettail, common	*Epitheca cynosura*	around ponds & nearby fields	
baskettail, prince	*Epicordulia princeps*	tree-tops	
baskettail, spiny	*Epitheca spinigera*	bogs & boggy wetlands, marshes & slow streams	S3
emerald, American	*Cordulia shurtleffii*	near still ponds, bogs, fens, marshes, small lakes, & over meadows	
emerald, brush-tipped	*Somatochlora walshii*	slow-moving clear streams through bogs, fens, & marshes	S3
emerald, clamp-tipped	*Somatochlora tenebrosa*	edge of fields & along shady tree lines	
emerald, Kennedy	*Somatochlora kennedyi*	bogs	SNA
emerald, mocha	*Somatochlora linearis*	forested streams	S1
emerald, Williamson's	*Somatochlora williamsoni*	shady streams & bog-bordered ponds	
GOMPHIDAE			
clubtail, ashy	*Gomphus lividus*	moderately fast-moving streams & sheltered inlets of lakes	
clubtail, lancet	*Gomphus exilis*	over fields, roads, & on rocks near water	
clubtail, least	*Stylogomphus albistylus*	around rocky streams	
clubtail, lilypad	*Arigomphus furcifer*	around still water & slow-moving streams	

(continued)

Appendix Table C-3. (cont.)

Common name	Scientific name	Habitat	Statewide Status[1]
GOMPHIDAE (cont.)			
clubtail, northern pygmy	*Lanthus parvulus*	over small shaded streams	S3
clubtail, russet-tipped	*Stylurus plagiatus*	rivers	S1
clubtail, unicorn	*Arigomphus villosipes*	around ponds & lakes	
snaketail, brook	*Ophiogomphus aspersus*	over clean running water, open sunny streams	S3
snaketail, Maine	*Ophiogomphus mainensis*	clear, rocky streams	S3
snaketail, rusty	*Ophiogomphus rupinsulensis*	near rivers & on nearby rocks	
LESTIDAE			
spreadwing, amber-winged	*Lestes eurinus*	near still water; esp. boggy or temporary ponds	S3S4
spreadwing, elegant	*Lestes inaequalis*	near still water & in shaded environments	
spreadwing, lyre-tipped	*Lestes unguiculatus*	small open ponds & temporary pools	S2S3
spreadwing, slender	*Lestes rectangularis*	around forested pools & small clearings	
spreadwing, spotted	*Lestes congener*	around still, marshy water	
spreadwing, swamp	*Lestes vigilax*	near still, swampy bodies of water	
LIBELLULIDAE			
amberwing, eastern	*Perithemis tenera*	around ponds & other still water, or in nearby fields	
corporal, chalk-fronted	*Ladona julia*	near ponds & small lakes	
dasher, blue	*Pachydiplax longipennis*	over still ponds	
glider, spot-winged	*Pantala hymenaea*	open temp. ponds, pools (incl. artificial)	
meadowhawk, band-winged	*Sympetrum semicinctum*	in meadows & fields	
meadowhawk, cherry-faced	*Sympetrum internum*	around small ponds & nearby fields	
meadowhawk, ruby	*Sympetrum rubicundulum*	around swamps, wet meadows, & wetlands	S3
meadowhawk, yellow-legged	*Sympetrum vicinum*	near still water or fields	
meadowhawk	*Sympetrum internum* x *rubicundulum*	variety of wetlands & slow streams	S3?
pennant, banded	*Celithemis fasciata*	marshy ponds	S3
pennant, calico	*Celithemis elisa*	around ponds or in nearby fields	
pennant, Halloween	*Celithemis eponina*	in fields & around ponds	
pondhawk, eastern	*Erythemis simplicicollis*	around ponds or (for females esp.) in fields	
saddlebags, black	*Tramea lacerata*	over fields & meadows	
skimmer, four-spotted	*Libellula quadrimaculata*	around ponds, swamps, & marshy streams	

continued

Appendix Table C-3. (cont.)

Common name	Scientific name	Habitat	Statewide Status[1]
LIBELLULIDAE (cont.)			
skimmer, painted	*Libellula semifasciata*	marshy forested seeps, ponds, & slow-moving streams	
skimmer, slaty	*Libellula incesta*	around edges of ponds & lakes	
skimmer, spangled	*Libellula cyanea*	around ponds & streams	
skimmer, twelve-spotted	*Libellula pulchella*	near bodies of water & over fields	
skimmer, widow	*Libellula luctuosa*	near ponds & lakes & in wide variety of fields	
whiteface, dot-tailed	*Leucorrhinia intacta*	around ponds or other small stagnant bodies of water	
whiteface, red-waisted	*Leucorrhinia proxima*	bogs, fens, acidic ponds	
whitetail, common	*Plathemis lydia*	all types of water (except fast-moving) & in fields	
MACROMIIDAE			
cruiser, stream	*Didymops transversa*	medium to large streams & rivers	

[1] New York Natural Heritage Program ranks (S1, S2, S3, etc.) are explained in Appendix D.

Appendix Table C-4. Butterflies of Dutchess County, New York.

Occurrence data are from Butterflies and Moths of North America (www.butterfliesandmoths.org). Flight time and foods from Cech and Tudor (2005); habitats from Cech and Tudor and local observations.

Common name	Flight Time	Caterpillar Food	Habitat	Statewide Status[1]
HESPERIIDAE				
broken-dash, northern	early Jun-mid Aug	panic grasses	oldfield	
cloudywing, northern	late May-early Jul	clovers & other legumes	"scrubby field"	
cloudywing[3], southern	early Jun-mid Jul	legumes	open habitats	
dash, black	late Apr-early Jun	sedges	sedgy wetlands	
dash, long	Jun-early Jul; Aug	grasses	open grassy meadow, often moist	
duskywing, columbine	May-Jun, Jul	columbine	calcareous ledge	
duskywing[3], dreamy	mid-May-Jun	willows, aspen, black locust	open forest & edges	
duskywing, Juvenal's	late Apr-early Jun	oaks	open upland habitats	
duskywing[3], mottled	May-Jun, Jul-Aug	New Jersey tea	open, dry forest	SGCN[HP] ,S1
duskywing, Persius	May-early Jun	lupines	barrens, dry forest	E, S1
duskywing, sleepy	May	scrub oak	balds, barrens	
duskywing, wild indigo	May-Aug	wild indigo, vetches	in or near alfalfa fields	
edge[3], hoary	Jun-Jul	legumes, e.g., tick trefoil	oldfield & field edges	
glassywing, little	late Jun-Jul	purple top & other grasses	oldfield & pasture	
skipper, crossline	late Jun-early Aug	grasses	dry and moist fields	
skipper, Delaware	mainly Jul	little bluestem, switchgrass, other grasses	open habitats, dry to wet	
skipper, Dion	Jul	sedges	wetlands	
skipper, dun	Jul-Aug	sedges, maybe grasses	oldfield	
skipper, European	Jun-Jul	timothy & other introduced grasses	meadow	
skipper, Hobomok	late May-early Jul	grasses	oldfield	
skipper, Indian	May-Jun	grasses, e.g., bluestem	dry, often shrubby, meadows	
skipper, least	Jun-Oct	grasses	wet meadow, grassy marsh	
skipper, Leonard's	late Aug/early Sep	native grasses, e.g., little bluestem	dry upland grassland near wet area	

(continued)

Appendix Table C-4. (cont.)

Common name	Flight Time	Caterpillar Food	Habitat	Statewide Status[1]
HESPERIIDAE (cont.)				
skipper, Peck's	late May-Sep	grasses	meadow	
skipper, pepper & salt	May-Jun	grasses	forest openings	
skipper, silver-spotted	Jun-Aug	black locust	shrubby fields	
skipper, tawny-edged	late May-mid Jul; early Aug-Sep	grasses	grassy, often moist	
sootywing, common	mid-May-mid Jun; late Jul-Aug	lamb's quarters & others	open habitats	
wing, mulberry	mid Jul-early Aug	sedges	sedgy wetlands	
LYCAENIDAE				
azure, Appalachian	May	black cohosh	forest & forest edges	S1S3
azure, northern	Mar-May	blueberry, cherry, *Viburnum* buds, & other	wooded or scrubby areas	
azure, spring-summer	Apr-Sep	(various)	mainly meadows	
blue, eastern tailed	May-Sep	Legumes	open, disturbed, low growth	
copper, American	May-Sep	*Rumex* (docks)	drier meadows	
copper, bronze	mid Jun-mid Jul; early Aug-mid Sep	*Rumex* (docks)	wetlands around ponds or streams	
elfin, brown	May	heaths	barrens, dry forest	
elfin, eastern pine	May-Jun	pines	near pine woods	
hairstreak, Acadian	Jul	willows	shrubby wet meadows & swamps	
hairstreak, banded	May-Aug	oaks, hickories	edges, open habitats	
hairstreak, coral	Jun	cherries, plums	oldfield, second growth	
hairstreak, Edward's	Jul	scrub oak	scrub oak forest, rocky barren	S3S4
hairstreak, gray	early May-mid Jun	various meadow & shrubland plants	open, weedy, disturbed	
hairstreak, hickory	late Jun-early Aug	hardwood trees	edges of rich, deciduous forests	
hairstreak, juniper	mid May-Jun; Aug	eastern red cedar	open uplands with red cedar	
hairstreak, striped	late Jun-mid Jul	roses, cherries, hawthorns, heaths, others	forest openings & edges	

(continued)

Appendix Table C-4. (cont.)

Common name	Flight Time	Caterpillar Food	Habitat	Statewide Status[1]
LYCAENIDAE (cont.)				
harvester	May-Sep	alder aphids	alder swamp	
NYMPHALIDAE				
admiral, red	May-Oct	nettles	moist forest & meadow, esp. floodplain forests	
admiral, white	mid Jun-early Aug; mid Aug-mid Sep	cherries	forests, edges, shrubland	
brown, Appalachian	late Jun-Aug	sedges	forested wet areas, near sedges	
brown, eyed	late Jun-early Aug	sedges	sedgy habitats	
checkerspot, Baltimore	mid Jun-mid July	turtlehead, English plantain	meadow	
checkerspot[3], Harris's	Jun-Jul	flat-topped white aster	wet, open habitats	
cloak, mourning	year around; most common in summer	willows, other trees	wanders among many habitats	
comma, eastern	May–Aug	elms and nettles	woods, especially floodplain forests	
comma, green	3 flights, April-Sep	willow, birch, alder, gooseberry, currant	forests, streamsides	
crescent, pearl	mid May-early Sep	asters	meadow	
emperor, tawny	Jul-Aug	hackberry	hackberry habitats	S2S4
fritillary, Aphrodite	late Jun-early Sep	violets	upland habitats on acidic soils, moist grasslands	
fritillary, great spangled	late Jun-early Sep	violets	forest edges	
fritillary, meadow	May-Sep	violets	moist fields	
fritillary,[3] regal	late Jun-mid Sep	violets	extensive open areas with some wetness	
fritillary,[3] silver-bordered	Jun-Sep	wetland violets	overgrowing wet habitats, marshes, bogs	
lady, American	mid May-late Oct	composites (asters, goldenrods, etc.)	(various)	
mark, question	late Jun-Oct	elms	forests and edges	
monarch	mid Jun-Sep	milkweeds	oldfield, edges	SPCN
nymph, common wood	Jul-early Sep	grasses	meadow with tall vegetation	
pearly-eye, northern	late Jun-early Aug	grasses	forest, often near water	

(continued)

Appendix Table C-4. (cont.)

Common name	Flight Time	Caterpillar Food	Habitat	Statewide Status[1]
NYMPHALIDAE (cont.)				
purple, red-spotted	mid Jun-early Aug; mid Aug-mid Sep	cherries	near deciduous, often moist forest	
satyr, little wood	late May-early Aug	grasses	edges, forest openings	
snout, American	late Jun-mid Oct	hackberry	forested stream edges	
tortoiseshell, Compton	Mar-fall	birches, willows	forest openings and edges	
tortoiseshell, Milbert's	mid Jun-Oct?	nettles	wet or moist habitats near forest	
viceroy	late May-early Oct	willow	moist, shrubby habitats	
PAPILIONIDAE				
swallowtail, black	May-Sep	parsley, carrot, & related plants	mainly open meadows	
swallowtail, Canadian tiger	May-early Jun?	birch, aspen, cherry	near deciduous trees	
swallowtail, eastern tiger	late May-Oct	black cherry, tulip tree, ash	near deciduous trees	
swallowtail, giant	May-Sep	prickly-ash, Rutaceae	various habitats, often semi-open	
swallowtail, pipevine	Jun-early Oct	pipevine	gardens, rocky forested uplands	
swallowtail, spicebush	May-Aug	spicebush	various open habitats, usually near forest	
PIERIDAE				
sulphur, clouded	May-mid Oct	legumes	open habitats	
orange-tip, falcate	May	mustards, rock cresses, two-leaved toothwort	"trap rock hills"	
sulphur, orange	mid May-early Oct	alfalfa and other legumes	open habitats, weedy, alfalfa meadows	
white, cabbage	May-Oct	mustards	pastures or cultivated fields	
white, West Virginia	early Apr-late May	mainly *Dentaria* & *Cardamine diphylla*	rich moist woods	

[1] NY State Ranks:

SC = special concern (Environmental Conservation Law 6NYCRR Part 182.[g])
SGCN = Species of Greatest Conservation Need
SGCN^{HP} = Highest Priority Species of Greatest Conservation Need
SPCN = Species of Potential Conservation Need (https://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf)

New York Natural Heritage Program ranks (S1, S2, etc.) are explained in Appendix D.

Cech, R. and G. Tudor. 2005. Butterflies of the East Coast: An observer's guide. Princeton University Press, Princeton, NJ.

Appendix Table C-5. Fishes of Milan streams, lakes, and ponds.

Records are from Crum Elbow Creek, Landsman Kill, Roeliff Jansen Kill, Saw Kill, and Wappinger Creek in the New York State Fish Atlas, 1934-2011.

Common name	Scientific name	Native (Yes/No)	Streams	Ponds/ Lakes	Statewide Status[1]
American eel	*Anguilla rostrata*	Y	x	x	SGCN^{HP}, S2S3
banded killifish	*Fundulus diaphanus*	Y	x	x	
black crappie	*Pomoxis nigromaculatus*	N	x	x	
bluegill	*Lepomis macrochirus*	N	x	x	
brook trout	*Salvelinus fontinalis*	Y	x	x	SGCN
brown bullhead	*Ameiurus nebulosus*	Y	x	x	
brown trout	*Salmo trutta*	N	x	x	
chain pickerel	*Esox niger*	Y	x	x	
common carp	*Cyprinus carpio*	N	x	x	
common shiner	*Luxilus cornutus*	Y	x	x	
creek chub	*Semotilus atromaculatus*	Y	x	x	
cutlip minnow	*Exoglossum maxillingua*	Y	x		
eastern blacknose dace	*Rhinichthys atratulus*	Y	x	x	
fallfish	*Semotilus corporalis*	Y	x	x	
fourspine stickleback	*Apeltes quadracus*	Y	x	x	SGCN^{HP}
golden shiner	*Notemigonus crysoleucas*	Y	x	x	
goldfish	*Carassius auratus*	N	x	x	
largemouth bass	*Micropterus salmoides*	N	x	x	
logperch	*Percina caprodes*	Y			
longnose dace	*Rhinichthys cataractae*	Y	x		
mummichog	*Fundulus heteroclitus*	Y	x	x	SGCN
pumpkinseed	*Lepomis gibbosus*	Y	x	x	
rainbow trout	*Oncorhynchus mykiss*	N	x	x	
redbreast sunfish	*Lepomis auritus*	Y	x	x	
redfin pickerel	*Esox americanus americanus*	Y	x		
rock bass	*Ambloplites rupestris*	N	x	x	
satinfin shiner	*Cyprinella analostana*	Y	x		
smallmouth bass	*Micropterus dolomieu*	N	x	x	
spotfin shiner	*Cyprinella spiloptera*	Y	x	x	
tessellated darter	*Etheostoma olmstedi*	Y	x	x	
walleye	*Sander vitreus*	N	x	x	
white perch	*Morone americana*	Y	x	x	
white sucker	*Catostomus commersonii*	Y	x	x	
yellow bullhead	*Ameiurus natalis*	Y	x	x	
yellow perch	*Perca flavescens*	Y	x	x	

[1] Statewide Status: SGCN = Species of Greatest Conservation Need
SGCN^{HP} = Highest Priority Species of Greatest Conservation Need
S2S3: New York Natural Heritage Program ranks are explained in Appendix D.

Appendix Table C-6. Amphibians and reptiles of inland habitats in Dutchess County, New York.

Occurrence data are from the New York State Reptile and Amphibian Atlas.

Common name	Scientific name	Habitat	Statewide Status[1]
SALAMANDERS			
blue-spotted salamander	*Ambystoma laterale*	swamp, vernal pool, upland forest	SC
eastern newt	*Notophthalmus viridescens*	perennial pond, other wetland, upland forest	
eastern red-backed salamander	*Plethodon cinereus*	upland forest	
four-toed salamander	*Hemidactylium scutatum*	swamp, upland forest	SGCN[HP]
Jefferson salamander	*Ambystoma jeffersonianum*	vernal pool, upland forest	SC
marbled salamander	*Ambystoma opacum*	vernal pool, upland forest	SC
northern dusky salamander	*Desmognathus fuscus*	cool stream	
northern slimy salamander	*Plethodon glutinosus*	talus, upland forest	
northern two-lined salamander	*Eurycea bislineata*	small forested stream	
spotted salamander	*Ambystoma maculatum*	vernal pool, upland forest	
TOADS & FROGS			
American toad	*Bufo americanus*	everywhere	
bullfrog	*Rana catesbeiana*	forest, meadow	
Fowler's toad	*Bufo fowleri*	sandy or rocky forest	SGCN
gray treefrog	*Hyla versicolor*	shallow pool, upland forest	
green frog	*Rana clamitans*	pond, marsh	
northern leopard frog	*Rana pipiens*	pond, marsh, meadow	
pickerel frog	*Rana palustris*	meadow, forest, wetland	
spring peeper	*Pseudacris crucifer*	upland forest, wetland	
wood frog	*Rana sylvatica*	vernal pool, upland forest	
TURTLES			
Blanding's turtle	*Emydoidea blandingii*	wetland, meadow, forest, disturbed area	T, SGCN[HP], S2S3
bog turtle	*Glyptemys muhlenbergii*	fen, nearby wetland	E, SGCN[HP] S2
eastern box turtle	*Terrapene carolina*	upland forest, meadow	SC
painted turtle	*Chrysemys picta*	pond, marsh, stream	
snapping turtle	*Chelydra serpentina*	pond, lake, wetland, meadow	SGCN
spotted turtle	*Clemmys guttata*	wetland, upland forest	SC
musk turtle (stinkpot)	*Sternotherus odoratum*	stream, lake	SGCN[HP]
wood turtle	*Glyptemys insculpta*	perennial stream, upland forest, meadow	SC
SNAKES			
common garter snake	*Thamnophis sirtalis*	everywhere	
copperhead	*Agkistrodon contortrix*	forest, ledge, meadow	SGCN
common garter snake	*Thamnophis sirtalis*	everywhere	

(continued)

Appendix Table C-6. (cont.)

Common Name	Scientific Name	Habitat	Statewide Status[1,2]
SNAKES (cont.)			
copperhead	*Agkistrodon contortrix*	forest, ledge, meadow	SGCN
Dekay's brown snake	*Storeria dekayi*	forest, meadow, wetland, yard	
eastern racer	*Coluber constrictor*	forest, meadow, ledge, talus	SGCN
eastern rat snake	*Elaphe alleghaniensis*	forest, ledge, talus	SGCN
eastern ribbon snake	*Thamnophis sauritus*	open wetland	SGCN
milksnake	*Lampropeltis triangulum*	meadow, forest, barnyard	
northern water snake	*Nerodia sipedon*	pond, lake, wetland, stream	
red-bellied snake	*Storeria occipitomaculata*	forest, meadow, wetland, yard	
ring-necked snake	*Diadophis punctatus*	forest, forest opening	
smooth greensnake	*Liochlorophis vernalis*	wet meadow, other wetland, open forest	SGCN
timber rattlesnake	*Crotalus horridus*	forest, meadow, ledge, talus	T, SGCN^{HP}

[1] New York State ranks:

E = Endangered; T = Threatened; SC = Special Concern (Environmental Conservation Law 6NYCRR Part 182.[g])
SGCN = Species of Greatest Conservation Need
SGCN^{HP} = Highest Priority Species of Greatest Conservation Need (http://www.dec.ny.gov/animals/9406.html)

New York Natural Heritage Program ranks (S1, S2, etc.) are explained in Appendix D.

Appendix Table C-7. Breeding birds of Milan.

Data are from the NYS Breeding Bird Atlas (confirmed and probable observations), the Ralph T. Waterman Bird Club, and Hudsonia.

Species	Statewide Status[1]	Species	Statewide Status[1]
WATERFOWL		**RAPTORS** (cont.)	
duck, American black	S3B, SGCN[HP]	hawk, red-shouldered	SC, SGCN
duck, wood		hawk, red-tailed	
goose, Canada		hawk, sharp-shinned	SC
grebe, pied-billed	T, S3B,S!N	owl, barred	
mallard		owl, great horned	
swan, mute		screech-owl, eastern	
teal, green-winged		**KINGFISHERS**	
GALLINACEOUS BIRDS		kingfisher, belted	
grouse, ruffed	SGCN	**WOODPECKERS**	
pheasant, ring-necked		flicker, northern	
turkey, wild		sapsucker, yellow-bellied[2]	
DOVES		woodpecker, downy	
dove, mourning		woodpecker, hairy	
rock, pigeon		woodpecker, pileated	
CUCKOOS		woodpecker, red-bellied	
cuckoo, black-billed	SGCN	**FALCONS**	
cuckoo, yellow-billed		kestrel, American	SGCN
NIGHTJARS		**PASSERINES**	
whip-poor-will, eastern	S3B, SC, SGCN[HP]	blackbird, red-winged	
SWIFTS & HUMMINGBIRDS		bluebird, eastern	
hummingbird, ruby-throated		bobolink	SGCN[HP]
swift, chimney		bunting, indigo	
SHOREBIRDS		cardinal northern	
killdeer		catbird, gray	
sandpiper, spotted		chickadee, black-capped	
woodcock, American	SGCN	cowbird, brown-headed	
WADING BIRDS		creeper, brown	
heron, great blue		crow, American	
heron, green		crow, fish[2]	
VULTURES		finch, house	
vulture, turkey		finch, purple	
RAPTORS		flycatcher, alder	
goshawk, northern[2]		flycatcher, great-crested	
harrier, northern		flycatcher, least	
hawk, broad-winged		flycatcher, willow	
hawk, Cooper's[2]	SC	gnatcatcher, blue-gray	

(continued)

Appendix Table C-7. (cont.)

Species	Statewide Status[1]	Species	Statewide Status[1]
PASSERINES (cont.)		**PASSERINES** (cont.)	
goldfinch, American		thrasher, brown	SGCN^{HP}
grackle, common		thrush, hermit	
grosbeak, rose-breasted		thrush, wood	SGCN
jay, blue		titmouse, tufted	
kingbird, eastern		towhee, eastern	
martin, purple		veery	
meadowlark, eastern	SGCN^{HP}	vireo, blue-headed	
mockingbird, northern		vireo, red-eyed	
nuthatch, red-breasted[2]		vireo, warbling	
nuthatch, white-breasted		warbler, black-and-white	
oriole, Baltimore		warbler, blue-winged	
ovenbird		warbler, Canada	SGCN
phoebe, eastern		warbler, chestnut-sided	SGCN^{HP}
raven, common		warbler, pine	
redstart, American		warbler, prairie	
robin, American		warbler, worm-eating	SGCN
sparrow, chipping		warbler, yellow	SGCN
sparrow, field		warbler, yellow-rumped	
sparrow, house		waterthrush, Louisiana	
sparrow, song		waterthrush, northern	SGCN
sparrow, swamp		waxwing, cedar	
starling, European		wood-pewee, eastern	
swallow, bank		wren, Carolina	
swallow, barn		wren, house	
swallow, northern rough-winged		yellowthroat, common	
swallow, tree		yellow-throated vireo	
tanager, scarlet	SGCN		

[1] New York State ranks
SC = special concern (Environmental Conservation Law 6NYCRR Part 182.[g]
SGCN = Species of Greatest Conservation Need
SGCN^{HP} = Highest Priority Species of Greatest Conservation Need
(https://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf)
New York Natural Heritage Program ranks are explained in Appendix D.

[2] Breeding in Milan is likely but not confirmed for this species.

Appendix Table C-8. Mammals of Dutchess County, New York.

Occurrence data are from Whitaker (in prep) and Hudsonia Ltd.

Common name	Scientific name	Statewide Status[1]
MARSUPIALS		
Virginia opossum	*Didelphis virginiana*	
INSECT-EATERS		
masked shrew	*Sorex cinereus*	
northern short-tailed shrew	*Blarina brevicauda*	
smoky shrew	*Sorex fumeus*	
eastern mole	*Scalopus aquaticus*	
hairy-tailed mole	*Parascalops breweri*	
star-nosed mole	*Condylura cristata*	
BATS		
big brown bat	*Eptesicus fuscus*	
eastern red bat	*Lasiurus borealis*	SGCN
eastern small-footed bat	*Myotis leibii*	SC, SGCN, S1S3
hoary bat	*Lasiurus cinereus*	SGCN
Indiana bat	*Myotis sodalis*	E, SGCN^{HP}, S1
little brown bat	*Myotis lucifugus*	SGCN^{HP}
northern long-eared bat	*Myotis septentrionalis*	T, SGCN^{HP}, S1
silver-haired bat[2]	*Lasionycteris noctivagans*	SGCN, S2S3B
tri-colored bat (eastern pipistrelle)	*Perimyotis subflavus*	SGCN^{HP}, S1
CARNIVORES		
black bear	*Ursus americanus*	
raccoon	*Procyon lotor*	
ermine	*Mustela erminea*	
fisher	*Martes pennanti*	
long-tailed weasel	*Mustela frenata*	
American mink	*Mustela vison*	
river otter	*Lutra canadensis*	
striped skunk	*Mephitis mephitis*	
eastern coyote	*Canis latrans*	
gray fox	*Urocyon cinereoargenteus*	
red fox	*Vulpes vulpes*	
eastern cougar[3]	*Felix concolor*	E, SX
bobcat	*Lynx rufus*	
RODENTS		
woodchuck	*Marmota monax*	
eastern gray squirrel	*Sciurus carolinensis*	
red squirrel	*Tamiasciurus hudsonicus*	
southern flying squirrel	*Glaucomys volans*	

(continued)

Appendix Table C-8. (cont.)

Common Name	Scientific Name	Statewide Status[1]
RODENTS (cont.)		
eastern chipmunk	*Tamias striatus*	
American beaver	*Castor canadensis*	
southern bog lemming	*Synaptomys cooperi*	
meadow vole	*Microtus pennsylvanicus*	
southern red-backed vole	*Clethrionomys gapperi*	
woodland vole	*Microtus pinetorum*	
muskrat	*Ondatra zibethicus*	
Norway rat	*Rattus norvegicus*	
deer mouse	*Peromyscus maniculatus gracilis*	
house mouse	*Mus musculus*	
meadow jumping mouse	*Zapus hudsonius*	
white-footed mouse	*Peromyscus leucopus*	
woodland jumping mouse	*Napaeozapus insignis*	
common porcupine	*Erethizon dorsatum*	
RABBITS		
eastern cottontail	*Sylvilagus floridanus*	
New England cottontail	*Sylvilagus transitionalis*	SC, S1S2
HOOFED MAMMALS		
white-tailed deer	*Odocoileus virginianus*	
moose[4]	*Alces alces*	SGCN

[1] Statewide Status:
E = endangered; T = threatened; SC = special concern (Environmental Conservation Law 6NYCRR Part 182.[g]
SGCN = Species of Greatest Conservation Need
SGCN^{HP} = Highest Priority Species of Greatest Conservation Need
(https://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf)
S1, S2, SX, etc.: New York Natural Heritage Program ranks are explained in Appendix D.
[2] Occurrence in Dutchess County is uncertain.
[3] Extirpated, but rare recent sightings; not known to breed in New York.
[4] Not known to breed in Dutchess County.

(Whitaker, J. O. (in prep). Mammals of New York. Cornell University Press, Ithaca.)

Appendix D

Explanation of Rarity Ranks

Appendix D

Explanation of Rarity Ranks

A. ANIMALS

The explanation below is from the New York Natural Heritage Program Rare Animal Status List (Schlesinger 2017). Explanation of all NYNHP ranks are given here, but the *NRI* lists none of the global (G) ranks and considers only the ranks of S1, S2, and S3 to denote species of conservation concern.

STATE & FEDERAL LISTINGS

NY Natural Heritage tracks a selected subset of New York's animals. The species tracked are chosen based on their degree of rarity or imperilment within the state, and as new information comes in, new species are sometimes added while others are discontinued. Information on the species and communities tracked by NY Natural Heritage are used for conservation, research, and regulatory purposes.

Many of the species tracked by NY Natural Heritage are listed as "endangered" or "threatened" under the state Environmental Conservation Law (ECL). Listing is a legal process that is conducted by the state agency with authority over the species in question, and for animals confers important protection requirements. See http://www.dec.ny.gov/animals/7494.html for all state-listed animals.

The NYSDEC Division of Fish, Wildlife, and Marine Resources has jurisdiction over rare animal species listed as "endangered," "threatened," or of "special concern" under ECL §11-0535. Animals listed as endangered or threatened receive notable legal protection, as it is illegal to take or possess any of these species or their parts without a permit from NYSDEC. Species of special concern warrant attention and consideration but current information does not justify listing them as either endangered or threatened.

A subset of the animal species listed under New York state law is also recognized under federal law. These species are so seriously imperiled across their entire range that they face the very real prospect of extinction. Species are listed as federally endangered or threatened by the US Fish and Wildlife Service in consultation with state agencies and other experts, and the Service works closely with NYSDEC on the protection of federally listed species in New York.

Ultimately, protection of New York's biodiversity lies with landowners and land managers regardless of state or federal listings. How private and public landowners manage their properties will determine what species and natural communities persist into the future. This situation is both a great opportunity and a serious challenge.

(continued)

A. ANIMALS (cont.)

State legal listings are identified with the following codes:

E Endangered
T Threatened
SC Special Concern

Federal legal listings are identified with the following codes:

E listed Endangered
T listed Threatened
C Candidate for listing

The New York Natural Heritage Program tracks all species listed as Endangered and Threatened. While they track many of the species listed as being of Special Concern, a subset of Special Concern species are currently not rare or imperiled enough to merit tracking at our precise scale. In addition, they track many species that are biologically rare and imperiled but that have not gone through the review process necessary for state listing.

NYNHP Active Inventory and Watch List

The NY Natural Heritage Program keeps two lists of rare animal species: the Active Inventory List and the Watch List. Species on the Active Inventory List are ones they currently track in our database; for the most part these are the most rare or most imperiled species in the state. Species on the Watch List are those that could become imperiled enough in the future to warrant being actively inventoried, or are ones for which the Heritage Program does not have enough data to determine whether they should be actively inventoried. Species are moved between lists, or off the lists entirely, as available information warrants.

NYNHP Global and State Status Ranks

NYNHP's statewide inventory efforts revolve around lists of rare species and all types of natural communities known to occur, or to have historically occurred, in the state. These lists are based on a variety of sources including museum collections, scientific literature, information from state and local government agencies, regional and local experts, and data from neighboring states.

Each rare species is assigned a rank based on its rarity, population trends, and threats. Like those in all state Natural Heritage Programs, NYNHP's ranking system assesses rarity at two geographic scales: global and state. The global rank (G-rank) reflects the status of a species or community throughout its range, whereas the state rank (S-rank) indicates its status within New York. Global ranks are maintained and updated by NatureServe, which coordinates the network of Natural Heritage programs. Both global and state ranks are usually based on the range of the species or community, the number of occurrences, the viability of the occurrences, and the vulnerability of the species or community around the globe or across the state. As new data become available, the ranks may be revised to reflect the most current information. Subspecific taxa are also assigned a taxon rank which indicates the subspecies' rarity rank throughout its range.

(continued)

A. ANIMALS (cont.)

For the most part, global and state ranks follow a straightforward scale of 1 (rarest/most imperiled) to 5 (common/secure). The Town of Milan *NRI* refers only to the three ranks—S1, S2, S3—that indicate rarity or limited occurrence in the state, as follows:

- **S1** Critically imperiled in New York State because of rarity (5 or fewer occurrences, or few remaining acres or miles of stream) or factors making it especially vulnerable to extinction rangewide (global) or in the state;
- **S2** Imperiled in New York State because of rarity (6-20 occurrences, or few remaining acres or miles of stream) or factors demonstrably making it very vulnerable to extinction (global) or extirpation from New York (state);
- **S3** Either uncommon or local in New York State, typically with 21 to 100 occurrences, limited acreage, or miles of stream rangewide (global) or in New York (state).

Additional species lists and codes are at https://www.acris.nynhp.org/.

Codes sometimes have qualifiers attached:

- **T1**, **T2**, etc. These ranks which, like global and state ranks, run from 1 (rarest/most imperiled) to 5 (common/secure), are attached to global ranks to indicate the status of a subspecies or variety.
- **Q** Indicates that the species, subspecies, or variety is in taxonomic dispute.
- **?** Indicates that the state or global rank is uncertain and more information is needed.
- **N** Indicates the migratory status of a migratory species when it is not breeding in NY (for example, populations that are overwintering in the state).
- **B** Indicates the state status of a migratory species when it has breeding populations in NY.

Species of Greatest Conservation Need

The list of Species of Greatest Conservation Need was developed for the *New York State Wildlife Action Plan* (NYSDEC 2015).

High-Priority Species of Greatest Conservation Need

The status of these species is known, and conservation action is needed in the next ten years. These species are experiencing a population decline, or have identified threats that may put them in jeopardy and are in need of timely management intervention, or they are likely to reach critical population levels in New York.

Species of Greatest Conservation Need

The status of these species is known and conservation action is needed. These species are experiencing some level of population decline, have identified threats that may put them in jeopardy, and need conservation actions to maintain stable population levels or sustain recovery.

Species of Potential Conservation Need

The status of these species are poorly known, but there is an identified threat to the species or features of its life history that make it particularly vulnerable to threats. The species may be declining or begin to experience declines within the next ten years, and studies are needed to determine their actual status.

(continued)

B. PLANTS

The explanation below is from the *New York Rare Plant Status List* (Ring 2022).
Explanation of all NYNHP ranks are given here, but the *NRI* lists none of the global (G) ranks and considers only the ranks of S1, S2, and S3 to denote species of conservation concern.

New York State Legal Status

The following categories are defined in regulation 6NYCRR part 193.3 and apply to New York State Environmental Conservation Law section 9-1503. Part (f) of the law reads as follows: "It is a violation for any person, anywhere in the state to pick, pluck, sever, remove, damage by the application of herbicides or defoliants, or carry away, without the consent of the owner, any protected plant. Each protected plant so picked, plucked, severed, removed, damaged or carried away shall constitute a separate violation." Violators of the regulation are subject to fines of $25 per plant illegally taken. The list and contact information for questions about the list may be accessed at the NYSDEC Protected Plants website. This list is updated only every 10 years so legal status ranks may not reflect the current Heritage rank.

E = Endangered: listed species are those with

1) 5 or fewer extant sites, or
2) fewer than 1,000 individuals, or
3) restricted to fewer than 4 USGS 7.5-minute topographical maps, or
4) species listed as endangered by the US Department of Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T = Threatened: listed species are those with

1) 6 to fewer than 20 extant sites, or
2) 1,000 to fewer than 3,000 individuals, or
3) restricted to not less than 4 or more than 7 USGS 7.5-minute topographical maps, or
4) listed as threatened by the US Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

R = Rare: listed species have

1) 20 to 35 extant sites, or
2) 3,000 to 5,000 individuals statewide.

(continued)

B. PLANTS (cont.)

New York Natural Heritage Program Ranks

The explanation below is from the New York Natural Heritage Program Rare Plant Status Lists (Ring 2022). The Town of Milan *NRI* refers only to the three ranks —S1, S2, S3—that indicate rarity or limited occurrence in the state, as follows:

- **S1** Critically imperiled in New York State because of extreme rarity (5 or fewer sites or very few remaining individuals) or extremely vulnerable to extirpation from New York State due to biological or human factors.

- **S2** Imperiled in New York State because of rarity (6 - 20 sites or few remaining individuals) or highly vulnerable to extirpation from New York State due to biological or human factors.

- **S3** Vulnerable in New York State. At moderate risk of extinction or elimination due to very restricted range, very few populations (usually 21 - 35 extant sites), steep declines, or other factors.

Double Ranks (S1S2, S2S3, S1S3)

The first rank indicates rarity based upon current documentation. The second rank indicates the probable rarity after all historical records and likely habitat have been checked. Double ranks denote species that need additional field surveys.

Codes sometimes have qualifiers attached, such as "Q" or "?":

- **Q** indicates a question exists whether or not the taxon is a good taxonomic entity.

- **?** indicates that an identification question exists about known occurrences. It also indicates the rank presumably corresponds to actual occurrences even though the information has not yet been documented in NYNHP files or historical records. It serves to flag species that need more field studies or specimen identification.