2022

Town of Sunapee Natural Resources Inventory & Conservation Plan

Photo 1. Frank Simpson Preserve wetland. Credit: Barbara Chalmers.

Town of Sunapee Conservation Commission

With assistance from the Upper Valley Lake Sunapee Regional Planning Commission

Table of Contents

FIGURES LIST

TABLES LIST

1. ACKNOWLEDGMENTS

The Sunapee Conservation Commission would like to thank its members and community residents who contributed greatly to the development of this Natural resources inventory and Conservation Plan for the Town of Sunapee.

VAN WEBB

TIMOTHY FLEURY

CLIFFORD FIELDS

GINNY GWYNN

MARK REYNOLDS

MATTHEW HURD

TERRY MATTSON

Special thanks to Conservation Commission member

BARBARA CHALMERS

Who led the update to this document, providing information and review that has advanced its purpose in service to the Town of Sunapee.

2. Introduction

Natural resources are an essential element and cultural contributor to the Town of Sunapee. Made up of soil, water, plant, wildlife, air, and energy, these natural resources are valuable in innumerable ways. These include but are not limited to: Aesthetic, inspirational, and spiritual aspects for public health and contemplation; Fundamental ecosystem services that are costly or impossible to replace; Recreational opportunities and its related recreation economy

Sunapee is a rural lakefront town covering 25 square miles in central New Hampshire, bordered on the east by Lake Sunapee. The town's lakes, ponds, river, and wetlands draw many seasonal human and wildlife visitors each year. These resources, in combination with open fields and forests, provide a diverse array of natural settings. Sunapee relies on its natural resources for drinking water, its tourist and seasonal home economy, and much of its taxbase. Its natural resources sustain production of agricultural products, construction materials, and wood-based fuel. Sunapee's natural resources also sustain a high quality of rural life with abundant wildlife, scenic vistas, and recreational opportunities.

This Natural Resources Inventory and Conservation Plan (informed by NH RSA 36-A:2) contains a visual and written description of the natural resources within the Town of Sunapee at the current time and suggests protections needed for the resilience of these resources. The goals are to:

- Identify critical natural resources, resource areas, and threats
- Prioritize protection and conservation efforts
- Inform decision-making about land use, development, infrastructure, and conservation
- Educate landowners about the values associated with their land for informed land use decisions

This report should not be construed as a "final product" as the status and significance of natural resources and their protections change over time. This document should be revisited periodically, suggested at least every 10 years, to update with newly available data, protections, and priorities for natural resources conservation.

3. Methodology

The Sunapee Conservation Commission (SCC) developed this Natural Resources Inventory and Conservation Plan, with technical assistance from the Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) in 2022. The first phase involved an inventory consisting of readily available data and input from SCC members. With that information, a co-occurrence analysis was performed to identify areas of high resource value. Town policies, planning documents, and land conservation practices were reviewed for their alignment or misalignment with the protection and resilience of the Town's natural resources as outlined in the inventory. With data and analysis in hand, the SCC identified priority focus areas and conservation topics, culminating with an updated the Town Conservation Plan.

Information on the natural resources in Sunapee was derived both from statewide data sources and local knowledge. Corrections to the statewide data were made by the SCC. This information is represented descriptively and visually. Digital maps were created by UVLSRPC, using ArcGIS Pro. Detailed information about data are described in Appendix A : Data Source Documentation.

4. Natural Resources

4.01 Political location

The town of Sunapee is in the west and central part of New Hampshire in Sullivan County. As of the 2020 census, the Town makes up a single, independent census tract. Within the Town of Sunapee, there are several villages and places – Georges Mills, Sunapee Harbor and Upper Village, Lower Village, Wendell, and South Sunapee. Lake Sunapee is the most prominent geographic feature of the town and covers 13% of its land area. The lake shore forms the eastern edge of town adjoining the towns of New London and Newbury. Nearby to the south is Mount Sunapee with its State Park and snow skiing resort. Sunapee is bordered by six municipalities (Map 1):

- New London and Newbury to the east,
- Goshen to the south,
- Springfield to the north, and
- Croydon and Newport to the west.

4.02 Geology & Topography

Photo 2.Bears Den, group of glacial erratics. Simpson Reserve 2021. Credit: Barbara Chalmers.

Bedrock geology. The bedrock underneath the Town of Sunapee is mostly igneous rock such as granite that formed when melted rock solidified inside the earth. These kinds of internally formed rocks are known as plutonic. There is also a belt of metamorphic rock that runs north to south at the centerline of the town, which was created when older rocks were changed by heat or pressure underground (Map 2). This bedrock dates to the Devonian Period, roughly 400 million years before the present day. This geologic period is nicknamed the Age of Fishes due to the significant fish diversity present. The period is also known for the large number of early plants that spread on dry land, evolving into the first seed-bearing plants by the end of the period. The Middle to Late Devonian is when the Acadian orogeny occurred, the third of four mountain building events that created the Appalachian Mountains.

The bedrock of Sunapee provides potential sources of geological resources for the town. Most of the town's bedrock is granite or granodiorite, which are popularly used as construction material, decorative stone, road building material, and more. There is a single active quarry for this stone about a mile south of the town center. There are also

Topography. The most significant peak is Blueberry Mountain at 1,509 ft, in the south-west part of Town. Other prominent hills and mountains include Youngs Hill, Tucker Hill, Cemetery Hill, Blaisdell Hill, Burkehaven Hill, Keyser Hill, Garnet Hill, Browns Hill, Smith Hill, Mica Mine Hill, and Trow Hill. The lowest elevation in town is along the Sugar River, at just under 300 feet above sea level (Map 3). All water in Sunapee drains eventually to the Sugar River, which begins at the outflow of Lake Sunapee. The prominent peaks in Sunapee coincide with many, but not all the Town's slopes of moderate or steep grade (Table 1). Slope is important for planning purposes for several reasons. The increase in slope corresponds to the potential increase for surface runoff and erosion. The soil depth is also thinner as slopes increase, thereby decreasing the capacity of the land to filter septic system effluent. Low lying areas are typically associated with water resources such as river corridors or wetlands and may be prone to flooding,

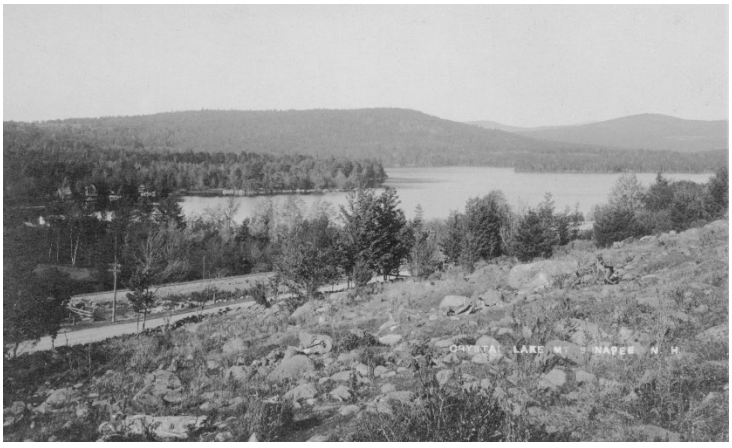


Photo 3. c1940 Photo of rocky soil, rolling hills, taken west of Mt View Lake. Credit: Sunapee Historical Society Collection.

and/or contain deposits of sand and gravel or rich farmland soils. The most suitable slopes for development are from zero to 12-15%.

Percent Slope Category	Square Miles	Acreage	% Town
Waterbody	4.2	2,716	17%
Slight, <6%	4.8	3,101	19%
Gently sloping, <12%	6.1	3,882	24%
Moderately sloping, <15%	2.6	1,637	10%
Strongly sloping, <18%	2.0	1,294	8%
Moderately steep, <25%	3.0	1,896	12%
Steep, >25%	2.5	1,574	10%

Table 1. Slope presence by class in Sunapee, LiDAR derived
Source: New Hampshire Granit, 2021.

Photo 4. Scenic view of Croydon Mountain from Burkehaven Hill. Taken from top of Burkehaven Hill Road. July 2022. Credit: Barbara Chalmers.

4.03 Ecoregion

According to the Commission for Environmental Cooperation (CEC), "ecological regions are areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources", identified by the CEC and supported by the US EPA (Omernick & Griffin, 2014). The CEC recognizes four levels of ecoregions in North America, with the two smallest levels updated in 2013. At the most refined scale of level IV, with 967 total, the Town keeps its namesake within the Sunapee Uplands ecoregion (Map 4).

> *"**The Sunapee Uplands** ecoregion of New Hampshire consists of open low mountains. With numerous, rolling, rocky hills and mountains, elevations are mostly 1000 to 2000 feet, but range from 500 to over 3000 feet. Monadnock Mountain anchors the southern end of the region at 3165 feet. Granite and granodiorite rocks are common with shallow, stony frigid soils, mostly coarse-loamy Spodosols. The uplands are dissected by numerous streams, and small lakes dot the landscape." (Griffith et al. 2009)*

At level III, which recognizes 182 identified ecoregions, Sunapee falls within the Northeastern Highlands ecoregion.

> *"**The Northeastern Highlands** covers most of the northern and mountainous parts of New England as well as the Adirondacks in New York. It is a relatively sparsely populated region compared to adjacent regions, and is characterized by hills and mountains, a mostly forested land cover, nutrient-poor frigid and cryic soils (mostly Spodosols), and numerous high-gradient streams and glacial lakes. Forest vegetation is somewhat transitional between the boreal regions to the north in Canada and the broadleaf deciduous forests to the south. Recreation, tourism, and forestry are primary land uses. Farm-to-forest conversion began in the 19th century and continues today. In spite of this trend, alluvial valleys, glacial lake basins, and areas of limestone-derived soils are still farmed for dairy products, forage crops, apples, and potatoes. In addition to the timber industry, recreational homes and associated lodging and services sustain the forested regions economically, but they also create development pressure that threatens to change the pastoral character of the region. Many of the lakes and streams in the region are sensitive to acidic deposition originating from industrial sources upwind from the ecoregion, particularly to the west." (Griffith et al. 2009)*

At the broadest level, the Town of Sunapee resides within the Atlantic Highlands of the Northern Forests ecoregion of North America, Level II and Level I respectively. Maps of all four ecoregion levels can be found in Appendix B : Ecoregions.

4.04 Surface waters, riparian zone & floodplains

Watershed. Water covers just over 16% of the total land area of Sunapee at 2,653 acres, while the land area of town is 13,447 acres (Map 5, Table 3).

Photo 5. Lake Sunapee Harbor, view to east. Credit: Barbara Chalmers.

All surface waters in Sunapee drain to the Sugar River which flows into the Connecticut River which flows into the Atlantic Ocean. This makes Sunapee fully a part of the Connecticut River watershed, HUC-4 level, and the Sugar River watershed, HUC-10. A watershed is the area of land that drains to a certain waterbody. The US Geological Survey uses hydrologic unit codes (HUCs) to identify a specific hydrologic feature, such as a drainage basin. The shorter the code, the larger the region delineated. The HUC-12 represents the local sub-watershed level, capturing tributary systems.

At the HUC-12 level, the Town is divided into two sub watersheds (Map 5, Table 2). The western portion of town is part of the Long Pond Brook-Sugar River watershed. The eastern side of town is a part of the Lake Sunapee watershed, draining directly into Lake Sunapee before flowing into the Sugar River.

HUC-12 Watershed	Square Miles	Acreage	% Town
Long Pond Brook-Sugar River	13.8	8,813	55%
Lake Sunapee	11.4	7,287	45%

Table 2. HUC 12 Watersheds within Sunapee
Source: National Hydrography Dataset Plus, 2018.

The riparian zone is a vegetated area abutting water, important for water quality, habitat, bank stabilization, and other functions (Figure 1). These strips of grass, shrubs, and/or trees along the banks of rivers and streams provide a transition zone between water and human land use, and are the single most effective protection for our water resources. Buffers are also complex ecosystems that provide habitat and improve the stream communities they shelter. While the important riparian zone varies by the function desired and stream size, this report standardizes the area to a 50-foot buffer from the stream centerline. As such the buffer area covers 703 acres or 4.4% of the Town. The New Hampshire Shoreland Water Quality Protection Act (RSA 483-B) (SWQPA) protects the riparian zone for public waters, including perennial streams of order four or above, and lakes or ponds greater than 10 acres. The Strahler stream order is a scientific method used to define stream size based on its place within the stream network, including intermittent streams.

Photo 6. Trask Brook at Johnson farm field 2020. Credit: Barbara Chalmers.

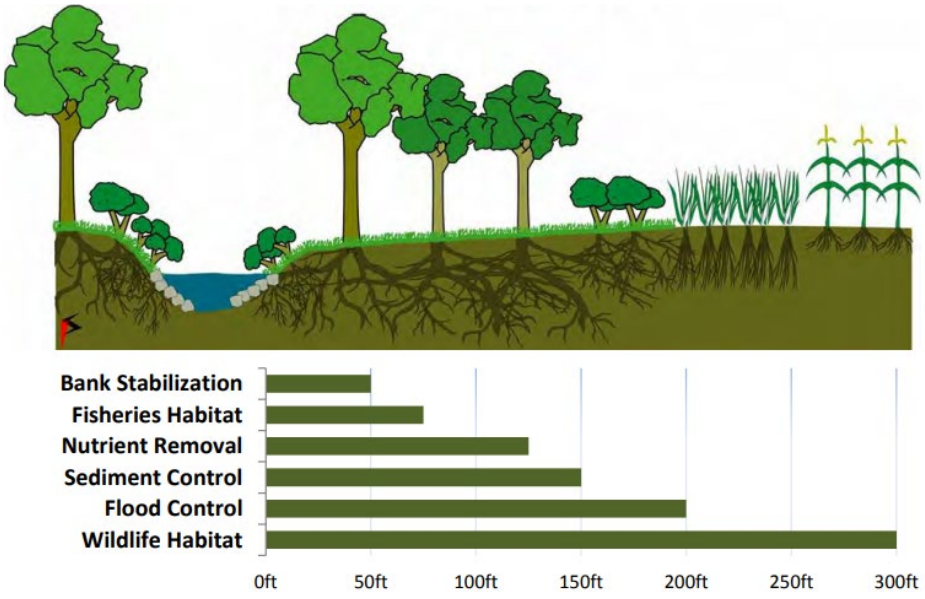


Figure 1. Common riparian buffer widths and their ability to perform various functions.
Source: Connecticut River Joint Commissions, 2018.

Streams and rivers. The Town contains 38 miles of streams and rivers with the larger Sugar River and Ledge Pond Brook stretching 4.7 miles. In particular, the influence of the Sugar River is significant

for the industrial history of the region. The Sugar River is also a secondary water supply for the City of Claremont. Smaller streams with names include Otter Pond Brook, Meadow-Muzzey Brook, and Angell-Trask Brook. First order streams represent the smallest headwater streams. Most streams in Sunapee, or 57.4%, are first order streams. While only 8.7% or 3.3 miles are fourth or fifth order streams, protected by the SWQPA.

Lakes and ponds. Sunapee is especially rich in surface waterbodies, with five lakes or ponds over 100 acres and numerous smaller ponds (Table 3). In Sunapee, Lake Sunapee is the largest body of water with a shoreland broken up by many coves and bays, including Georges Mill Harbor, Jobs Creek, Scott Cove, Gardner Bay, Sunapee Harbor, Hedgehog Cove, Burkehaven Harbor, Penny Cove, and Fishers Bay. The town shares Lake Sunapee with the Towns of Newbury and New London, linking them ecologically. The lake covers a total of 4,090 acres, with over half of its acreage in Sunapee. Unsurprisingly, the Lake provides layers of values to the Town. Drinking water for a significant portion of Sunapee's population comes from Lake Sunapee (see section 4.10 Groundwater resources & public water supplies). Lake Sunapee is identified as important wildlife habitat (see section 4.07 Habitat types & value) and provides recreational and aesthetic value to residents and visitors alike. The level of Lake Sunapee is controlled by the NHDES Dam Bureau at its only outlet, the Sunapee Harbor dam, using historic hi-low levels established in 1902 from the Sunapee Dam Corporation lawsuit. Lake Sunapee is an iconic symbol of the region and has been protected by concerned citizens since 1898 when the Lake Sunapee Protective Association was formed.

Photo 7. Ledge Pond Brook, photo from trail in MacWilliams lot, Mar 2020 (left). Ledge Pond at hiking trail end looking west (right). Credit: Barbara Chalmers.

Category	Length (mi)	Acreage	Buffer (50 ft) Acreage	% Town Waterbody & Buffer
Lakes and Ponds	-	2653	231	17.9%
Ledge Pond	-	116	17	0.8%
Mountainview Lake	-	116	16	0.8%
Mud Pond	-	10	4	0.1%

Otter Pond	-	125	21	0.9%
Perkins Pond	-	157	17	1.1%
Lake Sunapee	-	2114	125	13.9%
Wendell Marsh	-	4	2	0.0%
Unnamed ponds, <10 acres	-	12	29	0.3%
Streams and Rivers	38.0	-	472	2.9%
Sugar River	1.6	-	-	-
Ledge Pond Brook	3.1	-	-	-
Stream Order 5	3.1	-	39	0.2%
Stream Order 4	0.2	-	3	0.0%
Stream Order 3	3.3	-	41	0.3%
Stream Order 2	9.5	-	118	0.7%
Stream Order 1	21.8	-	272	1.7%
Land	-	22,912		83.5%

Table 3. Land and water area in Sunapee

Source: New Hampshire Hydrography Dataset Plus, 2018.

Floodplains are low-lying areas next to streams, rivers, or waterbodies with a potential to inundate with water during rain and snow melt events. They are areas that may warrant conservation or restoration priority and consideration in community land use policies. Floodplains often contain nutrient rich soils and important wildlife habitat. Also, they are important ecosystem tools to protect immediate and downstream areas from flooding events by slowing water down and reducing peak flows. Floodplains help to determine risk of flooding for buildings and infrastructure. The US FEMA flood maps are the standard US resource to identify flood plains or what they call zones. The FEMA flood zone designations can be grouped into three general categories high-risk areas with a 1-percent annual flood chance (or 100-year), moderate-risk areas between the 1-percent and 0.2-percent annual flood chance (or 500-year), and minimal risk. The majority of Sunapee, not a waterbody, is within the minimal risk zone. Only a quarter of an acre along Lake Sunapee is of moderate risk. Within the high-risk area are 492 acres, or 3% of the town (Map 6). The FEMA flood maps are informed by historical precipitation, flooding, and modeling, and do not consider intense rainfall or climate change. The FEMA flood maps often receive political and homeowner challenges to expanded flood zones.

The First Street Foundation Flood Factor model illuminates potential pitfalls of the FEMA method through its own analysis. The First Street methodology "analyzes flood hazards, projects future climate scenarios, incorporates local adaptation, and validates against satellite and government records." In Sullivan County, First Street shows more than double the number of properties with moderate risk of flooding over the next 30-year period (Flavelle et al., 2020).

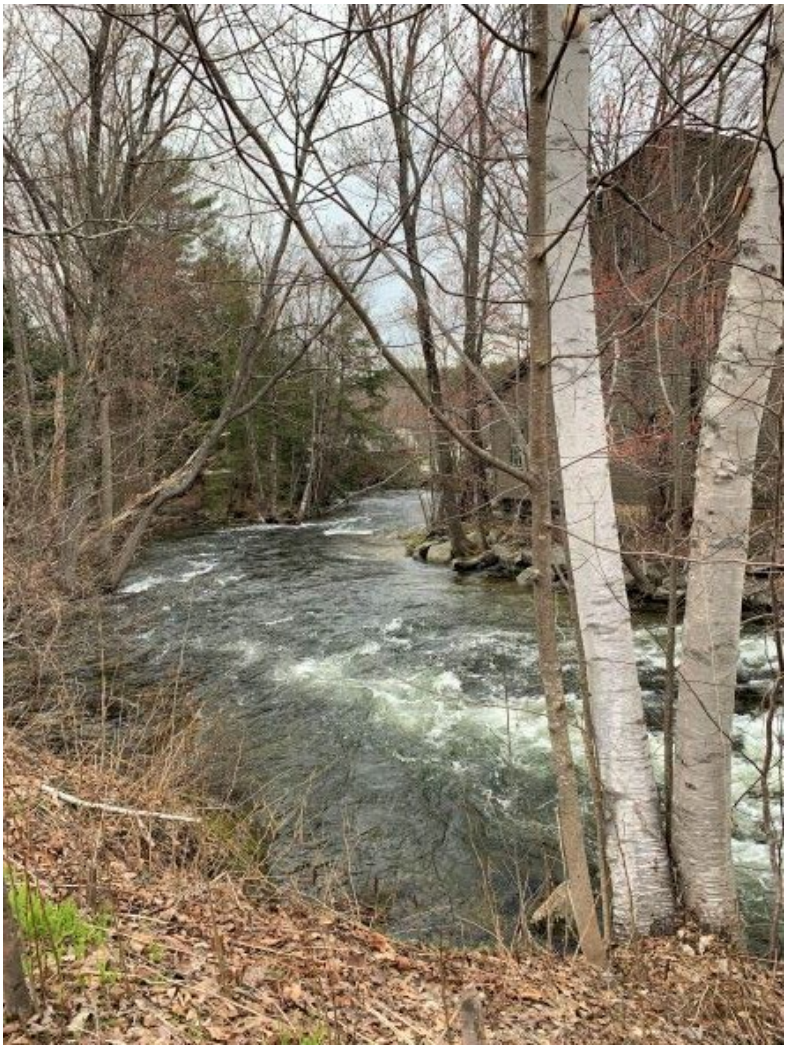


Photo 8. Sugar River at Lower Main St and Winn Rd bridge Mar 2021. Credit: Barbara Chalmers.

4.05 Land cover

The National Land Cover Database (NLDC), managed by the US Geological Survey, is updated every couple of years to show how the landscape changes due to both natural and human impacts. This regular reporting with spatial data allows communities to monitor land cover at a broader and longer time scale to identify trends or isolated challenges/opportunities. For details on types of land cover see Appendix A : Data Source Documentation.

2019 land cover. By far, the Town of Sunapee is dominated by a mixed forest land cover at 59% of Town. Another 17% of Town is covered by open water, wetland at 7% and hay/pasture at 4%.

As a rural town, the developed land cover sits at 12%, half of an open space type and the rest mainly at low or medium intensity. Residential development is densely clustered along the lakeshores, with some commercial development in Sunapee Harbor and along the state roads, Route 11 and 103. The western part of town is less developed than the eastern part near Lake Sunapee. An electric transmission line passes through Sunapee, heading south from I-89's Exit 12A toward the center of Sunapee and then west into Croydon. The pattern of development and network of interstate and state highways has fragmented the landscape (Map 7). Read more about fragmentation and intact habitat block in the next section 4.06 Habitat blocks.

Change in land cover between 2001 to 2019 shows a reduction in forest and hay/pasture agriculture, and an increase in developed areas and wetlands (Table 4, Map 7). The Northeast Land Cover analysis relies heavily on satellite imagery; there are inherent limitations to the accuracy of these estimates. An example of a misclassification is a single house with a small lawn surrounded by forest would likely be classified as forest, rather than developed. Therefore, the acreage reported for each class should be taken as an estimate, not as a direct measurement.

Photo 9. Sanctuary Dairy farm hayfields on W side of Route 103, to W is Trask Brook, S is Mt. Sunapee. Taken from Tasker Brook Rd. June 2021. Credit: Barbara Chalmers.

Between 2001 and 2011 is when most of the 158 acres (1.6%) of forest loss occurred, with some gains in the following decade but a continued decline of evergreen forest. Most of this change went to developed, grassland, or herbaceous land cover types.

Hay and Pasture agriculture decreased in land cover in both decades resulting in a total loss of 54 acres or 8.5% since 2001. Most of this loss happened in small patches around the edges of fields with conversion either to forested or developed land.

Developed land cover resulted in a 4.7% increase or 87 acres since 2001, mostly as either medium or high intensity. Some gains in open space occurred in the first decade, however this and more was lost in the recent decade. Most of this land cover change came from an expansion of an existing developed corridor or lot with consistent small increases around Sunapee's waters, especially Lake Sunapee and the wetlands in the south of Town.

Increases to wetlands were small but notable at 28 acres, a 2.7% increase. These changes can be seen at Fishers Bay on Lake Sunapee, the north end of Otter Pond, and around Wendell Marsh. Almost all this increase occurred in the last ten years.

Future land cover change. The last few years are not yet reflected in currently available NLCD data. Much of this time was during the COVID-19 pandemic, when Sunapee experienced an increase in use of its seasonal homes and higher residential development, especially during 2021 (Vital Communities 2022). It is then likely that the increase in developed land cover will continue into the next decade and that thoughtful consideration of land use policy may be needed to maintain appropriate coordination between development and natural resource protections. One such known increase in development is taking place on the slopes of Blueberry Mountain off Route 103B.

An adaptive, realistic balance can advance the economic vibrancy, livability, and affordability of the Town alongside the functioning of the Town's natural resources for its value to ecosystem services, aesthetics, recreation, business, and wildlife habitat.

Land Cover Class	2001		'01 to '11 Change		2011		'11 to '19 Change		2019		'01 to '19 Change	
	Acreage	% Town	Acreage	% Town	Acreage	% Town	Acreage	% Town	Acreage	% Town	Acreage	% Town
Developed High Int.	23	0.1%	3.2	14.1%	26	0.2%	3.6	14.0%	29	0.2%	6.8	30.1%
Developed Medium Int.	252	1.6%	25.0	9.9%	277	1.7%	26.5	9.6%	304	1.9%	51.4	20.4%
Developed Low Int.	598	3.7%	26.1	4.4%	624	3.9%	10.0	1.6%	634	3.9%	36.2	6.0%
Developed Open Space	978	6.1%	24.1	2.5%	1,002	6.2%	-31.2	-3.1%	971	6.0%	-7.1	-0.7%
Developed Sub-Total	**1,851**	**11.5%**	**78.4**	**4.2%**	**1,929**	**12.0%**	**8.9**	**0.5%**	**1,938**	**12.0%**	**87.3**	**4.7%**
Emerging Herbaceous Wetlands	53	0.3%	-2.2	-4.1%	51	0.3%	14.9	29.2%	66	0.4%	12.8	24.0%
Woody Wetlands	983	6.1%	2.4	0.2%	986	6.1%	12.7	1.3%	998	6.2%	15.1	1.5%
Wetlands Sub-Total	**1,037**	**6.4%**	**0.2**	**0.0%**	**1,037**	**6.4%**	**27.6**	**2.7%**	**1,064**	**6.6%**	**27.8**	**2.7%**
Deciduous Forest	1,307	8.1%	-1.2	-0.1%	1,306	8.1%	16.7	1.3%	1,322	8.2%	15.5	1.2%
Evergreen Forest	3,784	23.5%	-79.2	-2.1%	3,705	23.0%	-48.9	-1.3%	3,656	22.7%	-128.1	-3.4%
Mixed Forest	4,501	28.0%	-85.0	-1.9%	4,416	27.4%	39.5	0.9%	4,455	27.7%	-45.5	-1.0%
Forest Sub-Total	**9,591**	**59.6%**	**-165.5**	**-1.7%**	**9,426**	**58.5%**	**7.3**	**0.1%**	**9,433**	**58.6%**	**-158.1**	**-1.6%**
Shrub/Scrub	149	0.9%	58.4	39.2%	207	1.3%	34.6	16.7%	242	1.5%	93.0	62.5%
Herbaceous	131	0.8%	72.5	55.4%	203	1.3%	-44.5	-21.9%	159	1.0%	28.1	21.5%
Hay/Pasture	633	3.9%	-40.1	-6.3%	593	3.7%	-13.5	-2.3%	580	3.6%	-53.6	-8.5%
Barren Land	11	0.1%	-0.9	-8.0%	10	0.1%	7.7	74.6%	18	0.1%	6.8	60.6%
Open Water	2,696	16.7%	-2.8	-0.1%	2,693	16.7%	-28.3	-1.1%	2,665	16.6%	-31.2	-1.2%

Table 4. Land cover change in Sunapee

Source: National Land Cover Dataset 2011, 2011 & 2019.

4.06 Habitat blocks

Many wildlife species rely on large blocks of contiguous forest and secure connections to other large forest blocks for all or part of their habitat needs. Contrastingly, landscape fragmentation can be detrimental in terms of loss of habitat area, loss of habitat connectivity, increased potential for incursions of invasive or damaging species, and increased potential for vehicle-wildlife collisions as well as other undesirable human-wildlife interactions.

The maintenance of large forest blocks benefits both wide-ranging species, as well as habitat-specific species that live in interior forests, such as wood thrush. Native black bear, bobcat, fisher, and moose require huge acreages, often spanning two or more towns, to find food, shelter and successfully rear their young. The wildlife value of these forest blocks increases with size and with connectivity to wetlands, lakes, and rivers (Kanter *et al*. 2001).

A regional, bi-state project by the Linking Lands Alliance (LLA) seeks to identify and understand important natural habitats and connecting lands that support large, wide-ranging wildlife species. The maps produced from this project have been used by teachers in lessons about policy and ecology. As a result of this effort, a regional dataset of habitat blocks and their relative ecological importance is available for the Town of Sunapee, located on the southeastern edge of the LLA study region. Habitat blocks in the study were fragmented by:

1. Land cover types – developed lands, bare land, cultivated crops, and pasture/hay
2. Buildings and Roads (not including private / unmaintained) with a 330 ft buffer
3. Blocks less than 20 acres

To determine ecological importance, ten features were considered. These ten features were Wildlife Action Plan ranked habitats, ecological landscape unit groups, element occurrence count, percent core, block size, density of interior roads, percent lakes and ponds, percent wetlands, order and density of stream, and percent TNC matrix block. Full methodology details can be found on the LLA website.

The three most significant habitat blocks seen in Map8 in Sunapee include:

1. One in the south of 760 acres, completely contained within the Town, cover most of Blueberry Mountain and recently experienced residential development along Route 103B.
2. The highest scoring block is located on the southeastern edge of town and stretches beyond to more than 9,000 acres. This is the northernmost extent of the Sunapee-Pillsbury Highlands. Much of this mountainous area is protected from development by Mount Sunapee, Pillsbury State Parks and adjacent conservation land.
3. Another above average block has 45% of its almost 5,000 acres in the northwestern corner of Sunapee, including Ledge Pond and extending into Croydon and Springfield.

The most fragmented areas of Town are around Lake Sunapee and Routes 11 and 103B. The majority of town consists of forest blocks less than 500 acres in size, but there are five large blocks of unfragmented land with some coverage in Sunapee (Map 8). Most of these blocks were determined to be at or below the average ecological importance score for the NH part of the region. There are five habitat blocks with an above average ecological importance, including one for Lake Sunapee.

4.07 Habitat types & value

4.07(a) Native Species Value and Threats

By identifying and protecting the full range of ecological communities present in Sunapee, it should be possible to provide habitats for all native species, including those not identified as rare. Native wildlife and plants have evolved to local environments, in tune with each other and their surroundings.

Native plants provide essential nutrients to wildlife through nectar, nuts, fruits, and other edible products. These plants also provide essential materials and spaces for wildlife shelter, nesting, and micro-climates. For example, cold water fish habitat is maintained in part through a healthy native, riparian buffer that provides nursery habitat and river shading for temperature control. These cool, water corridors are likely to become increasingly important to many wildlife as global warming continues to escalate. Native plants often exist in concert with each other to establish ecological communities. While some plants fix nitrogen to the soil, others spread their roots increasing soil aeration or provide unique habitats (e.g., mycorrhizae fungi, epiphytes, orchids).

Native wildlife serves their host habitats through seed dispersion and an interconnected food web. Keystone species provide linchpin roles in ecosystem dynamics. Beavers uniquely engineer their homes in a way that provides habitat for other species, some of which only live in beaver impacted areas. Beavers are also a common conflict species due to their ability to damage and reduce the functioning of infrastructure. Fortunately, new technologies, such as the beaver deceiver, are being implemented and refined to address these beaver conflicts in a mutually beneficial way. Another keystone species are high-level predators, such as coyotes. Some native wildlife such as gulls, corvids, and raccoons often become overpopulated and threaten other native wildlife populations (e.g., ground nesting birds), habitats (e.g., deer feeding on forest understory), and human health (e.g., increased risk of lyme disease).

Invasive exotic species are those that are non-native (or alien) to the ecosystem and whose introduction causes or is likely to cause economic or harm to environment or human health. Not all exotic species are invasive. Those that are persist in a way that can be hard to control, altering native habitat composition and structure. This ability is due to a lack of natural predators and habitat dynamics curtailing growth. In Sunapee, multiple terrestrial plant species have raised concern. Japanese knotweed is observed along Routes 11 and 103B as well as several spots in the harbor area and at town hall. Phragmites, reed grasses found in wet areas, required active management at water and the wastewater treatment plant near Wendell Marsh. In 2000, Lake Sunapee did support a small infestation of Variable milfoil, but due to early detection and rapid response actions, the lake is invasive plant species- free now. As this example highlights, the best management for invasives focuses first on prevention and monitoring for early removal. Once established, many invasive species can be very difficult, or impossible, to remove.

Diseases and parasites are another threat to native wildlife and plants. Emerald Ash Borer, a non-native insect pest, is attacking ash trees in Sunapee and elsewhere. Other concerns include but are not

limited to white nose syndrome attacking native bats and hemlock woolly adelgid thinning out of hemlock stands.

4.07(b) Habitat types

The New Hampshire Fish and Game Department completed an analysis of habitat type, condition, and priorities for conservation published as the Wildlife Action Plan (WAP), most recently updated in 2020. Brochures for habitat types including species information are produced by NH Fish and Game for the Wildlife Action Plan and a subset of those relevant are included in this report as Appendix C : Habitat Types & Associated Species. The habitat classification used by the WAP separates habitats into broad ecological communities, summarized for Sunapee in Table 5 and visualized in Map 9.

Photo 10. Scenic historic view of Mt. Sunapee from Trow Hill Rd, circa 1930s. Credit: photographer unknow, Sunapee Historical Society.

Hemlock-hardwood-pine mixed forest is the dominant forest matrix in Sunapee covering 57.8% of Town. Hemlock-hardwood-pine forest is a broadly defined land cover type; this forest is heterogeneous, with varying amounts of hemlocks, hardwoods, and pines depending on water availability, nutrient status, and fire frequency. This forest type represents a transitional region between eastern deciduous forest, dominated by oaks, hickories, and other hardwoods, and the boreal forest, dominated by spruces, firs, and other conifers. Common tree species include eastern hemlock (*Tsuga canadensis*), American beech (*Fagus grandifolia*), red oak (*Quercus rubra*), and white pine (*Pinus strobus*). Early successional stages of this forest may have large numbers of paper birch (*Betula papyrifera*), red maple (*Acer rubrum*), and striped maple (*Acer pennsylvanicum*). Two typical understory plants are witch hazel (*Hamamelis virginiana*) and wintergreen (*Gaultheria procumbens*). Hemlock-hardwood-pine forest is also the most dominant forest type in New Hampshire, and supports 140 vertebrate species, including 15 amphibians, 13 reptiles, 73 birds, and 39 mammals, as well as many invertebrate species. All 4 New Hampshire big-game species are common in this type of forest: moose, white-tailed deer, black bear, and turkey.

Northern hardwood-conifer forest, also in Town, covers 2.7% of Town. Northern hardwood-conifer forest is dominated by American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), and yellow birch (*Betula alleghaniensis*), and tends to proliferate at elevations between 1,400 to 2,500 ft. This forest type is generally found mixed in the landscape with hemlock-hardwood-pine forests, with more

hardwoods on richer soils, more hemlocks on damp soils, and more pines on dry soils. Within this forest type are many defined communities, and there is a wide range of associated woody and herbaceous plant species within those more closely defined communities. Three of the most common herbaceous species are starflower (*Trientalis borealis*), wild sarsaparilla (*Aralia nudicaulis*), and Canada mayflower (*Maianthemum canadense*). The northern hardwood-conifer forest also hosts 137 vertebrate species, including ruffed grouse, American woodcock, wood thrush, veery, several warblers, 5 species of bat, and many reptiles and amphibians.

Floodplain forest can be found along the Sugar River in Sunapee. This habitat type covers just 0.2% of Town. Floodplain forests in New Hampshire rivers typically have silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), or red maple (*Acer rubrum*) as the dominant tree species. These forests are an interface between the river and upland forests, and the plants growing here can tolerate some flooding, but not constant standing water. The specific makeup of the Sugar River floodplain forests in Sunapee would require a habitat survey.

Wetland complexes, either of swamp or peatland type, cover 5.4% of Town. Marshes are scattered throughout town in stream valleys; in addition, the north end of Otter Pond and Perkin's Pond also have some swampland. Peatlands are less common than marshes at only 53 acres; the largest peatland is located near Stagecoach Rd. Wetlands provide habitat for a great number of amphibians, reptiles, birds, and invertebrates; moose are a frequent visitor to marshes and shallow ponds during the summer months. Vernal pools provide breeding habitat to many amphibians in the spring. More details on wetlands can be found in section 4.08 Wetlands.

Photo 11. Jobs Creek wetland looking north from Jobs Creek Rd, 2020. Credit: Barbara Chalmers.

Grasslands cover 6.7% of town and are defined as areas greater than 25 acres dominated by grasses, forbs, and sedges with little shrub or tree cover. The largest blocks of grassland are primarily located along Rt. 103 and Rt. 11 on the far western edge of town. Although grasslands were relatively rare prior to European settlement, they expanded in the mid-1800's. Several species of bird have adapted to take advantage of these communities, relying on the grasses for breeding grounds as well as a source of abundant food, in the form of seeds or insects. Now New Hampshire grasslands host some important native pollinators, as well as bird species endangered in their native states, such as the Northern Harrier (*Circus cyaneus*) and Upland Sandpiper (*Bartramia longicauda*). In the Northeast, large grasslands have been disappearing, and the populations of grassland birds have declined more rapidly than any other group of birds (NH Fish and Game, 2015). Due to their ecological significance, preserving remaining grassland habitat is a conservation goal for many. The historic Roger's farm meadow at

Dewey Woods, Town Forest, requires mowing to maintain this habitat. The National Park Service recommends once a year.

Lake and ponds with both coldwater and warmwater habitats are in Sunapee. The shorelines of these waterbodies are valuable real estate in New Hampshire, but their importance as wildlife habitat is also significant. The qualities that make shorelines attractive to wildlife may be very different from what makes them attractive for boating and swimming. The aquatic habitats in Sunapee range from large lakes to small shallow marshes, and support a wide variety of fish and invertebrate life. Lake Sunapee is noted as among the most resilient coldwater lakes in New Hampshire due to its quantity of deep-water. In fish surveys, Lake Sunapee is known to host many species, including Brown bullhead, Landlocked salmon, Lake trout, Smallmouth bass, Largemouth bass, Burbot, Eastern chain pickerel, and Rock bass (NH Fish and Game, 2017). The Sunapee trout (*Salvelinus aureolus oquassa*) was native to Lake Sunapee but has been extirpated and is listed as an endangered species in New Hampshire. Perkins Pond, one of the warmwater ponds, is known to host a smaller number of fish species, including Brown bullhead, Eastern chain pickerel, and Smallmouth bass. The Sugar River provides a coldwater habitat for Blacknose dace, Longnose dace brook, Creek chub, Common shiner, Common sunfish, Eastern brook trout, Eastern chain pickerel, Fallfish, Rainbow trout, and Yellow bullhead.

4.07(c) Natural community

A natural community is defined as a recurring assemblage of plants and animals that recurs across the landscape under similar physical conditions (NH Natural Heritage Bureau 2022). The NH Natural Heritage Bureau (NHB) tracks “exemplary” natural communities, which are those “of a rare type or must be a relatively undisturbed occurrence of a common community in good condition”. These exemplary natural communities represent the best remaining examples of the state’s biological diversity and are tracked by NHB. The NHB provides summary data of natural communities for public consumption at a coarse landscape level, specifically two square mile hexagon areas. Two areas covering both Sunapee and Newbury on the south-eastern border of Town include exemplary communities.

1. A Montane - subalpine circumneutral cliff on the southern end of Lake Sunapee
2. A Northern hardwood - conifer forest system with old growth on the very south-eastern corner of Town.

Appendix C : Habitat Types & Associated Species contains summaries of each community which are both flagged as “High Importance.”

4.07(d) Habitat value ranking

In the Wildlife Action Plan, habitat types are ranked according to their condition and risk of degradation. Measuring habitat condition entailed a lengthy analysis of various factors that impact wildlife, including those related to the landscape context, biodiversity, human recreation, development and land use, and air and water quality. For a thorough description of this analysis, please refer to the Wildlife Action Plan.

The WAP analysis results in four tiers of conservation value:

- Tier 1 - Highest ranked habitat in the state (top 10-15%),
- Tier 2 - Highest ranked habitat in the biological region,
- Tier 3 - Supporting landscapes important to highest ranked habitats, and
- Habitat not highly ranked.

Tier 1 wildlife habitat is of greatest conservation priority because they represent the top 10-15% of habitat in the entire state. Tier 2 wildlife habitat is also of high conservation priority because each part of the state has unique species and habitat types that are important on a regional scale. Tier 3 wildlife habitat helps maintain the high level of biological integrity of Tier 1 and Tier 2 habitat (Map 8, Table 5).

Many of the lakes and wetlands in and around Sunapee have very high wildlife value and have been ranked as top-tier habitat. There are large areas of high- quality habitat around Ledge Pond, Lake Coniston, Perkins Pond, and Lake Sunapee, and, to a lesser extent, around Mountainview Lake and Otter Pond. The floodplain forests and wetlands on the Sugar River, especially near Wendell village and the Wendell Wildlife Management Area, are also high-quality habitat. These areas may consist of open water, marsh or other wetland, and forest, which provide a mix of habitats to support many species.

Photo 12. Otter Pond. Credit: Barbara Chalmers.

	Tier 1 - Highest Ranked in State		Tier 2 - Highest Ranked in Biological Region		Tier 3 - Supporting Landscape		Total Habitat Area in Town	
Habitat type	**Acreage**	**% Tier**	**Acreage**	**% Tier**	**Acreage**	**% Tier**	**Acreage**	**% Town**
Open water	2,138	56.8%	-	-	-	-	2,653	16.5%
Hemlock-hardwood-pine	1,147	30.5%	174	42.2%	627	57.6%	9,298	57.8%
Developed Land	141	3.7%	-	-	2	0.1%	1,629	10.1%
Wet meadow/shrub wetland	105	2.8%	21	5.1%	12	1.1%	369	2.3%
Grassland	99	2.6%	181	44.2%	386	35.5%	1,085	6.7%
Northern swamp	90	2.4%	12	2.9%	47	4.3%	420	2.6%
Temperate swamp	14	0.4%	-	-	4	0.4%	34	0.2%
Rocky ridge	11	0.3%	-	-	1	0.1%	89	0.5%
Floodplain forest	7	0.2%	21	5.2%	-	-	29	0.2%
Northern hardwood-conifer	7	0.2%	-	-	1	0.1%	433	2.7%
Peatland	3	0.1%	2	0.4%	8	0.8%	53	0.3%
Cliff and Talus	-	-	-	-	-	-	5	<0.1%
Acreage Total	**3,762**		**411**		**1,090**			
% Town	**23.4%**		**2.6%**		**6.8%**			

Table 5. Important wildlife habitat types and value in Sunapee

** - Reported acreage for cliff and ridge community types is intentionally exaggerated. These areas have extraordinary ecological value; therefore the New Hampshire Heritage Bureau generalizes the data to protect them. Source: NH Fish and Game's Wildlife Action Plan, 2020.*

4.08 Wetlands

The State of New Hampshire defines wetlands by three characteristics: hydrology, soils, and vegetation. All three must be met to define an area as a wetland. The wetlands definition states "those areas that are inundated or saturated by surface water or groundwater at a frequency and duration of sufficient to support, and do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

Since the arrival of Europeans in North America, the most common uses of wetlands were conversion to other land uses, either by draining or filling in wetlands to create uplands, and impounding wetlands to create deep water lakes and ponds. This devaluation of wetlands as a land cover type led to the loss of roughly 50% of all wetlands in the United States, and roughly 9% in New Hampshire. Today, the values of intact wetlands are more recognized, and range from flood control to fish and wildlife habitat. The New Hampshire Method for Functional Wetlands Assessment (Ammann and Stone 1991) lists the following fourteen "functional values" of wetlands:

1. Ecological Integrity
2. Wetland Wildlife Habitat
3. Finfish Habitat
4. Education Potential
5. Visual/Aesthetic Quality
6. Water Based Recreation
7. Flood Control Potential
8. Ground Water Use Potential
9. Sediment Trapping
10. Nutrient Attenuation
11. Shoreline Anchoring and Dissipation of Erosive Forces
12. Urban Quality of Life
13. Historic Site Potential
14. Noteworthiness (such as habitat for endangered species)

Wendell Marsh

One noteworthy wetland in Sunapee is Wendell Marsh along the Sugar River. This marsh is a Wildlife Management Area with almost 280 acres of conserved lands. These lands are stewarded by the NH Fish and Game Department, Sunapee Conservation Commission, and Ausbon Sargent Preservation Land Trust. As part of the Sugar River floodplain, this marsh helps control floods and trap sediments. The marsh also provides important wildlife habitat and a resource for low impact recreation, with trails managed by the Lake Sunapee Snowmobile Club. In addition, there are wellheads on the property that could be used in the future for municipal water production.

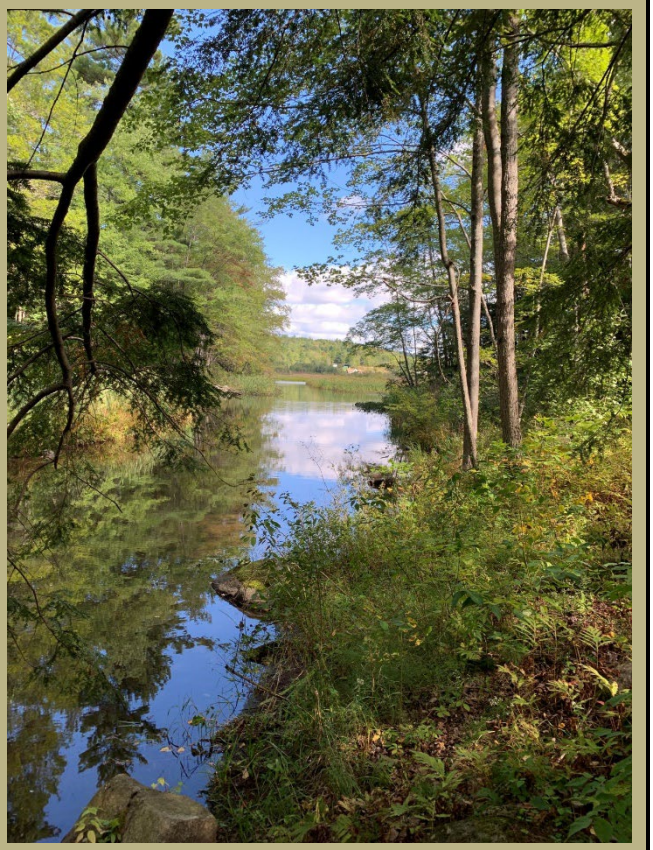


Photo 13. Wendell Marsh at NH Fish & Game access, Sept 2022. Credit: Barbara Chalmers.

Wetlands come in a wide variety of types; they may be forested, grassy, or covered in shrubs; they may be connected to a stream, lake, groundwater spring, or fed only by rainwater. This variety in wetlands leads to a diversity of wetland functions. Some wetlands are more important for flood control or nutrient retention, while others may be better for wildlife.

Photo 14. Trask Brook Marsh at Bradford Road looking south, Nov 2021. Credit: Barbara Chalmers.

Wetlands Inventory.

The only Town-wide wetlands inventory available is based on satellite imagery through the National Wetland Inventory (NWI) and hydric soils data. Together, these provide an appreciation for the extent and location of potential wetlands in Sunapee covering 2,037 acres or 12.7% of the Town (Map 10, Table 6). The NWI was an effort undertaken by the US Fish and Wildlife Service to catalog wetlands over the entire United States. Not all wetlands are mapped, due to the limitations of the study methodology and scope of work. Therefore, the NWI underestimates the total amount of wetlands, especially small wetlands.

The State of New Hampshire allows municipalities to designate "prime wetlands" under RSA 482-A:15. These are typically delineated by a wetland scientist. The municipality then designates specific high-quality wetlands as a "prime wetland", often due to its large size, unspoiled character, and ability to sustain important habitat for wildlife.

Type	Acreage	% Town
Wetlands	712	4.4%
Freshwater Emergent Wetland (e.g., cattail, reeds)	170	1.1%
Freshwater Forested Wetland/Shrub Wetland	542	3.4%
Hydric Soils	1,840	11.4%
Partially Hydric (76-95%)	1,415	8.8%
All Hydric	425	2.6%
NWI & Soil Survey overlap	515	3.2%
Total Coverage	**2,037**	**12.7%**

Table 6. Wetlands and Hydric Soils in Sunapee
NWI classifications not acknowledged in this list include riverine systems and areas permanently, semi-permanently or artificially flooded. Source: National Wetlands Inventory 2022 and Gridded National Soil Survey Geographic Database 2021.

Hydric soils are those soils that have developed under saturated conditions and are one of the three indicators of a wetland under the New Hampshire definition. Hydric soils from the Soil Survey database (2021) are identified through multiple parameters. Those soils meeting more than

75% of these parameters are called *hydric soils* in this report. A thorough description of hydric soil ratings can be found in Appendix D : Soil Survey Descriptions.

Named wetlands in Sunapee include the Wendell Marsh, MacWilliams Lot, Simpson Reserve Marsh, Flint-Webb Lot Marsh, Leone Lot Marsh, Jobs Creek Marsh, Perry-Sleeper Rd Marsh, Johnson-Sleeper Rd Marsh, Nutting Road Trask-Angell Brook Marsh, Hargbol-Route 103 Marsh, Perkins Lot-Mud Pond Marsh, and Webb Forest Marsh. There are also floodplain forests along the Sugar River, parts of which may be classified as wetlands. These areas provide flood retention, shoreline anchoring, wildlife habitat, and a unique natural community that is uncommon in the state.

Vernal Pools. Generally, not included in the NWI is a special type of small wetland, a vernal pool. This is an intermittently flooded small pond that is filled with water in spring and early summer, but completely dry the rest of the year. Vernal pools provide critical breeding habitat for many amphibians, as the intermittent nature of these ponds do not support aquatic predators. Amphibians breeding in vernal pools in New Hampshire include marbled salamanders, wood frogs, spotted salamanders, and Jefferson or blue-spotted salamanders. These species depend on vernal pools, which make this wetland type a highly important resource. Members of the Conservation Commission are aware of several vernal pools in Sunapee, seen in Map 8; however, many more are undoubtedly undocumented.

Photo 15. Vernal Pool east of Garnet Street, Apr 2022. Credit: Barbara Chalmers.

4.09 Rare Species

Sunapee's natural landscape is a mixed forest interspersed with grasslands, wetlands, and aquatic habitats. The heterogeneity of the landscape provides habitat for many species of wildlife, both the common and rare. Common species by habitat type are summarized in section 4.07(a) with additional information in Appendix C : Habitat Types & Associated Species from brochures produced by NH Fish and Game.

The iconic common loon is looked for by residents and visitors alike. A species on the state threatened list due to population declines from habitat degradation and lead poisoning from ingesting fishing tackle, common loon populations reportedly increased in 2014 with 289 pairs that nest on lake edges in New Hampshire, up 85 pairs in ten years (NH Natural Heritage Bureau, 2015).

In addition to local sources of information, the state also keeps records of wildlife and natural communities in New Hampshire. The New Hampshire Natural Heritage Bureau maintains a database of occurrences for rare, threatened, and endangered species and exemplary natural communities. In Sunapee, three documented rare species have been reported, all since 2011 (Table 7, Map 8). Exemplary natural communities are summarized in Section 4.07(c). The Natural Heritage Bureau has not exhaustively surveyed the state, so it is possible that additional rare species and exemplary natural communities do occur within Sunapee. If town residents have information about rare species occurrences in Sunapee, they should contact the Natural Heritage Bureau.

In areas of surrounding towns, within two miles of Sunapee, several other rare species have been spotted (Table 7). It is possible these species extend into Sunapee, even though they have been documented only in neighboring towns. The exact ranges are not provided for public consumption by the NH Natural Heritage Bureau.

Type	Species (Common – Scientific Name)	Listed in NH	Spotted in
Bird	American Kestrel – *Falco sparverius*	Special Concern	Sunapee
Bird	Common Loon – *Gavia immer*	Threatened	Sunapee, Springfield, Croydon
Plant	American water awlwort – *Subularia aquatica ssp. americana*	Endangered	Sunapee
Bird	Bald Eagle – *Haliaeetus leucocephalus*	Special Concern	Sunapee, New London
Plant	Fragrant Wood Fern – *Dryopteris fragrans*	Threatened	Newbury
Plant	Greater Fringed-Gentian – *Gentianopsis crinita*	Threatened	Newbury
Plant	Loesel's wide-lipped orchid – *Liparis loeselii*	Threatened	Newbury
Mammal	Canada Lynx – *Lynx canadensis*	Endangered	Springfield

Table 7. Rare Plants and Animals Reported during the last 20 years in Sunapee.
Source: NH Natural Heritage Bureau 2022 & Sunapee Conservation Commission 2022.

4.10 Groundwater resources & public water supplies

Aquifers. Sunapee has an abundance of surface waters, but somewhat limited groundwater resources in the form of stratified-drift aquifers. Stratified-drift aquifers are sand and gravel deposits from glacial lakes and rivers through which water can flow in large quantities. This flow is measured through transmissivity, which quantifies the ability for an aquifer to transmit water. In the State of New Hampshire, 12% of land and water is underlain by aquifers (USGS 2007). The methods utilized by USGS to create the aquifer dataset included hydrologic data, soils maps, existing well data, bridge-boring records and supplementary test wells/holes.

NHDES guidance for potential community well sites are to be located at aquifers with moderate or high transmissivity in areas away from potential contamination sources, such as roads, residences, and commercial development (Local potential contamination sources, NHDES 2019). The aquifers within Sunapee were found to have low transmissivity, less than 2,000 square feet per day (Flanagan 2007). For the report referenced, US Geological Survey defines transmissivity as foot squared per day. The standard unit for transmissivity is cubic foot per day per square foot times foot of aquifer thickness, which reduces to foot squared per day.

Ground water contaminants. The NHDES Drinking Water and Groundwater Bureau provides information on naturally occurring and artificial contaminants. About half of the state's bedrock wells have radon at levels of concern, and an estimated 30% have arsenic at levels that exceed the limit for public water systems. Iron and manganese are also quite common at levels that taste bad or cause staining of laundry or fixtures. Manganese may also occur at potentially unsafe levels. Fluoride, beryllium and radionuclides other than radon are less common but do occur naturally at levels of concern for human consumption throughout the state. Dug wells are less likely to have problems with minerals (arsenic, radon, etc.) but are more likely to have issues with bacteria, low pH, road salt and nitrate.

Sodium and chloride from salt used on roads during winter weather or used in drinking water treatment systems are detected in many residential wells and statewide concentrations in groundwater are generally increasing. Nitrate from septic systems and landscape fertilizer can be detected at levels of concern in residential wells. Volatile organic compounds (VOCs) occur statewide in groundwater, but several activities and land uses seem to be associated with a higher likelihood of contamination. These include nearby fuel spills or leaks and businesses that use petroleum products or petroleum-based chemicals. Poly- and perfluoroalkyl substances (PFAS) are in products that are used in domestic, commercial, institutional, and industrial settings. PFAS have also been used to fight certain types of fires. PFAS have affected wells throughout New Hampshire but are more frequently detected at elevated levels in southern New Hampshire. See Appendix H : Additional Resources for a summary of private well contaminant presence.

Groundwater wells and Wellhead protection areas. Groundwater wells draw water from a three-dimensional zone around the wellhead, rather than a single point below the wellhead. Therefore, the groundwater resource is best represented as an area, referred to as a wellhead protection area. Wellhead protection areas have been delineated for the active community

systems (Map 11). These protection areas are defined as the area from which water is expected to flow to the well under extremely dry conditions (Witten et al., 1995). Private well locations are regulated by the state permitting process (see section 5.02 State regulations). Potential water quality impacts of private wells are described in Section 4.11 Stormwater & water quality. These wellhead protection areas cover roughly 1,300 acres, or 10% of land area.

Public Water Supplies. Roughly half of Sunapee's residents receive their drinking water from Lake Sunapee, through a service connection with the Sunapee Water Department through three main system connections, as seen in Table 8. All others receive their drinking water from bedrock wells, either privately owned or from a public water supply. In addition to Sunapee Water Department, there are eight active public water supply systems registered with the NH Department of Environment Services, and five inactive.

Inactive wells can be reactivated by following the procedures for a new well approval. The system population would not change except if there is an expansion. Inactive wells are listed under their last approved registration name, even if has since changed. For example, Seminole Point Hospital area now hosts a private home after shut down in 1996 and building torn down in 1998.

In the Wendell Marsh, potential wells located on Town land may be used in the future as a municipal water source by the Sunapee Water Department, if and when the town has to stop using Lake Sunapee water. Four wells are being eyed as potential sources for a community system. The survey of these wells includes a 400-foot buffer as its well sanitary zone. These wells would need to work through the permitting process to become active systems.

Status	Name	System Type	Population	Service Connections
Active	Sunapee Water Dept.	C	1,680	507
Active	Sunapee Water Dept. – Georges Mills Village	C	500	200
Active	Sunapee Water Dept. – Granliden Village	C	292	117
Active	Georges Mills Cottages	T	33	6
Active	Mount Royal Academy	N	217	3
Active	Sunapee Pizza Chef	T	50	1
Active	Meadow Brook at Sunapee	C	56	20
Active	Dexters Inn	T	30	3
Active	Ziggys Pizza	T	100	1
Active	SUNA Restaurant	T	150	1
Active	Dollar General Store	T	100	1
Inactive	Woodham Spring Condominiums	C	20	10
Inactive	Seminole Point Hospital	N	65	6
Inactive	Burkhaven Motel	T	-	-
Inactive	The Inn at Sunapee	T	50	2
Inactive	Double Diamond Cafe	T	85	1
Potential	Wendell Marsh	C	-	-

Table 8. Public water supply wells by type and population served.
*A public well is a piped water system having its own sources of supply. **C** – Community systems include municipally managed operations. **N** – Non-transient, non-community systems include schools, businesses. **T** – Transient, non-community systems include hotels, campgrounds. Source: NHDES 2022.*

4.11 Stormwater & water quality

Given Sunapee's reliance on its abundance of water resources, maintaining and protecting water quality is critical. The water in Lake Sunapee is regularly monitored by the Lake Sunapee Protective Association, the New Hampshire Department of Environmental Services, citizen volunteer programs, and other organizations. According to the 2020/2022 NHDES 305(b)/303(d) assessments, or "watershed report cards," for the two watersheds present in Sunapee, all 144 tested locations achieved category 2 for drinking water. This means that they "[meet] water quality standards/thresholds by a relatively large margin" (NHDES, 2022). In addition, most tested locations in town passed inspection for swimming and other recreation (NHDES, 2022). However, there are several factors that can threaten this water quality, including human influence, deteriorating infrastructure, harmful organisms, and stormwater.

Chemicals & Nutrients. Some human-derived water pollution concerns include per- and polyfluoroalkyl substances (PFAS), road salt, agriculture, mining and industry, and recreational activities. These cause an increase in nutrients, heavy metals, mercury, and other chemicals, which may seriously harm water quality and threaten aquatic life. In Sunapee, mining and industry are unlikely to pose a significant threat due to their limited presence. Future expansion, however, could introduce pollutants such as heavy metals and acids into the water supply, as well as increasing water demand for industrial processes. Fortunately, Sunapee's zoning ordinance places strict prohibitions on location of hazardous materials, junkyards, and salt storage to protect local water, and the NH Department of Environmental Services (NHDES) currently reports no PFAS detected in Sunapee's water supplies (NHDES, 2021a). However, mercury levels in the region are high enough to warrant an NHDES warning against too much local fish consumption (NHDES, 2021b). The NHDES watershed report cards also label a sizable portion of sampled locations as poor quality for the integrity of aquatic life due to high phosphorus levels, low dissolved oxygen, and changing pH (NHDES, 2022a, 2022b). It is important to note that some of the pollutants listed can be deposited over the landscape via atmospheric deposition caused by human activity occurring outside the town of Sunapee, so the absence of such activity in Sunapee does not prevent all risk.

Sunapee's infrastructure may also provide several possible sources for water quality contamination, including aging septic systems, public sewer lines, and road runoff. These can directly or indirectly introduce pollutants into the water supply if not fully addressed. Much of Sunapee is underlain with glacial till with hardpan at shallow depths, which has moderate to poor absorption capability. This makes septic system and other infrastructure failure a critical issue, as the surficial geology does not have the capacity to serve as a natural leach field. Older septic systems, particularly those installed before plumbing code, can be a particular threat to water bodies that are in close proximity. Perkins Pond had been identified since the 1970s as being threatened by high phosphorus levels, which according to the NHDES is attributable to failing septic systems. However, after the construction of a municipal sewer line to shoreline cottages in 2014, the water quality in the pond improved dramatically. This and other new infrastructure installations, as well as nearby water quality trends, should be reviewed and carefully monitored for improvements.

In addition to major water bodies and public water supplies, private wells can be at great risk from decaying or misplaced infrastructure. Shallow wells that serve single residences can easily be affected by surface and near-surface contamination, and are often located at sites containing septic systems, cesspools, and outhouses.

Another one of the most significant pollutants in Sunapee's water supply is sodium chloride, widely used to de-ice roads in the winter. In Lake Sunapee alone, the level of specific conductivity, which can be used to determine salt content, has risen approximately 45% since the 80s (LSPA, 2016). Salt contamination can be even more severe in streams and rivers, especially those with lower flow rates. Proximity to water bodies does not necessarily decrease risk, as dissolved salts can easily spread across watersheds.

Beyond directly polluting water, substances such as these can have other indirect effects, such as a population increase of harmful organisms.

Cyanobacteria, or blue-green algae, are photosynthetic microorganisms that live in all types of water and are typically harmless to humans and wildlife. A rapid increase in population, or "algal bloom", however, can be very dangerous to humans and aquatic life, as cyanobacteria can produce powerful toxins, block sunlight, and negatively affect water composition. These dangerous blooms can occur in warm, slow-moving waters with high nutrient loads, causing populations to explode (CDC, 2022). In Sunapee, a unique type of cyanobacteria called *Gloeotrichia echinulate* is found that has only been documented in the northeastern United States. *Gloeotrichia echinulata*, unlike most cyanobacteria, can easily bloom in low-nutrient waters (NHDES, 2021c). Although harmful algal blooms are rare in Sunapee, they have been occurring more often in recent years due to nutrient pollution and increasing global temperatures (LSPA, NHDES). Cyanobacteria can also easily contaminate drinking water, with that drawn from Lake Sunapee being particularly vulnerable.

Stormwater and heavy precipitation can be very problematic for water quality. Runoff carries large quantities of pollutants such as oil, chemicals, pesticides, and fertilizers into bodies of water, as well as transporting sediments and increasing water turbidity. Turbidity is a measure of the number of suspended particles, and high turbidity can cause increased microbial growth. Sunapee is fortunate to have some natural protections against runoff, especially heavy forest cover that naturally slows, spreads, and absorbs water, and floodplains that slow water and reduce peak flow (Figures, previous section). Development, however, produces the opposite effect, reducing absorption and significantly increasing runoff (Map 6).

One way in which development exacerbates stormwater issues is through the replacement of permeable areas with impervious cover such as pavement and structures. This problem is twofold: 1) it increases and sometimes channels runoff, which poses flooding and erosion risks; and 2) it allows stormwater to pick up and carry

Photo 16. Dewey Beach erosion from uncontrolled road drainage Sep 2022. Credit: Barbara Chalmers.

materials deposited on these impervious surfaces as it flows. Drainage infrastructure helps avoid these issues by encouraging water infiltration and filtering pollutants but must be sufficiently sized or it can quickly become overwhelmed. Sunapee has such infrastructure, but it may be of limited effectiveness as climate patterns shift and precipitation increases. For example, a 2012 assessment estimated that anywhere between 35% and 75% of culverts in Sunapee could end up undersized for future needs (Simpson, et al., 2012). Some town roads established prior to 1900 continue to have rudimentary storm drainage infrastructure, including primitive catch basins without sumps to settle dirt and debris or no catch basins at all at culverts flowing into streams and waterbodies. For example, Garnet street was built in 1888 and continues to have rough-dug and rock-lined catch basins providing no settlement or pre-treatment of surface flows into Lake Sunapee.

Development, particularly deforestation, can also rapidly hasten the process of water erosion, especially in areas of steep slopes. In extreme cases of vegetation loss and severe weather in these areas, this can cause land movement such as mudslides. However, even in milder cases, stormwater can deteriorate slopes and carve paths through soil, deforming the landscape and bringing sediment loads into nearby bodies of water. Loss of vegetation in the riparian zone is especially harmful to water quality, as plants form “riparian buffers” that slow and filter water from runoff and flooding.

4.12 Agricultural resources

New Hampshire has relatively scarce agricultural resources compared to more fertile parts of the United States. Glaciers scoured the land down to bedrock 10,000 years ago and soil has been slowly rebuilding since then. Soils tend to be nutrient-poor, shallow, and rocky, and much of the terrain is hilly, which limits the agricultural uses of the land. Because of the long time required for soil development (tens of thousands of years), agricultural soil should be considered a nonrenewable resource.

Active Farms. In Sunapee, there are two working farms as of 2022 - Johnson Farm and Webb Farm (Map 12). A sense of the historical importance of farming in Sunapee can be ascertained by the extensive number of farm houses recognized as significant historic buildings, seen in Map 12 and listed in Appendix F : Historic & Cultural Resources. At one point, Sixty percent of Sunapee's families farmed and lived off the products of their land. That number dropped in half during the 1880s as workers left farming for mill jobs along the Sugar River and elsewhere.

Agricultural Soils. At the soil scale, the national soil survey database provides soil classes to reflect its capability for agricultural production, not the current land use. The soils chosen are based on qualities for raising crops or livestock and are differentiated into four classes: prime farmland, farmland of statewide importance, farmland of local importance, and unique farmland. These soil classes have been summarized in Table 9 and Map 12, with full definition in Appendix D : Soil Survey Descriptions.

Prime farmland soils are described as the best soils for production of food, feed, fiber, forage, and oilseed crops. Prime soil is designated for the purpose of carrying out the provisions of The Farmland Protection Policy Act of 1981. This Act was established to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. Less than 2% of New Hampshire soil is classified as prime farmland soil. In Sunapee, 2.4% of the land is considered prime farmland, which is slightly above average for New Hampshire.

The other soil classifications include soils that are useful for agricultural production and have some limitations that preclude their designation as "prime farmland", such as stoniness, nutrient limitations, or excessive drainage. Farmland of statewide importance is informed by criteria for defining and delineating soils with qualities determined by a state committee. The third class of important agricultural soils is farmland of local importance. The County Conservation District Board determines which soil units are locally important.

Farmland Soil Class	Acreage	% of Town
Prime (federally designated)	379	2.4%
Of Statewide Importance	442	2.7%
Of Local Importance	2942	18.3%
Total	**3763**	**23.4%**

Table 9. Farmland Soils in Sunapee
Source: Gridded National Soil Survey Geographic Database 2021.

4.13 Forest resources

In Sunapee, several parcels of land are managed for forest production, including state and town forests and some privately held tracts of land. Sunapee's land area is 60% under forest cover, primarily of a hemlock-hardwood-pine mixed forest type (for details see sections 4.04 Surface waters, riparian zone & floodplains and 4.05 Land cover). However, the soil types that are most favorable for tree growth occupy only 46% of Town (Table 10 and Map 13).

Forest Soils. The national soil survey database classifies soil types by their capability to support sufficient tree growth for commercial forestry operations, which are broken into 5 ratings: IA, IB, IC, IIA, and IIB (summarized in Table 10). The dominant tree species on these soil types varies depending on the succession stage of the forest or stand.

Group I soil is the best soil for forest management. Group IA soil is best for hardwood production because they are relatively deep, fertile, and well-drained. Group IB soil is slightly less fertile and sandier than Group IA soil where tree growth is less vigorous. Group IC soils are composed of outwash sands and gravels, and are ideally suited to softwood production. The most significant acreage in Sunapee is covered by Group IA soils at 24%.

Group II soil has significant limitations on either tree growth or management. Group IIA soil is physically limited (e.g., steep slopes) in a way that challenges management and increases cost. Group IIB soil is poorly drained and therefore generally has lower productivity and management limitations. A thorough description is found in Appendix D : Soil Survey Descriptions.

Forest Soil Group – Class I	Acreage	% of Town	Forest Soil Group – Class II	Acreage	% of Town
IA	3,792	23.6%	IIA	4,180	26.0%
IB	3,271	20.3%	IIB	1,394	8.7%
IC	281	1.7%			
Class I Sub-Total	**7,344**	**45.6%**	**Class II Sub-Total**	**5,574**	**34.6%**
Total = 12,918 acres or 80.2% of Town					

Table 10. Important Forest Soils in Sunapee
Source: Gridded National Soil Survey Geographic Database 2021.

Town Forest. The Town of Sunapee completed an update to their Forest Management Plan in 2018 with the assistance of Meadowsend Consulting. The plan covers the area of Bartlett Tyler Lot, Dewey Woods, Ledge Pond, Tilton Morse, Wendell Marsh, and Webb-Flint and Fieldstone Lot. Recommended actions are placed on a priority list through 2028 in areas of silviculture, recreation, boundaries, and open field. Silviculture, the "art and science of growing trees", is an important and under-appreciated activity. Silviculture activities are various depending on the type of forest and stated goals for management. In some cases management mimics a large-scale disturbance of wind, allowing for less shade tolerant species to grow or adjustment to overall forest age. Another management type is single tree selection where various sizes of a specific tree are removed to promote growth of remaining trees and space for regeneration. The Town's plan discusses a dozen different silvicultural treatments.

4.14 Sand & gravel resources

Sand and gravel are important raw materials for building, roadway maintenance, and other commercial purposes. Soil containing significant deposits of these materials are relatively scarce in New Hampshire. Sand and gravel sources are of glacial lake/river origin and are thus concentrated in river valleys or old lake beds. These sources do not require crushing for a product. The soil survey rates soils as "good", "fair" or "poor" in relation to their potential for sand or gravel; a rating of "good" or "fair" means that the source material is likely to be in or below the soil. A thorough description of these soil features can be found in the Appendix D : Soil Survey Descriptions.

Sunapee only contains fair rated soils for gravel or sand sources, summarized in Table 11 and Map 2. Although most of Sunapee's land area is indicated with a fair sand source rating, these are primarily occupied by loam soils that are unlikely to be significant opportunities for raw sand materials. For soils with a fair gravel source rating, only 4% of Town is identified, primarily along the western border.

There are no known sand or gravel operations in Town. There are rock mining and crushing operations which require additional machinery to achieve the desired product.

	Acreage	% of Town
Gravel Source – Fair	663	4.1%
Sand Source – Fair	13,088	81.3%
Gravel & Sand Source	663	4.1%

Table 11. Soils with a Fair Rating as a Sand or Gravel Source in Sunapee
Source: Gridded National Soil Survey Geographic Database 2021.

Photo 17. Stocker's quarry, google aerial view 2022, east of Edgemont Road and west of old Boyce quarry (left). Pine Hill Construction Chase Marine Pit, gravel mining & crushing, Rte 11 (right). Credit: Barbara Chalmers.

4.15 Renewable energy resources

Throughout its history, Sunapee's residents and businesses have relied to some degree on renewable energy resources. The Sugar River powered the mills, factories and earliest electric lights of yesteryear and today provides electricity to homes and businesses. Wood was previously the primary source of home heating fuel, and remains of some importance. There is a growing interest in tapping other renewable energy sources, such as solar and wind energy. Both biomass and geothermal energy resources are noted as limited potential in Town according to the National Renewable Energy Laboratory (NREL). Sunapee has the potential for developing systems for new hydro, solar, and wind energy. NREL provided maps and descriptions can be found in Appendix E : Renewable Energy.

Sunapee currently has one municipal hydro-electric generating plant located at the 1923 site of the former Lake Sunapee Power Company hydro-electric station, adjacent to Sunapee Town Hall. In 2015, this facility generated 1,663,360 kilowatt hours, operating from water flow at the historic granite block dam on River Road. The town also operates a water-powered pump, when water flow allows, at the granite block dam which pumps Lake Sunapee water up to the municipal reservoir tank on Burkehaven Hill. Historically water flow from Lake Sunapee into the Sugar River and the river's elevation drop within the town of Sunapee, powered ten to fifteen mills at any one time between the 1850s and 1920s. There is potential to develop more hydro-electric power in Sunapee, including power for the municipal sewer treatment plant.

Photo 18. Historic 1840 granite block dam at River Rd, penstock in-flow for municipal hydo station and Town hydro-powered water pump. 2019 (left). Municipal hydro-electric generating station, next to town office (right). Credit: Barbara Chalmers.

The utilization of solar energy requires prolonged exposure to sunlight, which requires a clear site where trees, other buildings, or the terrain will not shade the building or energy-harvesting device. Solar panels are best placed on south-facing roofs with a slope between 15 and 40 degrees. Sunapee is hilly and primarily forested, which limits somewhat the locations that could feasibly utilize passive solar design or a solar energy system. According to the National Solar Radiation Database (NSRDB), the Town has just below average direct normal irradiance (DNI) for the United

States. The DNI represents the amount of solar radiation from the direction of the sun, which is Sunapee is generally estimated to produce between 4 and 5 kWh/m^2/Day. New Hampshire experiences significant variation in DNI by month, with more resource in April to September, peaking in July.

Wind energy also has some potential in Sunapee, primarily along the ridgelines or at residential scale. Like solar energy systems, wind turbines must be sited away from other buildings and trees, which cause turbulence and decrease the amount of energy that can be harnessed. Measurement of wind energy potential is based on average wind speed at different heights from ground level. Heights of approximately 30-meter represent many current small residential systems, 50-meter height community systems, and 100-meter or higher for utility scale. In Sunapee, there is reasonable capacity for residential systems with wind speed potential near an average of 5.0 m/s. For community systems, opportunity is more marginal and focused on small patches near Lake Sunapee. Similarly, limited capacity for utility scale wind power resource has been identified in Town. Wind systems are known to have mortality to bird and bat species due to collisions and wind disruptions. Innovations are available and advancement under development to reduce these conflicts and establish best management practices. Wind Exchange, a resource of the U.S. Department of Energy, provides resources on current research on this conflict and best practices for siting. In 2022 there are no private or community wind installations in Sunapee.

Increasing renewable energy capacity is considered as a positive environmental change due to the impacts on emissions that worsen climate change. Also, the greater potential for more distributed energy systems can allow for local control. As technology prices become more competitive and its accessibility improves to more communities, Sunapee may do well to further their use locally as part of an integrated energy network. Simultaneously, the value of other natural resources must be considered during the development of solar and wind energy projects. Siting towers, solar arrays, or new homes in inappropriate locations may cause degradation. The Wildlife Action Plan describes two types of impacts on wildlife: collision with towers resulting in mortality and habitat loss and degradation from site development (NH Fish and Game 2006). Clearing and developing land near the tops of hills for renewable energy production would fragment the landscape and could cause significant erosion. In addition, there is potential for the aesthetic value of a rural landscape to be diminished. The potential and risk to harness local renewable resources of energy must be kept in balance to safeguard a holistic resilience considering climate change, energy independence, and conservation.

4.16 Historic & recreational resources

Human civilization is known to settle where natural resources and potential for commerce is available. People transform their surroundings for a particular aim, often exploiting and living off natural resources, and changing a place's form to better social or aesthetic qualities. In 2022, the Town of Sunapee thrives on a local economy that is inextricably linked to the natural resources of its land. Many live and visit Sunapee to enjoy, find peace, and play in its forests, lakes, ponds, and other natural attractions. Although outdoor recreation is largely what Sunapee is known for now, the Town's history is more deeply rooted in using natural resources for business and using the Sugar River to connect with outside markets and give power to industry.

Sunapee's cultural, historic, and some recreation resources are shown in Maps 14 and 15, and listed in Appendix F : Historic & Cultural Resources.

Photo 19. c1800 Lot line stone wall, northwest Sunapee, 2020. Credit: Barbara Chalmers.

Farming. Sunapee's rich farming history can be appreciated by the extensive presence of historic structures (Map 12). Farm houses make up more than half of the town's significant buildings, totaling 59 structures scattered to every corner of the Town and dating back to 1780. Many historic barns, barn foundations, and cellar holes are also found across town. In addition, the well-known New England stone walls run across Sunapee in a multitude of directions, once used to demarcate areas of farming and pasture, with others along roads, lakes, and rivers. These structures represent the community's foundational link to the land as a source of sustenance and human ingenuity to survive and thrive.

Photo 20. Boyce and Bailey granite quarry, circa 1890s. Credit: Sunapee Historical Society.

Geologic Features.

Sunapee's geologic features feed another rich history for Sunapee in the way of mines, quarries, and beautiful natural rock formations.

When mica was worth one-tenth the price of gold, a mica mine operated in Sunapee (est. 1895 to 1905). Granite quarries established a more long-standing business in Sunapee when Samuel Bailey, Sunapee's early and best-known quarry man, started his first operation using hand tools in the 1830s. The Boyce and Bailey granite quarry is Sunapee's largest quarry that produced a fine grain granite called Light Sunapee and Dark Sunapee, well suited for monuments and building use. Blocks from this quarry were purportedly used for the Library of Congress building in Washington D.C. The industry was aided by the arrival of the railroad in 1877 and continues to present day with the Stocker granite quarry, located on a portion of Bailey's original quarry.

Although often exploited, rock formations are also an attraction in Sunapee, particularly Indians Cave, Pulcifer Rock, and Bears Den (Map 2).

Photo 21. Railroad bed trail at Harding Hill Farm. Nov 2022. Credit: Barbara Chalmers.

Transportation and Energy. The ability to move people and goods advanced growth in Sunapee. Dating back to 1769, early settlement roads, and their culverts and bridges, crisscross the town. The Sugar River is the largest river in the region and provided the energy necessary for the industrial mill development of the mid-to-late-1800s. The River is still tapped for hydroelectric energy in the Sunapee Harbor village. In the 1870s, the Sugar River Railroad arrived, connecting Sunapee to communities in Newbury and Newport.

Recreation. A number of cultural and recreational opportunities are unique to Sunapee, and serve as important centers of community activity (Map 15). In the 1900s, Sunapee began to use its access to beautiful lakes and mountains as an outdoor recreational benefit to residents and draw for visitors. Sunapee's first parks, the Sunapee Town Ski Tows, known today as Tilton Park, and Dewey Beach, along with the town of Sunapee Recreation Committee, were established in 1938. In 2022 Sunapee has 9 parks and public recreation areas

including: Tilton Park, Georges Mills Town Wharf and Beach, Dewey Beach, Dewey Woods Ball Field, Veterans' Park, Sunapee Harbor Town Wharf and Park, Ben Mere Bandstand Park, Hames Park, and Coffin Park.

Scenic vistas of Lake Sunapee, Mount Sunapee in Newbury, and the Sugar River are significant recreational attractions. The Lake Sunapee Region Chamber of Commerce describes the special draw of Lake Sunapee:

> *"Visitors and residents alike know that Lake Sunapee is a destination in itself. Year-round recreational opportunities abound, including boating, biking, swimming, snowmobiling, downhill and cross-country skiing, ice-boating and maple-sugaring. Local residents take pride in Lake Sunapee for its exceptional water quality and beauty. Protection efforts have enabled Lake Sunapee to consistently be named one of the cleanest lakes in the state."*

The Lake Sunapee Scenic & Cultural Byway takes the interested traveler on a 25-mile route that borders Lake Sunapee and is a slow paced and beautiful experience. Extending from Lake Sunapee, snowmobile trails (also used for hiking) form a network through town.

Photo 22. Scenic view of Mt Sunapee from Dewey Woods town forest. Taken from east side of Seven Hearths Lane. Dec 2021. Credit: Barbara Chalmers.

Hiking and cross-country ski trails have been developed on the Town Forests and private lands with conservation easements that establish low-impact public recreation access. In addition, the Sunapee Ragged Kearsarge Greenway, a 75-mile loop circles the Lake Sunapee area and connects Sunapee, Ragged, and Kearsarge Mountains. The traveler who walks the whole loop will travel through the full North-South length of Sunapee plus nine more towns: Andover, Danbury, Goshen, Newbury, New London, Springfield, Sutton, Warner and Wilmot.

4.17 Climate change & resilience

Sunapee has both vulnerabilities and resiliencies to climate change impacts on its ecosystems and environment, natural resource industries, and infrastructure. This section provides a summary of the most recent climate change impact reports for the Sunapee region, which is then followed by an analysis of resilient land in Sunapee based on data from The Nature Conservancy.

4.17(a) Climate change impacts

A note on climate versus weather. Weather reflects short-term conditions of the atmosphere while climate is the average daily weather for an extended period at a certain location. In other words, "Climate is what we expect. Weather is what we get." (Mark Twain)

Two reports inform this summary of historical and projected climate change trends and impacts. The 2018 National Climate Assessment, mandated by the Global Change Research Act of 1990, is required to be provided to the United States Congress and the President no less than every four years (January 2018). In addition, the University of New Hampshire published a report in 2014 on Climate Change in Southern New Hampshire, including the Town of Sunapee, as well as a 2022 updated report titled New Hampshire Climate Assessment. The two New Hampshire reports provide a more focused impact assessment of historical data and two future climate scenarios. In southern New Hampshire, the major concerns for climate change include, but are not limited to, extreme heat, increase in precipitation, increase in extreme precipitation events, drought, decrease in snow cover, lengthening growing season, and reduced seasonality.

(i) Temperature

Historical long-term trends (1895-2012) show an increase in temperatures, with greatest increases in minimum, rather than maximum, during the winter season, and significant year-to-year variability. These trends have become more significant in recent decades and recent years show winters warming three times faster than summers (1970-2009) (Figure 2). By the end of the century, the largest increase in maximum temperatures would take place during the spring and summer, while in the winter minimum temperatures are projected to warm the most. These impacts are projected to result in significantly more extreme heat days and fewer extreme cold days. These changes will also result in the loss of the more distinctive seasons.

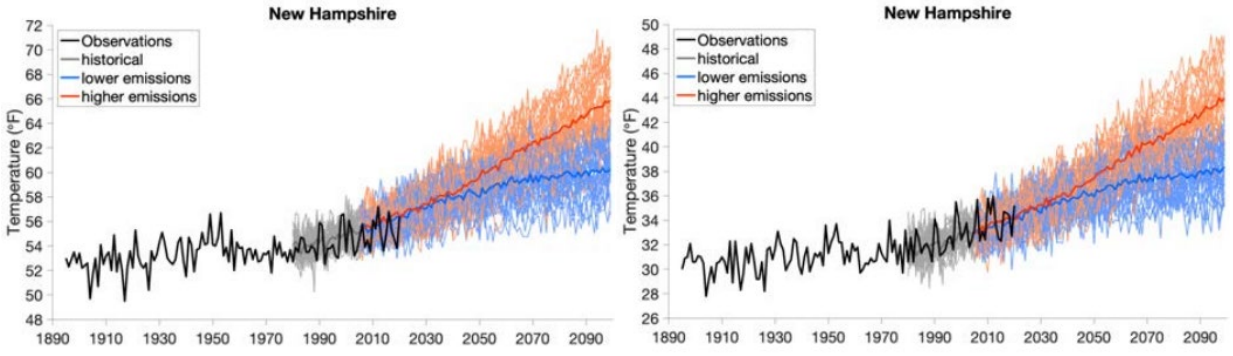


Figure 2. Mean annual minimum and maximum temperatures in NH under lower and higher emissions scenarios.
Annual maximum temperature (Left) and Annual minimum temperature (Right). Source: Lemcke-Stampone, 2022.

(ii) Precipitation

Recent trends (1970-2012) show an increase in annual precipitation, double to triple that since 1895 and largely driven by higher-than-average precipitation totals during 2005 to 2011. While these annual trends are more modest, the frequency of extreme precipitation events has increased four to ten times during the same period. One startling statistic relates to the FEMA funds spent on "Presidentially declared disasters and emergency declaration". Between the almost 20-year period of 1986 to 2004, only one event occurred where damages exceeded $10million (in 2012 dollars) While between 2005 to 2012, five of those eight years experienced events where damages exceeded that amount, both from floods and ice storms (Figure 3). This statistic reflects extreme events, aging infrastructure, and development patterns that are more vulnerable to damage.

In both future scenarios, annual precipitation is projected to increase between 8% to 12%. The difference between the two scenarios is not significant (Figure 4). More extreme precipitation events are expected under both scenarios.

(iii) Drought and Wildfires

During the spring and summer of 2016, 2020 and 2021, much of New Hampshire experienced what is known as a flash drought. These droughts develop over two to six weeks and is an area of active research. These droughts happen due to a lack of precipitation combined with other extreme weather conditions that increase evapotranspiration. In addition to temperature and precipitation, the frequency of droughts will depend in part on how ecosystems respond, especially New Hampshire's forests.

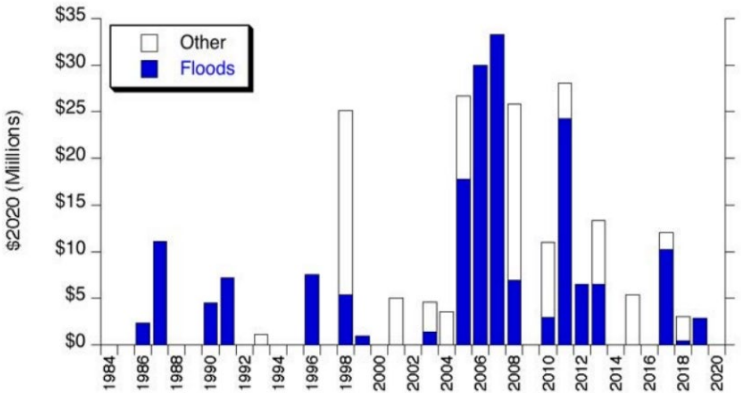


Figure 3. Federal Expenditures on Presidentially Declared Disasters and Emergency Declarations in New Hampshire from 1984 to 2020.
Expenditures adjusted to $2020 using the consumer price index. Source: Lemcke-Stampone, 2022.

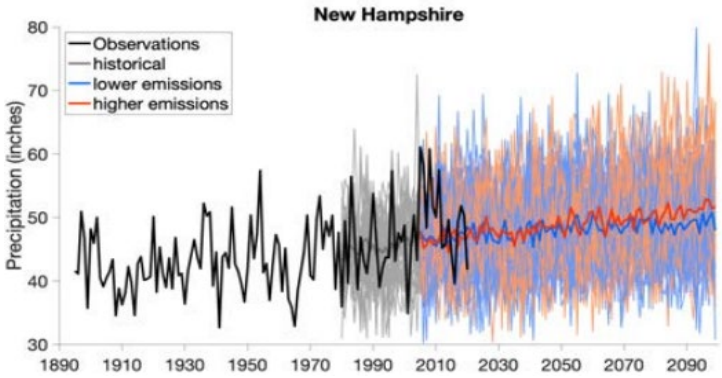


Figure 4. Mean annual precipitation in NH under lower and higher emissions scenarios.
Source: Lemcke-Stampone, 2022.

Flash droughts can have severe impacts on vegetation health, agriculture productivity and water availability. These most recent flash droughts show an increased risk for wildfires in New Hampshire. Although a large fire such as those seen on the US West Coast is unlikely, New Hampshire will be at a higher relative risk with impacts to air quality.

(iv) Snowpack and Lake Ice-out

The winter snowpack is important for its role in regional hydrology and the winter recreation industry, including that at Mount Sunapee. From 1971 to 2020, sites have been monitored across the state for snowpack, including three in the Lake Sunapee watershed. All three of these sites indicate declines in annual maximum snow water equivalent, a metric for snowpack. Over these 50 years, the trends show a decrease between 40% and 51% of this metric in the Lake Sunapee watershed sites. Under future scenarios, the number of days with deep snow is projected to decrease to as low as one month of snow-covered days per season (Figure 5).

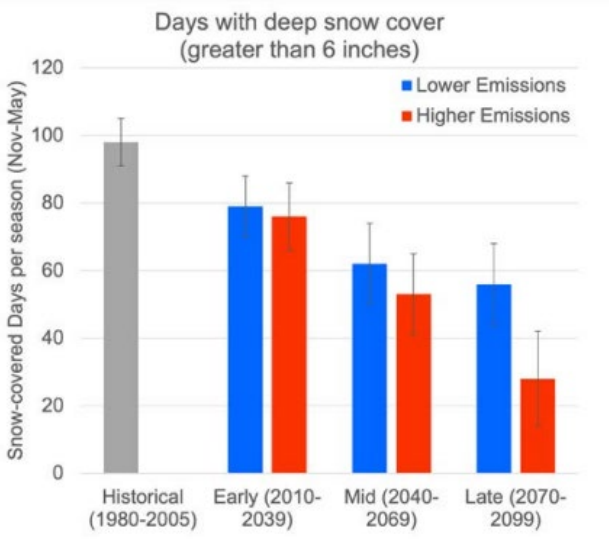


Figure 5. Number of days with deep snow in NH under historical and future emissions scenarios.
Source: Lemcke-Stampone, 2022.

Lake ice-out is the date when a boat can travel from the north end to the south end of the lake, a common indicator for early spring. Lake ice melt begins even earlier, encouraged by large areas of lake shore kept ice-free by dock bubblers and because the ice gets pushed by the wind southward and jambs up at the islands. According to state sources, lake ice-out is now coming more than 2 days earlier every decade at Lake Sunapee (Figure 6). Local data extends to 1869 and show consistent trends as the state data, details found in Appendix H : Additional Resources. The trends to earlier ice-out dates impact the winter recreation season at Lake Sunapee, the dynamic thermal stratification lake process with potential reductions of dissolved oxygen, and the biological interactions among species under new conditions.

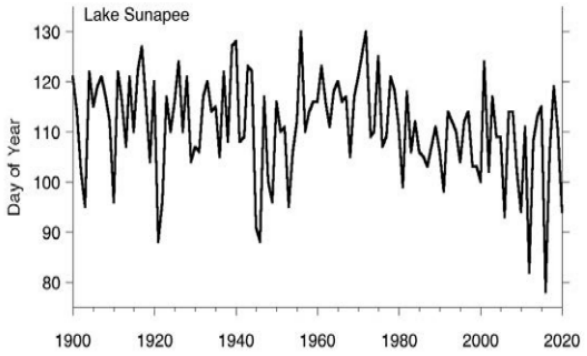


Figure 6. Ice-out dates on Lake Sunapee, 1900-2020.
Source: Lemcke-Stampone, 2022.

(v) Impacts

Ecosystems and Wildlife. The changing climate is already showing ecosystem responses, such as an earlier leaf-out and blooming, and shifting species distribution by elevation. Along the 1,500-mile Appalachian Mountain range, suitability for spruce-fir and northern hardwood forests

are projected to decline while zones for southern oaks and pines to increase (NWF, 2013). A longer growing season has been observed to be partially responsible for increases in forest growth; however, they have also resulted in reduced seasonal growth to native trees due to hard freezes that follow early blooming. In addition, warmer winters and less snow cover will increase white-tailed deer populations that degrade native forest understory. For freshwater ecosystem species, such as salamanders and cold-water fish like trout, climate change impacts increase their vulnerability due to flow changes and warmer water temperatures.

Although it is difficult to project and will likely have varied responses, availability of food sources for wildlife, including vegetation, nuts, and seeds, is a concern. Many food sources do not bear fruit during extreme drought, such as acorns that are important for squirrels, mice, jays, woodpeckers, bears and deer. For black bears, this loss of food, as well as shifting hibernation patterns during mild winters, will lead to bears looking to supplement their diet with food found in more human residential areas, increasing the number of bear-human conflicts (NWF, 2013).

While some birds are expected to be more adaptable, others are expected to become more vulnerable. Migratory birds may migrate earlier and experience misalignment with food source availability and thus increasing vulnerability. Some of these food sources are also experiencing shifts with early blooming of wildflowers and woody perennials, important for migratory birds. The Audubon Society's Survival by Degrees, provides a picture of vulnerable birds based on changing abilities to find food and reproduce, effecting both local and continent-wide populations.

Pests and invasives. The changes in temperature and growing season will have negative effects on the health of forests due to earlier insect emergences, and expanded ranges of pathogens and invasive plants, including hemlock woolly adelgid and emerald ash borer. Important ecological and tourism species are also likely to be impacted, such as moose that are already experiencing hardship from increased parasite infections and deaths from ticks.

Photo 23. Johnson's Sanctuary Farm, dairy farm Rte 103, Sep 2022 (left). Webb's Harding Hill Farm, beef & maple products, Stagecoach Rd, 2022 (right). Credit: Barbara Chalmers.

Agriculture. In the short-term agriculture is likely to benefit from a longer growing season (since 1960 it has increased 15 to 52 days in southern New Hampshire, Figure 7); however, the trend is likely to cause problems over time. Increasing intense precipitation events will increase the risk of soil compaction due to overly wet soils, as well increase nutrient runoff into waterbodies. There is risk of frost-freeze damage occurring more frequently as premature warming is followed by frost that can kill premature leaf-out or blooms; resulting in a large loss of fruit varieties. Further, wet springs will delay planting, extending harvest dates and potentially reducing yields. During the summer, too little water and more extreme heat will increase heat stress and drought. This shifting climate is also likely to increase weed and pest pressures, and the related interest in use of herbicides and pesticides.

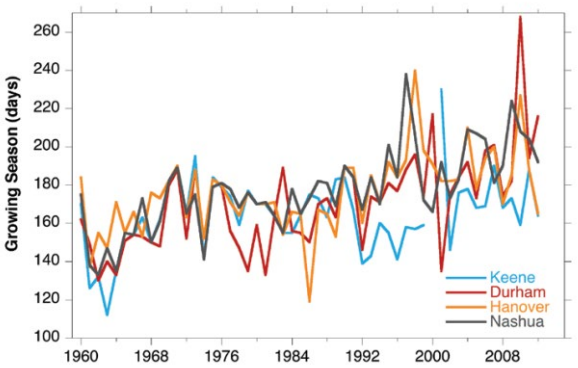


Figure 7. Length of the growing season. *Taken from four GHCN-Daily stations in southern New Hampshire, 1960-2012. (UNH, 2014)*

Tourism, Logging, and Maple Sugar Industries. In New England, seasonality is an important element to the regional economy in both recreation and natural resources. A decrease in the winter recreation season is expected by mid-century. The number of annual visitors to ski areas is strongly correlated to the number of days per season with natural snow cover. Also, natural resource-based industries will face new challenges. For logging, poor road conditions may limit operation due to the need for frozen or snow-covered soil. In addition, changes to forest composition and stress due to climate change will requires targeted actions to address as part of an adaptive management strategy, as recommended in the Town's 2018 Forest Management Plan. For maple syrup producers, production is already experiencing shifts due to changes in habitat and seasonality needed for quality sap production.

Infrastructure and development. These changes to climate and ecosystem functions in Sunapee will affect local infrastructure and development. For infrastructure, impacts may be most severely experienced by roads, culverts, and bridges functioning under more extreme precipitation events. Also, access to well water may be affected by flash droughts and reduced infiltration rates needed to replenish groundwater resources.

The national context of impacts puts the region's resilience ahead of many other places, which may result in additional migration to the region, and Sunapee. This migration would increase the need for development and infrastructure, beyond the current housing crisis, and thus requires thoughtful land use planning to be adaptive to future population needs.

Photo 24. Lake Sunapee Harbor public access 2021. Credit: Barbara Chalmers.

4.17(b) Resilient land

Resilient land in Sunapee is based on datasets from the Resilient Land Mapping Tool created by The Nature Conservancy (Anderson, 2014). The results largely align with important areas identified in earlier sections as ecologically important habitat blocks and habitats of priority for the state of New Hampshire (see sections 4.06 Habitat blocks and 4.07 Habitat types & value).These analyses are conducted on a regional scale and with limited local detail due to the complexity and local nuances of climate change. Still, the information is informative to conservation planning in Sunapee that seeks to be adaptive and resilient to the impacts of climate change. This TNC resource includes five major analyses, included below.

(i) Resilient and Connected Network

The Resiliency Network identifies the overlap between three major datasets where the location value is above average: 1) Biodiversity Value, 2) Resilient Sites, and 3) Local Connectedness, explained next. This map (Map 16) drives home the impact of the state road and development around Lake Sunapee. Identified land in this map is largely found in the northwest corner of Town, with small patches at Tucker Hill and Blueberry Mountain.

Landscape Diversity. Current research emphasizes the significance of landscape diversity in enabling a species to survive through a changing climate. This analysis reflects the ability for a

species to persist in an area relative to its variety of microclimates. In Sunapee, the largest landscape diverse areas are found around Blueberry Mountain, Mountain View Lake, and Mud Pond to the south, as well as Cemetery Hill, Perkins Pond and Ledge Pond. Smaller areas are found, most notably at Tucker Hill and just west of Wendell Marsh.

Biodiversity Value (Map 17). This analysis assembles information on places recognized for their biodiversity value (rare species, intact habitat, or exemplary natural communities), including those at Cemetery Hill and Blaisdell Hill.

Resilient Sites (Map 18). This analysis gives a Resilience Score to sites across the landscape according to its capacity to maintain species diversity and ecological function as the climate changes, although TNC admits that understanding of these impacts are limited. TNC describes the model's intention:

> *"We expect that these sites will support an array of specialist and generalist species, even as the composition and ecological processes change. In contrast, a vulnerable site was defined as one where processes are disrupted and fragmented, and where the site is likely to lose diversity. We expect that these sites will increasingly favor opportunistic "weedy" species adapted to high levels of disturbances and anthropogenic degradation. Climate change is expected to greatly exacerbate the degradation of vulnerable sites; however, these sites may still perform many natural services, such as buffering storm effects or filtering water. Thus, vulnerable sites are not without value, but they are places where it will be increasingly difficult to sustain the natural functions and species diversity of whole ecological systems over time." (TNC, 2016)*

The amount of resilient area reflects the highest scoring one-third of each setting in the region and is not an absolute measure of how much area is equally resilient to climate change. In Sunapee the most resilient sites are limited to Cemetery Hill and Blueberry Mountain, with additional sites above average.

(ii) Wildlife pathways

Conserving resilient sites would go a long way towards sustaining biological diversity, but it is not enough. If nature thrives in these sites, then the inhabitants (trees to salamanders) will produce offspring and these offspring will disperse to find new resilient sites, and over time the landscape will change. The value of connectivity in facilitating range shifts for wildlife and their adaptation has strong historical evidence and widespread agreement among the scientific community. TNC provides multiple products from this analysis, two have been highlighted as part of this report.

Local Connectedness (Map 19). This analysis identifies local connectedness by measuring the contrasting barriers to movement, such as the amount and configuration of human-created barriers like major roads, development, energy infrastructure, and industrial farming and forestry land. The analysis in Sunapee highlights the northwest corner of Town including areas of Cemetery Hill, Ledge Pond, and Perkins Pond, as well as small areas in the south that represent the northern reaches of the Sunapee-Pillsbury Highlands, mentioned in section 4.06 Habitat blocks.

Flow Permeability (Map 20). The objective of the flow analysis by TNC is to facilitate flow dynamics and identify conservation priorities, to ensure that plants and animals are thriving, landscape remains permeable to movement, and dispersing species have a place to go. TNC describes their modeling:

> *"Thus you can identify where population movements and potential range shifts may become concentrated or where they are well dispersed, and it is possible to quantify the importance of an area by measuring how much flow passes through it, and how concentrated that flow is… This may include pinch-points that play a disproportionally important role in facilitating range shifts, diffuse areas that offer many options for movement, or low-flow areas that could be improved through restoration." (Anderson et at., 2016)*

This analysis classifies areas of flow groups based on the amount and concentration of flow.

- Diffuse flow: areas that are extremely intact and consequently facilitate high levels of dispersed flow that spread out to follow many different and alternative pathways. The strategy here might be to keep these areas intact and prevent the flow from becoming concentrated.
- Concentrated flow: areas where large quantities of flow are concentrated through a narrow area. These pinch points are good candidates for land conservation.

5. Natural Resource Protections, Opportunities & Challenges

5.01 Land Use & Development

5.01(a) Current use lands

Current use assessment is a program designed to encourage preservation of open space by taxing undeveloped land at its "current use" rather than its "highest and best use." RSA 79A authorizes this program, which allows for a reduced assessment for parcels of the following use:

- field, farm, forest, and wetland of 10 acres or more
- natural preserves or recreation land of any size
- farmland of any size generating annual revenues in excess of $2,500

A penalty, the Land Use Change Tax, exists for withdrawing land from current use for another purpose, but it is possible to withdraw land from current use and develop it. Therefore, current use is not considered a long-term conservation method.

As of 2021, 6,587 acres are enrolled in current use, or 49% of the town's land area, according to the Department of Revenue Administration's annual current use report. This represents a slight increase of lands in current use up from 6,294 in 2002 and 6,556 in 2007. Taxation rates are based on the use of the land, which is broken into five categories: forest, forest with stewardship, farmland, wetland, and unproductive land (Table 12). These lands are held by 166 different landowners, and constitute 238 parcels, up from 144 owners and 206 parcels in 2007. The Town of Sunapee maintains a list of parcels with a portion or all of its lands under current use. These parcels, as of September 2022, can be viewed in Map 6.

	2021		2007		Change
Current Use Type	Acreage	% CU Land	Acreage	% CU Land	2007 to 2021
Forest	4,800	72.9%	3,695	56.4%	+30%
Forest with stewardship	629	9.6%	1,381	21.1%	-54%
Farmland	495	7.5%	737	11.2%	-33%
Wetland	414	6.3%	412	6.3%	0%
Unproductive	249	3.8%	331	5.0%	-25%
Total in Current Use	6,587 acres 49% of Sunapee		6,552 acres 49% of Sunapee		

Table 12. Current Use land in Sunapee by category, 2021 and 2007.
Definitions for each category can be found in Appendix A : Data Source Documentation.
Source: NH Department of Revenue Administration, 2021 and 2007 current use reports.

For the same period, Sullivan County has seen a slight increase in current use land, up from 68% in 2007 to 70% in 2021 of the county's land area. Sullivan County has the highest proportion of its land area in current use out of all counties in the State, with a 2021 State total of 52%.

5.01(b) Conservation lands

Conservation lands in Sunapee take many forms: they are owned by the state, the town, and by private individuals. Some are designated for public recreation, for wildlife, for forestry, or for drinking water. They range widely in size and in location. The smallest protected parcel in Sunapee is Dewey Beach on Lake Sunapee at 0.9 acres, and the largest is Webb Forest Preserve at 377 acres (Map 6). In total 2,577.4 acres, is protected from development with a summary by type of ownership in Table 13.

Sunapee also falls within the Quabbin to Cardigan partnership (Q2C), an effort to conserve 3,000-square-miles of intact and interconnected corridor straddling the New Hampshire and Massachusetts border. The Q2C corridor is a conservation priority with collaborative research for many land trusts and non-profit organizations. Most recently, the Q2C updated their Conservation Plan with additional data considering climate resilient wildlife corridors, see Appendix H : Additional Resources. In Sunapee, Q2C core conservation focus area and connectivity corridors were identified, specifically along the western border.

The State of New Hampshire owns 145 acres of conservation land in Sunapee (Map 15). The majority of which is owned by the Department of Fish and Game (F&G) through the management of three Wildlife Management Areas (WMA) in Sunapee. The Department of Resources and Economic Development (DRED) owns and manages the Ledge Pond Islands.

There are 89 acres protected as water supply lands or other needed facilities by the Sunapee Water & Sewer Department. For the water supply lands, or Georges Mills Waterworks, Two-thirds of this land is owned by the Department, and the other third is under a protective easement.

The Town of Sunapee owns 820 acres of land that is undeveloped and has some degree of protection. Much of this land is permanently conserved and managed as Town Forest accounting for 615 acres. There is also “unofficial” conservation land, such as Dewey Beach and School District SAU #43 land, which is not permanently conserved, but the use of the land is not compatible with development. The Town also owns the boat launch and the Ben Mere Park, which are considered valuable community assets and therefore undevelopable open space.

Privately-owned land protected with a conservation easement covers 1,524 acres; this is by far the most popular method of land conservation in Sunapee. Private landowners donate or sell the development rights on their property, but retain ownership of the land itself. Conservation easements are held and monitored by the Town or by a non-profit land conservation organization, such as Ausbon Sargent Land Preservation Trust or the Society for the Protection of New Hampshire Forests.

	Property Name	Acres		Property Name	Acres
State Owned	DRED - Ledge Pond Islands	3.2	Town Forest	Tilton Park	10.4
	F&G - Gordon WMA	35		Dewey Woods	97.7
	F&G - Smith Hill WMA	99		Ledge Pond	104.8
	F&G - Wendell Marsh WMA	7.6		Verne Morse Lot	10
	Sub-Total	**145**		Webb-Flint Lot	67
Private or Land Trust Owned	Browns Hill Farm	87		Wendell Marsh Extension	45.4
	Gordon – Chetwood Trust	36		Wendell Marsh North	136
	Jared Johnson Lot	3.5		Wendell Marsh South	144
	Jolyon Johnson Lots	241		**Sub-Total**	**615**
	Nutting Family Trust	84.6	Town Owned	Bartlett-Tyler/ Garnet Hill Park	47
	Otter Pond Protective Association	1.9		Birch Point	4.4
	Rowell MacWilliams woodlot	264.2		Cemetery	7
	Simpson Reserve	115		Coffin Park	4.9
	Sorrento/Gallup Lot	39		Collins Lot	14
	Stockwell Wetland	1.7		Dewey Beach	1.2
	Virginia Cooper Revocable Trust	17		Fire Department	6.1
	Webb Forest Preserve	419.1		Ben Mere Park	3.6
	Webb-Dane Lot	74		Hames Park	0.4
	Webb-Harrison Lot	70		Highway Department	11.8
	Webb-V-OZ Lot	79		Hydro Plant	0.7
	Wentzell Subdivision Lots	5		Landfill	28.1
	Wright Lot	27		Webb-Flint Lot Access	5
	Sub-Total	**1,524**		Otter Pond North Wetland	18.8
W&S Dept.	Georges Mills Waterworks	55.3		Penacook Woods	3.1
	Pump House	0.1		School SAU#43	40.1
	Pump Station	0.5		Harbor Waterfront Park	1
	Treatment Plant	28		Wentzell Subdivision Lots	7.2
	Water Plant	5.1		**Sub-Total**	**204**
	Sub-Total	**89**			

Table 13. Conservation and Limited Development land in Sunapee by ownership.
Definitions: Department of Fish and Game (F&G), Department of Resources and Economic Development (DRED), Sunapee Water and Sewer Department (W&S Dept).

Source: NH Granit Conserved Lands, 2021. Sunapee Conservation Commission, April 2023.

5.01(c) Population & new development

In general, Sullivan County has largely been exempted from the rapid population growth experienced by southern New Hampshire during the past twenty years, but that trend may not continue. The pace of land development is expected to stay strong statewide, as New Hampshire's population is expected to increase almost 125,000 by 2050. Although, the population of Sunapee is projected to remain stable through 2050 (NHOSI 2022), this model does not consider recent migration trends during the COVID-19 pandemic, in which many of Sunapee's seasonal residents converted their homes to full-time use and became local voters. Further, the state of New Hampshire has been recognized as a relatively more resilient region regarding climate change, which may result in additional in-migration (EPA 2017). As a result, Sunapee could face greater pressure on its natural resources, especially if not planned for thoughtfully and respectfully.

In 2020, Sunapee has an estimated 3,342 year-round residents. For vacant units, Sunapee had an estimated 1,233, the highest number in the Upper Valley Lake Sunapee (UVLS) region by 346 (number two being Lebanon). This number is up 36% since 2010 with most being seasonal or recreational units, specifically 1,164 in 2020. Overall, seasonal units make up 46% of the total housing stock in Sunapee, up from 33% in 2010. This data comes from ACS 5-year estimates for 2016 through 2020, and 2006 through 2010. The seasonal home aspect of the recreation economy in Sunapee places pressure on natural resources through their need to be accessible for public use and the valuable siting of homes in scenic locations. In Sunapee, Lake Sunapee and its shoreland is especially vulnerable. Simultaneously, this recreational aspect provides for appreciation and investment by many residents to ensure protection.

Sunapee must plan proactively in how to balance priorities for natural resources and maintaining and developing infrastructure, including year-round housing, needed for continued vitality. Development and poor land management can impact natural resources and the Town's relationship to them in a variety of ways:

- Lost or fragmented habitat, breeding places, or corridors for movement
- Degraded or lost productive use of important soils for agriculture/forestry, or locations for local renewable energy
- Increased stormwater runoff and creation/accumulation of pollutants
- Reduced air quality, water quality and groundwater recharge
- Extirpated native wildlife and plants
- Exacerbated flooding
- Less public access to inspirational, healing, and healthful experiences and life styles
- Increased impact/cost of roads and public reliance on personal cars

Sunapee's farms and forests are important to wildlife, local economy, public health, and culture. In addition, the need for reasonable regional independence from global supply chain issues, has been emphasized since the start of the COVID-19 pandemic with shortages and increased costs for goods such as food and construction raw materials. When siting locations for new development and crafting land use policies, these habitats and valuable soil should be safeguarded to a reasonable extent.

The UVLS region has experienced multiple recent storms where significant flood and fluvial erosion damage were caused, from Tropical Storm Irene to localized microbursts. This risk extends into Sunapee and cannot be wholly removed; however, policies and planning can be used to mitigate risks. New homes should not be built in flood prone areas or areas important for stormwater management. Further, consideration needs to be paid to the increasing frequency of intense storm events and how that expands the extent of flood prone areas. Also, Sunapee needs to maintain and improve river and wetland capacity to manage stormwater pollutants, recharge groundwater and mitigate flooding by protecting or restoring surface waters access to floodplains, well-functioning riparian areas, and reduced upland runoff primarily from impervious surfaces through techniques including but not limited to green infrastructure. By safeguarding these natural resources, those resources will also provide other valuable services such as water quality, wildlife habitat, and attractive waterfront areas.

If rural character is to be maintained in some form, Sunapee's development will need to hold multiple priorities simultaneously, sometimes in contradiction. This challenge is particularly salient regarding year-round home development, required to address New Hampshire's housing crisis. Some impact on natural resources from this development is expected, however the degree can be minimized and could even be offset by the implementation of other strategies on both new and existing development. At the same time, natural resource protection cannot be held up as a barrier to any realistic affordable housing development. Thus, creative strategies for land use policies, housing design, and Town infrastructure is needed to achieve goals for both natural resource and housing development priorities. To advance cooperation rather than entrenched conflict, advocates for an issue cannot expect to function without limits and would do well to work together. By timing this report's completion before that of the Town's updated Master Plan, the Sunapee Conservation Commission hopes to further this goal for cooperation.

5.02 State regulations

The State of New Hampshire legislates some broad protections and the need for permitting on activities that impacts natural resources. These protections and permits are typically carried out by the NH Department of Environmental Services (NHDES). This section provides highlights of these state-level permits but is not an exhaustive list.

The Comprehensive Shoreland Protection Act provides protection for Lake Sunapee and the Sugar River. This Act establishes minimum standards for the subdivision of adjacent lands and limits land uses withing a 250' shoreland buffer zone for the purpose of protecting water quality and aquatic habitat. There are restrictions on the amount of impervious surface in this zone, as well as provisions to preserve natural vegetation.

Activities impacting wetlands, such as excavation, removal, filling, dredging and/or construction of structures, are regulated by the NHDES Wetlands Bureau. Streets, roads, and utility right-of-way easements and water impoundments affecting wetlands require approval from NHDES, USDA Natural Resources Conservation Service, and Sunapee Conservation Commission, as well as the Sunapee Planning Board.

The Alteration of Terrain (AoT) permitting program requires the control and treatment of stormwater from large developments. The program applies to earth moving operations, such as gravel pits, as well as industrial, commercial, and residential developments. Treatment usually occurs through biological or physical means, and can take the form of rain gardens, infiltration ponds, gravel wetlands or other best management practices. Sand and gravel operations are regulated by the state under the provisions of RSA 155-e.

Drinking water provided by public water systems is regulated and monitored by the NHDES Drinking Water and Groundwater Bureau, but residential well water is not. NHDES recommends that residential well users test their water supply to determine whether the water should be treated before consuming it. The New Hampshire Groundwater Protection Act (RSA 485-C) identified potential contamination sources which should be avoided near surface water or groundwater supplies.

The NHDES Subsurface Systems Bureau must review design plans and specifications for proposed septic systems to ensure the proper siting, construction, and operation of these systems. Once the designed plans have been approved by NHDES and, if required, the municipality, NHDES will issue an Approval for Septic System Construction.

5.03 Town regulations

Zoning, a tool that allows towns to address the growth and development of a community, was adopted by the Town of Sunapee in 1987. The purpose of Sunapee's zoning ordinance is "to promote the health, safety and general welfare of the community by encouraging the most appropriate use of land (RSA 674:16,17), thereby protecting our natural resources and preserving the vitality, atmosphere and varied economic forces of our town."

The Zoning Ordinance, with its most recent amendment on March 8, 2022, addresses natural resources protection in several ways:

1. Zoning districts and Water resources overlay districts with different allowable uses and development requirements.
2. Subdivision stipulations with provision for cluster development and planned unit development.
3. Erosion control measures.
4. Provision for small wind energy systems.
5. Floodplain development measures.

5.03(a) Zoning districts

Sunapee has eight zoning districts (Map 21): Village Commercial, Village-Residential, Mixed Use I, Mixed Use II, Mixed Use III, Residential, Rural Residential, and Rural Lands. This is up from five districts reported in the 2009 Sunapee NRI.

Farming and forestry are uses permitted by right in the Rural Residential and Rural Lands districts. In all other districts, farming and forestry are neither permitted by right or special exception. Commercial and industrial uses are primarily restricted to the Village and Mixed Use districts. Residential development is allowed in all districts of varying types and densities. Workforce housing development provides incentives for the creation of added affordable units through easing of a zoning district's restrictions for density, building size, and lot size (article 4.80). Small wind generation systems are permitted by special exception in all districts. The minimum lot size for each district ranges from 0.5 acre to 3 acres in size (Table 14). A lot's dimensional requirements may be superseded by the water resources overlay district, which is made up of the aquifer, shoreline and wetlands overlays, summarized in Table 14 and Table 15.

District	Minimum Lot Size (acres)	Maximum Residential Density	Permitted Uses* (by right / special exception)	Maximum Lot Coverage	% of Sunapee
Village Commercial	0.5	1 du / 10,000 ft^2 or 0.23 acre	SFD, Duplex, MF 3-5 Multifamily / ADU, Wind	80%	1%
Village Residential	0.5	1 du / 10,000 ft^2 or 0.23 acre	SFD, Duplex, MF 3-5 / ADU, Wind	60%	1%
Mixed Use I	0.5	1 du / 0.5 acre	SFD, Duplex / MF 3-5, ADU, Wind	80%	<1%
Mixed Use II	1.0	1 du / 0.5 acre	SFD, Duplex / MF 3-5, ADU, Wind	50%	<1%
Mixed Use III	1.5	1 du / 1.5 acre	SFD, Duplex / ADU, Wind	40%	1%
Residential	1.0	1 du / 1 acre	SFD, Duplex / MF 3-5, ADU, Wind	50%	9%
Rural Residential	1.5	1 du / 1.5 acre	Farming, Forestry, SFD, Duplex / ADU, Wind	40%	57%
Rural Lands	3.0	1 du / 3 acre	Farming, Forestry, SFD, Duplex / ADU, Wind	30%	14%
Aquifer overlay	2.0	NA	NA	20%	2%
Shoreline overlay		Variable – see Table 15			7%
Wetlands overlay	1.5	NA	NA	0%	10%

Table 14. Dimensional Requirements of each Zoning District and Water Resources Overlay. *Note: Overlay district area does not include areas for Lakes or Ponds. du = dwelling unit, SFD = single family dwelling, Duplex = two family dwelling; MF = multifamily; ADU = accessory dwelling unit. * the list of permitted uses only includes reference to farming, forestry, residential, and wind generation uses, excluding reference to all other uses.*

Source: Town of Sunapee Zoning Ordinance, amended March 8, 2022.

5.03(b) Water resources overlay district

The Water Resources Overlay District is comprised of aquifer, shoreline, and wetland overlays (articles 2.30 and 4.30, amended 2020) (Map 22). Areas covered by this overlay district have more restrictive regulations with the intention to protect water resources and ecologically fragile areas.

The aquifer overlay, covering 338 acres or 2% of Town, is "defined as the areas having a high, medium or low potential to yield groundwater". The aquifer overlay allows construction of buildings, but prohibits potentially polluting uses, such as landfills, salt storage, and hazardous materials storage. In addition, natural drainage and vegetation must be maintained to allow recharge of the aquifer. Lots here have a two-acre minimum lot size and 20% maximum lot coverage.

The shoreline overlay, covering 1,068 acres or 7% of Town, is "defined as all lands within 250 feet of lakes and ponds greater than 10 acres and the Sugar River." The shoreline overlay allows docks and beaches as permitted uses that are subject to the requirements of the State and Town. It prohibits potentially polluting uses, including those identified in the aquifer overlay as well as

fertilizer application. Cutting and clearing is regulated within 150 feet of the Normal high-water, and construction requires an approved erosion control plan. Lots within the shoreline overlay have variable dimensional requirements by zoning district (Table 15).

District	Minimum Lot Size (acres)	Maximum Lot Coverage	
		Impermeable	Impermeable and Permeable
Village Commercial	1.0	60%	80%
Village Residential	1.0	30%	60%
Mixed Use I	1.0	40%	80%
Mixed Use II & III	*Not Applicable*		
Residential	1.0	30%	50%
Rural Residential	1.5	25%	40%
Rural Lands	1.5	20%	30%

Table 15. Dimensional Requirements within the Shoreline Overlay.
Source: Town of Sunapee Zoning Ordinance, amended March 8, 2022.

The wetland overlay, covering 1,610 acres or 10% of Town, is "defined as those areas mapped as very poorly drained soils and any contiguous poorly drained soils by the USDA Natural Resources Conservation Service. The district shall also include any poorly drained soils which are contiguous to the shorelines of lakes and ponds greater than 10 acres in area. The area 25'surrounding the above mapped areas shall also be part." The wetlands overlay protects wetlands by prohibiting the construction of structures or buildings, dredging, or addition of fill. Streets, roads, and utility right- of-way easements, as well as water impoundments, require approval from the State Wetlands Bureau, USDA Natural Resources Conservation Service, and Sunapee Conservation Commission. Lots within the wetlands overlay is restricted to a minimum lot size to 1.5 acres that is not wetland, and no allowable lot coverage.

5.03(c) Subdivision regulations

Subdivision regulations describe the municipal requirements for subdividing land and are developed to reflect the goals of the Master Plan. The purpose of these regulations (amended 2019) in Sunapee is "to foster the development of an economically and environmentally sound and stable community and to protect the people of the Town of Sunapee from the consequences of improper subdivision, planless growth and haphazard development."

The subdivision regulations place responsibility on the subdivider to protect existing natural features. Section 4.05 states, "The subdivider shall give due regard to the preservation and protection of existing features, trees, scenic points, brooks, streams, rock out-cropping, water bodies, other natural resources and historic landmarks in order to preserve the natural environment."

Minimum design requirements are established for subdivision road design. Of note are requirements for a drainage design to address a increase or modified drainage on a site based on a minimum 25-year return period. Driveways are required not to interfere with the connecting street's drainage.

In addition, these regulations stipulate that lots do not encroach upon environmentally sensitive or hazardous areas, i.e., areas with "health hazard or/and perils of fire, flood, poor draining, poor soils, slopes over 25% or other hazardous conditions." These areas cannot constitute more than 35% of the minimum lot size for the Zoning District. Also, there are additional restrictions and requirements for areas in the floodplain, inadequate capacity for sanitary sewage disposal, or with lake or pond access.

Protections for open space are also included in the subdivision regulations. Section 5.01 states, "Where a proposed park, playground, or other open space shown on the Master Plan located in whole or in part in a proposed subdivision, the Board may require substantial compliance with the Master Plan." Beyond open spaces identified in the Master Plan, the Planning Board also has the ability, where it deems essential, to require that a community open space or park is designated within any proposed subdivision. However, the size of this open space is not to exceed 15% of the total area of the subdivision. Alternative subdivision design with broader incorporation of open space fall under the Town's provisions for cluster development and planned unit developments, explained in the next section.

5.03(d) Cluster development & planned unit development

In 2003, Sunapee adopted two innovative land use techniques for subdivision development to promote flexibility in land development design and to promote the conservation of open space, historic resources, and natural features. Cluster development and planned unit development involve developing portions of a parcel while setting aside another portion as open space. Per the provisions of the ordinance, this open space should be suitable for use as a common area, recreation, agriculture, or conservation, and should be located so that the environmentally sensitive areas are protected, and scenic impacts minimized.

Cluster development (article 4.50, adopted 2003) pertains to development with a clustering of dwelling units more closely than otherwise permitted alongside at least 50% open space. The gross land area must be at least five acres, and the underlying dimensional requirements and uses of the zoning district, such as dwelling unity density and lot coverage, must be abided. All zoning districts are eligible for cluster development. The clustering of homes decreases the demand for road construction and utility extension, and natural resource protections increased through a continuous open space area.

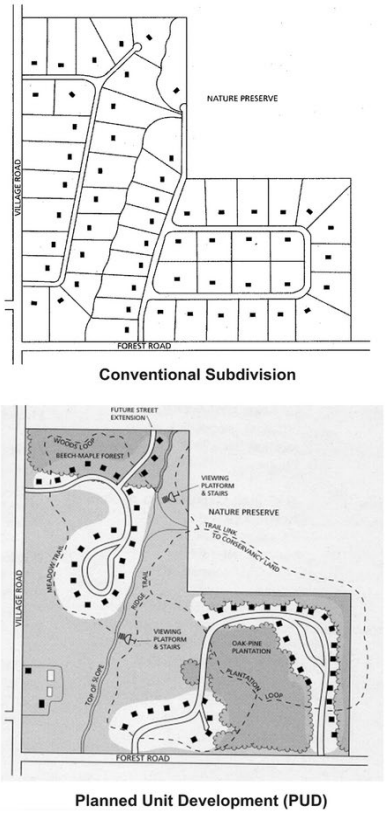


Figure 8. Planned Unit Development. *Source: Ardizone et al., 2010.*

Planned unit development (article 4.60, adopted 2003) pertains to development of commercial and/or residential uses in a form that preserves open space. This type of development is permitted in the Village, Mixed-Use, and Rural Residential zoning districts. In the Village and Mixed-Use districts, at least 25% of the land area must be protected as open space; in the Rural-Residential district, at least 50% must be open space. Like cluster development, the underlying zoning district requirements must be abided.

5.03(e) Erosion control provisions

The Zoning Ordinance prohibits construction on slopes greater than 25% (section 3.40, amended 2022). Driveways, stairways, and utilities are exempt, but require a drainage and erosion control plan. An erosion control plan is required for land clearing of greater than 100,000 square feet, or new construction on slopes greater than 15% with disturbance exceeding 1,000 square feet (section 3.40, amended 2011).

A vegetative buffer of 25 feet is required along major roads in the Rural land, Rural residential, and Mixed Use III districts. This requirement applies to Route 11, 103, and 103B (section 3.40, amended 2020). Depending on the width, a vegetative buffer can help with sediment control, filter out some pollutants in stormwater, diminish noise, and provide wildlife improved habitat and a travel corridor.

5.03(f) Small wind energy systems

Small wind energy systems and meteorological towers (article 4.70, adopted 2009) increase local mitigation from the use of fossil fuels and local energy independence and resilience through a distributed and renewable resource. The intent of the article is to allow the use by special exception and provide limits to protect public health, consistency with land use policy, compatibility with rural setting and character, and establishing standards for this use. These systems are limited to a height of 150 feet with limitations in number and specific locations on a lot in order to diminish noise and visual impacts to the neighborhood. There are additional limitations on lighting, signage, and a single non-reflective paint color. As of 2022, no wind energy systems have been installed in Sunapee.

5.03(g) Floodplain development ordinance

Adopted in 2006, the floodplain development ordinance applies to all lands designated as special flood hazard areas by the Federal Emergency Management Agency (FEMA) (described in Natural Resource section 4.04 Surface waters, riparian zone & floodplains).Permits are required for development on these lands in order to ensure “building sites will be reasonably safe from flooding”. Design guidelines include but not limited to requirements for the use of materials resistant to flood damage, water and sewer systems designed to eliminate infiltration from flooding.

5.04 Non-Regulatory protections

Education, voluntary programs, and monitoring play an important role in protecting natural resources. In Sunapee, these programs include:

- Household hazardous waste collections
- Water-quality monitoring
- Environmental education in schools and in the community
- Invasive species monitoring, education, and control
- Watershed planning projects for the Lake Sunapee watershed

Sunapee organizes household hazardous waste collections with neighboring New London and Newbury, and also participates in collections organized by the Upper Valley Lake Sunapee Regional Planning Commission; these collections minimize the risk of inappropriate disposal or accidental release of common toxic materials that may pollute the water supply.

New Hampshire Department of Environmental Services (NHDES) and local lake associations monitor water quality in Lake Sunapee, Ledge Pond, and Mountainview Lake through the Volunteer Lake Assessment Program. Each year, a water quality report is produced and improvements or declines in water quality can be identified and addressed.

Lake Sunapee has been protected by concerned citizens since 1898 when the Lake Sunapee Protective Association (LSPA) was formed. LSPA is involved in environmental education, both in schools and in the community, about issues that affect the lake and its watershed. This includes public events and presentations as well as demonstration sites for improved stormwater management.

The threat of invasive species, in particular variable milfoil, is addressed through several programs organized by the LSPA. Weed Watchers are volunteers who survey lakes to spot areas where milfoil is growing, providing early detection on new infestations. LSPA also organizes efforts to manage milfoil infestations, which involves divers harvesting the plants. The primary mechanism for milfoil spread is through boats moving among waterbodies. Lake Hosts educate boaters on milfoil and how to clean their boats, as well as inspecting incoming and outgoing boats and sending suspicious plant samples for species identification. In addition, there is a boat washing station at Sunapee Harbor to thoroughly clean off invasive plant parts.

In March 2020, LSPA completed a watershed management plan for Lake Sunapee. The plan identifies six categories for its action plan: Education and Outreach, Research, Further Evaluation, Monitoring and Assessment, Land Conservation and Land Use Regulation, Zoning and Ordinance. Similar action items would likely prove effective in improving water quality in other watersheds in Sunapee.

5.05 Planning documents

5.05(a) Master plan

The Sunapee Master Plan is a document that describes the status and future goals for the town. It is periodically updated to reflect changes in development, community attitudes, and new information. The most recent plan was adopted in 2010, and includes information on important natural, cultural, and historical resources, as well as a plan for future land use. The Master Plan provides the legal basis for zoning and other land use regulations for the Town.

In the 2010 Master Plan, the people of Sunapee outlined their support for the protection of the town's most important features. This included Lake Sunapee and Perkins Pond, the peaceful, rural nature of life, large undeveloped tracts of land, and outdoor recreational activities. Acknowledging land use trends over the last two centuries, the Sunapee Master Plan labels the town as a "recreation center and second home/retirement community," with an important rural character and environmental awareness.

Community attitudes and priorities informed the development of the Master Plan's goals for land use and approach to natural resources. For instance, the plan encourages denser development in existing village centers, while maintaining low-density development and uninhabited tracts of land in outlying areas. This approach would maintain the town's rural character, as well as protect resources found in such outlying areas from the negative effects of development. However, an increase in density must be met with higher utility and infrastructure capacity to avoid issues related to the stressing of natural resource functions such as wastewater and stormwater. A smaller consideration should be made to the effects of increased population density on the highly valued rural quietness and dark night sky in Sunapee, if only specifically in those important areas.

A subset of goals outlined in the Master Plan is to protect natural resources and the environment, while ensuring public access to and enabling use of these natural resources. By tying recreation and preservation together, Sunapee creates a system that encourages both. This system can also produce unique issues. Special care should be taken to ensure these goals do not conflict beyond a reasonable extent, as an imbalance in one could negatively affect the other. For example, overuse of a recreational beach could lead to contamination from chemical pollutants and bacteria. On the other hand, significantly limiting recreational use affects the town's important primary status as a recreation center. Complete lack of use of a natural resource could also lead to neglect and lower perceived value, preventing both goals from being reached.

When comparing the Master Plan's 2008 existing land use map to both the future land use map and a modern land use map from 2022, Sunapee has fallen short of the goal to meet the state's recommended percentage of conserved land. However, a significant amount of progress has been made through a combination of private and public land conserved in priority areas highlighted in the Land Use section of the Master Plan.

A limitation of the 2010 Master Plan are goals or ideas with vague or nonexistent plans to advance them. Examples of this include goals to protect prime wetlands, which have no

explanatory text in the recommendations portion of Section III. The Master Plan also acknowledges the lack of an institutional framework to address internal natural resource protection, but only goes so far to suggest the Town establish a process to identify groups who will be responsible for solving this problem. Although naming these goals begins the process of reaching them, the lack of clear next steps and/or identified leaders may cause inaction or hampered action that prevent effective implementation of goals.

The Master Plan is currently undergoing revision, and it is anticipated that this Natural resources inventory and Conservation plan will be used to inform the master planning process.

5.05(b) 2010 Natural resources plan

The Town of Sunapee 2010 Natural resources plan, informed by the 2009 Natural resources inventory, represents the Conservation Commission's guiding document to inform efforts to maintain, protect, and increase access to the Town's natural resources. This 2022 Natural resources inventory and Conservation plan intends to provide a comprehensive update and revision to these documents. This section will specifically focus on summarizing conversations and evaluate progress and challenges on recommendations in the 2010 plan (Table 16).

Goal	Recommendation	Status
Create and maintain a process for natural resource protection	Collaborate with neighboring Towns and watershed partners in the protection of Lake Sunapee	See Section 5.04
	Educate citizens on the value of natural resources and the importance of protecting these resources	See Section 5.04
	Assign town boards and staff to implement resource protection initiatives and administer code enforcement	In 2014, a public sewer line was put in around Perkins Pond
Protect the natural environment	Implement a Visual Resource Protection District around scenic areas and/or a Ridgeline Development ordinance*	Under Consideration
	Actively protect natural resources through conservation easements and land purchases*	New conservation easements purchased, Section 5.01(b)
	Increase the percentage of Land Use Change Tax dedicated to conservation, set at 50%	No Update
	Designate "prime wetlands" and allow special review by the State Wetlands Bureau*	The SCC started prime wetlands mapping in the 90s but it was not completed.
	Protect Lake Sunapee as a public drinking water supply	See Section 5.04
	Amend the zoning ordinance to reduce densities in rural areas and increase in village areas where connections to municipal water / sewer system are possible	No Update
	Implement a Transfer of Development Rights provision to encourage preservation of rural lands	No Update
	Introduce additional Low Impact Development provisions within zoning, subdivision, and site plan review	No Update
	Reclassify areas around drinking water wells according to the state Groundwater Protection Act	No Update

Goal	Recommendation	Status
	Create a local health ordinance for groundwater protection to allow inspection of septic systems for failure*	The Town is currently pursuing an ordinance to require the pumping/inspection of septic systems.
	Amend the Water Resource Overlay District to require stormwater treatment onsite, require submission of erosion control plans for construction permits, and minimize wetland disturbance	No Update
	Educate the public as to the value of conservation lands and easements	No Update
Provide public access to significant natural areas	Foster low-impact recreation in undeveloped areas while allowing high-impact recreation in appropriate locations	New hiking trails to improve public access to conservation land have been created in the past ten years: Wendell marsh trail, 3 new trails at Ledge Pond lot, Herbert Welsh trail at Dewey Wood and Bartlett-Tyler lot. Outdoor exercise equipment at Coffin Park.
	Incorporate into subdivision and site plan review regulations requirements to protect natural resources and provide easements for trails connecting conservation and recreation areas	No Update
Provide an opportunity for the use of significant natural resources	Protect prime agricultural soils and productive forest soils through amendment to the zoning ordinance	No Update
	Maintain existing agriculture-friendly zoning provisions	No Update
	Continue to protect the infrastructure required to support forestry and agricultural activities, e.g. log and farm roads, accessory structures, etc.	No Update
	Through landowner education, ensure that cultivation, management, harvesting, or extraction of natural resources takes place under conditions which foster compatibility with existing surrounding land uses, especially regarding Best Management Practices (e.g., Forest Management Plans, improvement cost-sharing programs, methods to prevent nuisance animals)*	No Update
Additional recommendations from the 2009	Align the Zoning Ordinance with the revised Comprehensive Shoreland Protection Act	No known issues, and any misalignment will be addressed in the next master plan, likely 2023.
	Increase the minimum lot size on lake shorelines, or adopt impervious surface standards; Increase minimum lot size in areas of high resource value	No Update

Goal	Recommendation	Status
Natural resources inventory	Extend jurisdiction of the Water Resources Overlay District to perennial streams and 100 ft on either side; to include a 100' upland buffer around wetlands. Any increase beyond 50' should be consistent across other waterbody protections.	In 2020, wetlands buffer to provide a 25' setback around jurisdictional wetlands.
	Create stormwater management regulations	No Update
	Incorporate into subdivision/site plan review regulations voluntary guidelines for developers to protect habitat	Subdivision has an allowance for up to 15% of land to be used for conservation purposes - this includes trails or any other potential use by SCC. The SCC worked successfully with a developer of an 85-acre former farm lot on the south side of Trow Hill Road and got a 10-acre or so set aside with access off a road that then provided access to a contiguous large landlocked wetland lot conserved in 1971.
	Develop a water resources protection plan for incorporation with the master plan	See LSPA 2020 Watershed Management Plan
	Establish a Local Agricultural Commission to advise town boards on agricultural issues and advocate for farming	No Update
	Create an Agriculture Conservation District in Zoning Ordinance, providing incentives to farm in this district	Considered in 2020. No action made as much of the prime ag land is already under deeded conservation easements.
	For renewable energy, consider town tax credits for residential installations and adopt a site plan review process which includes wildlife and other environmental considerations	No Update
	Present 2009 NRI results to the public via Town Meeting, roundtable discussions, presentations to local organizations	No Update
	Identify additional inventory work, such as mapping and documenting recreational, scenic, and historic resources	See Section 4.16 Missing vernal pools, invasive plants, and native wildlife sightings
	Develop a conservation plan	Complete

Table 16. Status on recommendations by goal put forward in the 2010 Natural resource plan and 2009 Natural resources inventory.
*Note: Those recommendations found in both documents are indicated with a *. Source: Sunapee Conservation Commission 2022*

6. Natural Resource Co-Occurrence

To identify areas with multiple natural resource value, the Sunapee Conservation Commission (SCC) used a method known as co-occurrence analysis. This is a geographic analysis of natural resource overlap and spatial coincidence. In such an analysis, the overlay resources yield "hot spots" where multiple important resources occur in the same location.

To organize this analysis, seven natural resource categories were identified by the SCC. Within each category, Commission members selected at least one mapped feature that represented the natural resource, such as riparian areas around ponds to represent the surface water resource (Table 17). Within each of the seven categories, all measurable features were combined and assigned an equal value. Therefore, the results are easy to interpret and explain –a score of "7" indicates that at least one feature of all 7 categories is present at that location. This analysis is performed using a spatial overlay algorithm in ArcGIS Pro 2.7.2.

The results are not authoritative, meaning hot spots are not always a priority or inclusive of all natural resource values. Areas that have the most overlap are likely to have the most natural resource value because they serve multiple identified purposes. Low overlap areas may be identified as a high priority for reasons to protect nearby natural resources or to restore value that has been diminished. The results are shown in Map 23 and conclusions highlighted in Section 7 Conservation plan.

	Natural Resource Category	How this Resource was measured
I	**Wildlife**	Important habitat identified in Wildlife Action Plan (Tier 1 / 2)
		Habitat Blocks greater than 500 acres
II	**Surface Water**	Lakes and ponds and land within 50-ft
		Streams and rivers and land within 50-ft
		Wetlands and land within 50-ft (identified by NWI / hydric soils)
		Floodplains (Regulatory floodway, 100 & 500 year floods)
III	**Farm and Forest Land**	Prime agricultural soils or Active farms
		Group IA forest soils
IV	**Climate Change Resilience**	Resilient sites (more / most resilient)
		Wildlife pathways (diffuse / concentrated flow permeability)
V	**Water Protections**	Land in Water Resources Protection Overlay District
		Wellhead protection area for active public water supplies, and sanitary zone for potential community systems (Wendell Marsh)
VI	**Land based protections**	Conservation land and land within ½-mile of conservation land
		Erosion control. Steep slopes –greater than 15%
VII	**Cultural / Recreation Natural Resources**	Natural Rock Features: Indians Cave, Bears Den, Pulcifer Rock and land within 50ft
		Waterbody access including land within 50ft for points only
		Abandoned sugar river railroad bed trail & Sunapee Ragged Kearsarge Trail including land within 50ft

Table 17. Natural resource categories for Town of Sunapee co-occurrence analysis.

7. Conservation plan

Purpose. The Sunapee Conservation Plan provides the Sunapee Conservation Commission (SCC) and other town officials with a science-driven and consensus-based approach to guide the SCC's mission. The plan integrates the best available information at the regional and local level with expert judgment. The Plan should be updated on a regular basis and used to inform revisions of the Sunapee Master Plan and to guide the town's sustainable growth and conservation of its natural resources.

Four priority zones and seven strategies are identified to inform an action plan. Recommended actions for each of the leading strategies have been outlined as part of this Conservation Plan. These actions range in type from discussion and partnership to assessment, education, regulatory, and management. This is an ambitious plan and the SCC welcomes participation. In fact, any effort to achieve these will require extensive partnership and engagement.

Priority Zones	Leading Strategies	Minor Strategies
Z.A. South Sunapee	LS.1. Planning and zoning collaboration	MS.1. Conserved lands management and advancement
Z.B. Drinking water supply areas	LS.2. Resilient area protection	MS.2. Natural settings recreation advancement
Z.C. Red Water Creek to Mud Pond	LS.3. Water quality protection	MS.3. Farmland protection
Z.D. Northwest Sunapee	LS.4. Invasives management	

7.01 Overview of planning process

In the Spring of 2022, the SCC initiated a process to update the Town's NRI and Conservation Plan. The primary purpose of these documents is to inform the Town Master Plan update and actions to be taken by the SCC. The process used to create this Conservation Plan included five steps by the SCC:

1. Understand the Town's natural resources through an NRI update.
2. Evaluate where SCC natural resource priorities exist in co-occurrence, described in section 6.
3. Identify topics and locations of conservation priority through a facilitated exercise, described in section 7.02.
4. Consult Town staff and community stakeholders on identified conservation priorities, described in section 7.02.
5. Review the Plan in consultation with Town staff and the Planning Board.

This planning process was facilitated by the project consultant, the Upper Valley Lake Sunapee Regional Planning Commission.

7.02 Geographic zones of priority

Informed by the 2022 Natural Resources Inventory (NRI) and its co--occurrence analysis, the SCC will prioritize Conservation Plan strategies with impact on four geographic zones (Map 23). These areas received strong support from most SCC members. In addition to these four zones, the Lower Sugar

River area is given honorable mention with strong support from a few SCC members. The Zone for drinking water supplies partially covers the Lower Sugar River area due to the proximity of Wendell Marsh.

Z.A. South Sunapee

The South Sunapee zone encompasses the land southwest of Route 103. The western and eastern edges of this zone host important natural resources for water resources and wildlife habitat. The eastern edge remains undeveloped, besides the main roads. The western edge hosts low density single-family homes along Nutting Road near Trask Brook. In the zone's mostly forested central area, there are stretches of steep slopes, contributing to its minimal development. The SCC co-occurrence analysis results in high scores along the western edge that coincides with Trask Brook.

Along the zone's western edge is a large wetlands complex including forested, shrub/scrub, and emergent habitats. Trask Brook flows through these wetlands, feeding them, until joining the Sugar River. This corridor is recognized by the NH Wildlife Action Plan (WAP) as a Tier 1 important habitat where the rare American Kestrel has been spotted. The area is also significant with underlying aquifers, roughly half of all found in Sunapee. A FEMA Floodway is designated along Trask Brook between Penacook Path and Depot Road. One public water supply is in this area at the former Touchette mobile home park.

Photo 25. Trask Brook wetland off Nutting Rd, Nov 2022. Credit: Olivia Uyizeye.

The small eastern part of the zone provides a link to a 30,000 acre habitat block stretching south across Mount Sunapee and through the Towns of Goshen, Newbury, and Washington. This small section in Sunapee is recognized by the Quabbin to Cardigan partnership (Q2C) as a key wildlife connectivity corridor, which extends up through Northwest Sunapee (another priority zone for the SCC). This small edge hosts soil identified with potential high forest productivity, coinciding with Northern hardwood-conifer forest. Rare plant species have been spotted in or near this eastern part of the zone.

Z.B. Drinking water supply areas

This priority zone includes all current well head protection areas, aquifers, potential future municipal wells and their sanitary zone in the Wendell Marsh conservation land, areas on Lake Sunapee and other water bodies not served by municipal sewer, and Lake Sunapee at-large as a surface water used for Town's municipal water supply. This priority zone is closely aligned with the leading strategy for water quality protection outlined in the next section.

These drinking water supply areas also coincide with other natural resource features, and with three other geographic zones of priority. Most notably, overlays occur with important Trask Brook and its wetland complex, Red Water Creek, and Ledge Pond. The drinking water priority zone also adds areas, most notably the large Wendell Marsh area with ecological assets for habitat, wildlife, and flood control; Lake Sunapee and its harbor with significant recreational, cultural, and wildlife value (e.g., habitat for the Common Loon); and the Georges Mills village area.

Photo 26. Left – Lake Sunapee, public water supply, view from Mount Sunapee, 2022. Right - Wendell Marsh Public Access, 2022. Credit: Meghan Hoskins, Barbara Chalmers.

Z.C. Red Water Creek to Mud Pond

This priority zone includes three important natural features: Red Water Creek at the zone's northern boundary, Mud Pond at the southern edge, and Blueberry Mountain between them. Route 103B cuts through Red Water Creek and extends south near Mud Pond. The road gives access to housing developments on Lake Sunapee side developed since the late-1960s. On the northeastern slopes of Blueberry Mountain, a recently approved single-family home development is underway. The SCC co-occurrence analysis results in high scores throughout much of Red Water Creek and to the south through the zone.

From its headwaters in a large wetland complex, Red Water Creek flows into Lake Sunapee at Fishers Bay. Almost all of these wetlands are identified as Tier 1 important habitat in the State's Wildlife Action Plan. The Creek's headwaters are protected by two parcels, totaling almost 142 acres, with conservation easements held by the Ausbon Sargent Land Preservation Trust (ASLPT). These conserved lands protect wetland and upslope habitat. Both parcels allow access to the public, including parts of the Sunapee Ragged Kearsarge Greenway (SRKG) trail. The SCC, along with many others, contributed to the acquisition of the easements for these parcels. A historic water-powered mill site on Red Water Creek is also protected by this conserved land. The Meadow Brook development wellhead protection area covers much of the land near the outlet of Red Water Creek.

Blueberry Mountain is the central feature of this zone, part of the 760-acre habitat block completely contained within Sunapee's borders. This large undeveloped and forested area is a result of the Mountain's steep slopes, and a conserved parcel named the Webb Forest Preserve. While Blueberry Mountain is part of the Lake Sunapee watershed, the Webb Preserve is part of the headwaters for Trask Brook to the West and includes valuable wetlands. The conservation easement on Webb Preserve is held by ASPLT, covers 376 acres, and provides unlimited public access for low impact recreation, such as the SRKG trail. This part of the zone also hosts multiple historic deeryards, and the stone remains of 18th century farms.

Mud Pond sits below the slopes of Blueberry Mountain, to the north of Mountain View Lake. House along Route 103B is the closest development. A few small wetlands surround Mud Pond, which is relatively isolated and undeveloped, in contrast to Mountain View Lake which hosts residential lake-side development.

Photo 27. Left – Red Water Creek at Simpson Reserve, 2021. Right – View of Blueberry Mountain towards Mud Pond from the Mountainview Lake southern shore, Nov 2022. Credit: Barbara Chalmers, Olivia Uyizeye.

Z.D. Northwest Sunapee

The Northwest Sunapee zone encompasses all of Ledge Pond, its surrounding forests, and undeveloped stretches to the west. To the south and east of this zone are Perkins Pond Road, North Road, and Route 11. The entire zone is part of a 4,636-acre habitat block that stretches into the Towns of Croydon and Springfield. Ledge Pond has housing on its south and west shores as well as surrounding large parcels in the Rural Lands zoning district, the lowest density in Sunapee. The SCC co-occurrence analysis results in medium-high scores throughout much of this zone.

For productive soils, the zone contains patches of federally and locally designated prime agricultural soils, and more extensive areas of productive forest soils for high and moderate value hardwood. The cultural resources in this zone includes scenic views from Trow Hill, historic Twin Willow Mica Mine, stone remains of 19th century farms, and Ledge Pond public access. This access is in the Ledge Pond Lot town forest, which hosts part of a designated municipal wellhead protection area. This zone includes a Tier 1 habitat area of the state Wildlife Action Plan. Additional Tier 1 and Tier 2 habitats run along the western part of this zone. These habitats support a couple of rare species, including the Canada Lynx. Historic deeryards are found in patches across this zone. A network of Ledge Pond Brook wetlands on the southern end in the Rowell-MacWilliams Lot is already protected by a conservation easement with Ausbon Sargent Preservation Land Trust. This woodlot allows for low impact recreation.

Photo 28. From Rowell MacWilliams woodlot. Left – Ledge Pond Brook wetland, Mar 2020. Right – Of recreational trail on property, Apr 2021. Credit: Barbara Chalmers.

7.03 Strategies to conservation

Action to conserve important natural resources in Sunapee has been structured into five leading strategies (LS) and three minor strategies (MS). The SCC will seek to advance these strategies with particular emphasis on the Priority Zones. Minor strategies will receive attention to maintain existing work and may be advanced through synergies.

7.03(a) Leading Strategies

LS.1. Planning and zoning collaboration

The SCC plans to more frequently advise town planners and decision makers regarding the town's conservation priorities to ensure they are reflected in the town's zoning map, local regulations, processes, and planning efforts. The SCC sees it as a priority to inform planning and zoning decisions relative to land development and enforcement. This is of particular concern given the interest in seasonal developments and the need for more affordable housing in Sunapee and throughout New Hampshire. On this topic of collaboration, the SCC identified the following topics for focused attention:

- Ensure changes in local regulations and planning documents include consultation with SCC
- Reduce variance approvals and increase predictability
- Advance appropriate enforcement, use of fines, and coordination with Town staff
- Advance development needed for overall community vitality and public health where infrastructure is available
- Improve infrastructure in a way that conserves natural resources (e.g., public water and wastewater services expansion)
- Increase density in villages and reduce in rural residential

The SCC is aware that situations exist where a site's potential may be well suited for more than one land use, and that conservation cannot always be given priority at every location. With simultaneous needs for public health, community character, and transportation, the SCC seeks to inform a Town-wide view that keeps these needs, alongside those for conservation, in balance. Further, the SCC seeks to advance efficient planning and zoning strategies, so that any seemingly necessary loss in ecosystem value or function is done with full knowledge of the impact and with a result that provides tangible community wide benefits.

LS.2. Resilient area protection

The SCC seeks to advance protections for areas important for the long-term resilience of native wildlife populations, natural communities, and functioning ecosystems services. Of special priority includes protections to maintain and expand wildlife corridors and wetlands in Town.

LS.3. Water quality protection

The SCC seeks to increase protection for water quality, especially drinking water, through regulation and education. Regulations need to be reviewed for their adequacy to provide baseline protection for important riparian buffers, aquifers, wellhead protection areas for current and future municipal wells (e.g., Wendell Marsh wells), and surface waters, especially Lake Sunapee used as a public drinking water source. The Town's 2018 Forest Management Plan includes detailed recommendations for water quality protections for the SCC to review for broader applications or educational opportunities. The Lake Sunapee shore in New London and Newbury is not served by a municipal sewer system, But Sunapee has been proactive in the regard and much but not all of Sunapee's shoreline is served by Sunapee's municipal sewer system. Along the shoreline of Lake Sunapee in Sunapee, residential homes rely on private septic systems are around Jobs Creek, Fishers Bay, and in Burkehaven. Adopting an enforceable regulation that requires periodic septic system pumping and inspection as a first measure and ultimately connecting these homes to the municipal sewer system is an SCC priority. Pollution at Mountain View Lake with its many old cottages on small lots with septic systems is also of concern, as this waterbody and the Mt. Sunapee State Park with its thousands of winter visitor ultimately are part of the Lake Sunapee watershed. Perhaps a future Sunapee municipal sewer line extension along Route 103 will address these concerns and pollution sources. SCC looks to protect and target public infrastructure investments, as well as reduce additional costs and public health impacts due to poor water quality. Through this effort, the Town will better optimize the value of manmade and natural ecosystem functions for all-around benefit.

LS.4. Invasives management

The SCC seeks to control invasive plant species throughout the town, while increasing the presence of important native species. As of 2022 there has been no Town-wide assessment or management plan for invasive species, although problem areas are known, and a few are actively managed by various private entities. Transportation rights of way and boat landings are especially at high risk of spreading invasive species. Important scenic vistas are found along many roads and waterbody public access points, which are diminished by the presence of invasives. The Lake Sunapee Protective Association runs a volunteer driven program called Invasives Watch. This program is focused on both the identification and management of aquatic invasive species in Lake Sunapee. Once a thorough assessment is made within the Town beyond the lake shore, the SCC can explore a partnership with LSPA to expand or establish a parallel land-based program. The SCC management program for invasives will seek to identify opportunities for native plantings, or green infrastructure, when the removal of invasives is sufficient.

7.03(b) Minor Strategies

MS.1. Conserved land acquisition and management

The SCC serves as the manager of Sunapee's town forests where active forest management and low-impact recreation is happening. The responsible management of these forests can serve as a model and educational opportunity to private landowners. The SCC will continue to provide community hikes as educational events for the public at times of active work for town forest management. The SCC shall continue to acquire properties and develop conservation easements for the purpose of conserving priority lands in Town. The SCC maintains a Conservation Fund to support these activities. The fund receives revenue from the Land Use Change Tax, and conservation land warrant articles.

MS.2. Natural settings recreation advancement

The SCC seeks to further recreation located in natural settings for its value to the local economy, public health, and education. The most common form of public recreation in Sunapee's town forests is trail use by hikers, runners, skiers, and mountain bikers. The public's enjoyment of trails is generally a function of accessibility to well-constructed and maintained trails, forest aesthetics, and the opportunity to view wildlife. Trails need to be constructed and maintained to allow access to a diversity of users in a variety of natural settings. Many actions are already outlined in the Town's 2018 Forest Management Plan. Additional actions, such as building accessible trails for the mobility-impaired could be considered. Improvements made in 2022 at trailhead kiosks could be expanded to be available in Town facilities, and along trails themselves to improve public understanding and appreciation for the natural resources that surround them. Access points can be interconnected to other Town hot spots, such as field-based recreation parks or facilities, commercial activity, residential neighborhoods, and multi-modal pathways. For example, the Sunapee Recreation Department is interested in providing a facility for recreation and public events, which the SCC could seek to support at a suitable location that integrates with natural setting recreation.

MS.3. Farmland protection

The SCC seeks to maintain existing agriculture-friendly zoning provisions, as recommended in the 2010 Natural Resources Plan. As part of the SCC's broader effort to influence planning and zoning rules and decisions, the SCC will continue to advise town boards on agricultural issues and advocate for farming, and protection of prime agricultural soils. The impacts of climate change on agriculture, as well as pandemic induced disruptions to food supply, highlight the need for increasing opportunities for local food production. The SCC recognizes the importance of the working landscape of agricultural soils and active and potential farmland as critical infrastructure needed to strengthen resiliency.

7.04 Action plan

	Strategy Code	Action Type	Description	(Confirmed) Partners	Funding	Timeline (yrs)	Plus Strategies
LS1 - Planning and Zoning Collaboration	**LS1-a**	Partnership	Establish quarterly or bi-yearly communications on local regulatory topics among the planning, zoning and conservation commission in compliance with RSA 676:2.	PB, ZBA	NA	1	
	LS1-b	Partnership	Support Town staff to implement resource protection initiatives and administer code enforcement*	Town Manager	NA	Ongoing	
	LS1-c	Assessment	Consult with Water and Sewer Department on system capacity, condition, and expansion options, including those that would further higher village density and connection of homes on waterbodies with private septic systems.	Water & Sewer Dept, PB	CWSRF	2	LS3
	LS1-d	Assessment	Perform a build out analysis to evaluate and inform SCC zoning recommendations that align with conservation priority zones and inform implementation of the Town's 2023 Master Plan update. Consider application of the UVLSRPC Places for Homes.	UVLSRPC, PB, ZBA	InvestNH	1	LS2, LS3, MS3
	LS1-e	Education	Present 2022 NRI and Conservation Plan results to the public via Town Meeting, roundtable discussions, and presentations to local organizations.	UVLSPRC, PB, LSPA	TBD	Ongoing	
	LS1-f	Regulatory	Amend the zoning ordinance to reduce densities in rural areas and increase in village areas where connections to municipal water / sewer system are possible. Potentially informed by build-out analysis action*	PB, ZBA, UVLSPRC	InvestNH	2	
	LS1-g	Regulatory	Implement a Transfer of Development Rights provision to encourage preservation of rural lands*	PB, ZBA	InvestNH	TBD	LS2
	LS1-h	Regulatory	Introduce additional Low Impact Development provisions within zoning, subdivision, and site plan review*	PB, ZBA	InvestNH, LSWPG	TBD	LS2, LS3
	LS1-i	Regulatory	Incorporate into subdivision and site plan review regulations requirements to provide easements for trails connecting conservation and recreation areas*	PB, ZBA	TBD	3	MS2, MS1
	LS1-j	Regulatory	For renewable energy, adopt a site plan review which includes specific environmental considerations. For example, windmills with one blade painted show reduced wildlife collisions.*	Energy Committee	TBD	3	LS2

	Strategy Code	Action Type	Description	(Confirmed) Partners	Funding	Timeline (yrs)	Plus Strategies
	LS1-k	Regulatory	For renewable energy, consider town tax credits for residential installations.*	Energy Committee	TBD	5	LS2
LS2 – Resilient Area Protection	**LS2-a**	Discussion	Review Wetlands Overlay District. Consider the following questions – Are all important wetlands protected? Are wetlands protected with little ecosystem service value? Should a broader water quality buffer be considered, up to 100 feet?	LSPA, PB, ZBA	LSWPG	1	LS1, LS3
	LS2-b	Assessment	Delineate Town Wetlands.		TBD	TBD	
	LS2-c	Assessment	Map vernal pools.		Volunteer	3	
	LS2-d	Assessment	Review existing maps and supplement with any needed inventory and mapping of Town natural settings recreation, including ownership, accessibility, and condition.	Recreation Committee, SRKG, LSRCC	Volunteer	1	MS2
	LS2-e	Education	Increase awareness of and programming for natural settings recreation (e.g., maps available at Town facilities and Recreation website, advance youth programs in Town Forests).	Recreation Dept, LSRCC, SRKG	TBD	3	MS2
	LS2-f	Regulatory	Designate "prime wetlands" and allow special review by the State Wetlands Bureau*	PB	NA	5	
	LS2-g	Management	In Town Forests, enact adaptive management strategies and provide simultaneous educational opportunities with property owners, especially regarding water quality and habitat.			Ongoing	LS3, MS1
LS3 – Water Quality Protection	**LS3-a**	Partnership	Keep informed and support LSPA efforts to implement the 2020 Lake Sunapee Watershed Management Plan	LSPA	NA	Ongoing	
	LS3-b	Discussion	Consult with Highway Department yearly on water quality issues and improvements, such as efforts to reduce the use of salt on Town roads and storm drainage improvements.	Highway Dept	NA	Ongoing	LS2
	LS3-c	Discussion	Review Shoreline Overlay District. Consider the following questions – Should a broader water quality buffer be considered, up to 100 feet?	LSPA, Water & Sewer Dept	LSWPG	1	LS1, LS2
	LS3-d	Discussion	Discuss opportunities to improve groundwater protection through inspection of private septic systems for failure. Performed either through a Health Ordinance and/or expansion of the LSPA Watershed Wise program*	LSPA, PB	LSWPG	TBD	LS2

	Strategy Code	Action Type	Description	(Confirmed) Partners	Funding	Timeline (yrs)	Plus Strategies
	LS3-e	Assessment	Assess current stormwater management regulations.	Highway Dept	LSWPG, CWSRF	TBD	LS2
	LS3-f	Assessment	Evaluate needs for green infrastructure improvements and identify funding mechanisms to further priority projects.	Highway Dept, UVLSRPC	LSWPG, CWSRF	2	LS2, MS1
	LS3-g	Education	Educate the public on PFAS impact on wastewater management to encourage reductions in contamination.	Water & Sewer Dept, LSPA, LSRCC	LSWPG	TBD	LS1
	LS3-h	Education	Educate the public on protecting drinking water. Support and consider expanding the LSPA Watershed Wise program to be Town-wide. Consult Town Forest Management Plan.	LSPA	LSWPG	3	LS2
	LS3-i	Regulatory	Expand the Aquifer Overlay District to include wellhead protection areas, including future municipal wells at Wendell Marsh.	Water & Sewer Dept, PB	LSWPG	1	
	LS3-j	Regulatory	Reclassify areas around drinking water wells according to the state Groundwater Protection Act*	Water & Sewer Dept, PB	LSWPG	3	LS1
LS4 – Invasives Mgmt	LS4-a	Assessment	Inventory and map locations with known invasive species.	Highway Dept, LSPA	Volunteer Driven	1	MS2
	LS4-b	Education	Educate the public on identification of invasive species and known mechanisms in their spread. Support and consider expanding the LSPA Invasive Monitor program to be Town-wide and include terrestrial invasives.	LSPA	TBD	TBD	MS1
	LS4-c	Management	Create an Invasives Management plan. Prioritize invasives management at Scenic Viewing sites. Incorporate native species plantings when appropriate.		TBD	TBD	MS2
	General	Discussion	Regular review and discussion of Conservation plan.	SCC	NA	March, September	

Table 18. 2022 Conservation Plan Action List for the Sunapee Conservation Commission.
*Note: Those actions previously mentioned in SCC planning documents are indicated with a *.*

Shorthand Partner Note: PB = Planning Board, ZBA = Zoning Board of Adjustment, LSPA = Lake Sunapee Protective Association; LSRCC = Lake Sunapee Regional Chamber of Commerce; SRKG = Sunapee Ragged Kearsarge Greenway.

Shorthand Funding Note: NA = fits within baseline function of SCC; CWSRF = NHDES Clean Water State Revolving Fund; LSWPG = NHDES Local Source Water Protection Grant Program; InvestNH = NH Housing InvestNH Grant Program.

8. MAPS

The maps in this NRI and Conservation Plan are include:

Map 1. Local Geography
Map 2. Geology
Map 3. Topography
Map 4. Level IV Ecoregion around Sunapee
Map 5. Surface Waters: Waterbodies and Streams
Map 6. Community and Development
Map 7. Land Cover
Map 8. Wildlife and Important Habitat
Map 9. Habitat Types
Map 10. Surface Waters: Wetlands
Map 11. Groundwater
Map 12. Agriculture
Map 13. Forest Soil Productivity
Map 14. Culturally Historic Resources
Map 15. Recreation and Conserved Land
Map 16. Resiliency Network
Map 17. Recognized Biodiversity
Map 18. Resilient Sites
Map 19. Local Connectedness
Map 20. Regional Wildlife Flow
Map 21. Zoning
Map 22. Water Protections
Map 23. Natural Resource Co-Occurrence and Priority Geographic Zones

9. APPENDICES

9.01 Appendix A : Data Source Documentation

Name	Date	Source
Political boundaries	2021	NH GRANIT/VCGI
Roads	2021	NH DOT/VCGI
Deeryards	2021	NH GRANIT
Surface water (National Hydrography Plus Dataset)	2018	US Geological Survey
Watershed boundaries (National Hydrography Plus Dataset)	2018	US Geological Survey
Wetlands (National Wetlands Inventory)	2021	US Fish and Wildlife Service
Soils	2021	NRCS SSURGO Database
Rare species and communities	2022	NH Natural Heritage Bureau
Topography and Slopes, LiDAR	2021	NH GRANIT
Vernal Pools	2021	Sunapee Conservation Commission
Prominent Peaks	2021	Sunapee Conservation Commission
Ecoregion	2013	Commission for Environmental Cooperation
Active Farms	2022	Sunapee Conservation Commission
Conserved Land	2022	Town of Sunapee
Current Use Land	2022	Town of Sunapee
Tax Map Parcels	2022	Town of Sunapee
Zoning Districts	2022	Town of Sunapee
Wildlife Habitat Type and Tier (Wildlife Action Plan)	2020	NH Fish and Wildlife Service
National Land Cover Dataset	2001,2011, 2019	Multi-Resolution Land Characteristics (MRLC) consortium
Climate Change Resilience Dataset	2016	The Nature Conservancy
Aquifers	2007	US Geological Survey
Public Water Supplies	2022	NH DES
Wellhead Protection Areas	2022	NH DES
Flood Hazard Areas	2021	Federal Emergency Management Agency
Shoreland Protection area	2020	NH DES
Habitat Blocks	2021	Linking Lands Alliance
Wendell Marsh Wells and Sanitary zone	2015	Town of Sunapee

Data distributed by NH GRANIT, the state's GIS Clearinghouse, are periodically updated, as new data sources become available and conditions on the ground change.

NH GRANIT Data Disclaimer: Digital data in NH GRANIT represents the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the Office of Energy and Planning (OEP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. OEP, CSRC, and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data.

Current Use Category Definitions:

1. Farmland means any cleared land devoted to or capable of agricultural or horticultural use as determined and classified by criteria developed by the NH Commissioner of Agriculture, Markets, and Food and adopted by the Current Use Board.
2. Forest land means any land growing trees as determined and classified by criteria developed by the state forester and adopted by the board. For the purposes of this paragraph, the board shall recognize the cost of responsible land stewardship in the determination of assessment ranges.
3. Forest land with documented stewardship has a lower assessment, to reflect the cost of active stewardship of the land; documentation of a Certified Tree Farm, a Forest Stewardship plan from a licensed forester, or a summary of a Forest Stewardship plan developed privately are sufficient to enroll a parcel in current use as forest land with documented stewardship.
4. Unproductive Land means land, including wetlands, which by its nature is incapable of producing agricultural or forest products due to poor soil or site characteristics, or the location of which renders in inaccessible or impractical to harvest agricultural or forest products, as determined and classified by criteria developed by the board. The board shall develop only one category for all unproductive land, setting its current use value equal to that of the lowest current use value established by the board for any other category.
5. Wetland means those areas of farm, forest and unproductive land that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support and that under normal circumstances.

National Land Cover Database Class Legend Description

Class\ Value	Classification Description
Water	
11	**Open Water**- areas of open water, generally with less than 25% cover of vegetation or soil.
12	**Perennial Ice/Snow**- areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.
Developed	
21	**Developed, Open Space**- areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22	**Developed, Low Intensity**- areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
23	**Developed, Medium Intensity** -areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
24	**Developed High Intensity**-highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.
Barren	

	31 **Barren Land (Rock/Sand/Clay)** - areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
Forest	
	41 **Deciduous Forest**- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
	42 **Evergreen Forest**- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
	43 **Mixed Forest**- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
Shrubland	
	51 **Dwarf Scrub**- Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.
	52 **Shrub/Scrub**- areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Herbaceous	
	71 **Grassland/Herbaceous**- areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
	72 **Sedge/Herbaceous**- Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.
	73 **Lichens**- Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.
	74 **Moss**- Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.
Planted/Cultivated	
	81 **Pasture/Hay**-areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
	82 **Cultivated Crops** -areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
Wetlands	
	90 **Woody Wetlands**- areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
	95 **Emergent Herbaceous Wetlands**- Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

9.02 Appendix B : Ecoregions

This Appendix contains Ecoregion maps for:

1. Level III and IV for New England
2. Level III for the Continental United States
3. Level I and II for North America

Level III and IV Ecoregions of New England

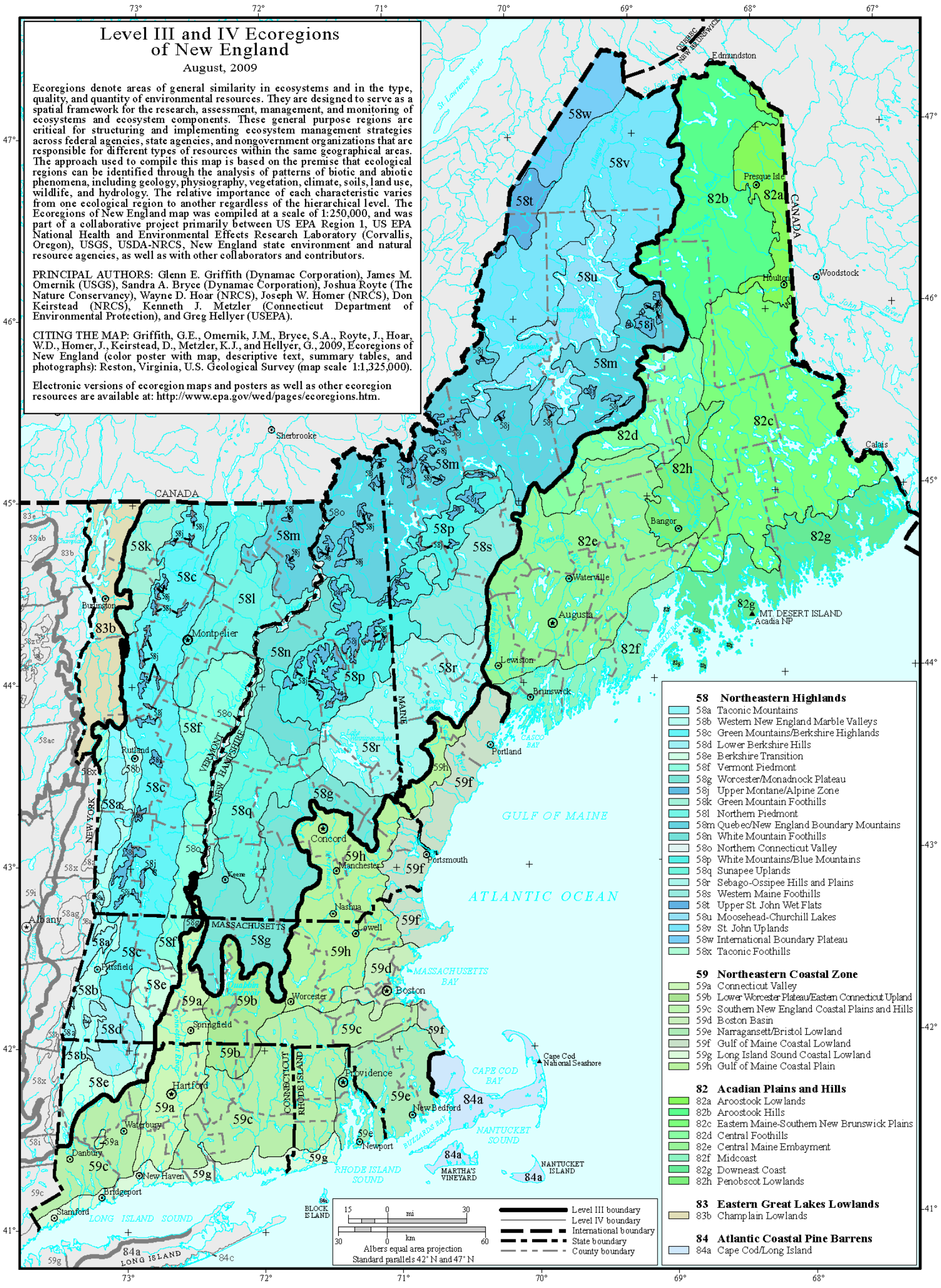
August, 2009

Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. These general purpose regions are critical for structuring and implementing ecosystem management strategies across federal agencies, state agencies, and nongovernment organizations that are responsible for different types of resources within the same geographical areas. The approach used to compile this map is based on the premise that ecological regions can be identified through the analysis of patterns of biotic and abiotic phenomena, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The relative importance of each characteristic varies from one ecological region to another regardless of the hierarchical level. The Ecoregions of New England map was compiled at a scale of 1:250,000, and was part of a collaborative project primarily between US EPA Region 1, US EPA National Health and Environmental Effects Research Laboratory (Corvallis, Oregon), USGS, USDA-NRCS, New England state environment and natural resource agencies, as well as with other collaborators and contributors.

PRINCIPAL AUTHORS: Glenn E. Griffith (Dynamac Corporation), James M. Omernik (USGS), Sandra A. Bryce (Dynamac Corporation), Joshua Royte (The Nature Conservancy), Wayne D. Hoar (NRCS), Joseph W. Homer (NRCS), Don Keirstead (NRCS), Kenneth J. Metzler (Connecticut Department of Environmental Protection), and Greg Hellyer (USEPA).

CITING THE MAP: Griffith, G.E., Omernik, J.M., Bryce, S.A., Royte, J., Hoar, W.D., Homer, J., Keirstead, D., Metzler, K.J., and Hellyer, G., 2009, Ecoregions of New England (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,325,000).

Electronic versions of ecoregion maps and posters as well as other ecoregion resources are available at: http://www.epa.gov/wed/pages/ecoregions.htm.



58 Northeastern Highlands

- 58a Taconic Mountains
- 58b Western New England Marble Valleys
- 58c Green Mountains/Berkshire Highlands
- 58d Lower Berkshire Hills
- 58e Berkshire Transition
- 58f Vermont Piedmont
- 58g Worcester/Monadnock Plateau
- 58j Upper Montane/Alpine Zone
- 58k Green Mountain Foothills
- 58l Northern Piedmont
- 58m Quebec/New England Boundary Mountains
- 58n White Mountain Foothills
- 58o Northern Connecticut Valley
- 58p White Mountains/Blue Mountains
- 58q Sunapee Uplands
- 58r Sebago-Ossipee Hills and Plains
- 58s Western Maine Foothills
- 58t Upper St. John Wet Flats
- 58u Moosehead-Churchill Lakes
- 58v St. John Uplands
- 58w International Boundary Plateau
- 58x Taconic Foothills

59 Northeastern Coastal Zone

- 59a Connecticut Valley
- 59b Lower Worcester Plateau/Eastern Connecticut Upland
- 59c Southern New England Coastal Plains and Hills
- 59d Boston Basin
- 59e Narragansett/Bristol Lowland
- 59f Gulf of Maine Coastal Lowland
- 59g Long Island Sound Coastal Lowland
- 59h Gulf of Maine Coastal Plain

82 Acadian Plains and Hills

- 82a Aroostook Lowlands
- 82b Aroostook Hills
- 82c Eastern Maine-Southern New Brunswick Plains
- 82d Central Foothills
- 82e Central Maine Embayment
- 82f Midcoast
- 82g Downeast Coast
- 82h Penobscot Lowlands

83 Eastern Great Lakes Lowlands

- 83b Champlain Lowlands

84 Atlantic Coastal Pine Barrens

- 84a Cape Cod/Long Island

new_eng_eco_pg_v4GG 09/17/09

Level III Ecoregions of the Continental United States

(Revised April 2013)

National Health and Environmental Effects Research Laboratory

U.S. Environmental Protection Agency

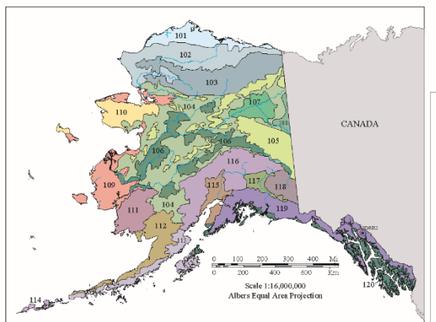
1. Coast Range
2. Puget Lowland
3. Willamette Valley
4. Cascades
5. Sierra Nevada
6. Central California Foothills and Coastal Mountains
7. Central California Valley
8. Southern California Mountains
9. Eastern Cascades Slopes and Foothills
10. Columbia Plateau
11. Blue Mountains
12. Snake River Plain
13. Central Basin and Range
14. Mojave Basin and Range
15. Northern Rockies
16. Idaho Batholith
17. Middle Rockies
18. Wyoming Basin
19. Wasatch and Uinta Mountains
20. Colorado Plateaus
21. Southern Rockies
22. Arizona/New Mexico Plateau
23. Arizona/New Mexico Mountains
24. Chihuahuan Deserts
25. High Plains
26. Southwestern Tablelands
27. Central Great Plains
28. Flint Hills
29. Cross Timbers
30. Edwards Plateau
31. Southern Texas Plains
32. Texas Blackland Prairies
33. East Central Texas Plains
34. Western Gulf Coastal Plain
35. South Central Plains
36. Ouachita Mountains
37. Arkansas Valley
38. Boston Mountains
39. Ozark Highlands
40. Central Irregular Plains
41. Canadian Rockies
42. Northwestern Glaciated Plains
43. Northwestern Great Plains
44. Nebraska Sand Hills
45. Piedmont
46. Northern Glaciated Plains
47. Western Corn Belt Plains
48. Lake Agassiz Plain
49. Northern Minnesota Wetlands
50. Northern Lakes and Forests
51. North Central Hardwood Forests
52. Driftless Area
53. Southeastern Wisconsin Till Plains
54. Central Corn Belt Plains
55. Eastern Corn Belt Plains
56. Southern Michigan/Northern Indiana Drift Plains
57. Huron/Erie Lake Plains
58. Northeastern Highlands
59. Northeastern Coastal Zone
60. Northern Allegheny Plateau
61. Erie Drift Plain
62. North Central Appalachians
63. Middle Atlantic Coastal Plain
64. Northern Piedmont
65. Southeastern Plains
66. Blue Ridge
67. Ridge and Valley
68. Southwestern Appalachians
69. Central Appalachians
70. Western Allegheny Plateau
71. Interior Plateau
72. Interior River Valleys and Hills
73. Mississippi Alluvial Plain
74. Mississippi Valley Loess Plains
75. Southern Coastal Plain
76. Southern Florida Coastal Plain
77. North Cascades
78. Klamath Mountains/California High North Coast Range
79. Madrean Archipelago
80. Northern Basin and Range
81. Sonoran Basin and Range
82. Acadian Plains and Hills
83. Eastern Great Lakes Lowlands
84. Atlantic Coastal Pine Barrens
85. Southern California/Northern Baja Coast

0 100 200 300 400 Mi

0 200 400 600 Km

Scale 1:7,500,000

Albers Equal Area Projection



101. Arctic Coastal Plain
102. Arctic Foothills
103. Brooks Range
104. Interior Forested Lowlands and Uplands
105. Interior Highlands
106. Interior Bottomlands
107. Yukon Flats
108. Ogilvie Mountains
109. Subarctic Coastal Plains
110. Seward Peninsula
111. Ahklun and Kilbuck Mountains
112. Bristol Bay-Nushagak Lowlands
113. Alaska Peninsula Mountains
114. Aleutian Islands (Western portion not shown)
115. Cook Inlet
116. Alaska Range
117. Copper Plateau
118. Wrangell Mountains
119. Pacific Coastal Mountains
120. Coastal Western Hemlock-Sitka Spruce Forests

Ecoregions are areas where ecosystems (and the type, quality, and quantity of environmental resources) are generally similar. This ecoregion framework is derived from Omernik (1987) and from mapping done in collaboration with U.S. EPA regional offices, other Federal agencies, state resource management agencies, and neighboring North American countries (Omernik and Griffith 2014). Designed to serve as a spatial framework for the research, assessment, and monitoring of ecosystems and ecosystem components, ecoregions denote areas of similarity in the mosaic of biotic, abiotic, terrestrial, and aquatic ecosystem components, with humans considered as part of the biota. These ecoregions have been used to develop regional biological criteria and water quality standards, set management goals for nonpoint source pollution, assess land cover trends, report on ecosystem carbon sequestration, and frame wildlife conservation research, among other applications.

Ecological regions can be identified by analyzing the patterns and composition of biotic and abiotic phenomena that affect or reflect differences in ecosystem quality and integrity (Omernik 1987, 1995). These phenomena include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The relative importance of each characteristic varies from one ecological region to another regardless of the hierarchical level. A Roman numeral classification scheme has been adopted for different levels of ecological regions. Level I is the coarsest level, dividing North America into 15 ecological regions; at Level II the continent is subdivided into 50 classes (CEC 1997, 2006). Level III, shown here, has 105 ecoregions in the continental U.S. For the conterminous United States, the ecoregions have been further subdivided to 967 Level IV ecoregions. Details about the ecoregions or their applications are explained in reports and publications from the state and regional projects (e.g., Bryce et al., 1998, 2003; Chapman et al., 2001, 2006; Gallant et al., 1989, 1995; Griffith et al., 2004, 2009, 2014; McGrath et al., 2002; Omernik, 2004; Omernik et al., 2000; Thorson et al., 2003; Wilken et al., 2011; and Woods et al., 1996, 2002, 2004). For additional information, contact James M. Omernik, USGS, c/o U.S. EPA, 200 SW 35th Street, Corvallis, OR 97333, phone (541) 754-4458, email omernik.james@epa.gov; or Glenn Griffith, USGS, c/o US EPA, 200 SW 35th Street, Corvallis, OR 97333, phone (541) 754-4465, email ggriffith@usgs.gov.

REFERENCES CITED

Bryce, S.A., J.M. Omernik, D.E. Pater, M. Ulmer, J. Schaar, J. Freeouf, R. Johnson, P. Kuck, and S.H. Azevedo. 1998. Ecoregions of North Dakota and South Dakota (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,500,000.

Bryce, S.A., A.J. Woods, J.D. Morefield, J.M. Omernik, T.R. McKay, G.K. Brackley, R.K. Hall, D.K. Higgins, D.C. McMorran, K.E. Vargas, E.B. Petersen, D.C. Zamudio, and J.A. Comstock. 2003. Ecoregions of Nevada (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,350,000.

Chapman, S.S., G.E. Griffith, J.M. Omernik, A.B. Price, J. Freeouf, and D.L. Schrupp. 2006. Ecoregions of Colorado (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,200,000.

Chapman, S.S., J.M. Omernik, J.A. Freeouf, D.G. Huggins, J.R. McCauley, C.C. Freeman, G. Steinauer, R.T. Angelo, and R.L. Schlepp. 2001. Ecoregions of Nebraska and Kansas (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,950,000.

Commission for Environmental Cooperation. 1997. Ecological regions of North America: toward a common perspective. Commission for Environmental Cooperation, Montreal, Quebec, Canada. 71 p. Map (scale 1:12,500,000).

Commission for Environmental Cooperation. 2006. Ecological regions of North America – Levels I, II, and III: Montreal, Quebec, Canada, Commission for Environmental Cooperation, scale 1:10,000,000, https://www.epa.gov/eco-research/ecoregions-north-america.

Gallant, A.L., T.R. Whittier, D.P. Larsen, J.M. Omernik, and R.M. Hughes. 1989. Regionalization as a tool for managing environmental resources. EPA/600/3-89/060. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR. 152p.

Gallant, A.L., E.F. Binnian, J.M. Omernik, and M.B. Shasby. 1995. Ecoregions of Alaska. U.S. Geological Survey Professional Paper 1567. U.S. Government Printing Office, Washington D.C. 73 p.

Griffith, G.E., S.A. Bryce, J.M. Omernik, J.A. Comstock, A.C. Rogers, B. Harrison, S.L. Hatch, and D. Bezanson. 2004. Ecoregions of Texas. (map poster). U.S. Geological Survey, Reston, VA. Scale 1:2,500,000.

Griffith, G.E., J.M. Omernik, S.A. Bryce, J. Royte, W.D. Hoar, J.W. Horner, D. Keirstead, K.J. Metzler, and G. Hellyer. 2009. Ecoregions of New England (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,325,000.

Griffith, G.E., J.M. Omernik, C.B. Johnson, and D.S. Turner. 2014. Ecoregions of Arizona (map poster). U.S. Geological Survey Open-File Report 2014-1141, map scale 1:1,325,000, http://dx.doi.org/10.3133/ofr20141141.

McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher. 2002. Ecoregions of Idaho (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,350,000.

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Map (scale 1:7,500,000). Annals of the Association of American Geographers 77(1):118-125.

Omernik, J.M. 1995. Ecoregions: A spatial framework for environmental management. In: Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Davis, W.S. and T.P. Simon (eds.). Lewis Publishers, Boca Raton, FL. Pp. 49-62.

Omernik, J.M. 2004. Perspectives on the nature and definition of ecological regions. Environmental Management 34 (Suppl. 1): S27-S38.

Omernik, J.M., S.S. Chapman, R.A. Lillie, and R.T. Dumke. 2000. Ecoregions of Wisconsin. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 88:77-103.

Omernik, J.M. and G.E. Griffith. 2014. Ecoregions of the conterminous United States: evolution of a hierarchical spatial framework. Environmental Management 54(6):1249-1266, http://dx.doi.org/10.1007/s00267-014-0364-1.

Thorson, T.D., S.A. Bryce, D.A. Lammers, A.J. Woods, J.M. Omernik, J. Kagan, D.E. Pater, and J.A. Comstock. 2003. Ecoregions of Oregon (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,350,000.

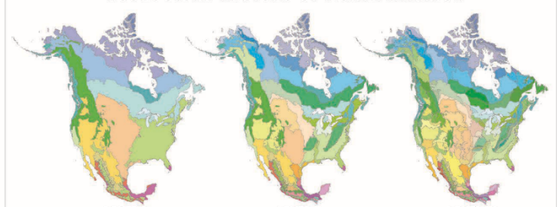
Wilken, E., Jiménez Nava, F., and Griffith, G. 2011. North American Terrestrial Ecoregions-Level III. Commission for Environmental Cooperation, Montreal, Canada. 149 p., https://www.epa.gov/eco-research/ecoregions-north-america.

Woods, A.J., T.L. Foti, Chapman, S.S., J.M. Omernik, J. Wise, E.O. Murray, W.L. Prior, J. Pagan, J.A. Comstock, and M. Radford. 2004. Ecoregions of Arkansas (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,000,000.

Woods, A.J., J.M. Omernik, D.D. Brown, and C.W. Kiilsgaard. 1996. Level III and IV ecoregions of Pennsylvania and the Blue Ridge Mountains, the Ridge and Valley, and Central Appalachians of Virginia, West Virginia, and Maryland. EPA/600/R-96/077. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Corvallis, OR. 50p.

Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor. 2002. Ecoregions of Kentucky. (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,000,000.

ECOLOGICAL REGIONS OF NORTH AMERICA



The names and identification numbers for North American Level I, II, and III ecological regions are given in CEC 1997, 2006.

CITING THIS MAP: U.S. Environmental Protection Agency, 2013, Level III ecoregions of the continental United States: Corvallis, Oregon, U.S. EPA – National Health and Environmental Effects Research Laboratory, map scale 1:7,500,000, https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states.

Ecological regions are areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. They are effective for national and regional state of the environment reports, environmental resource inventories and assessments, setting regional resource management goals, determining carrying capacity, as well as developing biological criteria and water quality standards. The development of a clear understanding of regional and large continental ecosystems is critical for evaluating ecological risk, sustainability, and health.

The maps shown here represent a second attempt to holistically classify and map ecological regions across the North American continent (Commission for Environmental Cooperation Working Group, 1997). The mapping from 1997 and 2006 was built upon earlier efforts that had begun individually in all three countries (e.g., Wiken 1986; Omernik 1987). These approaches recognized the need to consider a full range of physical and biotic characteristics to explain ecosystem regions (Omernik 2004). Equally, they recognized that the relative importance of each characteristic varies from one ecological region to another regardless of the hierarchical level. In describing ecoregionalization in Canada, Wiken (1986) stated:

> *Ecological land classification is a process of delineating and classifying ecologically distinctive areas of the Earth's surface. Each area can be viewed as a discrete system which has resulted from the mesh and interplay of the geologic, landform, soil, vegetative, climatic, wildlife, water and human factors which may be present. The dominance of any one or a number of these factors varies with the given ecological land unit. This holistic approach to land classification can be applied incrementally on a scale related basis from very site-specific ecosystems to very broad ecosystems.*

Determining ecological regions at a continental level is a challenging task. It is difficult, in part, because North America is ecologically diverse and because a nation's territorial boundaries can be a hindrance to seeing and appreciating the perspectives across the landmass of three countries. Developing and refining a framework of North American ecological regions has been the product of research and consultation between federal, state, provincial and territorial agencies. Those agencies were often government departments, but the initiative also involved nongovernmental groups, universities and institutes. The Commission for Environmental Cooperation (CEC) was instrumental in bringing these groups together. The CEC was established in 1994 by Canada, Mexico and the United States to address environmental concerns common to the three countries. The CEC derives its formal mandate from the North American Agreement on Environmental Cooperation (NAAEC). The environmental side accord to the North American Free Trade Agreement (NAFTA).

These maps represent the working group's best consensus on the distribution and characteristics of major ecosystems on all three levels throughout the three North American countries. The methodology incorporated these points in mapping ecological regions:

- Ecological classification incorporates all major components of ecosystems: air, water, land, and biota, including humans.
- It is holistic ("the whole is greater than the sum of its parts")
- The number and relative importance of factors that are helpful in the delineation process vary from one area to another, regardless of the level of generalization.
- Ecological classification is based on hierarchy—ecosystems are nested within ecosystems as mapped, although in reality, they may not always nest.
- Such classification integrates knowledge: it is not an overlay process.
- It recognizes that ecosystems are interactive—characteristics of one ecosystem blend with those of another.
- Map lines depicting ecological classification boundaries generally coincide with the location of zones of transition.

A Roman numeral hierarchical scheme has been adopted for different levels of ecological regions. Level I is the coarsest level, dividing North America into 15 broad ecological regions. These highlight major ecological areas and provide the broad backdrop to the ecological mosaic of the continent, putting it in context at global or intercontinental scales. The 50 Level II ecological regions that have been delineated are intended to provide a more detailed description of the large ecological areas nested within the level I regions. Level II ecological regions are useful for national and subcontinental overviews of ecological patterns. At level III, the continent currently contains 182 ecological regions. The level III ecological region map depicts revisions and subdivisions of earlier level I, II, and III ecological regions (CEC 1997, McMahon et al., 2001, Omernik 1987, USEPA 2006, Wiken 1986, Wiken et al., 1996). These smaller divisions enhance regional environmental monitoring, assessment and reporting, as well as decision-making. Because level III regions are smaller, they allow locally defining characteristics to be identified, and more specifically oriented management strategies to be formulated.

Literature Cited:

Commission for Environmental Cooperation Working Group. 1997. Ecological regions of North America – toward a common perspective. Montreal: Commission for Environmental Cooperation, 71 p.

McMahon, G., Gregonis, S.M., Waltman, S.W., Omernik, J.M., Thorson, T.D., Freeouf, J.A., Rorick, A.H., and Keys, J.E., 2001, Developing a spatial framework of common ecological regions for the conterminous United States: Environmental Management, v. 28, no. 4, p. 293-316.

Omernik, J.M., 1987, Ecoregions of the conterminous United States (map supplement): Annals of the Association of American Geographers, v. 77, no. 1, p. 118-125, scale 1:7,500,000.

Omernik, J.M., 2004, Perspectives on the nature and definition of ecological regions: Environmental Management, v. 34, Supplement 1, p. s27-s38.

U.S. Environmental Protection Agency, 2006, Level III ecoregions of the continental United States (revision of Omernik, 1987): Corvallis, Oregon, USEPA, National Health and Environmental Effects Research Laboratory, Map M-1, various scales.

Wiken, E.B., 1986, Terrestrial ecozones of Canada: Ottawa, Ontario, Environment Canada, Ecological Land Classification Series no. 19, 26 p.

Wiken, E.B., Gauthier, D., Marshall, I.B., Lawton, K., and Hirvonen, H., 1996, A perspective on Canada's ecosystems: An overview of the terrestrial and marine ecozones: Ottawa, Ontario, Canadian Council on Ecological Areas, Occasional Paper No. 14, 95 p.

9.03 Appendix C : Habitat Types & Associated Species

This Appendix contains the habitat summary brochures for the following:

1. Hemlock-Hardwood-Pine Forest
2. Northern Hardwood-Conifer Forests
3. Grasslands
4. Shorelines
5. Headwater Streams
6. Marsh and Shrub Wetlands
7. Natural Community: Montane - subalpine circumneutral cliff
8. Natural Community: Northern hardwood - conifer forest system

9.04 Appendix D : Soil Survey Descriptions

This data dictionary provides essential information about the soil attributes contained in the spreadsheet tables located on the NH NRCS web site http://www.nh.nrcs.usda.gov/Soil_Data/Soil_Data or the attribute table accompanying the NRCS soil spatial data distributed through GRANIT (NHSoilMaster.dbf). The description, units of measure and labeling of soil attributes conforms to the standards of the USDA National Cooperative Soil Survey (NCSS) and the National Soil Information System (NASIS). The data contained within the tables are consistent with, and are derived from, the NRCS National Soil Information System. The tables located on the NH NRCS web site reflect the official soil dataset for New Hampshire. They take precedence over any other source of soil information. The attribute information is specific for each survey area and reflects the most current level of understanding of soil properties and their behavioral characteristics. This data may not agree with previously published soil survey reports that represent historical records of our level of knowledge at the time of publication. Likewise, the attribute data that is provided in these tables are subject to change as the soil survey program continues to refine our ability to measure and interpret soil physical and chemical properties. It is the responsibility of the users of this information to adequately document when these attributes were retrieved for a specific purpose and that any land use decision made based on these attributes reflect the NCSS standards at that time. Because this data is subject to change, it is the user's responsibility to update their records as appropriate and not to rely on data previously downloaded from the NH NRCS web site or from the GRANIT web site.

9.04(a) Farmland classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

9.04(b) Forest soil group

NH Forest Soil Groups (NHFSGs) consist of map units that are similar in their potential for commercial forest products, their suitability for native tree growth, and their use and management. Considered in grouping the map units are depth to bedrock, texture, saturated hydraulic conductivity, available water capacity, drainage class, and slope. The grouping applies only to soils in the State of New Hampshire.

The NHFSGs have been developed to help land users and managers in New Hampshire evaluate the relative productivity of soils and to better understand patterns of plant succession and how soil and site interactions influence management decisions. The soils are assigned to one of five groups (IA, IB, IC, IIA, and IIB). Several map units in New Hampshire either vary so greatly or have such a limited potential for commercial forest products that they have not been assigned to an NHFSG (NC). Examples of NC map units are very poorly drained soils and soils at high elevations. The kinds of tree species generally growing in climax stands in each of the five NHFSGs vary from county to county. This information is available through local NRCS field offices.

IA—This group consists of very deep, loamy, moderately well drained or well drained soils. Generally, these soils are more fertile than other soils and have the most favorable soil moisture relationships.

IB—The soils in this group are generally sandy or loamy over sandy material and are slightly less fertile than group IA soils. Group IB soils are moderately well drained or well drained. Their soil moisture is adequate for good tree growth, but it may not be quite as abundant as that in group IA soils.

IC—The soils in this group are in areas of outwash sand and gravel. They are moderately well to excessively drained. Their soil moisture is adequate for good softwood growth but is limited for hardwoods.

IIA—This diverse group includes many of the same soils as those in groups IA and IB. The soils are separated into a unique group, however, because they have physical limitations that make forest management more difficult and costly, i.e., steep slopes, bedrock outcrops, erosive textures, surface boulders, and extreme rockiness.

IIB—The soils in this group are poorly drained. The seasonal high water table is generally within 12 inches of the surface. Productivity is generally less than that of soils in the other groups.

NC—The map units in this category either vary so greatly or have such a limited potential for commercial forest products that they have not been assigned to an NHFSG. Commonly, onsite visit would be required to evaluate the situation.

9.04(c) Hydric soils

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these

soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

9.04(d) Gravel source

Gravel consists of natural aggregates (2 to 75 millimeters in diameter) suitable for commercial use with a minimum of processing. It is used in many kinds of construction. Specifications for each use vary widely. Only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of gravel are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains gravel, the soil is considered a likely source regardless of thickness. The assumption is that the gravel layer below the depth of observation exceeds

the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be gravel.

The soils are rated "good," "fair," or "poor" as potential sources of gravel. A rating of "good" or "fair" means that the source material is likely to be in or below the soil. The bottom layer and the thickest layer of the soils are assigned numerical ratings. These ratings indicate the likelihood that the layer is a source of gravel. The number 0.00 indicates that the layer is a poor source. The number 1.00 indicates that the layer is a good source. A number between 0.00 and 1.00 indicates the degree to which the layer is a likely source.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

9.04(e) Sand source

Sand is a natural aggregate (0.05 millimeter to 2 millimeters in diameter) suitable for commercial use with a minimum of processing. It is used in many kinds of construction. Specifications for each use vary widely. Only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains sand, the soil is considered a likely source regardless of thickness. The assumption is that the sand layer below the depth of observation exceeds the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet.

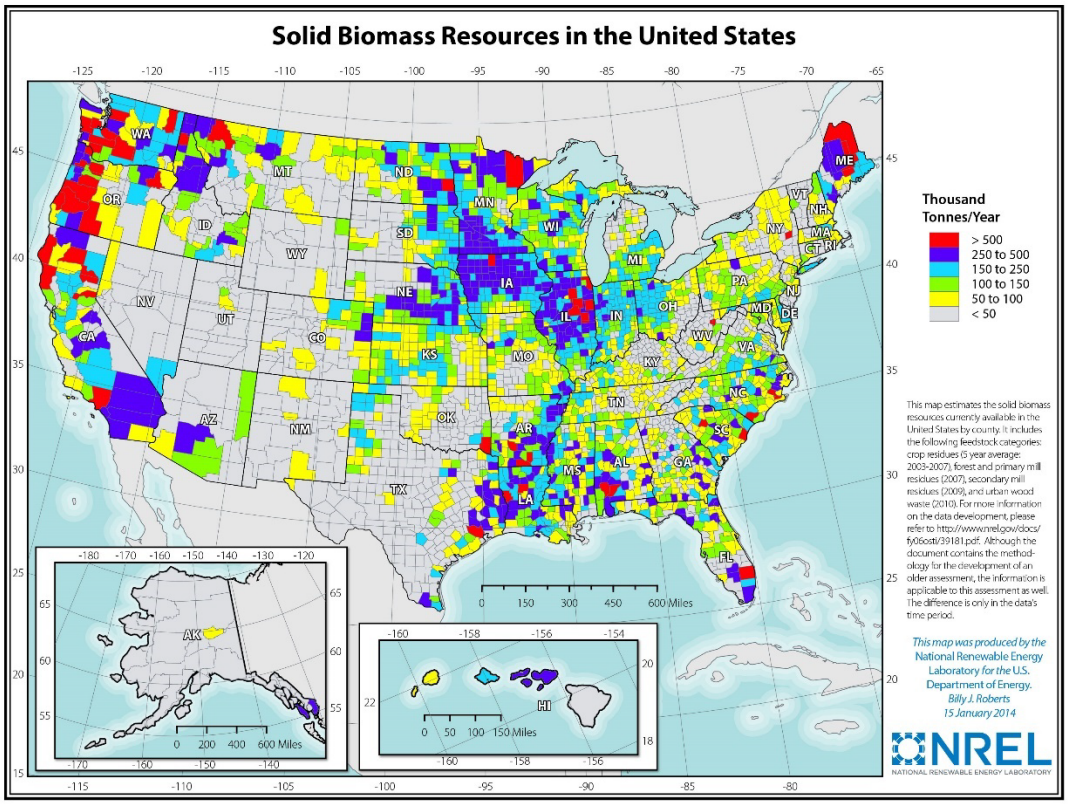
The soils are rated "good," "fair," or "poor" as potential sources of sand. A rating of "good" or "fair" means that sand is likely to be in or below the soil. The bottom layer and the thickest layer of the soil are assigned numerical ratings. These ratings indicate the likelihood that the layer is a source of sand. The number 0.00 indicates that the layer is a "poor source." The number 1.00 indicates that the layer is a "good source." A number between 0.00 and 1.00 indicates the degree to which the layer is a likely source.

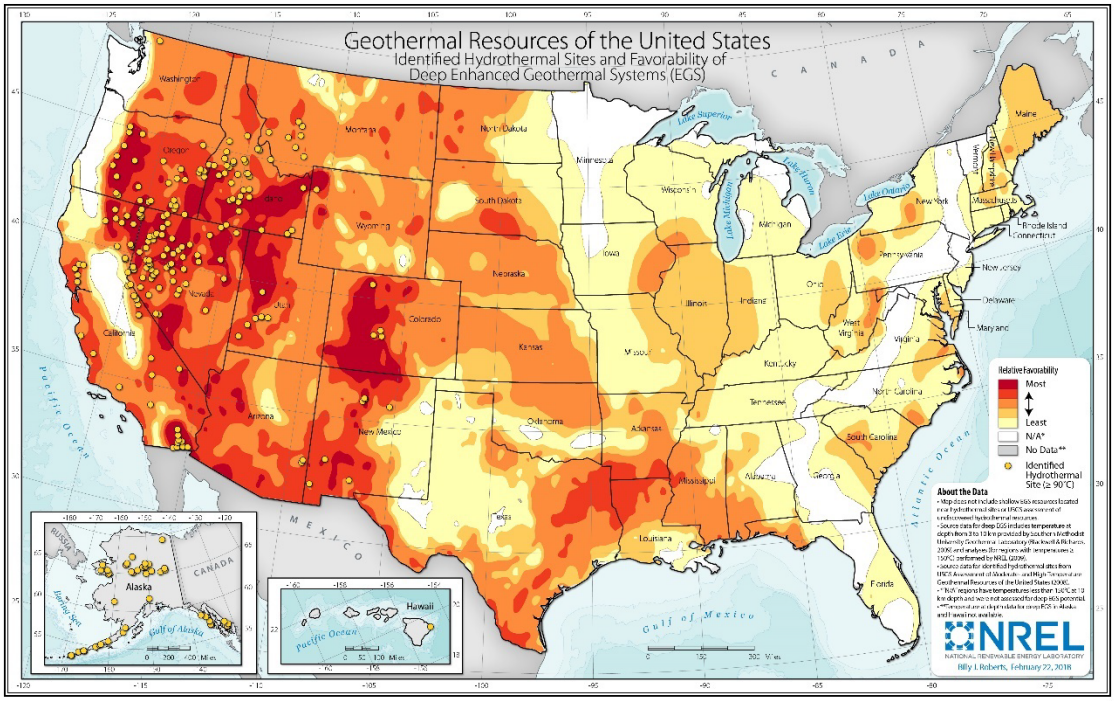
The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent

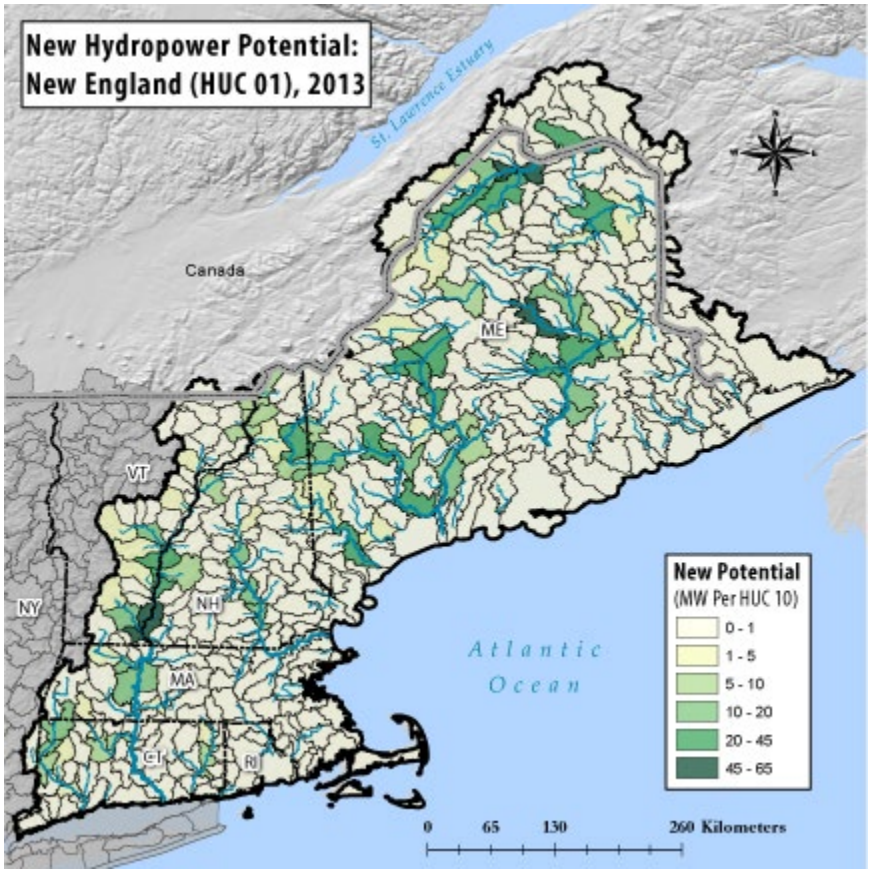
composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

9.05 Appendix E : Renewable Energy

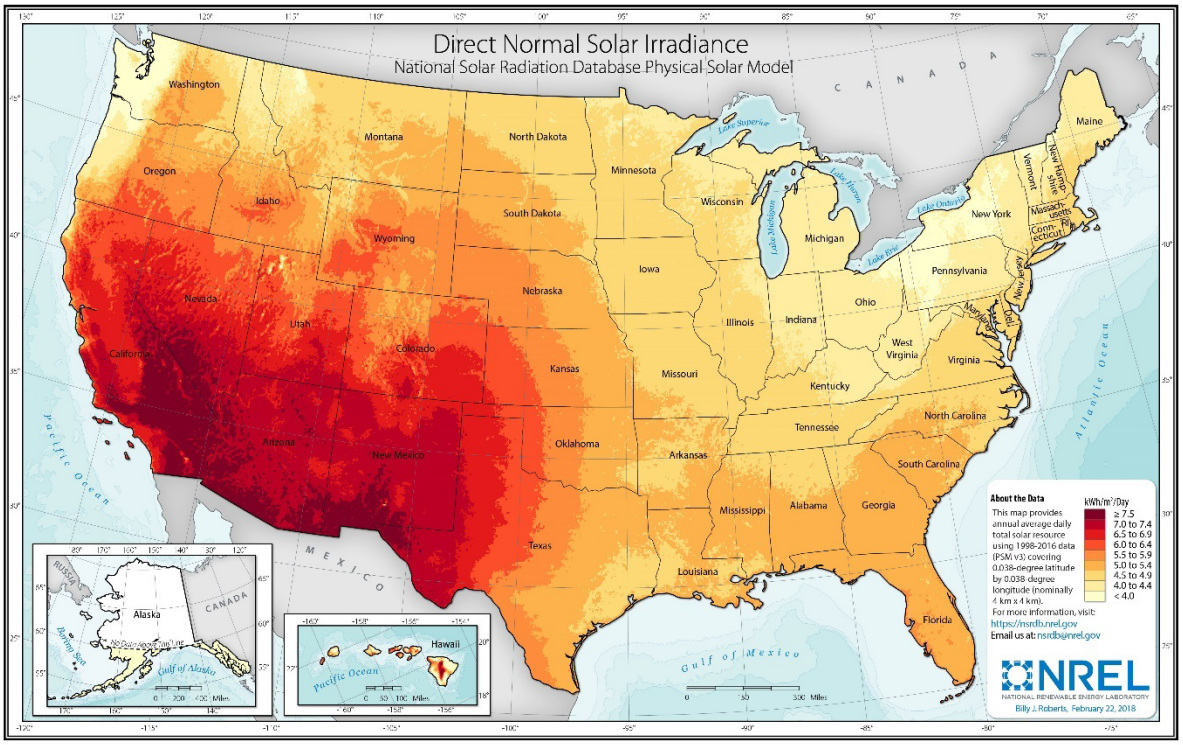


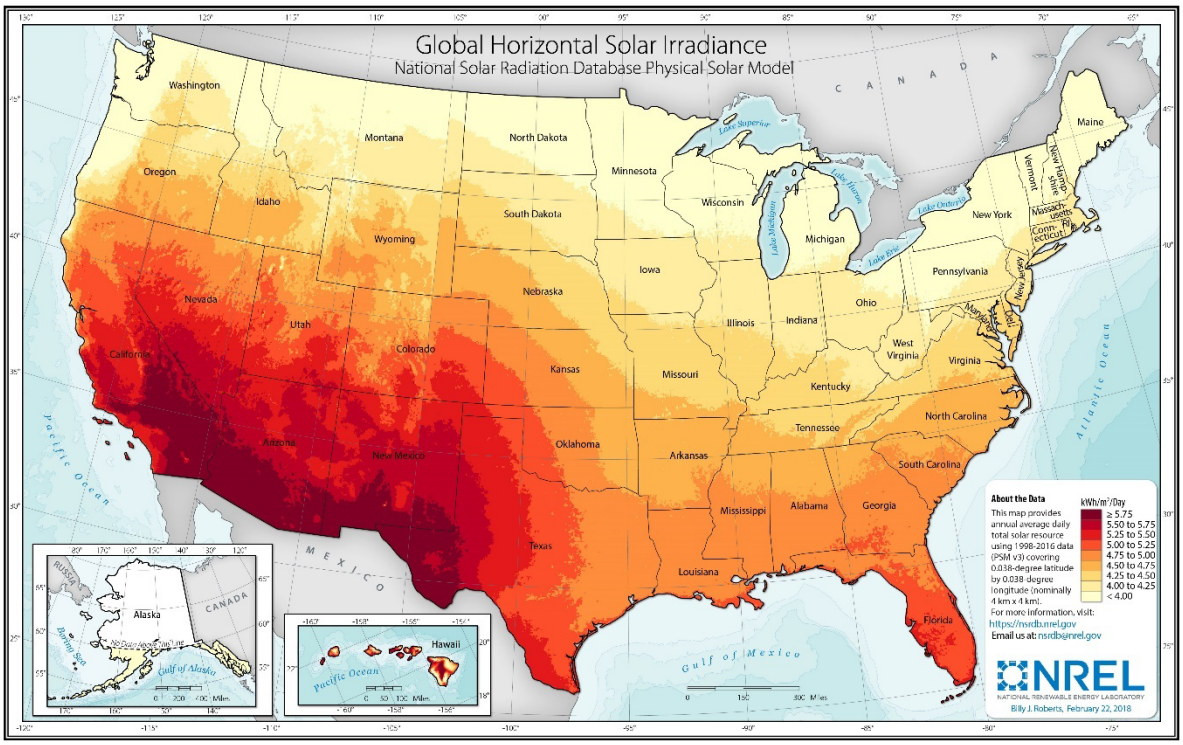




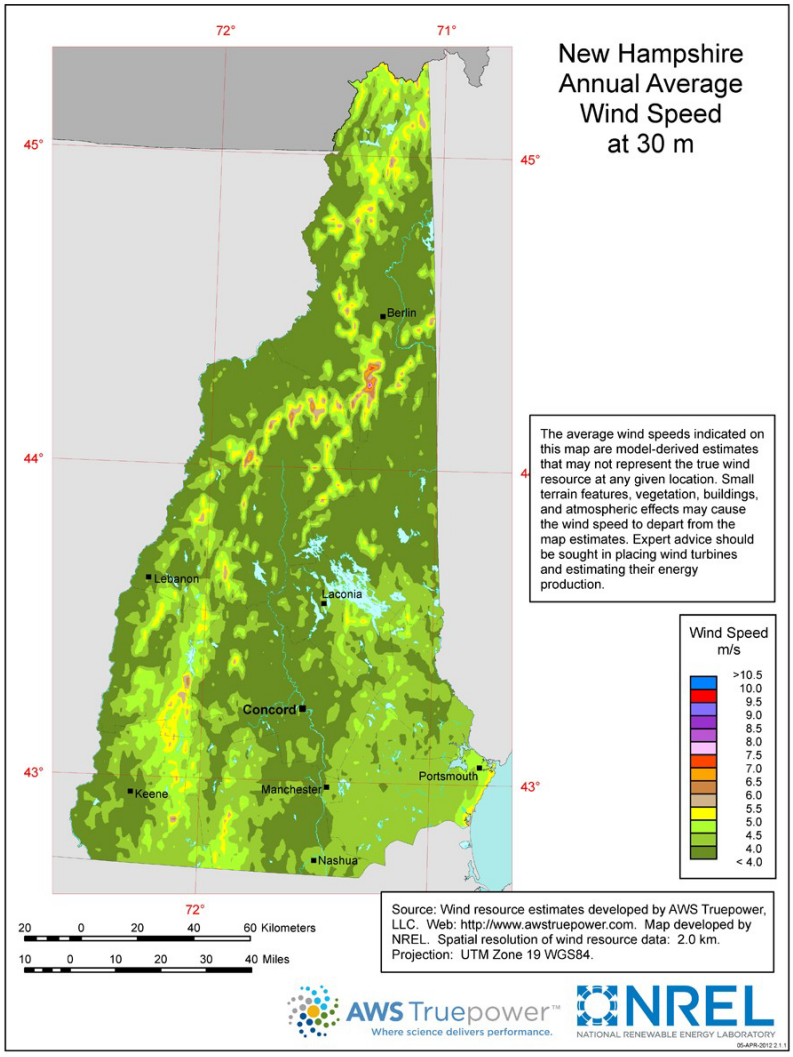
Source: Oak Ridge National Laboratory 2013

Hydropower Potential from New Stream-Reach Development for New England Region Dataset Overview. This dataset provides hydropower potential data (high-energy intensity stream-reaches and new potential areas for hydropower development) and environmental attributes in stream segments that do not currently have hydroelectric facilities in the New England Region 1 HUC. The data is aggregated to HUC10 watersheds.

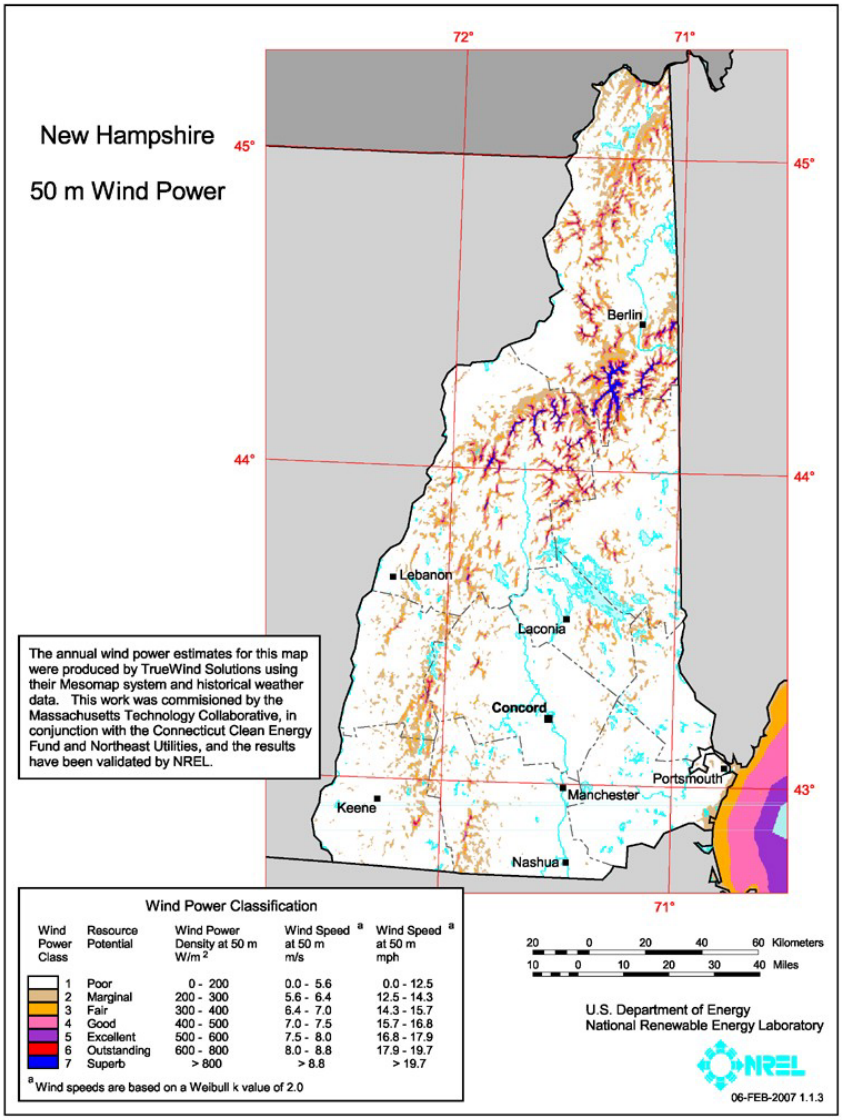

Direct Normal Solar Irradiance
National Solar Radiation Database Physical Solar Model
Washington
Oregon
California
Idaho
Nevada
Montana
Wyoming
Utah
Arizona
Colorado
New Mexico
North Dakota
South Dakota
Nebraska
Kansas
Oklahoma
Texas
Minnesota
Iowa
Missouri
Arkansas
Louisiana
Wisconsin
Illinois
Michigan
Indiana
Ohio
Kentucky
Tennessee
Mississippi
Alabama
Georgia
Florida
South Carolina
North Carolina
Virginia
West Virginia
Pennsylvania
New York
Maine
Vermont
New Hampshire
Massachusetts
Connecticut
Rhode Island
New Jersey
Maryland
Delaware
Alaska
Hawaii
CANADA
MEXICO
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
Gulf of Alaska
Bering Sea
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario
About the Data
This map provides annual average daily total solar resource using 1998-2016 data (PSM v3) covering 0.038-degree latitude by 0.038 degree longitude (nominally 4 km x 4 km).
For more information, visit:
https://nsrdb.nrel.gov
Email us at: nsrdb@nrel.gov
kWh/m²/Day
≥ 7.5
7.0 to 7.4
6.5 to 6.9
6.0 to 6.4
5.5 to 5.9
5.0 to 5.4
4.5 to 4.9
4.0 to 4.4
< 4.0
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
Billy J. Roberts, February 22, 2018


Global Horizontal Solar Irradiance
National Solar Radiation Database Physical Solar Model
Washington
Oregon
California
Idaho
Nevada
Montana
Wyoming
Utah
Arizona
Colorado
New Mexico
North Dakota
South Dakota
Nebraska
Kansas
Oklahoma
Texas
Minnesota
Iowa
Missouri
Arkansas
Louisiana
Wisconsin
Illinois
Michigan
Indiana
Ohio
Kentucky
Tennessee
Mississippi
Alabama
Georgia
Florida
South Carolina
North Carolina
Virginia
West Virginia
Pennsylvania
New York
Maine
Vermont
New Hampshire
Massachusetts
Connecticut
Rhode Island
New Jersey
Maryland
Delaware
Alaska
Hawaii
CANADA
MEXICO
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
Gulf of Alaska
Bering Sea
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario
About the Data
This map provides annual average daily total solar resource using 1998-2016 data (PSM v3) covering 0.038-degree latitude by 0.038 degree longitude (nominally 4 km x 4 km).
For more information, visit:
https://nsrdb.nrel.gov
Email us at: nsrdb@nrel.gov
kWh/m²/Day
≥ 5.75
5.50 to 5.75
5.25 to 5.50
5.00 to 5.25
4.75 to 5.00
4.50 to 4.75
4.25 to 4.50
4.00 to 4.25
< 4.00
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
Billy J. Roberts, February 22, 2018

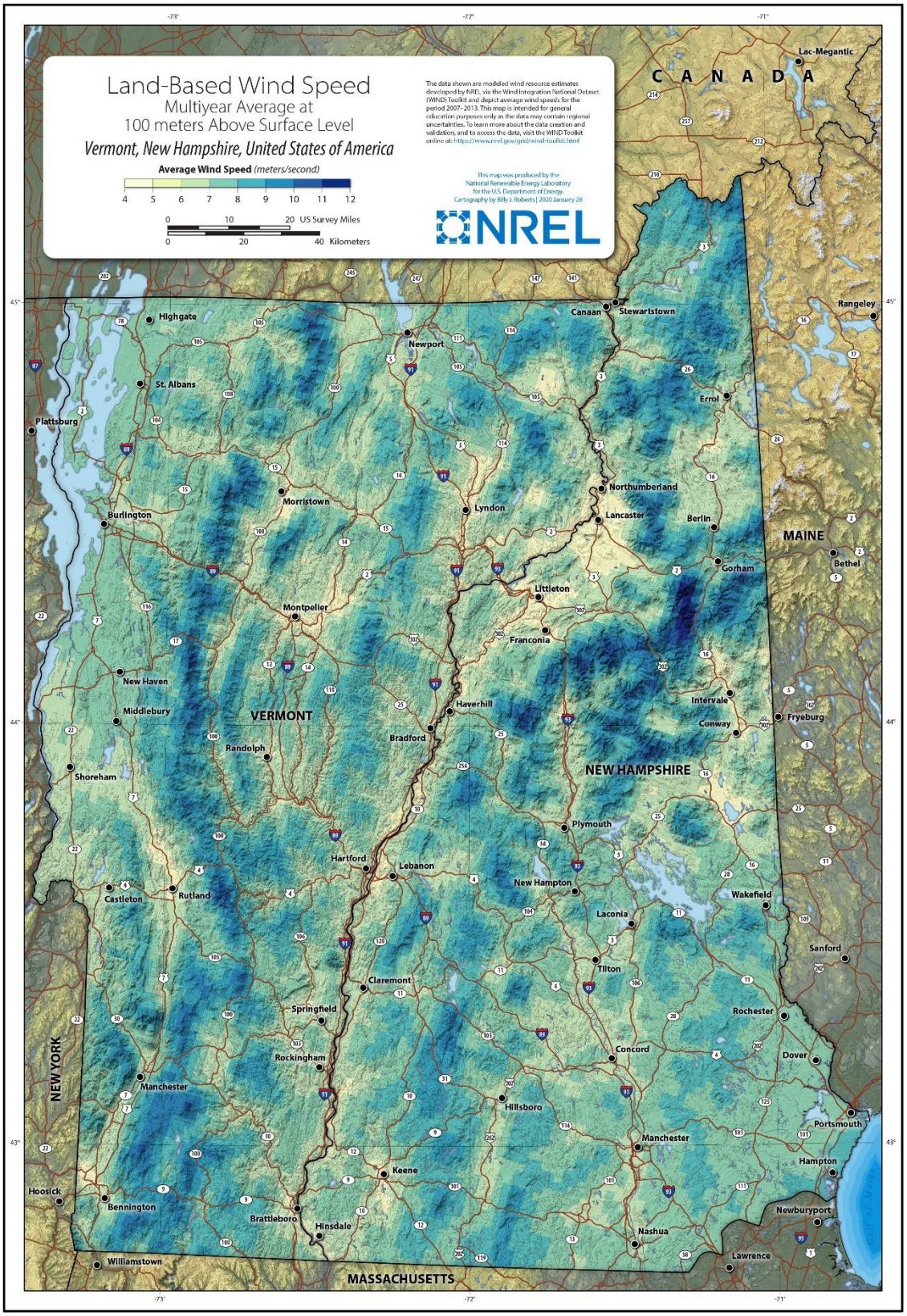
Wind Power Sources: National Renewable Energy Laboratory and AWS Truepower.



This map shows the predicted mean annual wind speeds at a 30-m height, presented at a spatial resolution of 2 kilometers that is interpolated to a finer scale. Areas with good exposure to prevailing winds and annual average wind speeds around 4 meters per second and greater at a 30-m height are generally considered to have a suitable wind resource for small wind projects. Small wind turbines are typically installed between 15 and 40 m high. Given the technological advancements in the wind industry, locations with lower wind speeds that may not have been suitable for wind development in the past may be suitable today or in the future. The average wind speeds indicated on this map are model-derived estimates that may not represent the true wind resource at any given location. Small terrain features, vegetation, buildings, and atmospheric effects may cause the wind speed to depart from the map estimates. Consumers should seek expert advice for siting wind turbines and estimating their energy production.



This resource map shows estimates of wind power density at 50 m above the ground and depicts the resource that could be used for community-scale wind development using wind turbines at 50-60-m hub heights. As a renewable resource, wind was classified according to wind power classes, which were based on wind speed frequency distributions and air density. These classes ranged from Class 1 (the lowest) to Class 7 (the highest). In general, at a 50-m height, wind power Class 4 or higher could have been useful for generating wind power with turbines in the 250-kW to 750-kW rating. Given the advances in technology, resources below Class 4 may now be suitable for the new midsize wind turbines. In recognition of these continuing advancements in wind energy technologies and the ability for the current generation of wind turbines to extract cost competitive wind energy from lower wind speeds the Energy Department has moved away from the wind power classification system and now reports wind speeds only.


Land-Based Wind Speed
Multiyear Average at
100 meters Above Surface Level
Vermont, New Hampshire, United States of America
Average Wind Speed (meters/second)
4 5 6 7 8 9 10 11 12
0 10 20 US Survey Miles
0 20 40 Kilometers
The data shown are modeled wind resource estimates developed by NREL via the Wind Integration National Dataset (WIND) Toolkit and depict average wind speeds for the period 2007–2013. This map is intended for general education purposes only as the data may contain regional uncertainties. To learn more about the data creation and validation, and to access the data, visit the WIND Toolkit online at: https://www.nrel.gov/grid/wind-toolkit.html
This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.
Cartography by Billy J. Roberts | 2020 January 28
NREL
CANADA
Lac-Megantic
Canaan
Stewartstown
Rangeley
Highgate
Newport
St. Albans
Errol
Plattsburg
Northumberland
Morristown
Lyndon
Lancaster
Berlin
Burlington
MAINE
Gorham
Bethel
Littleton
Montpelier
Franconia
New Haven
Intervale
Middlebury
VERMONT
Haverhill
Conway
Fryeburg
Bradford
Randolph
NEW HAMPSHIRE
Shoreham
Plymouth
Hartford
Lebanon
New Hampton
Wakefield
Castleton
Rutland
Laconia
Sanford
Tilton
Claremont
Springfield
Rochester
NEW YORK
Concord
Dover
Rockingham
Manchester
Hillsboro
Portsmouth
Manchester
Hampton
Keene
Hoosick
Bennington
Brattleboro
Hinsdale
Nashua
Newburyport
Williamstown
Lawrence
MASSACHUSETTS

9.06 Appendix F : Historic & Cultural Resources

9.06(a) Geological

(i) Mine, Quarried, Natural Rock Features

1. Indians Cave: Located on Keyser Hill

Indians' Cave is a natural cave formed by broken granite at the surface of the hill that have shifted to create this natural cave that forms the basis of a local legend from the 1860s or earlier. Legend has a native American man and woman sheltering at the cave after small pox wiped out their tribe, but they were also infected and died together in the cave. The cave first known as Hedgehog Den was renamed by a group of excursionists in 1878 who paid a local stone cutter to carve the name and date into the stone at the cave entrance.

2. Bears' Den: Located in Simpson Reserve

Bear's Den is a natural group of huge glacial erratic boulders that form a cave near Red Water Brook, accessed today by a hiking trail.

3. Pulcifer Rock: off Caldwell Lane

Pulcifer Rock is a glacial erratic, like the nearby Bear's Den rock cluster. It is consistently referenced in all the old deeds for the land within the triangle formed by Hells Corner Road, Rte 103-B (Edgemont Road) and Caldwell Lane.

4. Twin Willow Mica Mine: Located on Mica Mine Hill north of Trow Hill Road

Sunapee's only commercial mica mine was located at a deposit discovered in the early 1880s by John L. George (1839-1919) a local farmer and amateur mineralogist. Mine operations began in 1895 by men from Lempster when large pieces of mica were worth about 1/10 the price of gold. In 1896 mining rights were purchased by the Boston Mica Company that extracted mica from the spring to fall until about 1905.

5. Samuel Bailey Granite Quarry: Located off south side of Rolling Rock Road

Samuel Bailey (1792-1892) was Sunapee's early and best-known quarryman who operated a granite quarry from the 1830s into the 1860s at this location quarrying natural fissured surface rock with hand tools, first establishing Sunapee's long quarry history.

6. Boyce & Bailey Granite Quarry: Located off Burkehaven Hill Road

In 1884 Samuel Bailey (1792-1892) sold the rights to his 2nd major quarry, north of Rolling Rock Road to his grandson Murvin Bailey and neighbor Arland Boyce. This was Sunapee's largest quarry that produced a fine grain granite called Light Sunapee and Dark Sunapee, well suited for monuments and building use. The industry was aided by the arrival of the railroad in 1877. Blocks from this quarry were purportedly used for the Library of Congress building in Washington D.C. This quarry remained active until about 1910.

7. Stocker Granite Quarry: Located off Edgemont Road

This quarry is located on land that was once Samuel Bailey's land, now owned by William Stocker. He and his family quarry, cut, shape and polish granite for a variety of uses since the 1980s to present day.

9.06(b) Historic

(i) Burial Grounds & Burial Structures

1. Colby Burial Ground: Located on Stagecoach Road

Established in 1801 as the town's official burial ground on land of Joshua Gage, surrounded by a stone wall. Burials include several Revolutionary War veterans. This cemetery continues to be in use today.

2. Old Eastman Burial Ground: Located on North Road

Established in 1801 as the town's official burial ground on land of Elijah Eastman.

3. Cooper-Young Burial Ground: Located off Stagecoach Road

Established about 1808 on land of Cornelius Young, who was the first burial, and contains several Revolutionary War veteran graves. About _ were buried there, all lived in the local area of this cemetery, with the last in 1925.

4. Lower Village Burial Ground & Granite Tomb: located at Lower Main Street

Established about 1815 on land of Nathanial Perkins, where the North Meeting House was built in 1832. In 1868 the town had a granite holding tomb constructed at this cemetery. 1950 was the last burial here.

5. South Sunapee Cemetery: Located on Harding Hill Road

Established about 1822 on land owned by Thomas Pike, where the South Meeting House was built in 1833. Families from south Sunapee are buried here. This cemetery continues to be used today.

6. George's Mills Village Cemetery: Located on Main Street

Established in 1865 by Elbridge G. Chase (1815-1895) for residents of George's Mills. Graves are unusually laid-out to orient North-South with burials facing Lake Sunapee. This cemetery continues to be in use today.

7. Crowther Chapel & Burial Ground: Located on Stagecoach Road

Built in 1936 by Mary and Samuel Crowther on their property after the death of their young son John. This small stone chapel with a Tiffany window, is a quiet, reflective place in the forest on land once owned by Joshua Gage. The Crowther family graves are nearby. The Chapel is open Sundays in the summer to the public.

(ii) Early Settlement Roads & Stone Culverts / Bridges

1. Mill Road (stone culverts) laid-out 1769, at Webb Home Farm Forest, in use as Angell Brook Rd, Trask Brook Rd, Cross Rd, Brook Rd
2. Thurber Road, laid-out in 1772, in use as Stagecoach Rd, Winn Rd, North Rd to Springfield
3. Whipple Road to Croydon, laid-out in 1773, in use as Ryder Corner Rd
4. North Road, laid-out 1786, in use as Prospect Hill Rd, part of Otter Hill Rd
5. County Road, laid-out 1786, in use as Bradford Rd
6. Goshen Road, laid-out 1789, in use as Nutting Rd
7. Abandoned sections of the Georges Mills Road

(iii) Sugar River Railroad

1. Railroad bed built 1870-71 from Newbury to Newport; discontinued 1955.

2. Granite block trestle 1871, off Paradise Rd
3. Wendell Depot 1872, 52 Depot Rd (see buildings)

(iv) Stone Structures

1. Sugar River Railroad granite trestle

Built in 1870 with granite blocks provided by Augustus Trask and George Paul, probably from Samuel Bailey's granite quarry off Rolling Rock Road for the Sugar River Railroad formed in 1865 to build the section of track and stations between Bradford and Claremont. The line later became part of the concord & Claremont Railroad and then the B&M Railroad. Rail traffic began over the trestle in 1872 and continued to 1955.

(v) Stone Dams

1. Sugar River granite block dam: Located on River Road

Built circa1836 by the Sunapee Company, a consortium of businessmen, it is the oldest surviving dam on the Sugar River in Sunapee. Several mills on both sides of the river were powered by water held by this dam. The damaged top section was rebuilt.

2. Sugar River gristmill, tannery & pulp mill dam: Located by Hames Park, Main Street

First built in 1797 by millwright John Chase Jr for a mill pond to power a grist and sawmill, This dam was also used by a leather tannery and excelsior mill from the 1860s to 1890s. In 1888 the dam was refurbished for use by the new wood pulp mill and in 1925, refurbished again for use by the Lake Sunapee Power Company's new hydroelectric station penstock. Portions of this dam still exist.

3. Sugar River excelsior mill dam: Located north of Town Hall, Edgemont Road

The boulder dam was built in 1888 by Wm. Clinton Stocker of Sunapee for a new excelsior mill after selling is old mill to the wood pulp company. The excelsior mill operated until about 1898. In 1895 the Sunapee Electric Light Company, of Clinton Stocker and his nephew Arthur Stocker, located a turbine at the excelsior mill powered by water in the mill pond at this dam, and installed the first village street and house lighting.

4. Sugar River Smithville dam: Located off Abbott court

Boulder dam built in 1854 by John B. Smith (1818-1884) arguably Sunapee's most important machinist, inventor and industrialist, who founded Smith Machine Company in the lower village on the bank of the Sugar River where he built a wood shop, machine shop, and forge where his patented wooden clothes pin machines were manufactured for sale across the country. His mills burned down in 1871 but he rebuilt and in 1874 had perfected a grinding technique to make a perfect two-piece achromatic lens, then the standard for telescopes. John had become interested in astronomy and was one of very few men in America who had achieved this. John produced about 5 telescopes in Sunapee, quite an achievement. One telescope was 60" long, 4" diameter with a power from 80 to 400 diameters. His telescopes were purchased by the Cambridge Observatory and Grand Prairie College.

5. Sugar River George Sawmill Canal: Located off Lower Main St.

About 1840 Elijah George 2nd and his sons began construction of canal, about 370-ft long, averaging 6-ft deep and totalling about 644,000 cu ft of soil and rock dug and moved by hand on the south side of the Sugar River to flow water to a grist and sawmill that they built located south of the Lower Main Street bridge. The canal remained in use until 1887. It remains as a land form with stone walls and the remains of pulleys and shafts from the mill.

6. Sugar River Trow Sawmill dam: Located off Lower Main St

The second Willis Trow sawmill in the Lower Village, its dam and canal race were built in 1895 at the south side of the Sugar River. After damage to the dam from the Great Hurricane of 1938, a diesel engine provided power to run the mill instead of water power. The canal was filled in, but the portions of the stone dam remain. This sawmill continues to be operated by the 4th generation, Jeffrey Trow in 2022, a 127-year family history on this site. The Trow Sawmill is the last operating wood products mill in Sunapee.

7. Sugar River dam at Wendell Marsh

About 1800, Abiathar Young (1753-1827) built a dam that created Wendell Marsh to operate a sawmill at the south end of today's marsh. Operation of the sawmill continued after his death by his 4 sons until 1832 when the land was sold out of the family. In 1923 the Abiathar Young water flow rights and dam site were sold to Francis Murphy, who represented the newly formed Lake Sunapee Power Company. A new dam was built near the site of the old dam and nearly 1-mile of 6-ft diameter wooden penstock was built to power a 750-HP hydro-electric turbine located near Wendell Depot. This dam and hydro-electric facility operated until 1952. The dam remained in place and in 2014 was rebuilt to modern standards by the NH Fish and Game Department to maintain water levels in Wendell Marsh, a wildlife refuge.

8. Otter Pond dam at Otter Brook

In the late 1780s John Harvey built a mill at Otter Pond, sold to Ichabod Hearsee in 1791, and sold again in 1805 to miller Daniel George. The dam at Otter Pond has been maintained to this day. Daniel George and his descendants operated grist and sawmills on Otter Brook that flows from this dam into the 1890s. The village of Georges Mills was named for Daniel George.

9. Ledge Pond Brook dams

The stone dams on Ledge Pond Brook were built about 1810 by Caleb Mudgett and about 1840, probably by Wells Davis to create two mill ponds on Ledge Pond Brook for the operation of a sawmill on the brook at the north side of Perkins Pond Road. In 1849 the sawmill was owned by James Trow, who built a third dam at Ledge Pond. From James, 5 generations of the Trow family have operated sawmills in Sunapee and continue to do so in 2022. These stone dams exist in 2022 and two are protected in the MacWilliams Lot, conserved by Ausbon Sargent. The sawmill operated from about 1810 to the 1880s.

10. Angell Brook sawmill dam

This stone dam powered a sawmill, built bout 1795, by Joseph Chase on Angell Brook at the north side of Bradford Road. It was one of two sawmills in south Sunapee and the only dam remnants in this part of town to survive today.

(vi) Stone Walls

1. Range & Lot line stone walls (see stone wall mapper)
2. Farm yard & pasture stone walls
3. Granite bank walls at roads: High Street 1890, Central St 1948
4. Granite bank walls at river: Hames Works at High Street 1890, Main St at Rte.11 1909
5. Granite bank walls at lake: Sunapee Harbor 1890

(vii) Cellar holes and barn foundations

1. Wm McBritton house site at Webb Home Farm Forest
2. E. Young-Eleaser Sischo house site at Webb Home Farm Forest
3. Nathaniel Perkins house site c1800 at 279 Youngs Hill Rd

4. Joshua Freeto house site 1829, at Wendell Marsh
5. Francis Pingree c1794, Trow Hill Road
6. Sam Cilley-Josiah Conant farm house c1800, Dodge Pasture Rd
7. Theodore Davis farm house & barns c1828, Dodge Pasture Rd
8. James Eastman farm house c1834 Maurer Rd
9. Robert Emerson farm house c1800, Dodge Pasture Rd
10. David Perrin - Noyes farm house c1810, Dodge Pasture Rd
11. No. 6 Schoolhouse 1817 site of 741 North Rd
12. Joseph Pillsbury farm house c1795 off Main St Geo Mills
13. Jacob Evans-John Bartlett farm house & barn c1780, site of 800 North Rd

(viii) Significant Buildings

Type	Circa year	Description	Location	Type	Circa year	Description	Location
Farm	1780	Benjamin George farm house	101 Bradford Rd	Lighthouse	1892 rebuilt 1960	Loon Island Lighthouse	Lake Sunapee
	1780	Woodward farm house	Bradford Road		1909 rebuilt 19802	Burkehaven Lighthouse	Lake Sunapee
	1780s	Esek Young -John Angell farm house	45 Angell Brook Rd	Church	1859	Methodist Church parsonage	11 Lower Main St
	1789	Whittier Perkins farm house	175 North Road		1871	Methodist Church	9 Lower Main St
	1790	William Gage farm house	324 Stagecoach Rd		1897	Methodist Church	37 Prospect Hill Rd
	1790s	Abiathar Young farm house	183 Youngs Hill Rd		1898	St. James Episcopal Church	378 Lake Avenue
	1791 rebuilt 1881	Stephen Lang farm house	3 Messer Rd	Schoolhouse	1860	No. 5 Schoolhouse	85 Prospect Hill Road
	1790s	Daniel Moses - Merrill farm house & barns	144 Route 11		1867	No. 8 Schoolhouse	86 Lower Main St
	1790 altered 1931	Joshua Gage farm house & barns	258 Stagecoach Rd		1870	No. 7 Schoolhouse	77 Route 11
	1794	Abijah Emerson farm house	526 North Road		1877	No. 2 Schoolhouse	10 Schoolhouse Lane
	1795	Ichabod Heasee farm house	1279 Route 11		1877	No. 3 Schoolhouse	310 North Road
	1796	Esquire Woodward farm house	Keyes Road off Trow Hill Rd		1893	No. 1 Schoolhouse	48 Bradford Rd
	1798	Philbrick Huntoon farm house	77 Burkehaven Hill Rd	Store / Amenity	1815	Dane house general store	21 High St
	1798	Samuel George farm house	223 North Road		1826	Conant - Russell Store	4 Prospect Hill Rd
	1800	Job Clapp farm house	110 Brook Rd		1835	Cutting tavern house	77 Main St
	1800	James Young farm house	34 Stagecoach Rd		1843	Marble General Store	87 Lower Main St
	1800	Enoch Perkins farm house	140 Perkins Pond Rd		1850	Gardner Tavern	100 Lower Main St

Type	Circa year	Description	Location	Type	Circa year	Description	Location
	1800	Perkins farm house	140 Perkins Pond Rd		1851	Josiah Turner's general store	3 Alpine Court
	1800	Francis Smith farm house	511 North Road		1855	Hopkins Wallet Shop house	9 Central St
	1800	Samuel Patch farm house & barn	962 Route 11		1857	Tin Shop	2 Alpine Court
	1800	Hadley Muzzey farm house	1007 Main St Georges Mills		1870	Knowlton Block – IOOF Hall	41 Main St
	1802	Joseph Chase farm house	47 Harding Hill Rd		1872	Wendell Depot	52 Depot Rd
	1804	Thomas Pike farm house	28 Bradford Rd		1889	Hame Works Office	1 High St
	1805	Trask-Paul farm house	9 Youngs Hill Rd		1890	Flanders Livery-Museum	74 Main St
	1805	Enoch Harvey farm house	171 Burkehaven Hill Rd		1890	Harbor Hotel Livery	58 Main St
	1806	James Atwood farm house	218 Nutting Rd		1792	Philip Huntoon Stone House	100 Rolling Rock Rd
	1808	Asahel Dickinson farm house	66 Hells Corner Rd		1800	Jonathan Worster house	7 Alpine Court
	1808	Joshua Bartlett farm house	749 North Rd		1800	Moses Muzzey house	Route 11
	1809	John Currier farm house	26 Caldwell Lane		1800	Stone House	485 Edgemont Rd
	1810	Caleb Whitaker farm house	330 Nutting Rd		1823	Nathan Burpee - Russell house	1 Prospect Hill Rd
	1810	Jonathan Crowell farm house	143 Bradford Rd		1832	John Colby house	24 High St
	1810	Cornelius Young farm house & barn	207 Stagecoach Road		1840	Moses Muzzey house	7 North Rd
	1810	Samuel Gardner farm house	24 Fairway Drive		1844	Jesse Wilson house	110 Lower Main St
	1812	Amos Rowell-Levi Colby farm house	172 Sleeper Rd		1845	Amos George house	116 Lower Main St
	1812	Moses Eastman farm house	247 Prospect Hill Rd		1851	William Stevens house	55 Central St
	1815	Clapp farm house	59 Cross Rd		1854	John B. Smith house	25 Abbott Court
	1815	Abiathar Young Jr farm house	164 Lower Main St		1876	Robert C. Osgood cottage, Star Island, oldest surving lake cottage	
	1820s	Samuel Bailey farm barn	154 Edgemont Rd	House	1880	Pleasant Home - Conrad Manor	27 Prospect Hill Road

Type	Circa year	Description	Location	Type	Circa year	Description	Location
	1821	Ichabod Eastman farm house	12 Ryder Corner Rd		1906	Billy B Van estate house and barn	242 & 247 Prospect Hill Rd
	1822	Abial Cooper farm house	28 Old Granliden Rd	Farm	1830s	Ryder farm house	250 Perkins Pond Rd
	1824	William Trow farm house	16 Trow Hill Road		1832	Hackett farm house	199 Edgemont Rd
	1825	Ira Hurd farm house	270 Nutting Rd		1832	Abial Cooper farm house	79 Rolling Rock Rd
	1825	William Trow farm house	915 Route 11		1832	John Balch farm house	34 High St
	1825	Eliakim Putney farm house & barn	37 Meadow Brook Rd		1832	John Gardner farm house	15 Central St
	1825	Jacob Stickney farm house	60 Wayland Rd off Prospect Hill Rd		1835	Daniel George Jr. farm house	1282 Route 11
	1825	Elbridge Chase farm house & barns	79 Prospect Hill Rd		1840s	Gideon Angell farm barn	524 Stagecoach Road
	1828	Francis Pingree farm house	Woodham Springs Route 11		1840	Gardner farm barn	125 Burkehaven Hill Rd
	1830s	Elijah George farm barn	325 North Rd		1840s	Welcome Angell farm house & barns	171 Route 103
	1830	Oliver Young farm house	66 Stagecoach Rd		1847	Elias Abbott farm house	6 Prospect Hill Rd

9.06(c) Recreation

(i) Hiking & snowmobile trails

1. Ledge Pond Town Forest trails
2. MacWilliams Conservation Land trails
3. Class 6 - Dodge Pasture Rd, laid-out 1810, abandoned in 1930s.
4. Dewey Woods Town Forest 1928, hiking trails 2007 & 2011
5. Garnet Hill Park 1948, hiking trails 2011
6. Wendell Marsh Town Forest trails
7. Harbor River Walk 1997
8. Tilton Park aka Ski Tow Hill, 1938, Sun-Ragged-Kearsarge Greenway Trail
9. Frank Simpson Reserve 2004, Sun-Ragged-Kearsarge Greenway Trails
10. Webb Harrison lot trail 2006
11. Webb Home Farm Forest trails 1972
12. Abandoned railroad bed trail
13. Webb-Dane Lot trail 2006

(ii) Parks

1. Sunapee Harbor Park 1971, Bandstand 1996, Main St.
2. Sunapee Harbor Town Wharf 1944, Main St.
3. Coffin Park 1966, Harbor River Walk 1997, Fitness equipment 2020, Edgemont Rd
4. Tilton Park aka Ski Tow Hill 1938, Playground at Edgemont Rd
5. Hames Park 1998, 42 Main St
6. Osborne Reflecting Pool 1966, at High St bridge
7. Veterans' Park 1948, ball field, 567 Route 11
8. Dewey Beach 1936, Garnet St
9. Dewey Woods Ball Field 1973 & 1990
10. Georges Mills Beach & Town Wharf 1938, Cooper St

(iii) Water Body Access

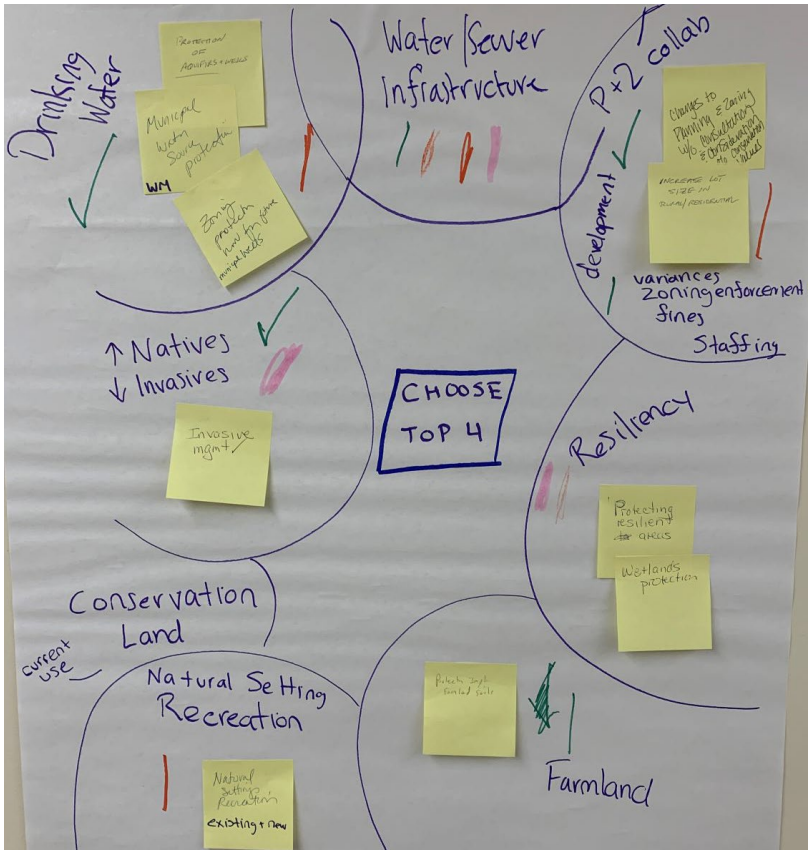
1. Sunapee Harbor town wharf and boat launch 1944, 83 Main St
2. Georges Mill town wharf and boat launch, Cooper St
3. Dewey Beach, 1936 Garnet St
4. Perkins Pond boat launch, Perkins Pond Rd
5. Ledge Pond, off Meadow Brook Rd
6. Sugar River at River Road
7. Sugar River at Coffin Park
8. Sugar River at Wendell Marsh

(iv) Scenic Vistas and Viewpoints

1. View to Corbin Park from Burkehaven Hill Road
2. View to Mt Sunapee from North Rd, Trow Hill Road
3. View of Sugar River from River Road
4. View to Mt Sunapee from Trask Brook Road
5. Views of Lake Sunapee from Harbor & Beaches
6. Note: Lake Sunapee Scenic & Cultural Byway: 103-B / Rte 101 / Rte 11 / Sun Harbor

9.07 Appendix G : Conservation Plan Process

At the regular meeting of the Sunapee Conservation Commission on November 11, 2022, project consultant (Upper Valley Lake Sunapee Regional Planning Commission) facilitated a prioritization exercise. Commission members were asked to provide their priority focus areas, focus topics, and specific actions for the conservation plan. Members were provided with Town maps and results of the co-occurrence analysis to inform their choices. The consultant than facilitated discussion with opportunity for members to describe their choices and for consensus on how similar items were grouped together. Once priorities were understood, members were asked to select those focus areas and focus topics of highest priority. Members who were not in attendance at the meeting shared their highest priorities via email based on those chosen during the meeting. This process resulted in the following:



Focus topics. Each heading indicates a group of priorities and discussion topics, further described under each bullet. The numerical value next to each heading reflects the number of SCC members who voted for this topic as a high priority.

- 5 - Water / sewer infrastructure
  - where expansion might occur
  - advance development where infrastructure available to reduce impact on natural resources
- 5 - Planning and zoning collaboration
  - Advance enforcement through available staffing
  - Reduce variance and increase predictability
  - Consider appropriate enforcement and use of fines
  - Increase lot size in rural residential
  - Ensure changes in planning/zoning include consultation with SCC and consideration of conservation values
- 4 - Protect resiliency zones
  - Protect resilient areas
  - Wetlands protection
- 4 - Protect drinking water sources
  - Municipal water source protection
  - Zoning protection for future wells

    - Protection of aquifers
- 3 - Invasives management
    - Unsure where to start, not much information available outside of the efforts by LSPA
    - Keep scenic vista sight lines clear from invasive species disturbance.
    - Flip side is to advance native plants and species.
- 3 - Preserve farmland and important farmland soils
- 2 - Advance natural settings recreation
    - Support existing and new places

Focus areas. Each heading indicates a group of priority areas, further described under each bullet. The numerical value next to each heading reflects the number of SCC members who voted for this topic as a high priority.

- 5 - South Sunapee south of Rte. 103 (connection to large Mt Sunapee tracts)
    - Concern for use of NH Highway garage at high co-occurrence area along Nutty Rd
    - Discussion of opportunity to connect with Q2C corridor just south
- 5 – Wellhead and drinking water supply protections
    - Wendell Marsh Well head protection area
    - Shoreland along Lake Sunapee protections, particular concern for homes not connected to public systems and septic that may fail, impacting WQ
    - Wellhead protection areas over all
- 5 - Red Water Creek to Mud Pond including Blueberry Mt southeast corner of town
- 4 - Identify preferred area for development and no development
- 4 - Ledge Pond / northwest corner of town (highest rated area on the draft co-occurrence map)
- 1 - Lower Sugar River

Specific actions. Each item listed below was identified as a specific action the SCC could take as part of the Conservation Plan. These items were not prioritized.

- Continue protecting large and small high value conservation lands
- Protecting large undeveloped land tracts
- Identify prime wetlands
- Zoning protection now for future municipal wells
- Enforcing existing regulations
- Integrating NRI into planning board decision making
- Protecting wildlife corridors
- No variances
- What can be done to further protect NW Sunapee?

Interviews. To inform the Conservation Plan, project consultant performed a series of interviews with the following individuals.

- Town Water and Sewer Department, Aaron Cartier.
- Town Recreation Department, Steve Bourque.
- Town Highway Department, Scott Hazelton.
- Town Planning and Zoning Department, Scott Hazelton and Michael Marquise.
- Lake Sunapee Protective Association, Geoff Lizotte.

9.08 Appendix H : Additional Resources

This Appendix contains the following information:

1. Private Well water testing & exceedance rates in Sunapee (2006-2020)
2. Quabbin to Cardigan Partnership, 2018 Regional Plan
3. Lake Sunapee Scenic and Cultural Byway brochure
4. Lake Sunapee Ice-Out dates according to the Sunapee Historical Society

New Hampshire
Health and Human Services Data Portal

NH DIVISION OF Public Health Services
Department of Health and Human Services

Private Well Water Quality: Town Summary

Sunapee: Private well water testing & exceedance rates by town (2006-2020) with associated county and state exceedance rates

Town	Contaminant	Health limit	Units	Number of wells tested by town	Percent of wells exceeding health limit by town	Percent of wells exceeding health limit by county	Percent of wells exceeding health limit in NH
Sunapee	Arsenic	5.0	µg/L	170	10.0	6.2	25.2
	Chloride	250.0	mg/L	188	2.7	1.1	2.9
	Copper (flushed)	1.3	mg/L	170	0.6	1.1	0.9
	Copper (stagnant)	1.3	mg/L	162	10.5	10.3	12.6
	Fluoride	4.0	mg/L	183	0.0	0.4	0.7
	Iron	0.3	mg/L	169	17.8	19.6	18.7
	Lead (flushed)	15.0	µg/L	172	0.6	1.4	1.8
	Lead (stagnant)	15.0	µg/L	163	19.0	14.9	14.0
	Manganese	0.3	mg/L	169	8.9	6.6	5.8
	Nitrate	10.0	mg/L	187	0.5	0.1	0.5
	Nitrite	1.0	mg/L	187	0.0	0.0	0.0
	Radon	2,000.0	pCi/L	92	77.2	59.4	50.1
	Sodium	20.0	mg/L	169	19.5	20.7	33.9
	Uranium	30.0	µg/L	178	15.7	7.0	4.2

- These data cannot predict whether individual wells are above or below a drinking water health limit for a given contaminant. Testing your well water is the only way to know what is in your water. These data are to inform well users of water quality trends found in tested wells in and around the town or county of interest. More information for testing and treating private well water: https://www.des.nh.gov/water/drinking-water/private-wells
- Towns with less than 20 wells tested have been excluded from this analysis as the number of tested wells are too low to support reliable estimates. These suppressed town level data are shaded grey in the map and indicated with an asterisk (*) in the chart. Years of private well testing data include 2006 - 2020.
- Maximum values were compared against health limits based on NH Maximum Contaminant Levels (MCLs), NH Ambient Groundwater Quality Standards (AGQS), USEPA MCLs, NH DES Recommended Action Levels, or Aesthetic Levels.

Q2C Regional Plan

Quabbin to Cardigan Partnership - 2018

The Quabbin-to-Cardigan Partnership Q2C

- Q2C Regional Boundary
- Core Conservation Focus Areas
- Connectivity Corridors
- Conservation & Public Lands
- Lakes & Reservoirs
- Rivers & Streams
- State Boundaries
- Town Boundaries
- Interstate Highways
- US & State Highways
- Local Roads

ABOUT

Launched in 2003, the Quabbin to Cardigan Partnership (Q2C) is a collaborative, landscape-scale effort to conserve the Monadnock Highlands of north-central Massachusetts and western New Hampshire. The two-state region spans one hundred miles from the Quabbin Reservoir northward to Mount Cardigan and the White Mountain National Forest, and is bounded to the east and west by the Merrimack and Connecticut River valleys. Encompassing approximately two million acres, the Quabbin to Cardigan region is one of the largest remaining areas of intact, interconnected, ecologically significant forest in central New England, and is a key headwater of the Merrimack and Connecticut Rivers.

The Quabbin to Cardigan Partnership is a collaborative effort of twenty-seven private organizations and public agencies working on land conservation in the two Q2C states. The Quabbin to Cardigan Partnership does not protect land directly, its member organizations do. Land is conserved strictly on a willing-seller basis through a combination of conservation easements and land acquisitions, managed by private landowners, conservation organizations, and public agencies. The Quabbin to Cardigan partners share a vision of consolidating the permanent protection of the region's most ecologically significant forest blocks, and key connections between them for wildlife movement and human recreation.

With the original plan completed in 2007, the Q2C strategic conservation plan was updated in 2018 using new natural resource data and an improved, science-based methodology. Newly released climate change resilience data from The Nature Conservancy was also incorporated into the updated plan. Quabbin to Cardigan partners also participated in a consensus-building process to update the "shared vision" for the Q2C region. The Q2C plan has identified approximately 750,000 acres of core conservation focus areas that represent the region's most ecologically significant forests. These conservation focus areas represent about 38% of the two million acre region. An additional 290,000 acres, or 15% of the region, has been identified as key connectivity corridors that buffer and link the core areas.

For more information: www.q2cpartnership.org

METHODOLOGY OVERVIEW

First, the Q2C partnership reviewed and affirmed the 2006 conservation planning goal and focus, as follows:

"To consolidate the permanent protection of the region's most ecologically significant forest blocks, and key connections between them for wildlife passage and human recreation."

Several natural resource features were evaluated to identify forest blocks with significant embedded ecological features, as follows:

- **Forest blocks** in three size classes: 250 to 500 acres, 500 to 1,000 acres, and blocks greater than 1,000 acres;
- **Water resources**, including riparian, shoreline, and wetland buffers; wetlands; floodplains; and, high-quality stream watersheds;
- **Wildlife habitat**, including state wildlife action plan habitat condition mapping for both New Hampshire and Massachusetts, as well as uncommon wildlife habitat types; and,
- **Climate change resilience**, using The Nature Conservancy's (TNC) prioritized diversity and connectivity data from 2016.

A GIS Advisory Team comprised of several knowledgeable staff drawn from various partnership organizations and agencies then assigned weighted values to the natural resource data layers, and a co-occurrence map was generated to determine areas within the Q2C region with high aggregate scores. A GIS-based "focal mean analysis" was then produced from the co-occurrence mapping with the goal of smoothing values across the region to aid in focus area identification. The top 40% of focal mean scores was selected as core conservation focus areas.

Connectivity was addressed by using the conservation focus areas as nodes between which connecting corridors were determined by "least cost" GIS processing using TNC landscape permeability data generated as part of the climate change resilience study released in 2018. The top 20% of corridor route scores were selected as having the highest probability of long-term functioning as regional wildlife movement patterns.

See the technical report at the link above for more detailed information.

Mt. Cardigan

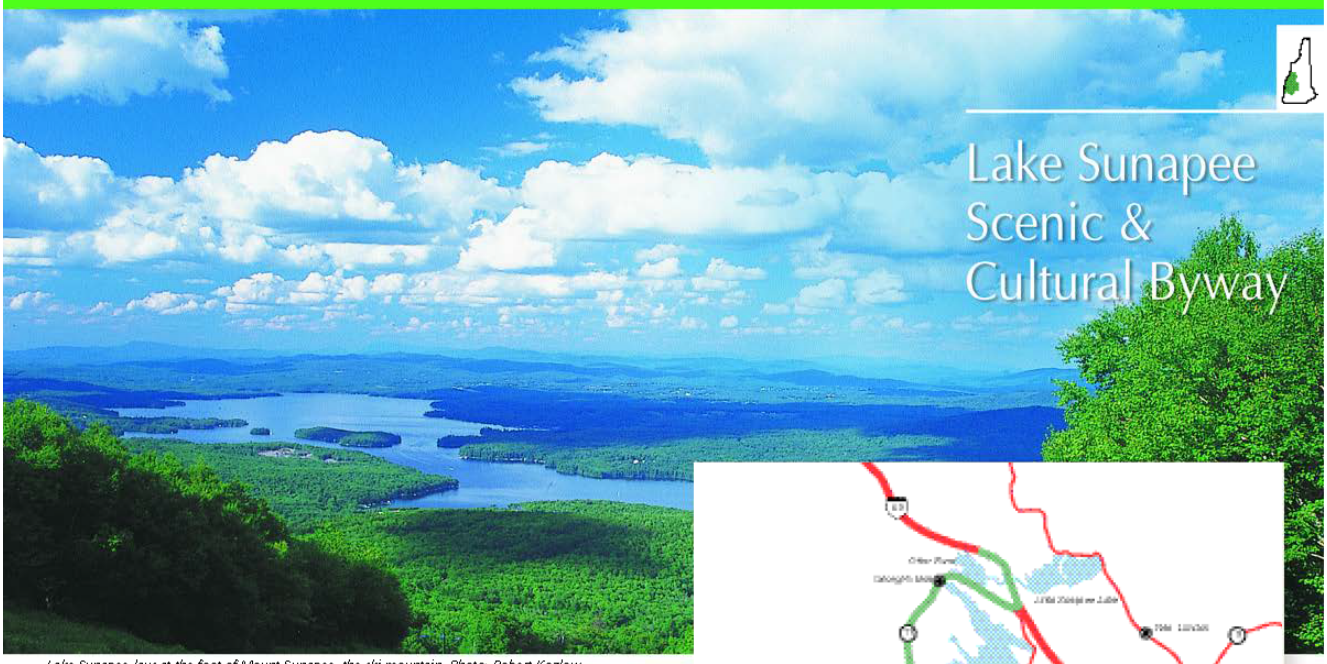
Quabbin Reservoir

0 5 10 20 Miles

Map Prepared by
GreenFire GIS
June 2018

DISTANCE: 25 MILES ♦ HIGHLIGHTS: STATE BEACH, WILDLIFE REFUGE, SCENIC SHORELINE, BOAT TOURS, AND YEAR-ROUND RECREATION

Lake Sunapee Scenic & Cultural Byway



Lake Sunapee lays at the foot of Mount Sunapee, the ski mountain. Photo: Robert Kozlow

This 25 mile route borders Lake Sunapee and is a slower paced and beautiful alternative to Interstate 89. Visitors and residents alike know that Lake Sunapee is a destination in itself. Year-round recreational opportunities abound, including boating, biking, swimming, snowmobiling, downhill and cross-country skiing, ice-boating and maple-sugaring. Local residents take pride in Lake Sunapee for its exceptional water quality and beauty. Protection efforts have enabled Lake Sunapee to consistently be named one of the cleanest lakes in the state.

Early European settlers were drawn to the Sunapee area's rich natural resources as were Native Americans, and tourism has been an important part of life in this area for over 100 years. Before the dawn of the automobile, guided steamboats met the trains at Newbury Harbor to deliver passengers and freight all around the 9-mile long lake. Today, the scene has changed, and where once there were grand hotels and boarding houses, now are year-round homes and summer cottages.

NEWBURY. Newbury has long been a popular summer vacation spot, and the population triples in the summer. Along this route, stop in at the new Bell Cove Caboose, a caboose renovated as a small interpretive center along the byway. Along NH 103 you might also want to stop off at Sunapee State Beach or at Mount Sunapee Resort, a popular ski and winter sports area. From the top of Mount Sunapee you can look westward into Vermont or look north toward the fabled Franconia Range, and on a clear day, view Mount Washington in the Presidential Range.

The Fells Historic Site at the John Hay National Wildlife Refuge is part of 876 protected acres of a forest country estate. This site along Route 103A includes perennial and woodland gardens, hiking trails and abundant wildlife. Escape for a while by stopping to enjoy the full richness of this beautiful area.

SUNAPEE. Sunapee Harbor, along Route 11, is the heart of the Sunapee region and is a great place to stop and take in the area's heritage, culture and natural beauty. Go for a walk on the "greenway" or take one of the guided boat tours offered on Lake Sunapee. Also visit the Sunapee Scenic Byway Information Booth on Route 11 for information about other activities in the area.

SPECIAL CONSIDERATIONS: Newbury's Bell Cove Caboose Information Center and the Sunapee Scenic Byway Information Booth are open seasonally from Memorial Day thru Columbus Day.

CONTACT: The Lake Sunapee Business Association, 800-258-3530. Town of Newbury www.town.newbury.nh.us or www.town.newbury.nh.us/act/bellcove.html

ICE OUT DATES FOR LAKE SUNAPEE

YEAR	DAY	YEAR	DAY	YEAR	DAY	YEAR	DAY	YEAR	DAY
1869	May 10	1902	Apr. 12	1935	Apr. 25	1968	Apr. 14	2001	May 4
1870	May 10	1903	Apr. 5	1936	Apr. 14	1969	Apr. 27	2002	Apr. 12
1871	Apr. 12	1904	May 1	1937	May 2	1970	May 1	2003	Apr. 27
1872	May 3	1905	Apr. 25	1938	Apr. 18	1971	May 6	2004	Apr. 18
1873	May 6	1906	Apr.29	1939	May 7	1972	May 9	2005	Apr. 19
1874	May 9	1907	May 1	1940	May 7	1973	Apr. 19	2006	Apr. 3
1875	May 12	1908	Apr. 26	1941	Apr. 18	1974	Apr. 20	2007	Apr. 24
1876	May 11	1909	Apr. 22	1942	Apr. 19	1975	May 5	2008	Apr. 23
1877	Apr. 25	1910	Apr. 6	1943	May 3	1976	Apr. 16	2009	Apr. 12
1878	Apr. 18	1911	May 2	1944	May 1	1977	Apr. 19	2010	Apr. 4
1879	May 12	1912	Apr. 26	1945	Apr. 1	1978	May 1	2011	Apr. 21
1880	Apr. 20	1913	Apr. 17	1946	Mar 29	1979	Apr. 28	2012	Mar. 22
1881	May 6	1914	May 1	1947	Apr. 27	1980	Apr. 20	2013	Apr. 18
1882	Apr. 29	1915	Apr. 20	1948	Apr. 9	1981	Apr. 9	2014	Apr. 23
1883	May 7	1916	May 1	1949	Apr. 6	1982	Apr. 28	2015	Apr. 25
1884	May 2	1917	May 7	1950	Apr. 26	1983	Apr. 16	2016	Mar. 18
1885	Apr. 30	1918	Apr. 26	1951	Apr. 20	1984	Apr. 21	2017	Apr. 16
1886	Apr. 24	1919	Apr. 14	1952	Apr. 20	1985	Apr. 16	2018	Apr. 29
1887	May 7	1920	Apr. 29	1953	Apr. 5	1986	Apr. 15	2019	Apr. 20
1888	May 14	1921	Mar. 29	1954	Apr. 16	1987	Apr. 13	2020	Apr. 3
1889	Apr. 20	1922	Apr. 6	1955	Apr. 22	1988	Apr. 16	2021	Apr. 9
1890	Apr. 26	1923	Apr. 27	1956	May 9	1989	Apr. 21	2022	Apr. 7
1891	Apr. 24	1924	Apr. 19	1957	Apr. 20	1990	Apr. 16	2023	
1892	Apr. 16	1925	Apr. 26	1958	Apr. 24	1991	Apr. 8	2024	
1893	May 13	1926	May 4	1959	Apr. 26	1992	Apr. 23	2025	
1894	Apr. 19	1927	Apr. 20	1960	Apr. 25	1993	Apr. 22	2026	
1895	Apr. 30	1928	Apr. 30	1961	May 3	1994	Apr. 20	2027	
1896	Apr. 28	1929	Apr. 14	1962	Apr. 26	1995	Apr. 14	2028	
1897	Apr. 29	1930	Apr. 17	1963	Apr. 21	1996	Apr. 21	2029	
1898	Apr. 18	1931	Apr. 16	1964	Apr. 28	1997	Apr. 24	2030	
1899	May 3	1932	Apr. 26	1965	Apr. 30	1998	Apr. 13	2031	
1900	Apr. 30	1933	Apr. 30	1966	Apr. 26	1999	Apr. 13	2032	
1901	Apr. 24	1934	Apr. 24	1967	Apr. 27	2000	Apr. 9	2033	

Sunapee Historical Society, Inc. 4/9/2022

9.09 Appendix I: Bibliography

Anderson, M.G., A. Barnett, M. Clark, C. Ferree, A. Olivero Sheldon, J. Prince. 2016. Resilient Sites for Terrestrial Conservation in Eastern North America. The Nature Conservancy, Eastern Conservation Science.

Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.

Anderson, M.G., M. Clark, and A. Olivero Sheldon. 2014. Estimating Climate Resilience for Conservation across Geophysical Settings. Conservation Biology 28 (4) 1523-1739. http://dx.doi.org/10.1111/cobi.12272

Ardizone, Katherine A. and Mark A. Wyckoff, FAICP. FILLING THE GAPS: Environmental Protection Options for Local Governments, 2nd Ed. Michigan Department of Natural Resources and Environment, Coastal Management Program with financial assistance from the National Oceanic and Atmospheric Administration, authorized by the Coastal Zone Management Act of 1972. December 2010.

Auger, P. & J. McIntyre. 1991. Revised 2001 by A. J. Lindley Stone. *Natural Resources Inventories: A Guide for New Hampshire Communities and Conservation Groups*. Durham, NH: University of New Hampshire Cooperative Extension.

Centers for Disease Control and Prevention (CDC). 2022, June 1. Harmful Algal Bloom (HAB)-Associated Illness. Available online at https://www.cdc.gov/habs/

Connecticut River Joint Commissions. “A Homeowner s Guide to Water Quality Protection.” 2018, https://crjc.org/wp-content/uploads/2018/10/homeguide-07162018R.pdf.

Flavelle, Christopher, et al. “New Data Reveals Hidden Flood Risk Across America.” *The New York Times*, The New York Times, 29 June 2020, https://www.nytimes.com/interactive/2020/06/29/climate/hidden-flood-risk-maps.html.

Jay, A., D.R. Reidmiller, C.W. Avery, D. Barrie, B.J. DeAngelo, A. Dave, M. Dzaugis, M. Kolian, K.L.M. Lewis, K. Reeves, and D. Winner, 2018: Overview. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 33–71. doi: 10.7930/NCA4.2018.CH1

Lake Sunapee Protective Association (LSPA). 2016. Water Quality Trends and Concerns. Available online at: https://www.lakesunapee.org/trends-concerns

Lemcke-Stampone, Mary D.; Wake, Cameron P.; and Burakowski, Elizabeth, "New Hampshire Climate Assessment 2021" (2022). The Sustainability Institute. 71.

Moore, R.B., Johnson, C.D., and Douglas, E. M. 1994. Geohydrology and water quality of stratified-drift aquifers in the lower Connecticut River basin, southwestern New Hampshire: U.S. Geological Survey Water-Resources Investigations Report 92-4013. Denver, CO: United States Geological Survey Earth Science Information Center.

Murphy, J. and L. Anderson, 2019. Responsible Wind Power and Wildlife. Washington, DC: National Wildlife Federation.

National Wildlife Federation. 2013. *Wildlife in a Warming World*. Available online at: https://www.nwf.org/~/media/PDFs/Global-Warming/Reports/NWF_Wildlife-Warming-World_Report_web.pdf

New Hampshire Bureau of Economic and Labor Market Information. 2008. *Community Profiles.* Available online at: http://www.nh.gov/nhes/elmi/communpro.htm.

New Hampshire Department of Environmental Services (NHDES). 2021. Status Report on the Occurrence of Per- and Polyfluoroalkyl Substance (PFAs) Contamination in New Hampshire. Concord, NH: New Hampshire Department of Environmental Services.

New Hampshire Department of Environmental Services (NHDES). 2021. New Hampshire Fish Consumption Guidelines. Available online at https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/ard-ehp-25.pdf

New Hampshire Department of Environmental Services (NHDES). 2021. Cyanobacteria Sightings Reported - Gloeotrichia. Available online at https://www.des.nh.gov/news-and-media/cyanobacteria-sightings-reported-gloeotrichia

New Hampshire Department of Environmental Services (NHDES). 2022. New Hampshire Watershed Report Cards built from the 2020/2022, 305(b)/303(d), HUC 12: Newport Tributaries. Available online at https://www4.des.state.nh.us/onestoppub/SWQA/010801060405_2020.pdf

New Hampshire Department of Environmental Services (NHDES). 2022. New Hampshire Watershed Report Cards built from the 2020/2022, 305(b)/303(d), HUC 12: Sunapee Lake. Available online at https://www4.des.state.nh.us/onestoppub/SWQA/010801060405_2020.pdf

New Hampshire Department of Environmental Services. 2008. *DES List of Fourth Order and Higher Streams (Publication WD-08-9)*. Available online at http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm.

New Hampshire Department of Environmental Services. 2008. *DES List of Public Water Supplies*. Available online at http://www2.des.state.nh.us/OneStop/.

New Hampshire Department of Environmental Services. 2008. *Official List of Public Waters*. Available online at http://www2.des.state.nh.us/OneStop/.

New Hampshire Department of Natural and Cultural Resources Division of Forests and Lands. 2020. *New Hampshire Forest Action Plan*. Available online at: https://www.nh.gov/nhdfl/documents/nh-stateforestactionplan_2020.pdf

New Hampshire Department of Revenue Administration. 2021 (reports generated annually). *Current Use Reports*. Available online at: https://www.revenue.nh.gov/mun-prop/property/equalization-2019/documents/current-use-alpha.pdf.

New Hampshire Fish and Game Department. 2015. *Wildlife Action Plan*. Concord, NH: New Hampshire Fish and Game Department.

New Hampshire Natural Heritage Bureau. 2008. *Rare Plants, Rare Animals and Exemplary Natural Communities in New Hampshire Towns* (an online resource, regularly updated). Concord, NH: Department of Resources and Economic Development.

New Hampshire Office of Energy and Planning. 2022. *OEP Population Projections*. Available Online at: https://www.nh.gov/osi/data-center/population-projections.htm.

Omernik, J.M., and G.E. Griffith. 2014. Ecoregions of the conterminous United States: evolution of a hierarchical spatial framework. Environmental Management 54(6):1249-1266, http://dx.doi.org/10.1007/s00267-014-0364-1.

Simpson M.H., Stack L.J., Gruber J., Wood R., Crosslin T., Lawson C., Roseen R., Smith J. 2012. Stormwater drainage system vulnerability, capacity, and cost: Response to climate change and population growth. Final project report: Sectoral Applications Research Program FY2009, Climate Program Office, National Oceanic and Atmospheric Administration

Society for the Protection of New Hampshire Forests and The Nature Conservancy NH Field Office. 2005. *New Hampshire's Changing Landscape 2005*. Concord, NH: Society for the Protection of New Hampshire Forests.

Sperduto, D. D. & W. F. Nichols. 2004. *Natural Communities of New Hampshire*. Concord, NH: New Hampshire Natural Heritage Bureau and The Nature Conservancy.

United States Department of Agriculture Natural Resources Conservation Service. 1999. *Soil Survey of Sullivan County Area, New Hampshire*. Available online at: http://nh.nrcs.usda.gov/Soil_Data/index.html.

Wake, Cameron P.; Burakowski, Elizabeth A.; Wilkinson, Peter; Hayhoe, Katharine; Stoner, Anne; Keeley, C.; and LaBranche, Julie, "Climate Change in Southern New Hampshire: Past, Present and Future" (2014). The Sustainability Institute. 2. https://scholars.unh.edu/sustainability/2