

1 Introduction



In 2011, the Orford Conservation Commission completed its first Natural Resource Inventory (NRI) with the assistance of the Upper Valley Lake Sunapee Regional Planning Commission. This update is an addendum to the original. The NRI is a recognized method for identifying, inventorying, and tracking changes in our natural resources. The objective of this update is to ensure that the Inventory remains relevant. An NRI is a tool that helps the Conservation Commission fulfill its purpose: to work toward “the proper utilization and protection of the natural resources and for the protection of watershed resources of said city or town (RSA 36-A).”

This update includes the addition of a new chapter about Climate Change (Chapter 5), because it is integral to our understanding of the future changes and climate impacts to Orford’s natural resources. Within each chapter, when applicable, information is included about how the changing climate will likely impact that particular resource.

The update also includes a new chapter about Orford’s Geology (Chapter 6). The geology chapter discusses Orford’s geologic history with a discussion about the rocks beneath the surface and how that substrate affects our natural resources, including our groundwater and our soils. This edition also includes numerous stories and images from Orford’s residents. These stories help to document Orford’s natural resources as well as the people who reside here at a particular time in history.

Why inventory natural resources?

Human health and welfare are dependent on healthy, functioning natural ecosystems. The future of the natural resource base is largely dependent on land use decisions made at the local level. Communities frequently need to make decisions affecting natural resources, but very often don’t have adequate data available to back those decisions. By identifying and describing natural resources in a local setting, a natural resource inventory provides communities with a strong foundation for more informed decision-making. It also encourages participation in identifying and protecting natural resources important to the community and provides information that will support careful land use planning, voluntary land conservation, and improved resource protection measures.

-Natural Resources: An Inventory Guide for NH Communities

Orford - Today

Orford is a rural town chartered in 1761. The town is located in a rural region of Grafton County, where town populations are frequently below 2,000 people and most of the land is forested [adjacent towns: Lyme, to the south, population 1,733; Piermont, to the north, 754; and Wentworth, to the east, 896].

The relative population density in Orford is about 33.9 persons per square mile of land area. The median age is 40.4 and about 30% of the population is between 35-54 years of age. The second largest age group is 5-19 (21.6%) (American Community Survey 2014).

The town is roughly 48 square miles, with 46.4 square miles of land and

1.3 square miles of inland water. Orford connects to nearby towns by NH Route 10 which runs north-south on the western edge of the town and Route 25A which runs east-west through the center of the town.

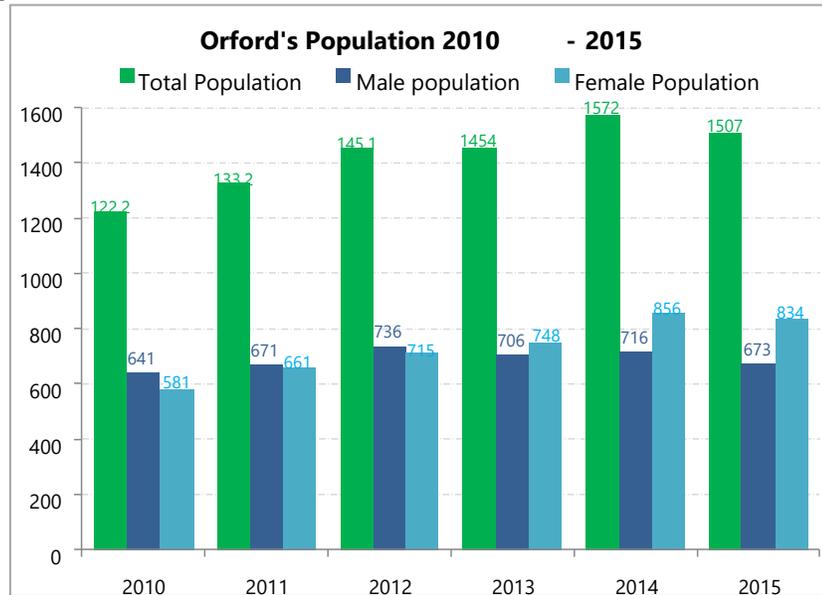
The topography of Orford rises dramatically from the Connecticut River (~400 ft elevation) to the hills and mountains to the east. The highest elevation in town is 2,909 feet above sea level, at the summit of Mount Cube, which can be reached by hiking along a section of the Appalachian Trail.

Orford has a rich land use history, and within the context of the natural setting it is important to protect and maintain. There are several historic villages in town including: Gilman's Corner, Orfordville and Quinttown.

The Orford Conservation Commission has prepared this Natural Resources Inventory to serve as an index of natural resources and important natural areas in town.

A Natural Resources Inventory can be used as:

- A baseline of information from which changes in the town can be assessed
- A tool for public outreach to inform citizens about the town's resources
- A source of information to support voluntary land protection and resource conservation
- A source of information to support land use decision-making



- A source of information to support sound decisions about town and state projects, such as siting new community facilities or planning for roadway improvements.

The status and significance of natural resources and their protections do change over time, and this inventory should not be construed as a “final product.” It should continue to be updated on a regular schedule. This first update to the inventory maintains the heart of the original, adding to the summary of what existed at the time and adds or improves recommended actions for the future if new information was available. Periodic updates may incorporate new data, regulatory protections, and priorities for natural resources conservation. At minimum, the NRI should be reviewed at a regular cycle, perhaps in sync with Master Plan updates, so that it can be used to inform the development of the Master Plan.

2 The Natural Resources of Orford

In 2010, during the development of the first natural resources inventory (NRI), the Orford Conservation Commission identified seven important natural resources for inclusion in this inventory: **surface waters, wetlands, floodplains, groundwater, agricultural lands, forest lands, and wildlife habitat.** The NRI also documented scenic views and vistas, outdoor recreation opportunities, and cultural and historic areas. These resources were included because town residents place important cultural value on the natural landscape that provides scenery, recreation and links to culture and history. Some of the data obtained from the State of NH for the original NRI has been updated and is incorporated into this update. Examples include, Current Use data, Conserved Lands data, and the data associated with the NH Wildlife Action Plan.

We residents of Orford are so fortunate to live in a town richly endowed with natural resources. The greatest advantage we have in caring for these gifts of resources is the people who live here. We individuals can make a genuine difference in the quality of our environment.

Our environment is a gift to our town, and we as individuals can return the gift to the future residents by the choices we make and actions we take.

– Conservation Commission Member,
2016

3 Inventory Methods and Data Sources

The 2020 NRI Update began with a review of the NRI from 2017 (revision edits) and 2011. The Conservation Commission determined the best course of action was to incorporate new information right into the 2011 / 2017 documents.

During the update, the Orford Conservation Commission, again, was a critical part of the process. Members provided a great deal of insight, writing, photography, research and creativity. Members of the Orford Conservation Commission researched town records, interviewed residents, and recorded stories, sometimes their own, for use in this document. Additional data sources include habitat and wildlife information from the NH Fish & Game's Wildlife Action Plan (2015) <https://www.wildlife.state.nh.us/wildlife/wap.html>, climate research published by the National Science Foundation (NSF) <https://www.nsf.gov>, the Environmental Protection Agency (EPA) <https://www.epa.gov>, University of New Hampshire (UNH) <https://unh.edu> and the Sustainability Institute <https://www.sustaininstitute.com>.

4 Land in Conservation and Current Use

Conservation lands protect a wide variety of natural resources in Orford. Some are part of the working landscapes of forestry and agriculture, while other lands are held for recreation and wildlife management while still others are protected for cultural and scenic value. The goal of most conservation action is to provide the lands, as they are – open and undeveloped – for the future.

In 2010, approximately 2,945 acres of land in Orford were protected, about ten percent of the town's land area. By 2020, the total was 3,882 acres, about 13 percent. Much of the conserved land in Orford is located in the mountainous eastern region and in the western region along the Connecticut River.

There are several kinds of protected land in Orford:

- *Publicly Owned - Undeveloped*: Land that does not have a conservation easement, but is owned by a public entity (town, state, federal government), with the intention that it remain undeveloped and be used for public benefit.
- *Conservation Easement or Deed Restriction*: Land (publicly or privately owned) that is protected with a legal document such as a conservation easement or deed restriction, specifying that the land will remain undeveloped and how it can be used.

Natural Resources Inventory – 2020 Update

- *Owned by Conservation Organization:* Land that does not have a conservation easement, but is owned by an organization like a land trust whose primary purpose is conservation.
- *Enrolled in Current Use:* Undeveloped land that is enrolled with the state of New Hampshire's Current Use program and receives an alternative tax assessment. If development occurs a penalty is assessed.

Some parcels of land have more than one form of protection, for instance, conservation easement and current use, or publicly owned and conservation easement.

Please note – Not all conservation lands are open for public recreation. Please consult with the easement holder or land-owning agency for information on public access.

Publicly Owned Undeveloped Land

The Town of Orford owns numerous lands held for public benefit. These include ball fields, town beaches on Indian Pond and Upper Baker Pond, as well as boat access areas on Lower Baker Pond and the Connecticut River.

The Rivendell Interstate School District also owns undeveloped land in Orford, a narrow strip extending from Main Street to Town Shed Road. A conservation easement on the western portion protects an agricultural field, while the forested eastern part hosts the Cross-Rivendell Trail.

[The New Hampshire Fish and Game Department](https://ebird.org/hotspots) owns [Reeds Marsh \(Reeds Waterfowl Management Area\)](#), adjacent to the Connecticut River. It is listed as a birding hotspot on the eBird website: <https://ebird.org/hotspots>.

Appalachian Trail: The largest public landholder in Orford is the US Department of Interior's National Park Service (NPS). They hold nearly 1914 acres of land: 1293 acres in fee (full ownership) and 623 acres permanently protected with conservation easements. The generally narrow swath of land stretches along the southeastern corner of Orford, over Mt Cube, to the northeast corner. The protected area surrounds the Appalachian Trail corridor, providing a natural buffer along the nearly 10 miles of the Appalachian Trail that extends through Orford.

Table 1: Publicly Owned Undeveloped Lands in Orford

Map ID	Name of Tract(s)	Acres	Owner/Manager
1	Appalachian Trail	1292.8	US Dept. of Interior/ National Park Service
22	Reeds Marsh Waterfowl Management Area	72.0	NH Fish & Game Dept.
26	Rivendell School Land	50.0	Rivendell Interstate School District
5	Community Field	9.0	Town of Orford
6	Connecticut River Boat Landing & Recreation Area	9.0	Town of Orford
13	Flat Rock	0.7	Town of Orford
14	Former Brookside Store Land	0.2	Town of Orford
17	Indian Pond Beach	1.1	Town of Orford
19	Lower Baker Pond - Boat Access	0.3	Town of Orford
31	Smith-Jacobs Brook	1.1	Town of Orford
32	Sunday Mtn Development Land	0.5	Town of Orford
34	Town Offices	7.0	Town of Orford
35	Upper Baker Pond - Town Beach	3.7	Town of Orford
	Total	1447.4	

Note: The number of acres represents the “calculated acres” within the Town of Orford.

Lands with Conservation Easements and Deed Restrictions

Conservation easements on privately owned land (and in some cases, town-owned land) in Orford have been steadily increasing the acreage of protected land. According to Conservation Commission records compiled by Sarah Schwaegler, nine conservation easements were completed in the 1980’s, nine in the 1990’s and seven in the 2000’s. Two properties have been conserved since 2011: *Windfall*, 16± acres along Upper Baker Pond, and *Brackett Brook Farm*, 103± acres in East Orford. There are also two properties in town that are protected with deed restrictions.

Several of these easements have been placed over time on different lots owned by the same family; the commitment of these families to the preservation of open space and natural resources is truly outstanding. These conserved lands provide permanent protection for the natural resources of Orford for the benefit of present and future generations.

Table 2: Orford Lands with Conservation Easement (CE) or Deed Restriction (DR)

Map ID	Name of Tract(s)	Acres	Owner/ Manager	Prot.	Protection Agency
1	AT Tracts - Easement with USDI	622.6	Private	CE	USDI/NPS/AT
2	Brackett Brook Farm	102.6	Private	CE	UVLT
3	Brownson	53.3	Private	CE	UVLT
4	Bunten (2 parcels)	193.6	Private	CE	NH Department of Agriculture
7	Cook T. & L.	17.7	Private	CE	SPNHF
8	Eck Blackberry Hill	82.7	Private	CE	UVLT
9	Eck Freestone Forest (2 parcels)	214.5	Private	CE	UVLT
10	Eck Riverfront	12.2	Private	CE	UVLT
11	Eck Wilson Archertown	95.5	Private	CE	UVLT
12	Eck Woodlands	31.3	Town of Orford	CE	UVLT
15	Green, A. (Bugbee House)	4.6	Private	CE	UVLT
16	Hewitt & Lewis	7.9	Private	CE	SPNHF
18	Lamb	22.8	Private	CE	SPNHF
21	Orford Village District	9.6	Town of Orford	DR	
23	Richardson, J & C	7.4	Private	CE	Town of Orford
24	Richmond Conservation Land (aka Orford Conservation Land)	11.0	Town of Orford	CE	SPNHF
25	Rivendell (field north of school)	13.2	Rivendell ISD	CE	UVLT
27	Schwaegler, B. & S. (A)	119.9	Private	CE	SPNHF
28	Schwaegler, B. & S. (Indian Pond)	123.2	Private	CE	NRCS/ USDA
29	Schwaegler, B & S (B) and (C) /Richardson Lots (2 parcels)	74.3	Private	CE	SPNHF
30	Schwaegler, S. /Richardson	28.5	Private	CE	Town of Orford; SPNHF
33	Thorndike	194.8	Private	CE	SPNHF
36	Wilson, A	17.6	Private	CE	NH Department of Agriculture
37	Wilson, G (2 parcels)	88.8	Private	CE	NH Department of Agriculture
38	Windfall (Bischoff)	15.2	Private	CE	UVLT
39	Zaldestani	128.0	Private	DR	Town of Orford
	<i>Total</i>	2292.8			

Lands in Orford Owned by Conservation Organization

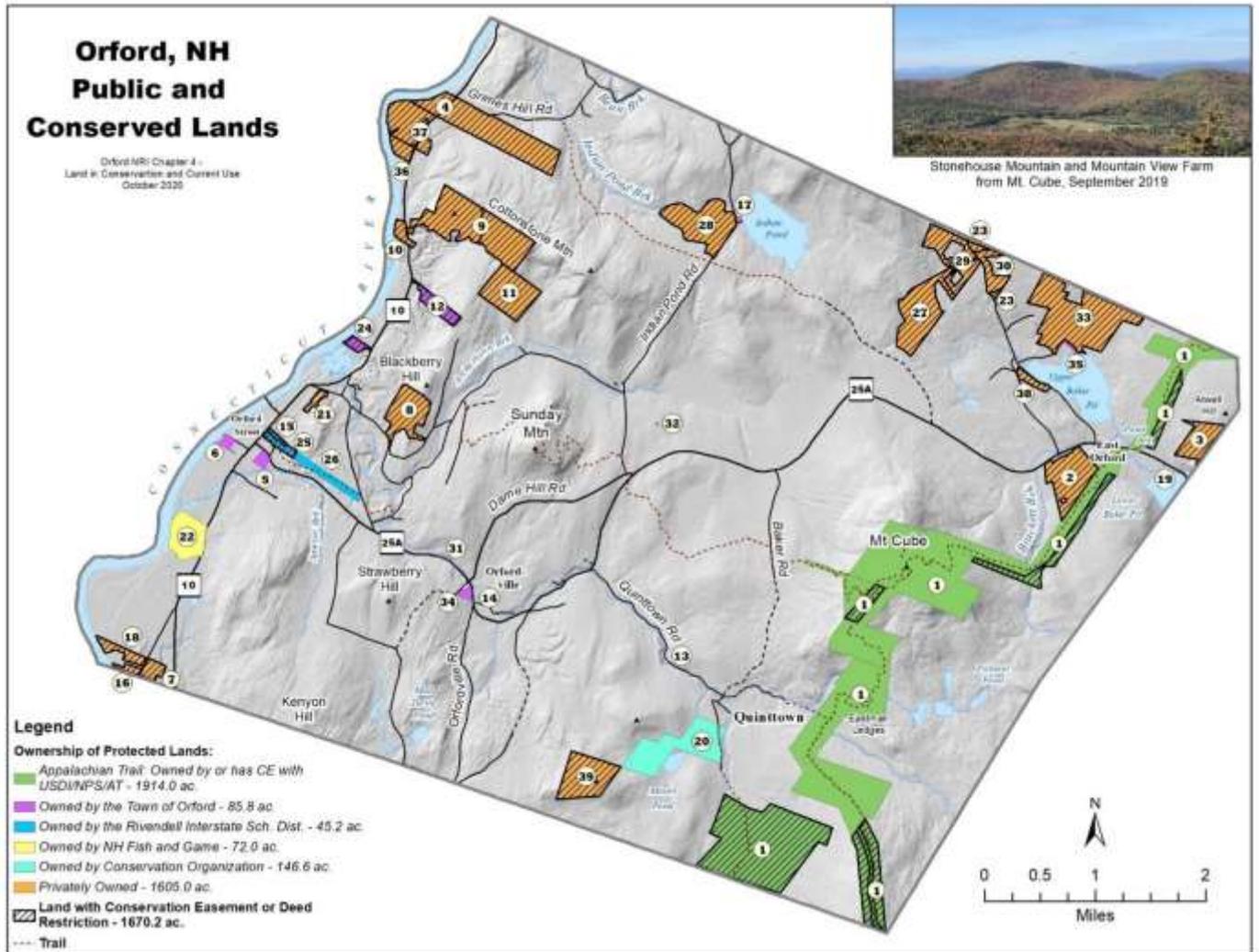
Mountain View Farm (also known as the Billy Brown farm) in Quinttown, which includes frontage on Mason Pond, is the only parcel in Orford whose protection is ownership by a conservation organization (with no conservation easement). The Upper Valley Land Trust purchased it in 2016, helped by a bargain sale from the owners, a contribution from Orford’s Conservation Fund, and fund-raising from the Town of Orford as well as contributions from several other funding sources. The Town of Orford has back-up rights to the land if the Upper Valley Land Trust should fail to protect it in the future.

Table 3: Land Owned by Conservation Organization

Map ID	Name of Tract(s)	Acres	Owner/Manager
20	Mountain View Farm	146.6	Upper Valley Land Trust

Figure 1 below is a map showing the protected lands. Each parcel has a “Map ID” number which keys to the Map Id number in the Tables 1, 2, and 3 above.

Figure 1: Map of Public and Conserved Lands in Orford



Lands Enrolled in Current Use

Overview of Current Use

New Hampshire’s Current Use program is designed to encourage preservation of open space “thus providing a healthful and attractive outdoor environment for work and recreation of the state’s citizens, maintaining the character of the state’s landscape, and conserving the land, water, forest, agricultural and wildlife resources” (NH RSA 79-A:1). Land enrolled in the Current Use program uses an alternative tax assessment method: its value is determined from its ability to grow trees and crops rather than its market value for real estate development. Current Use

assessments are typically significantly lower than standard assessments, and so taxes are typically less as well. The program was authorized in 1973 through RSA 79-A.

To be eligible for Current Use, a parcel must:

- Be at least 10 acres in size and be farmland or forestland. -or-
- Can be less than 10 acres if it generates annual farm or forest revenue of at least \$2500.

Within Current Use there are several categories of open land with different assessments. The categories have changed over the years, but currently include farm land, forest land, forest land with documented stewardship, unproductive land, and wetland. Forest land with documented stewardship has a lower assessment than just forest, to reflect the cost of active stewardship of the land.

Current Use land that is open to the public for recreation year-round with no fee can receive an additional 20% reduction in its assessment. The recreation activities that must be allowed are skiing, snowshoeing, fishing, hunting, hiking, and nature observation.

Although the intent of the Current Use program is that the enrolled land will remain open perpetually, sometimes the use changes, and the land no longer qualifies for the Current Use assessment. If this happens, the acreage that no longer qualifies is removed from Current Use, and the owner pays a penalty - the Land Use Change Tax (LUCT). A town can vote to have all or part of the LUCT put into its Conservation Fund. The Conservation Commission is authorized to use these funds to undertake conservation projects, including (following a public hearing) land acquisition or purchase of conservation easements.

There have been some changes in the Current Use program over the years; for up-to-date information about the current use program, see:

<https://www.revenue.nh.gov/current-use/booklets.htm>

Current Use in Orford

Orford has 29,715.4 land acres; the amount enrolled in Current Use has steadily increased since Current Use was initiated in 1973, as shown in Table 4 and Chart 1. No Current Use acres were reported in 1973, but by 1978, 2,926 acres (10% of the town) was enrolled. By 1986, this increased to 62% and since 1994 it has been 80% or more. There were 6 owners whose land was enrolled in Current Use in 1978; by 2018, there were 214 landowners and 427 parcels. The percentage of Current Use land with the 20% recreational adjustment has varied between 36% and 52.5% since 1994.

Most of the Orford land enrolled in Current Use falls in the Forest, or Forest with Stewardship category (Table 5, Chart 1).

Chart 1: Orford Land in Current Use by Category

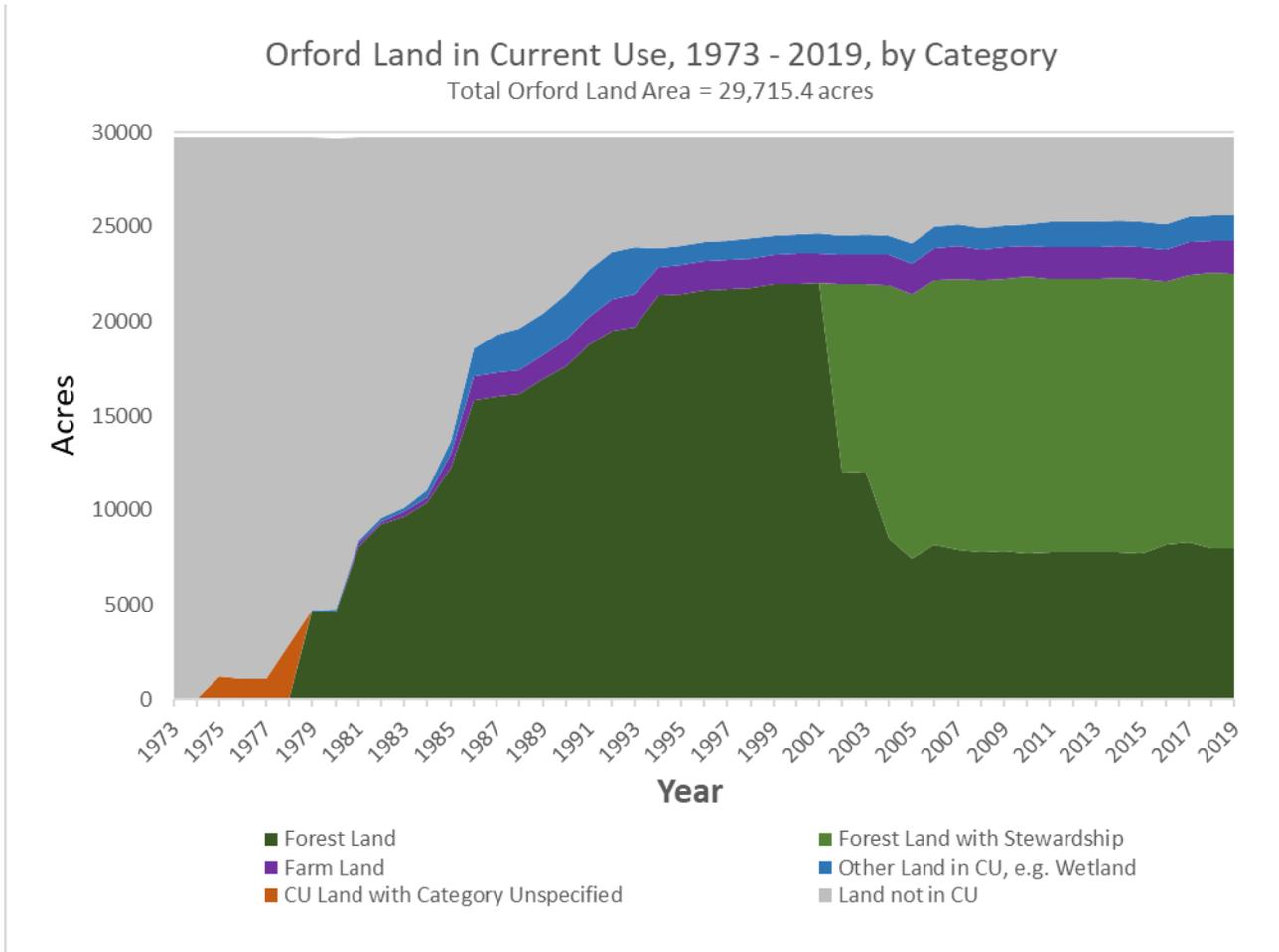
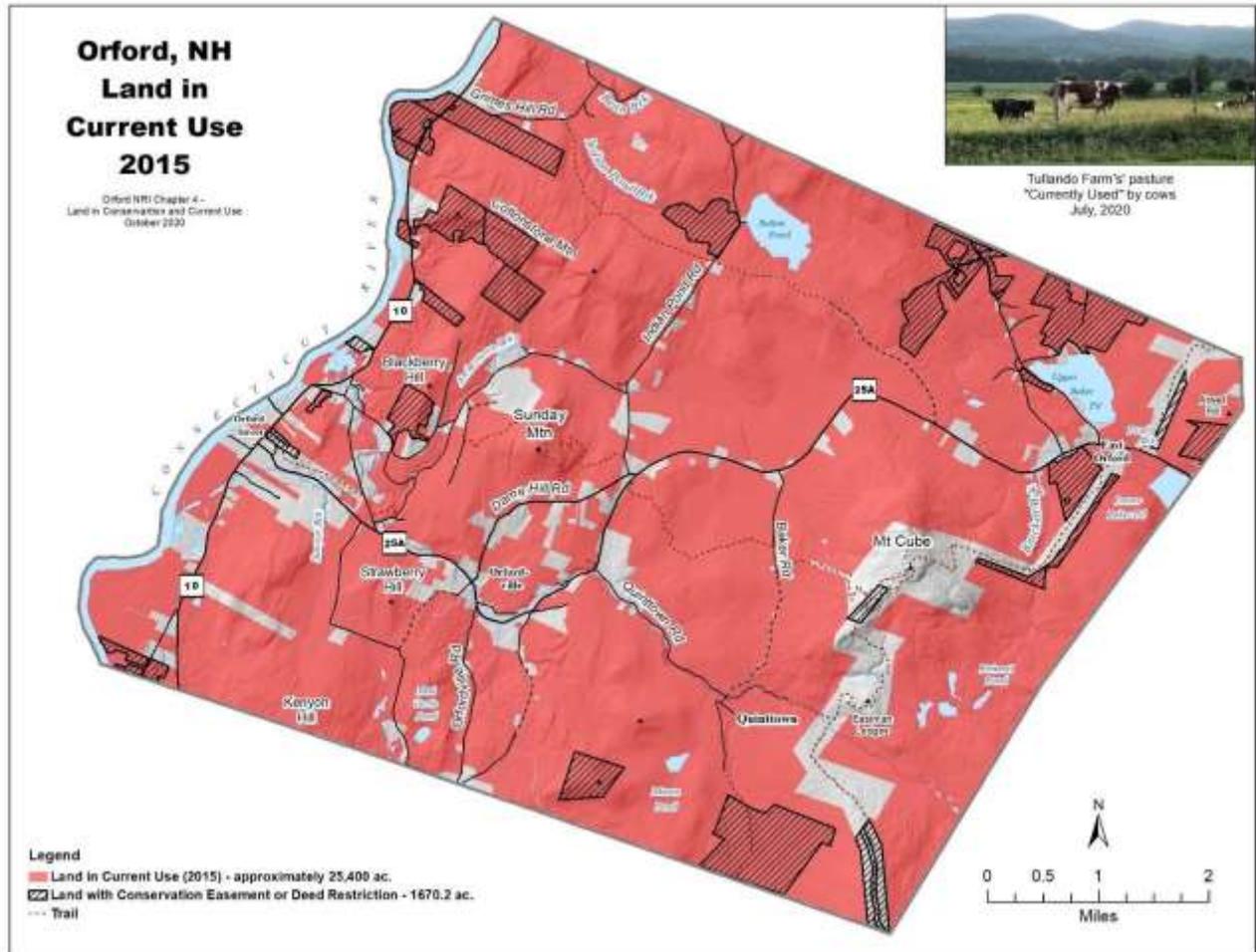


Figure 2: Map of Orford, NH Land in Current Use



The number of acres removed from Current Use in Orford as reported in the Town Reports is:

1973 – 1986: No acres removed.

1987 – 1999 total: 178.08 acres removed. LUCT went to the Town's General Fund.

2000 – 2019 total: 170.14 acres removed. LUCT went to the Conservation Fund.

1973 – 2019 overall total: 348.22 acres removed.

In 2000, the Orford Town Meeting (Article 19) voted to deposit 100% of the Land Use Change Tax into to the town's Conservation Fund. The fund has helped with several conservation projects in Orford, including the Orford Conservation Land along the Connecticut River, Mountain View Farm in Quinttown, and Brackett Brook Farm and Windfall in East Orford. The Conservation Fund is an important mechanism for assisting landowners who want to conserve their land.

Table 4. Current Use Totals for the Town of Orford 1973 – 2019

Year	Acres in CU	% of Total Orford Land Area* in CU	Acres Removed from CU	# CU Owners	# CU Parcels	# CU Acres with 20% Recreational Adjustment	% of CU Land with 20% Recreational Adjustment
1973		0%					
1974		0%					
1975	1,211.00	4%		5			
1976	1,120.00	4%		5			
1977	1,076.00	4%		4			
1978	2,926.00	10%		6			
1979	4,675.00	16%		6			
1980	4,775.50	16%		8			
1981	8,389.50	28%		13			
1982	9,567.50	32%		16			
1983	10,134.50	34%		22			
1984	11,056.25	37%		34			
1985	13,693.00	46%		48			
1986	18,555.60	62%					
1987	19,269.75	65%	33.00				
1988	19,633.15	66%	5.00				
1989	20,430.73	69%	64.50				
1990	21,450.70	72%	2.30				
1991	22,688.00	76%	1.00				
1992	23,677.82	80%					
1993	23,941.00	81%	0.00				
1994	23,858.00	80%				12,450.00	52%

Natural Resources Inventory – 2020 Update

1995	23,960.00	81%	6.50			12,457.00	52%
1996	24,166.00	81%	1.00			12,644.00	52%
1997	24,245.32	82%	5.00			12,811.59	53%
1998	24,350.54	82%	17.42		322	12,835.19	53%
1999	24,528.83	83%	42.36	142	630	12,835.19	52%
2000	24,582.54	83%	1.80	151	631	33,829.00	138%
2001	24,625.14	83%	55.77	143	630	12,094.28	49%
2002	24,539.86	83%	18.71	164	347	8,855.78	36%
2003	24,566.62	83%	2.62	153	644	7,866.36	32%
2004	24,507.19	82%	7.06	162	348	7,778.01	32%
2005	24,128.82	81%	8.00	181	348	11,437.90	47%
2006	24,975.92	84%	0.00	184	359	12,810.90	51%
2007	25,101.54	84%	0.00	197	388	12,717.94	51%
2008	24,911.96	84%	17.41	199	390	12,671.87	51%
2009	25,035.53	84%	1.00	195	396	12,637.11	50%
2010	25,131.27	85%	0.00	198	400	12,397.61	49%
2011	25,253.47	85%	7.62	203	411	12,442.52	49%
2012	25,255.61	85%	9.74	202	414	12,369.29	49%
2013	25,279.44	85%	5.74	199	414	12,063.43	48%
2014	25,328.59	85%	1.99	204	416	12,196.43	48%
2015	25,269.52	85%	18.41	202	417	12,166.43	48%
2016	25,091.46	84%	0.00	207	420	10,939.53	44%
2017	25,488.41	86%	8.75	210	424	10,241.02	40%
2018	25,596.79	86%	1.00	214	427	10,332.90	40%
2019	25,585.39	86%	4.52	220	428	10,332.90	40%

Sources: Orford Town Reports, NH Dept of Revenue Administration (<https://www.revenue.nh.gov/current-use/reports.htm>) * Total Land Area of Orford = 29,715.4 ac.

Table 5: Acres of Land in Current Use in Orford, by Category, 1973 - 2019

Year	Farm Land	Forest Land	Forest with Stewardship	Other, e.g. Wetland	CU Category Unspecified	Total Land in CU
1973					0.00	0.00
1974					0.00	0.00
1975					1,211.00	1,211.00
1976					1,120.00	1,120.00
1977					1,076.00	1,076.00
1978					2,926.00	2,926.00
1979	21.00	4,622.00		32.00		4,675.00
1980	20.50	4,649.50		91.00		4,775.50
1981	159.00	8,082.00		148.00		8,389.50
1982	161.00	9,253.00		153.50		9,567.50
1983	268.00	9,674.00		192.50		10,134.50
1984	280.75	10,412.00		363.50		11,056.25
1985	717.25	12,291.35		684.00		13,693.00
1986	1,262.25	15,808.35		1,485.00		18,555.60
1987	1,262.25	15,993.90		2,046.60		19,302.75
1988	1,293.25	16,127.90		2,212.00		19,633.15
1989	1,320.50	16,934.30		2,175.93		20,430.73
1990	1,410.50	17,633.50		2,406.70		21,450.70
1991	1,446.50	18,770.80		2,470.70		22,688.00
1992	1,656.97	19,492.30		2,528.55		23,677.82
1993	1,684.00	19,725.00		2,532.00		23,941.00
1994	1,511.59	21,353.16		993.25		23,858.00
1995	1,529.00	21,430.00		1,001.00		23,960.00
1996	1,539.00	21,626.00		1,001.00		24,166.00
1997	1,542.19	21,698.62		1,004.51		24,245.32

Natural Resources Inventory – 2020 Update

1998	1,558.56	21,773.17		1,018.81		24,350.54
1999	1,569.46	21,940.63		1,018.74		24,528.83
2000	1,554.20	21,996.80		1,031.54		24,582.54
2001	1,551.43	22,043.47		1,030.24		24,625.14
2002	1,559.51	12,058.82	9,895.59	1,025.94		24,539.86
2003	1,556.11	11,975.51	10,002.71	1,032.29		24,566.62
2004	1,574.61	8,503.36	13,434.06	995.16		24,507.19
2005	1,607.71	7,473.31	13,931.97	1,115.83		24,128.82
2006	1,645.72	8,185.35	14,013.07	1,131.78		24,975.92
2007	1,688.75	7,938.87	14,333.74	1,140.18		25,101.54
2008	1,628.57	7,807.16	14,336.05	1,140.18		24,911.96
2009	1,654.99	7,833.97	14,415.24	1,131.33		25,035.53
2010	1,606.27	7,739.37	14,620.10	1,165.53		25,131.27
2011	1,636.47	7,787.41	14,479.64	1,349.95		25,253.47
2012	1,636.47	7,804.08	14,464.11	1,350.95		25,255.61
2013	1,657.61	7,809.77	14,464.11	1,347.95		25,279.44
2014	1,667.61	7,775.92	14,537.11	1,347.95		25,328.59
2015	1,651.61	7,725.60	14,544.36	1,347.95		25,269.52
2016	1,656.26	8,216.44	13,884.51	1,334.25		25,091.46
2017	1,704.54	8,330.87	14,118.85	1,334.15		25,488.41
2018	1,709.39	8,001.53	14,545.62	1,340.25		25,596.79
2019	1,707.83	7,993.67	14,540.54	1,343.35		25,585.39

Sources: Orford Town Reports, NH Dept of Revenue Administration (<https://www.revenue.nh.gov/current-use/reports.htm>) Total Land Area of Orford = 29,715.4 ac.

5 Climate Change



This was a new chapter of Orford’s Natural Resource Inventory (NRI) in 2017. The Conservation Commission had added this chapter to provide the community with a synopsis of climate science as it relates to our region; to develop a common set of baseline data from which to measure future change; to provide the community with information about adapting to these changes; and to bring the community to a common place of understanding and dialogue so that we can work together to create solutions. While NH is geographically a small state, the climate is sometimes quite different from south to north and east to west (Figure 1). Therefore, when changes in the climate are generalized for the state of NH, they often aren’t reflected in what we in the western central part of the state are observing. See the 2014 report entitled, *Climate Change in Southern New Hampshire: Past, Present and Future*, published by Climate Solutions of New England, wherein they studied the changing climate in New Hampshire.¹

Climate Solutions New England (CSNE) promotes collaboration and collective impact towards the goal of greater energy selfreliance and weather resilience that contribute to healthy, prosperous, and sustainable communities across New England. CSNE is an initiative of [The University of New Hampshire Sustainability Institute](#) and is lead by faculty and staff from the Sustainability Institute and the University of New Hampshire. The report can be found online in the “Tools & Resources”

Local climate analyses were completed using data from Orford’s nearby southern neighbor, Hanover. Hanover has a meteorological station that is part of the US Historical Climatology Network and has provided continuous daily records from since 1895. These daily weather records, particularly those collected from 1960-2012, were used to establish historic norms and predict climate trends for the region for the rest of the century. This local context was difficult to come by until now and it is information from this report and associated online data that is used in this NRI update.

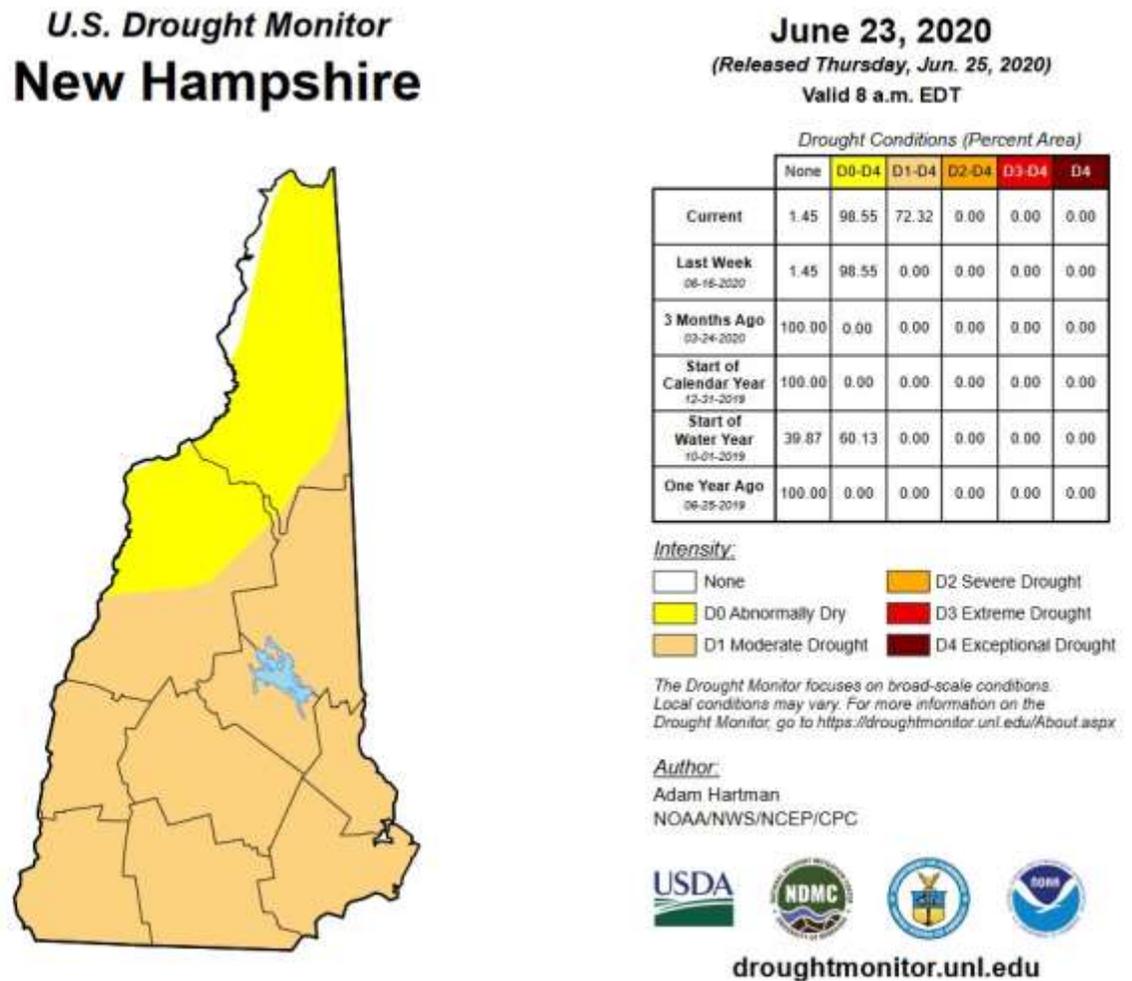


Figure 1: Maps from the US Drought Monitoring Program, a service of the USDA
https://droughtmonitor.unl.edu/data/pdf/20200616/20200616_NH_trd.pdf

section of UNH’s Sustainability Institute website

<https://sustainableunh.unh.edu/sites/sustainableunh.unh.edu/files/images/southernnhclimateassessment2014.pdf>

Weather versus Climate

“Climate is what we expect...Weather is what we get.” - Robert Heinlein

Weather is what we feel from **day-to-day** when we step outside. It refers to the short-term characteristics of temperature, precipitation, wind speed, cloud cover, etc., and how we describe the day: *it's raining, it's snowing, it's cold, it's windy...*

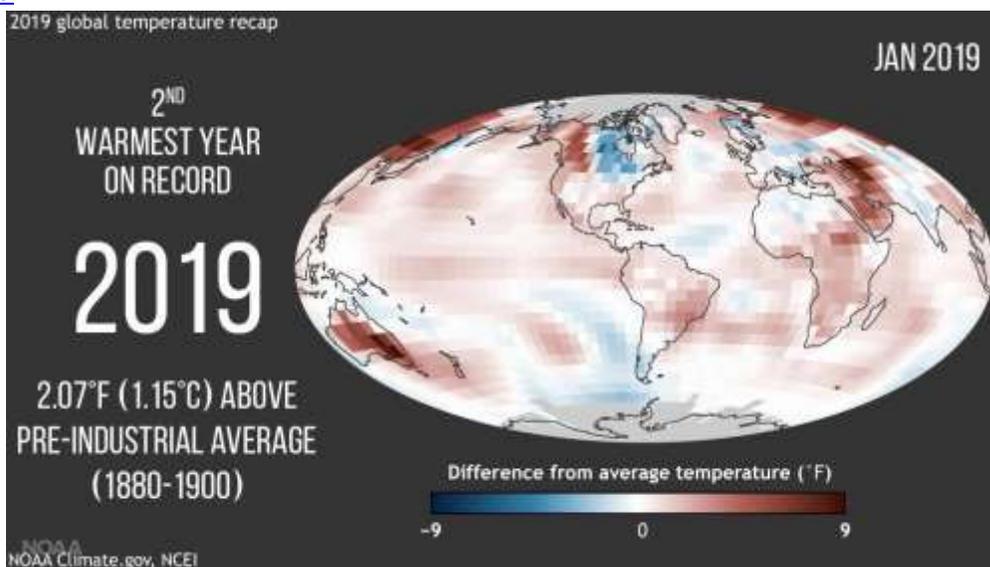
Climate, on the other hand, describes the **long-term** aspects of weather and is generally referred to in *averages*, such as “average annual precipitation”, “average annual snow cover”, and “average annual maximum temperature.” In Orford, we expect snow and ice in the winter months because of the climate we are living in, but from day to day, or even year to year, we may have greater and lesser amounts of snowfall and ice.

Climate Change, Global Warming & Greenhouse Gases

Climate Change refers to changes in the climate that last long periods of time, decades, or centuries. Some of the changes that scientists have observed are rising sea levels, melting of glaciers and a change in both plant and animal life cycles.

Warmer temperatures are one of the most notable signs that our climate is changing.

According to an article published in the New York Times on January 9th, 2017, the National Oceanic Atmospheric Administration (NOAA) stated that “...the breadth of the 2016 warmth is unparalleled in the nation’s climate history. No other year had as many states breaking, or close to breaking, their warmest annual average temperature.” The article continues to state that 2016 will likely be the warmest global temperature on record. Currently, NOAA observes that 2019 was the 2nd hottest year ever recorded. <https://www.noaa.gov/news/2019-was-2ndhottest-year-on-record-for-earth-say-noaa-nasa>



The term “**global warming**” is often confused with the term “**climate change**”. Global warming is one aspect of climate change and specifically refers to the increasing temperature in the atmosphere near the Earth’s surface. This is primarily caused by the increasing amount of **greenhouse gases** in our atmosphere. Common greenhouse gases include carbon dioxide (CO₂); methane; nitrous oxide (N₂O); and some fluorinated gases such as fluorine, hydrofluorocarbons, and perfluorocarbons. The accumulation of these gases in the atmosphere since the Industrial Age are the result of emissions from human-related activities such as the production of energy, from the burning of fossil fuels when heating and cooling buildings, and from driving our cars. According to Dr. Michael E Mann, a climate scientist at Pennsylvania State University, “Human-induced climate change has made it at least 160 times more likely that three consecutive years after 2000 would be record-setting” and “that if human-induced climate change was not part of the equation, the amount of warming in 2016 would have less than one-in-a-million odds of occurring.” He further argues that about 75% of the warmth is due to human impact.¹ Warming occurs because greenhouse gases trap heat within the lower part of our atmosphere and have an effect on the earth’s atmosphere similar to that of the warming within a greenhouse. These gases last a very long time in the atmosphere. So, even reductions that we make now in our emissions will not have an immediate impact and the reason why we can expect global temperatures to continue to rise in the future, but we may be able to slow or reduce the rise if we continue to cut emissions across the globe.

¹ <https://www.nytimes.com/interactive/2017/01/18/science/earth/2016-hottest-year-on-record.html>

Predicting how the climate will continue to change is complicated science! It involves using complex scientific modeling based on a LOT of climate data. It is however, important for us to understand how the climate will change as we approach the middle of the century so that we can adapt to those changes and have better opportunity to mitigate some of the problems that are likely to occur.

Climate Indicators

Climate indicators are set of common measures that are used to track and communicate the causes and effects of climate change. Climate indicators include temperature, precipitation, snowfall, and snow cover as well as many other environmental measures such as Arctic sea ice, atmospheric CO₂ and the start of spring. Climate indicators also include societal trends such as the number of heat related deaths, cases of Lyme Disease and the length of the growing season. Climate indicators are also used in climate modeling, which helps make predictions about the future climate based on the trends in the data.

Table 1: Historical measures of Climate Indicator data for the Hanover, NH weather station. This information in this table is adapted from a report titled *Climate Change in Southern New*

Climate Indicators	Historical (1980-2009)
Cold Days	
Annual average minimum temperature	35.2°F
Days per year less than 32°F	156
Days per year less than 0°F	18
The average minimum temperature on the coldest day of the year	-18
Hot Days	
Annual average maximum temperature	56.7°F
Days per year greater than 90°F	8
Days per year greater than 95°F	1
The average maximum temperature on the hottest day of the year	94.2
Seasonal Days	
Average Winter minimum temperature	14
Average Winter maximum temperature	36.1
Average Spring minimum temperature	32.8
Average Spring maximum temperature	56.7
Average Summer minimum temperature	56.4
Average Summer maximum temperature	80.6
Average Fall minimum temperature	37.7
Average Fall maximum temperature	61.3
Growing Season	

Hampshire: Past, Present, and Future (2014).

Hanover. Data for a variety of climate indicators have been collected at that location since 1895. It was information from this station that was used to understand climate change in New Hampshire and was presented in a report published in 2014 by Climate Solutions New England². Understanding historic trends allows us to identify the extent of change that has occurred as well as predict, based on trends, what climate conditions in the region will likely be like. Historic conditions of common climate indicators for the region are summarized in Table 1.

Temperature

Temperature is the most commonly referred to climate indicator. It is one that can be measured on all the earth and is observable. Rising global temperatures have been a concern and in the news for more than a decade. On January 18, 2017, the New York Times published an article titled: *Earth Sets a Temperature Record for the Third Straight Year*. The article stated that, “the Earth reached its highest temperature on record in 2016, trouncing a record set only a year earlier, which beat one set in 2014. It is the first time in the modern era of global warming data that temperatures have blown past the previous record three years in a row.”³

In Orford, average annual high temperature is 56.3°F and has increased since 1970, but the average annual minimum temperature is 35.4°F and has increased since 1970 at a greater rate (Table 2). This is particularly noticeable during our winter months. With the average warming trend in the winter increasing an average of 1.45°F per decade since the 1970’s it is no surprise that it is predicted to increase to between 40°F and 46°F by 2099 (Figure 2). The warming temperature trends have provided Orford with earlier springs, more precipitation falling as rain, earlier ice out, increased length of the growing season and sometimes shortened winter recreation opportunities.

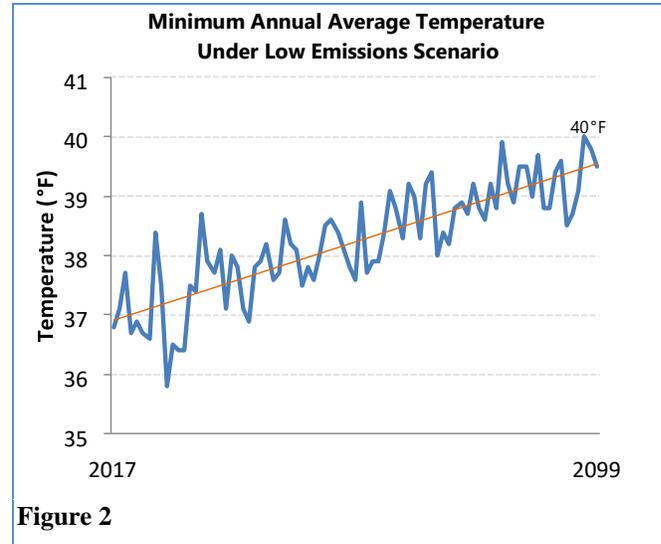
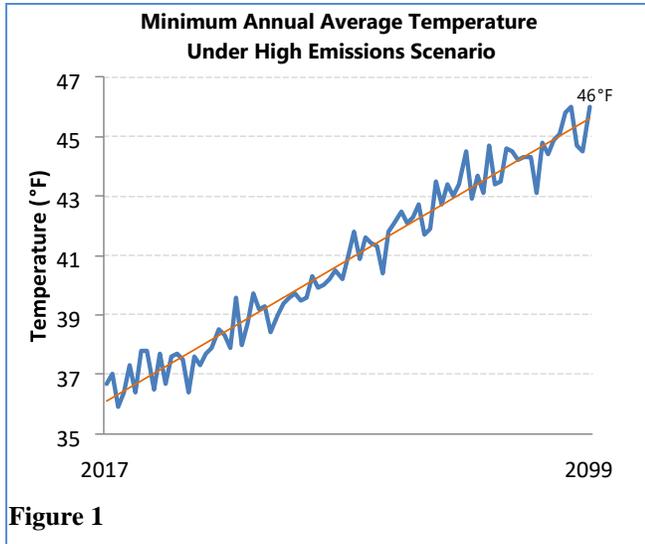
Table 2: Annual trends in average temperature for two periods from the Hanover, NH, weather station. This information in this table is adapted from a report titled *Climate Change in Southern New Hampshire: Past, Present, and Future* (2014).

	1895-2012	1970-2012
Avg Annual Max Temperature (°F per decade)		
Annual	+0.05	+0.25
Winter	+0.08	+0.37
Spring	+0.15	+0.29
Summer	+0.08	-0.05
Fall	-0.05	+0.60
Avg Annual Min Temperature (°F per decade)		
Annual	+0.25	+0.74
Winter	+0.36	+1.45
Spring	+0.23	+0.60
Summer	+0.27	+0.60
Fall	+0.22	+0.61

² Climate Change in Southern New Hampshire: Past, Present, and Future. 2014

(<https://sustainableunh.unh.edu/sites/sustainableunh.unh.edu/files/images/southernnhclimateassessment2014.pdf>)

³ <https://www.nytimes.com/2017/01/18/science/earth-highest-temperature-record.html? r=0>



Length of Growing Season

The growing season is defined as the number of days between the last hard frost of spring and the first hard frost of winter (hard frost = 28°F), roughly marking the period in which plants grow most successfully⁴. The growing season has lengthened by 15 to 52 days in the state of NH since the 1960’s, with the southern portion of the state gaining the greatest number of days, averaging an increase of 10 days per decade.

In Orford, the growing season has been lengthening nearly 6 days per decade since the 1960’s. From 1960-2012, the average length of the growing season was 175.9 days.⁵ Although there will be fluctuations from year to year, by 2099 the growing season could be as many as

60 days longer in the region, under a high emissions scenario (Figure 3).

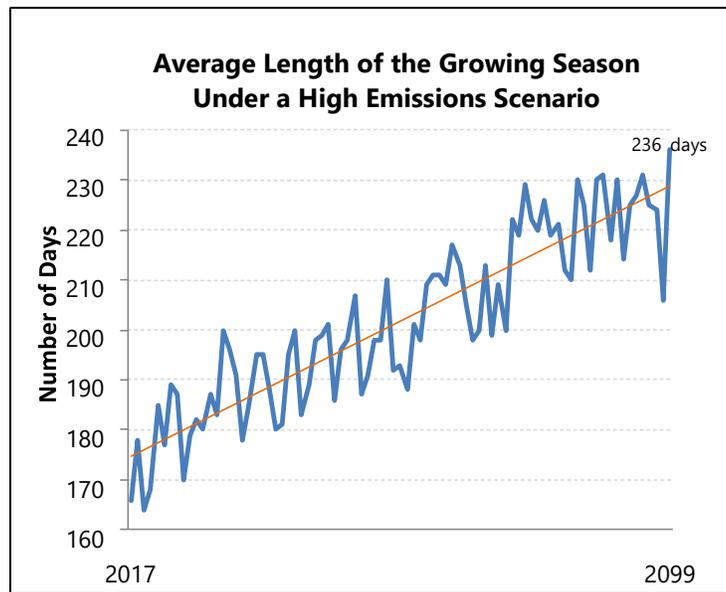


Figure 3: Length of the growing season, from the last frost of spring to the first frost of fall, in Hanover, NH under a high emissions scenario. Modeling by NH EPSCoR, UNH, 2014. Data was downloaded from the Data Discovery Center, https://ddc.unh.edu/ddc_data/variables/list/ accessed January 2017.

⁴ Climate Change in Southern New Hampshire: Past, Present, and Future. 2014 (<https://sustainableunh.unh.edu/sites/sustainableunh.unh.edu/files/images/southernnhclimateassessment2014.pdf>)

⁵ Climate Change in Southern New Hampshire: Past, Present, and Future. 2014

This increase will have the greatest influence on our region’s agriculture and home gardeners. Farmers and home gardeners alike often try to extend the growing season by using greenhouses or smaller hot houses and a variety of other methods that keep the soil warmer longer so that some plants will keep producing. So, often, a longer growing season doesn’t threaten agriculture, but if the increase in our region actually becomes as long as 230 days, warm-season crops will have an advantage over cold-season crops, which are more of the traditional crops of the northeast. Of course, the timing of this lengthening is also important. If we experience more warmer days in the spring compared to more days in the fall, this would likely have a better outcome for agriculture, and plants alike. This is because earlier germination could occur which may improve yields and opportunity for crop diversification, compared to later, at the end of the season, when daylight, also critical to plant productivity, is declining. With increased temperatures lasting longer soils may become drier which could decrease productivity as well as mortality. On the other hand, some crops will have a beneficial response and increase yields.

A longer growing season would also likely increase the region’s “hardiness zone” (defined as the average annual minimum winter temperature divided into 10°F zones). Again, this could have both positive and negative effects. It would improve the opportunity for home gardeners to plant a larger diversity of plants, but the plants that prefer colder climates, such as our native lilacs as well as our favored apples, which tend to have earlier bloom dates, may suffer declining yields and perhaps no blossoms or fruit at all with more frequency.

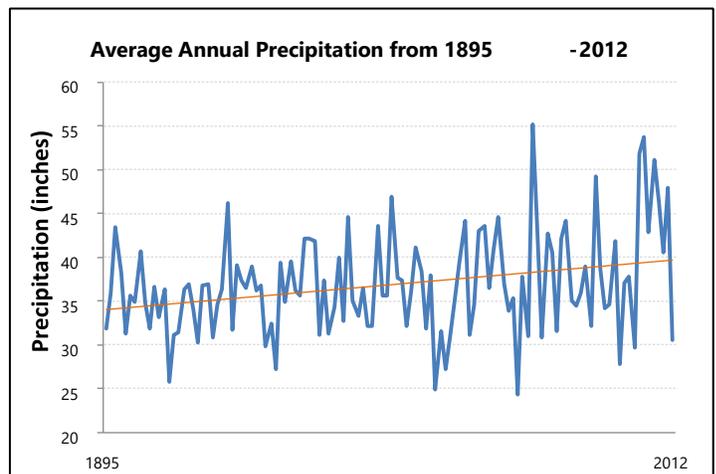


Figure 4: Historic average annual precipitation records, in Hanover, NH, from 1895-2012. Data downloaded from the Data Discovery Center, https://ddc.unh.edu/ddc_data/variables/list/

Precipitation

Orford generally gets an average of 37” of precipitation per year. The long-term average (1895-2012) has an increasing trend of 0.26” more per decade. However, that trend has tripled since 1970, to 1.16” per decade (Figure 4)⁶. Modeling suggests that the average amount of precipitation in the region will increase to between 41” and 45” over the next century.

⁶ Climate Change in Southern New Hampshire: Past, Present, and Future. 2014

Unlike some other towns in the region, such as Newport and Sunapee, Orford has experienced fewer extreme rain events since the 1960’s (Figure 5).⁷ This is expected to continue into the future.

Temperature affects precipitation. As the region’s temperatures trend warmer we will likely continue to see an increase in the amount of precipitation because: (1) warmer air masses frequently hold more moisture; and (2) the increase in extreme weather events will contribute a greater amount of precipitation in a short period of time.

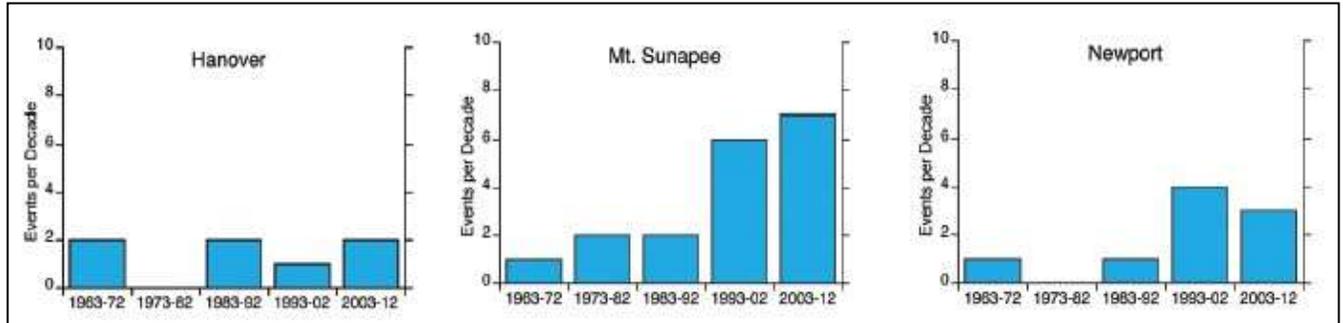
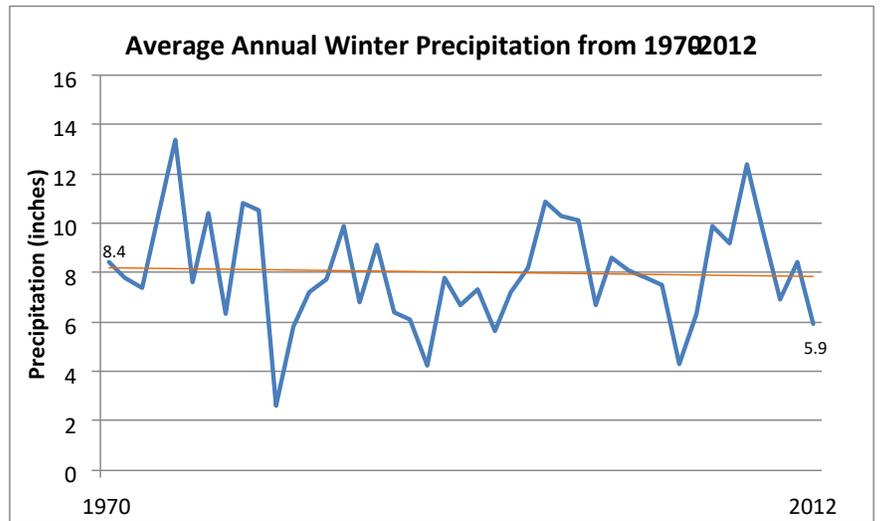


Figure 5: Trends in extreme weather events per decade (greater than 4” of precipitation in 48 hours) for Hanover, Mt. Sunapee, and Newport. Adapted from *Climate Change in Southern New Hampshire: Past, Present, and Future* (2014).

Snowfall & Snow Cover

The annual average amount of winter precipitation has shown a decreasing trend since 1970. This is primarily due to decreasing snowfall during the month of December. Overall, the average snowfall (November through April) is about 56± inches per year. The number of snow covered days (daily snow depth greater than 1”) averages about 117 days (1980-2009) per year in the region and is tied to the amount of snowfall but also to temperature trends and the reflectivity of freshly fallen snow.⁸ The number of snow covered days has also been decreasing, losing just about 3 days/decade since 1970.



⁷ Climate Change in Southern New Hampshire: Past, Present, and Future. 2014

⁸ Climate Change in Southern New Hampshire: Past, Present, and Future. 2014

This is expected to continue to decrease at a faster rate into the future (Figure 5). By 2099, it is likely that the number of snow-covered days will be only between 50-80 days, nearly half of the current average.

The transition from the end of winter to the spring growing season is known as the “vernal window” or the “spring wake up.” During the vernal window, snow is melting and water is moving, the soils are warming, and buds on trees are opening.⁹ Both temperature and amount of snow cover are critical drivers of the timing and duration of this window and have been impacted by climate change for at least the past 30 years.¹⁰ Spring is arriving earlier and duration of winter snow cover has been decreasing. The earlier warming has also accelerated the rate at which the snow melts.¹¹

The long-term annual average amount of winter precipitation is 7.7 inches for the Orford area. Since the 1950’s the annual average has increased about 5%, to 8.15 inches. As we continue into the middle of the century, the total amount of winter precipitation is expected to continue to increase to an annual average of between 9.5-9.9 inches, in the second half of century.¹² However, more of the precipitation is expected to fall as rain rather than snow. Aside from impacting winter recreation in the region, the amount and timing of snowfall can also affect the spawning of fish and groundwater recharge, as it is the runoff from melting snow that feeds streams and recharges our groundwater. The early melting of snow in the spring can change the amount of water available to plants in the early stages of the growing season.

Ice-Out Trends

The spring ice out trends have been getting earlier across the state. Perhaps the lake closest to Orford with the longest tracking of ice-out is Lake Sunapee. Ice-out records have been kept since 1869.¹³ In the 147 years of record keeping, only three years have had ice-out in March and those were 2012 (22nd), 2013 and 2016 (both on March 18th). All years prior have occurred in April and May.

⁹ <http://www.unh.edu/unhtoday/news/release/2017/03/09/spring-getting-longer-unh-research-points-lengthening-vernalwindow>

¹⁰ Global Change Biology, 2017. Contesta et al. A longer vernal window: the role of winter coldness and snowpack in driving spring transitions and lags.

¹¹ Currents, Winter 2017. EPSCoR New Hampshire. Website: NHEPSCoR.org

¹² Data Discovery Center, https://ddc.unh.edu/ddc_data/variables/list/, accessed February 2017.

¹³ <https://sustainableunh.unh.edu/sites/sustainableunh.unh.edu/files/images/southernnhclimateassessment2014.pdf>

Conclusion

WHAT HAS ORFORD EXPERIENCED SINCE 1970...

Temperature

- The average annual minimum temperature has increased in the last decade from the long-term average nearly 3°F annually and 3.6°F in the winter
- The number of hot days per year (>90°F) has increased by 5-6 days
- The number of cold days (<32°F) has decreased by 10 days
- The number of extremely cold days (<0°F) has decreased by 5 days

Precipitation

- The average annual precipitation has increased by 3.7 inches, mostly in spring, summer, and fall

Growing Season

- Growing season has lengthened by nearly 14 days

Snow Covered Days

- The number of snow covered days have decreased by about 10 days

Lake Ice Out Dates

- Lake Ice Out dates have occurred earlier more times in the last decade than any time since 1895

WHAT CAN ORFORD EXPECT TO EXPERIENCE BY 2099...

Temperature

- The average annual minimum temperature has increased between 3.98.8°F annually and between 5.5-10.3°F in the winter
- The number of hot days per year (>90°F) has increased by 18 to as many as 50 days
- The number of cold days (<32°F) has decreased by between 22-44 days
- The number of extremely cold days (<0°F) has decreased by 10-16 days

Precipitation

- The average annual precipitation has increased by 6.4-9.1°F

Growing Season

- Growing season has lengthened by 23-51 days

Snow Covered Days

- Snow covered days have decreased by 25-50 days

Lake Ice Out Dates

- Lake Ice Out dates are occurring 7-10 days earlier

Recommendations

- Education is important: inform us and our community about our vulnerabilities. Engage with Rivendell students in topics including how to adapt to climate change, the affect of climate change to the region's agriculture and global food security.
- Make a community commitment to address climate change and create a community response strategy that addresses community vulnerabilities.
- Evaluate the built environment by completing a culvert inventory (Completed in 2019)
- Promote renewable energy resources in residential buildings and for heating public buildings

6 Surface Waters



Figure 1 Reeds Marsh, December 2019

Surface waters are rivers, streams, lakes and ponds. Many surface waters are associated with wetlands. The rivers, streams, lakes and ponds in Orford provide a fundamental resource required by all life: water. While there are no public water supplies drawing water from Orford's surface waters, these features are hydrologically connected to groundwater. Surface waters also provide significant wildlife habitat, renewable energy sources, recreation opportunities, and scenic views. Ponds and lakes impounded by dams may also be used for fire protection, flood control, or agricultural irrigation. Roughly 83% of the Town of Orford is within the Connecticut River watershed; the remaining

17% around Upper and Lower Baker Ponds drains to the Pemigewasset River to the east. The Connecticut River flows along the western border of Orford. There are two large wetlands on the eastern shore of the Connecticut River in Orford. One is at the confluence of Jacobs Brook and the second forms Reeds Marsh.



Figure 2 Jacobs Brook & Connecticut River confluence, October, 2019

The primary stream draining to the Connecticut River in Orford is Jacobs Brook. It drains 15,600 acres. The north and south branches of Jacobs Brook originate in the southeast corner of town and join together west of the Appalachian Trail corridor, where they form the main stem of Jacobs Brook. It then flows towards the former settlement of Quinttown, where Mousley Brook flows into it. From that point Jacobs Brook flows westward along Quinttown Road, then along Route 25A west through Orfordville. Just east of Creamery Rd. at Tillotson Falls, Jacobs Brook turns to the northwest, along the east side of Townshed Road and meanders toward the Connecticut River.

Archertown Brook drains the central section of Orford and is a major tributary of the lower section of Jacobs Brook. The upper reaches of Archertown Brook flow through significant wetland areas and the lower reaches flow along Archertown Road. Archertown Brook enters Jacobs Brook below Tillotson Falls near Highbridge Road.



Figure 3 Archertown Road – Upper Archertown Brook Crossing

Indian Pond Brook, the outlet stream of Indian Pond, drains the northwestern section of town, and then flows into Piermont before entering the Connecticut River. At the outlet of Indian Pond, Indian Pond Brook flows through an extensive wetland complex on either side of Indian Pond Road. The Indian Pond Brook watershed drains the western slopes of Indian Pond Mountain and Pine Hill and the northern slopes of Cottonstone Mountain. Bean Brook is a northern tributary to Indian Pond Brook, located primarily in Piermont. The Bean Brook watershed drains the west side of Piermont Mountain and the brook rises in the south-central section of Piermont near Piermont Heights Road. Bean Brook flows through a large wetland complex in Clay Hollow before turning southward into Orford. In Orford, Bean Brook Road follows the stream, which meanders into Piermont and drains into Indian Pond Brook just east of NH Route 10.

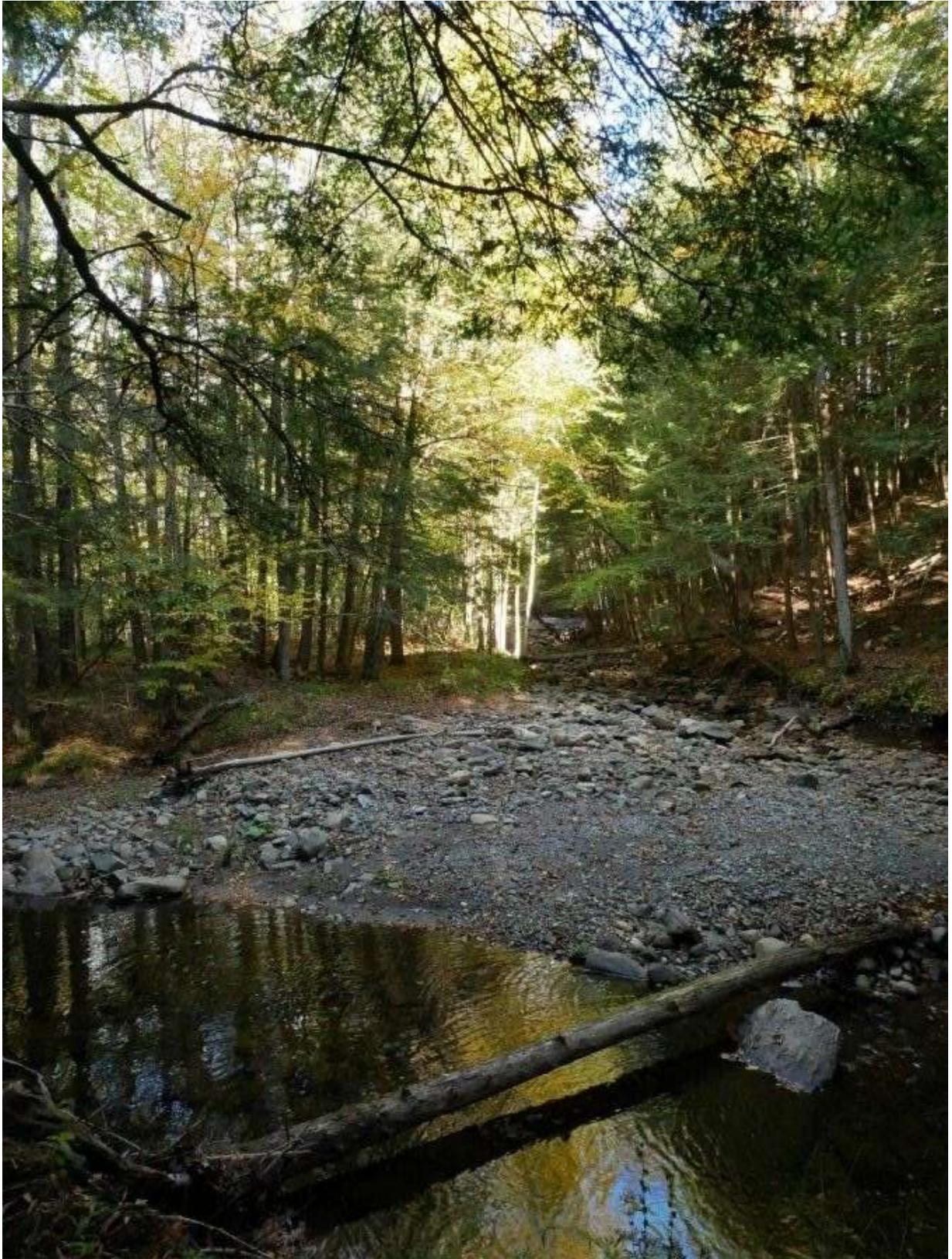


Figure 4 Bean Brook Piermont segment

In the southwestern section of town, Mud Turtle Pond drains southward into Lyme as part of the Clay Brook watershed that drains to the Connecticut River. Sawyer Brook drains the northern slopes of Kenyon Hill in Lyme and flows northward near Strawberry Hill Rd and then bends to flow westward near Route 25A. Sawyer Brook flows into Reeds Marsh on the Connecticut River.

Upper and Lower Baker Ponds lie in the northeastern corner of Orford, and are connected by Pond Brook. Between the two ponds, Brackett Brook joins Pond Brook, draining the northeastern side of Mount Cube. These mountain ponds and streams lie at the headwaters of the Pemigewasset watershed, which flows through the southern White Mountains and into the Merrimack River.



Figure 5 Upper Baker Pond

Existing and potential threats to the resource

Invasive species present in the Connecticut River threaten its water quality, native plant and animal communities, and recreational opportunities of the river itself as well as waterbodies nearby. Boaters and fishermen can and have unwittingly spread a number of unwanted plant species in and around New Hampshire. The Connecticut River Joint Commission's 2007 Connecticut River Aquatic Invasive Plants Outreach and Survey Project's Final Report identified five aquatic invasive species in and along the river in Orford:

- Purple Loosestrife,
- Yellow Flag Iris,
- Eurasian Milfoil,
- Phragmites, and
- True Forget-me-not.

Invasive species, including Japanese knotweed are established in both the river's main channel and the wetland areas at the mouth of Jacobs Brook. While not yet present in Orford, Didymo (a.k.a. "rock snot") is a major concern in the Connecticut River; Didymo is an invasive algae species that grows in dense mats on river beds.

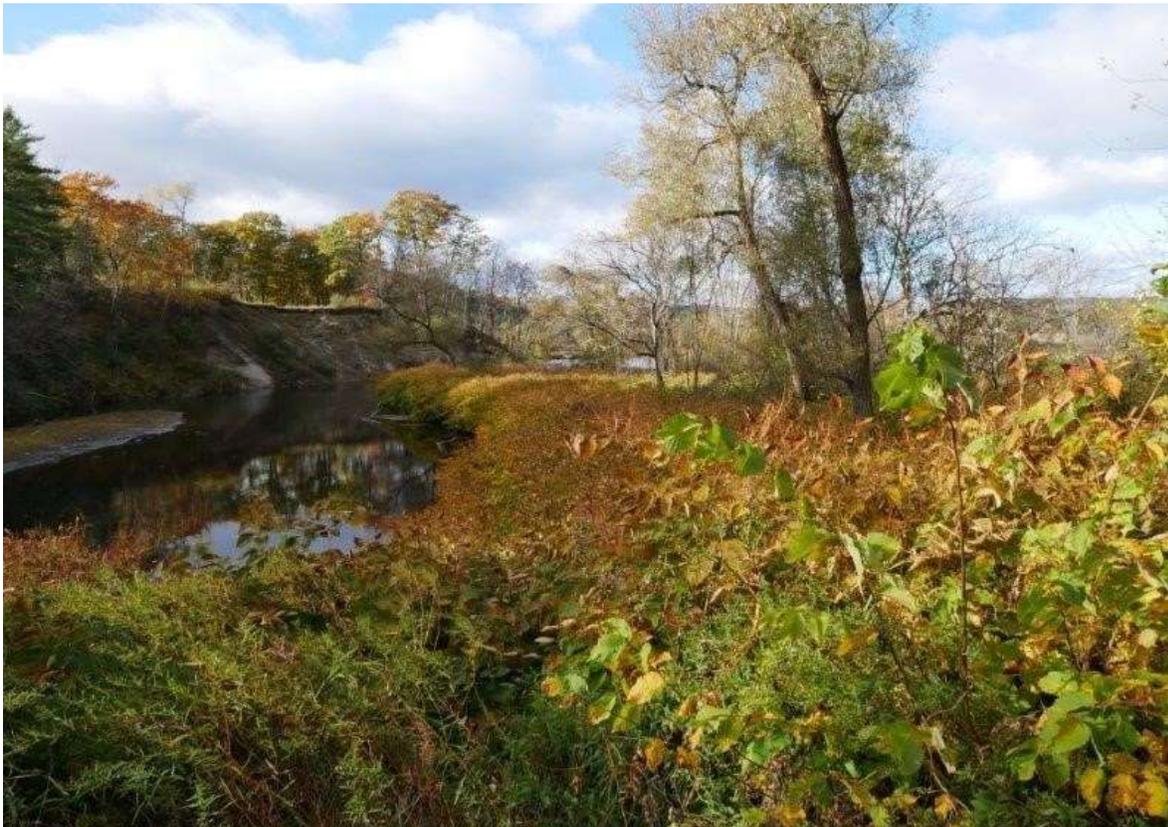


Figure 6 Japanese knotweed colonies - Jacobs Brook Connecticut River Estuary

Land development may pose threats to water quality, whether the land is immediately on a shoreline or far from a stream or pond. Shoreline development and removal of native vegetation can contribute to increased sedimentation from bank erosion, runoff of lawn or agricultural chemicals or road salt, and increased water temperature. These may lead to degradation of water quality and the capacity to support fish and other aquatic organisms.

Recent hurricanes in 2011 (Irene) and 2012 (Sandy) and storms during July and October of 2017 had major impacts on streams in Orford. Route 25A in Orfordville was flooded by Jacobs Brook and remediation efforts ensure that flood waters in that part of the brook will flow deeper and faster with the next one. Archertown Brook now runs through a massive culvert that was installed after the road was washed out because the, then existing, culvert was too small for the volume of water passing through it. Data showing dramatic increases in average temperature and rainfall in the past 20 years suggest that aging culverts and bridges will be tested by 100-year rainfalls that now occur every decade. These fixes are expensive, but the expense can be mitigated through the use of tried and tested best practices.

Current management and protection

The Connecticut River Joint Commissions (CRJC) acts as a voice for the Connecticut River in New Hampshire and Vermont. The CRJC is organized into five local river subcommittees, represented by volunteers appointed by each town; Orford is part of the Upper Valley River Subcommittee. In 2009, the CRJC published an update to the 2007 Water Resources Management Plan for each river subcommittee. The plan addresses water quality, river flow, water withdrawals and uses, land uses and riverbank erosion. The CRJC has also coordinated water quality testing, sediment pollution studies, river education and outreach, riparian restoration projects and a wide variety of other river protection projects all along the Connecticut River.

The Comprehensive Shoreland Protection Act is a state law regulating land use within 250-ft of public waters in the State of New Hampshire. Public waters are defined as lakes and ponds greater than 10 acres in size and rivers and streams of the fourth order or higher. In Orford, the Comprehensive Shoreland Protection Act applies to four ponds (Table 4) and the Connecticut River.

Table 1: Public Waters in the Town of Orford

<i>Waterbody Name</i>	<i>Acres</i>	<i>Elevation</i>
Indian Pond	142.0	1,111 ft
Lower Baker Pond	94.6	895 ft
Mason Pond	14.5	1,315 ft
Upper Baker Pond	185.5	901 ft

In recognition of the important conservation value of undeveloped shoreline, several landowners have placed conservation easements on roughly 20 percent of the Connecticut River shoreline in Orford, or 1.5 miles of Orford’s eight miles of shoreline (Table 5). The State of New Hampshire also manages a quarter-mile of shoreline as part of Reeds Marsh Wildlife Management Area.

The Bunten easement and Wilson easements about each other, protecting one full mile of continuous undeveloped shoreline.

Table 2: Conservation Land on the Connecticut River

<i>Conservation Land Name</i>	<i>River Frontage (miles)</i>
Bunten	0.33
Eck Riverfront (town-owned)	0.17
Lamb	0.20
Reeds WMA (state-owned)	0.26
Richmond (town-owned)	0.11
Wilson, A	0.19
Wilson, G	0.54
<i>River Frontage Protected from Development: 1.8 miles</i>	

The four ponds in Orford are largely undeveloped, except Upper Baker Pond, where two summer youth camps and several lakefront homes have been built on or near the shoreline. There is also Camp Pemigewasset on Lower Baker Pond in the town of Wentworth.

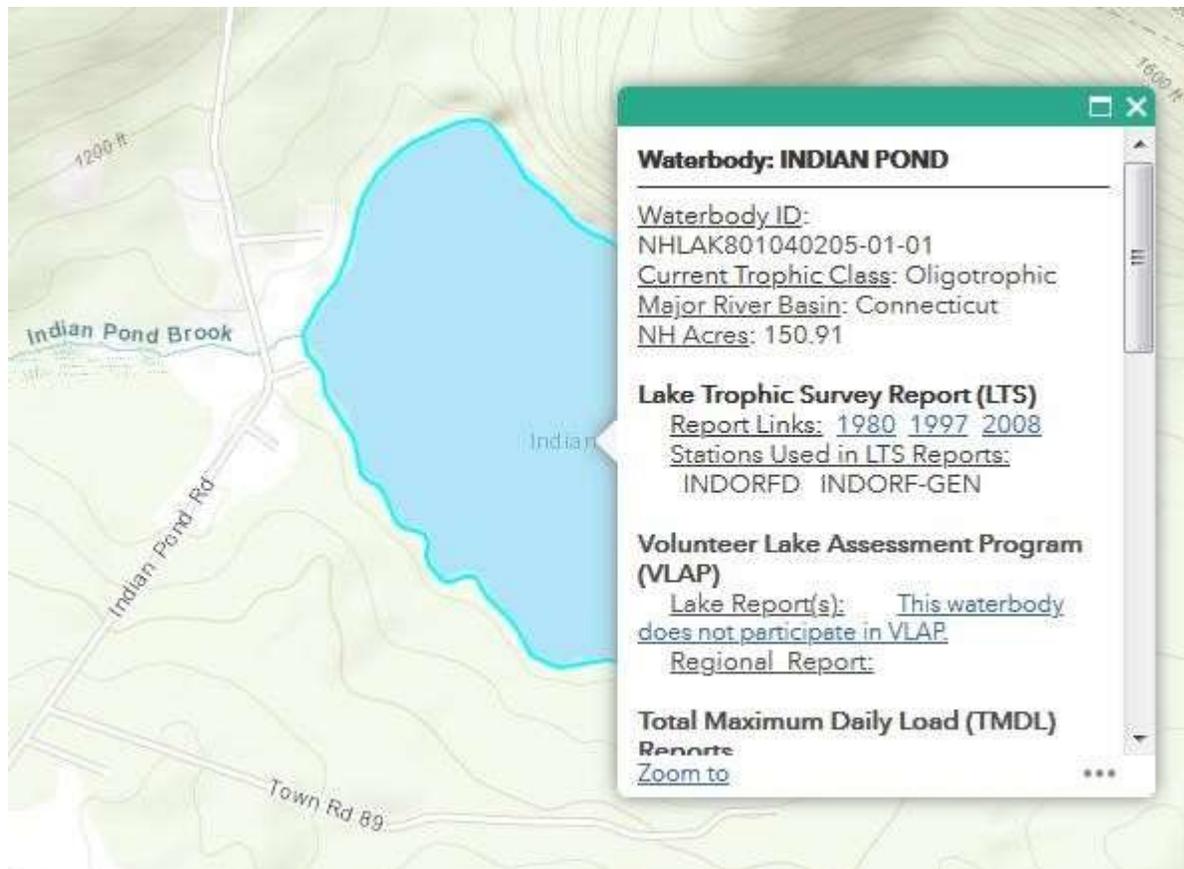
Jacobs Brook, Archertown Brook, Indian Pond and the Upper and Lower Baker Ponds have been routinely tested for contaminants during the last half-dozen years by the Orford Conservation Commission.

Each month, from June through September, volunteers take water quality samples at four locations on Jacob's Brook and one location on Archertown Brook. Three of the measures (temperature, dissolved oxygen, pH) are indicators of the ability of the waterway to sustain fish and other aquatic species. Over the years, these measures show that important attributes vary consistently from season to season in local waterways, providing good habitat for fish and other aquatic creatures. Volunteers also test for the level of E. coli bacteria in the brooks, which has detected a seasonal cycle in Jacob's Brook. Throughout the summer, large animal activity in the large bogs that constitute the headwaters of Jacob's Brook gradually increases the presence of bacteria. Heavy rainfall flushes the bogs into the brook, yielding spikes in E. coli colony counts. Sampling has also detected a couple of unusual events which have been attributed to possible illegal dumping of black-water from campers leaving the area. Upper and Lower Baker Ponds have long been sites of boys and girls summer camps. When these waters were tested E. coli bacteria was below detectable levels in all sample locations in both ponds.

Recommendations for resource protection

- ✦ The Conservation Commission should consider participating in the Volunteer Lake Assessment Program (VLAP) on Upper Baker Pond. VLAP is a water-quality monitoring program coordinated by the NH Department of Environmental Services; in 2010, 153 lakes and ponds were participating in the program. VLAP volunteers test the waters each summer in many lakes in neighboring towns, including Lakes Armington, Katherine and Tarleton in Piermont, Post Pond and Reservoir Pond in Lyme, and Canaan Street Lake and Goose Pond in Canaan. It is common for lakefront homeowners and homeowner's associations to become active volunteers in the water quality testing.

<https://www.des.nh.gov/organization/divisions/water/wmb/vlap/index.htm>



- ✦ The Conservation Commission should continue to support land conservation efforts that protect surface waters and shorelines, building on previous private and public conservation efforts that have protected shorelines along the Connecticut River and Indian Pond Brook. <https://uvlt.org/>
- ✦ The Conservation Commission should continue to educate and work with willing landowners who want to restore riverbanks and shorelines and to communicate best practices to landowners. The Connecticut River Joint Commissions publishes an excellent series of worksheets describing the value of riparian buffers and the USDA has technical resources available to assist farmers. <https://www.ctriver.org/>
<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/water/manage/restoration/>
- ✦ The Planning Board should encourage the use of Low Impact Development techniques and stormwater infiltration systems to protect water quality. The board should help to ensure that town highway crews use best practices in restoring and maintaining streams' form, meander and floodplain connection. <https://www.wbdg.org/resources/low-impactdevelopment-technologies>

- ✦ The Conservation Commission should work to educate landowners on the threat of invasive species and options for management. The Conservation Commission should work to control invasive species on town-owned or town-managed properties. <https://extension.unh.edu/resource/invasive-plants>

7.0 Wetlands



Figure 1 Bog / Wetland, Orfordville Road

Wetlands are defined as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetland areas include, but are not limited to, swamps, marshes, and bogs.

In New Hampshire, a certified wetland scientist identifies the location of a wetland through field delineation, taking the vegetation, hydrology, and soil types into account. It has been unfeasible to complete a nation-wide field delineation of wetlands, and so the US Fish and Wildlife Service mapped wetlands based on aerial photography, resulting in The National Wetlands Inventory, or NWI. Also, the Natural Resources Conservation Service has identified and mapped soils with poor drainage, which is one of the three wetland indicators, in their county soil surveys. The NWI tends to underestimate the acreage of wetlands, as smaller wetlands were not captured using

this methodology, and using the soils data from the County Soil Survey tends to overestimate wetlands coverage, as the soil survey generalizes soil characteristics (Table 6). Both of these sources of information have been used to paint a general picture of the major wetlands in Orford. There are certainly many smaller wetlands that could only be mapped on a site-specific basis by a certified wetland scientist.

Table 6: Estimates of Wetlands Acreage

<i>Data Source of Wetlands Mapping</i>	<i>Acres</i>
National Wetland Inventory, US Fish and Wildlife Service	691
Soils with Poor or Very Poor Drainage, Grafton County Soil Survey	1,758

Wetlands in Orford are most often associated with headwater streams and ponds. Extensive wetlands are found along the North and South Branches of Jacobs Brook, the Mud Turtle Pond stream corridor, the upper reaches of Archertown Brook, and around Indian Pond, Upper Baker Pond and Lower Baker Pond.

There are two large wetland areas along the Connecticut River in Orford, at the mouth of Jacobs Brook and at Reeds Marsh.



Figure 2 Jacobs Brook - Connecticut River Estuary

There is a wide variety of the types of wetlands. They may be forested, grassy, or covered in shrubs, and may be connected to a stream, lake, groundwater spring, or they may be separate and fed only by rainwater. This variety in the types of wetlands results in a diversity of wetland functions. Some wetlands are more important for flood control or nutrient retention, while others may be better for wildlife. The NWI classified each wetland into a category based on its dominant type of vegetation (Table 7).

Table 7: NWI Wetland Types in Orford

<i>Wetland Type</i>	<i>Acreage</i>
Emergent (e.g., cattail, reeds)	116
Forested	228
Scrub-shrub	241
Other	106
<i>Total Acres</i>	<i>691</i>

Wetlands provide a great number of natural services, including groundwater recharge, erosion control and shoreline anchoring, flood control and floodwater storage, sediment and nutrient trapping, and wildlife habitat for aquatic, semi-aquatic and terrestrial animals. Some wetlands also offer education and recreation opportunities.

A vernal pool is a special type of small wetland that is generally not included in the National Wetlands Inventory. This is an intermittently flooded small pond that is filled with water in the spring and early summer but dries up completely during 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, like fish. 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.

Existing and potential threats to the resource

Wetlands suffer many of the same threats as surface waters. Encroachment into a wetland eliminates some of the function of the wetland, and land clearing and development can degrade wetland function as well. Additional stormwater runoff can

pollute and overwhelm the flood storage capacity of wetland areas, changing the water quality and flow in a watershed. Land clearing around wetlands can have especially harsh consequences for the quality of the wildlife habitat, particularly for migratory amphibians and other animals that require both wetland and upland habitat.

Beavers play an important role in the formation and development of many wetlands in New Hampshire. Often referred to as “ecosystem engineers”, beavers can enlarge existing wetlands and create new ones along stream corridors and ponds by building dams and flooding upland areas. This activity creates excellent habitat for moose, turtles, warm-water fishes, a variety of birds, and dragonflies and damselflies, but sometimes leads to undesired consequences for adjacent landowners, including flooded roads, driveways, yards, fields and basements.

Current management and protection

NHDES Wetlands Bureau administers a permitting program for any dredge, fill or construction in wetlands and surface waters, pursuant to RSA 482-A.

<https://www.des.nh.gov/organization/divisions/water/wetlands/index.htm> In addition, the NHDES Subsurface Bureau requires that new septic systems be set back from poorly and very poorly drained soils.

<https://www.des.nh.gov/organization/divisions/water/ssb/index.htm> The Orford Conservation Commission receives copies of state wetlands permits for its review.

Reeds Marsh is partially protected by a State Wildlife Management Area. Conservation easements also protect wetland areas above Upper Baker Pond, along Indian Pond Brook, and on the Connecticut River near Grimes Hill Road.

Recommendations for resource protection

- The Conservation Commission should continue to support land conservation efforts that protect wetlands, in particular vernal pools, which provide outstanding wildlife habitat.
<https://www.des.nh.gov/organization/divisions/water/wetlands/index.htm>
- The Conservation Commission should present educational workshops on vernal pool ecology, identification and stewardship to raise awareness of these particularly important wetlands.
- The Conservation Commission should provide information to landowners on methods to address beaver-caused flooding, such as baffles and “beaver deceivers.” <https://www.wildlife.state.nh.us/wildlife/profiles/beaver.html>

8.0 Floodplains

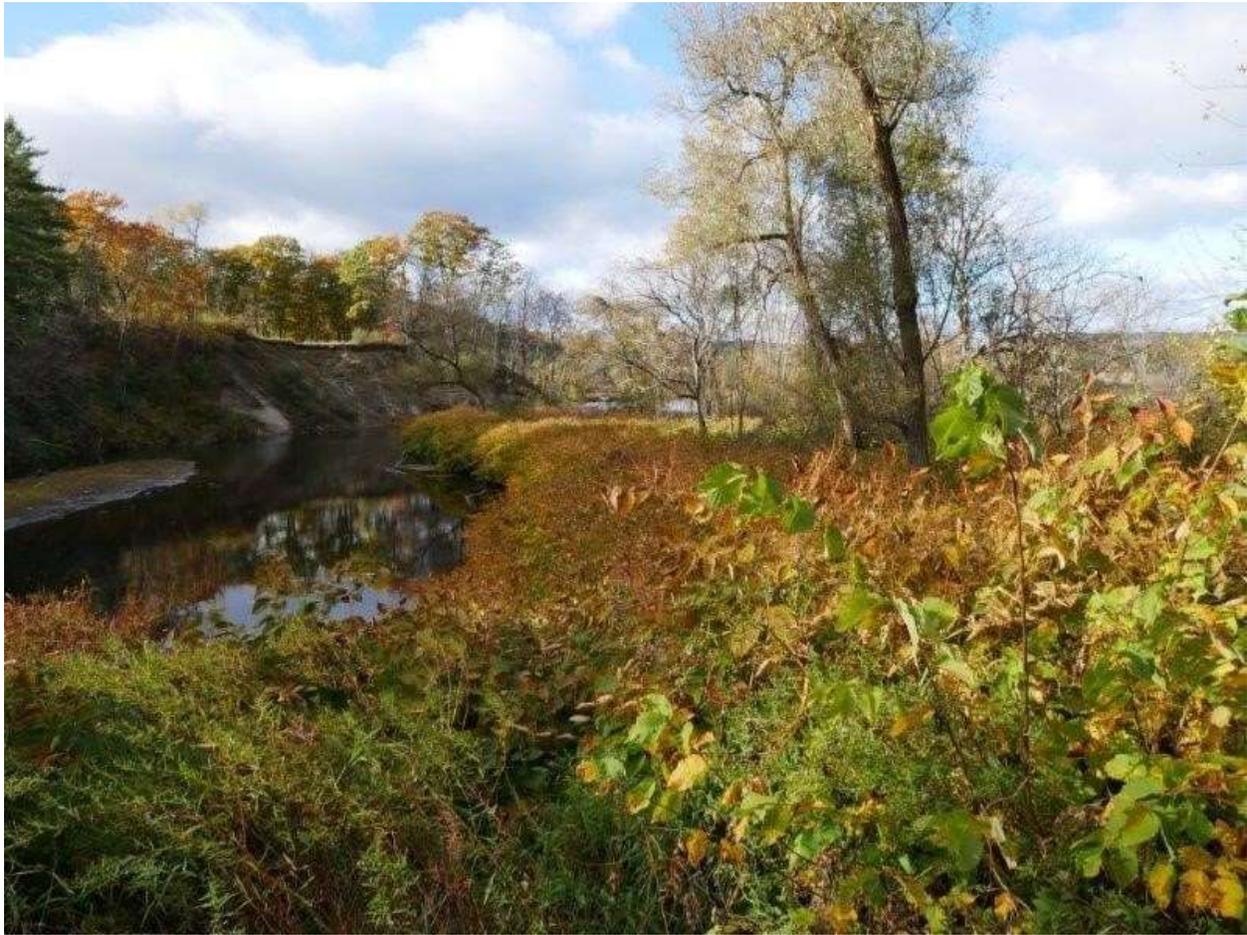


Figure 1 Floodplain Area - Jacobs Brook - Connecticut River Estuary

Floodplains describe the area of land adjacent to a river or stream that may flood. The Federal

Emergency Management Agency has mapped floodplain and flood-prone areas with their Flood Insurance Rate Maps, defining Special Flood Hazard Areas as those areas that would be inundated by a 1-percent annual chance flood, also referred to as the base flood or 100-year flood.

In Orford, floodplains have been mapped along the Connecticut River, Jacobs Brook, Archertown Brook and Indian Pond Brook. The Connecticut River floodplain lies primarily west of Route 10, and the floodplains for the brooks are relatively narrow. The total acreage within the Special Flood Hazard Areas is 2,141 acres, which includes the

area of the Connecticut River, Indian Pond, Upper Baker Pond and Lower Baker Pond at ordinary high water.



Figure 2 Upper Baker Pond



Figure 3 Jacobs Brook Floodplain near Brook Road at NH Route 25A

Floods are the most common and most costly natural disaster and leaving floodplains as open space helps to slow and absorb floodwaters. Floodplains also provide unique wildlife habitats and a transition between the river ecosystem and upland ecosystem.

The Connecticut River floodplain is known for having some of the richest agricultural soils in the world.

Existing and potential threats to the resource

Development in the floodplain increases stormwater runoff and, at the same time, reduces the absorption capacity of the floodplain, increasing the severity of floods. Development also increases the risk of environmental contamination during a flood event if the flooding affects septic systems and carries away home heating fuel or other household chemicals.

Undersized or failing culverts pose another threat to flood-prone areas. Insufficient culverts can easily be blocked by debris and overwhelmed by floodwaters, which can exacerbate flooding, lead to road and culvert washouts, create additional bank streambed erosion and also serve as barriers for fish migration. Note that the Upper Valley Lake Sunapee Regional Planning Commission contracted with Orford to prepare a comprehensive culvert inventory during 2019.

This inventory provides vital updates to the NH DES Statewide Asset Data Exchange System (SADES) Stream Crossing Initiative database and is available to the Selectboard and Highway Department in establishing priorities for culvert replacements.

<https://www.uvlsrpc.org/files/1315/8048/6880/2019CulvertMapbook.pdf>

Current management and protection

The Town of Orford does maintain a floodplain development ordinance and participates in the

National Flood Insurance Program, which allows homeowners to purchase flood insurance. The Town of Orford also has an up-to-date Hazard Mitigation Plan, which assesses the risk of several natural hazards, including flooding, and identifies mitigation strategies to reduce the impact of natural hazards. This plan is available upon request at the Orford Town Offices - Selectboard.

[Recommendations for resource protection](#)

The following recommendations have been excerpted from the CRJC Water Resources Management Plan for the Upper Valley River Subcommittee, published in 2009:

- The Planning Board should encourage developers and landowners to establish and/or maintain buffers of native vegetation along rivers and streams for privacy, pollution control and habitat.
- The Conservation Commission should work with public agencies and private landowners to retain current natural flood storage, such as in wetlands and floodplains.
- The Town of Orford (has undertaken – see above under “threats”) a survey of culverts and bridges to identify those that are undersized, also noting if they block fish passage, and seek grants for replacing them where necessary. The Nature Conservancy and Trout Unlimited are two organizations that have been active in fish passage/culvert studies in other areas of New Hampshire.

http://www.crjc.org/new%20WR3%20chapter/WATER_RESOURCES_UpperValley.pdf

9.0 Groundwater Resources

Groundwater provides drinking water for all Orford residents, supplies water for irrigation and commercial uses, and also recharges ponds and streams, sustaining aquatic ecosystems in times of low water or drought. In New Hampshire, groundwater supplies are classified into two major groups: sand and gravel aquifers and within fractures or cracks in bedrock.

Sand and gravel aquifers have the greatest potential for development for community wells but are limited in their extent to only 10% of the State of New Hampshire. In Orford, 12% of the town’s land and waterbodies are underlain by sand and gravel aquifers. These aquifers are located generally along the Connecticut River, lower Jacobs Brook in the vicinity of Townshed Road and Jacobs Brook in Orfordville, as well as around the Upper and Lower Baker Ponds.

Wells in fractured bedrock generally provides lower yields than sand and gravel aquifers, however, the yield is usually sufficient for residential use. In New Hampshire, 85% of water extracted by private domestic wells comes from fractured bedrock wells.

While most residents of Orford rely on private wells for their drinking water, the Orford Village District serves 51 connections and approximately 128 residents in the village area of Orford on Archertown Road, Routes 10 and 25A, and Bridge Street. The Rivendell campus of the Rivendell Interstate School District, located just east of Route 10, has its

own water supply. In addition, there are five other active public water systems registered with NHDES, as of September 2010* (Table 8). A public water system is defined as “a system that provides water via piping or other constructed conveyances for human consumption to at least 15 service connections or serves an average of at least 25 people for at least 60 days each year.”

Table 8: Active Public Water Wells in Orford

<i>Public Water Supply Name</i>	<i># Served</i>	<i>Well Type</i>
Orford Village District	128	3 Bedrock Wells
Rivendell Interstate School	282	Bedrock Well
The Pastures Campground	145	Point Well
Camp Merriwood	170	Bedrock Well
Camp Moosilauke	200	Bedrock Well
Indian Woods	50	Bedrock Well
Peyton Place	45	Gravel Well
Orford Enterprises, LLC	UNK	Gravel Well

<https://www.des.nh.gov/organization/divisions/water/dwgb/dwspp/reports/documents/orford.pdf> * NOTE currently available NH DES document updated September, 2007 and well assessments last performed between 2000 and 2002. Data on numbers served not currently available and those shown refer to previous values from 2011 NRI.

Existing and potential threats to the resource

The most pressing threat to groundwater in Orford is the contamination of groundwater through manmade pollution. It should be noted that some groundwater contaminants are natural in origin, such as radon and uranium. The New Hampshire Water Resources Primer, published in 2008 by New Hampshire Department of Environmental Services

https://www.des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/primer_chapter10.pdf identifies three main causes of groundwater contamination:

- leaking underground storage tanks
- heating oil tank leaks or spills
- hazardous waste releases.

Road salt and fertilizers have also degraded groundwater quality in certain locations within New Hampshire.

As the population of New Hampshire grows, concerns are being raised about the quantity of groundwater, as well as the quality. More development leads to more areas of impervious surface, which reduces the recharge of water to the bedrock or sand and gravel aquifers. At the same time, more development leads to increased demand for groundwater.

Current management and protection

Public water systems in Orford (Table 8) are required by the State to test their water and ensure it meets standards for safe drinking water. The State also requires well drillers to report the locations, depths and yields of new wells, which provides an important source of data to study groundwater availability.

The Town of Orford currently participates in the Household Hazardous Waste Collections organized by the Upper Valley Lake Sunapee Regional Planning Commission. 2010 was the first year that unwanted medicines were accepted **, in addition to household chemicals. This program reduces the improper disposal of toxic substances and the threat of groundwater contamination. <https://hww.uvlsrpc.org/hazardous-waste-collections/>

Several farms in Orford practice sustainable farming methods that strive to protect safe drinking water. Landowners who have sought Tree Farm certification demonstrate their commitment to sustainable forestry and commitment to protecting natural resources, particularly surface waters. ** See link above for information regarding safe disposal of medicines, no longer accepted directly.

Recommendations for resource protection

- The Planning Board should consider developing a Water Resource Protection Plan per

RSA 4-C:22. <http://orfordnh.us/commissions-committees/planning-board/>

This plan requires an inventory of a community's water resources and an analysis of the demands and threats to those resources. Once adopted, a water plan becomes an element of the Town Master Plan and may be implemented through

the adoption and enforcement of municipal ordinances. This recommendation reflects a similar strategy identified in the 2001 Master Plan, Section 7.4.

- The Planning Board should also encourage the use of Low Impact Development techniques and stormwater infiltration systems to protect water quality.

https://www.des.nh.gov/organization////////divisions/water/dwgb/wrpp/documents/primer_chapter10.pdf

- The Town of Orford should continue to encourage residents to participate in household hazardous waste collections and unwanted medicine collections.

<https://hww.uvlsrpc.org/hazardous-waste-collections/>

- The Conservation Commission should consider drinking water protection when evaluating land conservation projects. Grant funding may be available to protect areas around the community's water supplies.

10 Agricultural Resources



Figure 1 Echo Hill Farm Hoophouses

Agriculture in Orford is an important component of the local economy and the character of the town - and has been for centuries.

There are a variety of types of agriculture in Orford. Historically, Orford has been dotted with hill farms; like much of New England, Orford carried the iconic image of dairy farms scattered throughout the town. As recently as the 50's there were some two dozen farms in town shipping milk. The concentration on dairy has shifted greatly, with many fewer farms and more diversity. Currently (2017), in addition to milk production, Orford farms include those that raise beef cattle, fresh produce and flowers, and farms that produce crops such as hay and sweet corn. A new component in Orford's agricultural economy is land in Orford that is owned by or leased to farmers outside of town, reflecting a trend of farms in the valley getting larger and therefore needing a larger land base.

No matter which type of agriculture is occurring on the land, it is all tied to the soils. Soil type, soil moisture and soil health all impact the productivity or yield of the plants, as well as the type of plants that can thrive here. The most productive soils for plant

growth are “prime farmland soils.” These soils are based on a national ranking and cover 1500± acres in Orford, roughly 5% of the land area. “Statewide significant soils” are also important agricultural soils, but are determined at the state level, whereas, “locally important” soils are determined at a county level, and reflect soils that may not provide exceptional productivity but have been historically farmed. The most productive soils are primarily located along the Connecticut River.

Existing and potential threats to the resource

There are a number of challenges to maintaining our agricultural resources and economy; perhaps the main ones are development pressures, and loss of soil productivity.

“River bottom” land is not only some of our most productive agricultural land; this same land is generally scenic, open, level, and well drained: perfect for house sites!

The attractiveness of riverfront land for housing poses a real threat to the finite resource of important agricultural soils. Residential development would take these soils out of production, effectively eliminating this resource.

A second threat to these soils along the Connecticut River that is gaining recognition comes with the fluctuating river levels that result from the downstream hydro-electric dam drawing down the level of the river during peak electricity use, then allowing the level to rise during low demand. This fluctuation in level results in substantial erosion of riverbank soils, with many tons of soil going downstream each year.

A further threat to current agricultural endeavors in Orford comes with the many challenges posed by climate change and climate disruption. This is described further in the section titled “Climate Change & Orford’s Agriculture,” below.

Current management and protection opportunities

There is much that can be done to preserve and advance our agricultural economy and heritage.

Current Use encourages landowners of undeveloped land through reduced tax assessments to preserve the potential of those soils – both forest and agricultural – by keeping land open and productive.

Improvements in farm technology and cultural practices, including organic and sustainable ag practices, are critical for farmers in their efforts to be ever better stewards of this natural resource. Organic farming practices encourage abundant soil life through cover crops that build organic matter, maintaining semi-wild natural reserves for

pollinators and other beneficial insects, and through implementation of careful crop rotation plans.

In terms of management options, diversification can in some cases increase economic returns without significant further demands on soils and other natural resources. And - both currently, and likely to increase in future years - Orford farmers can realize high value on even limited acreages through various small- scale agricultural ventures.

The floodplain protection ensured through Orford's Floodplain Ordinance - while it doesn't prevent development - is likely to discourage development from places that are better left undeveloped.

Tullando Farm, Rte. 10, Orford NH

As stewards of the land and living near the river, we realize the value of clean water and fertile soils - now and for future generations. Farm lands along the Connecticut River are some of the best in the Northeast. For decades we have used crop rotation and manure management rather than commercial fertilizer to grow crops and improve soil quality. New technology is allowing us to do a better job with these practices. We have started injecting manure into our corn and grass lands. The manure goes into the ground rather than on top. On land that is less than a mile from the farm we have been able to drag line and inject the manure which means that we don't have to haul it with a truck or tractor. It is pumped straight to the field through an eight inch hose that saves on fuel and reduces compaction. The other key thing manure injection does is prevents runoff. Using manure injection allows us to do a better job planting cover crops earlier in the fall. Cover crops are known as small grain crops that will winter over to protect the soil between harvests and produce and hold nutrients between harvests to prevent erosion and runoff.

Using new technology allows us to plant corn and grasses with the least amount of tillage known as notill. An 80 mil plastic-lined manure pit holds nutrients until we need them and protects the water from leaching into the ground.

- Karen and Rendell Tullar

Climate Change & Orford's Agriculture

Our daily experience in recent years strongly suggests a gradual change in the climate. We note such things as milder winters, warmer and earlier springs, longer warm stretches in the fall, and hotter summers. Perhaps most concerning is the increasing frequency of severe weather events.

Warmer temperatures appear to be lengthening the growing season, which is sure to have an impact on agriculture in Orford. By the end of the century, we could see a growing season of 2-5 weeks longer than it is currently – a change from an average of 168 days to as many as 220 days annually. A longer growing season and warmer temperatures would make it possible to grow a variety of crops previously unsuited to this region.

On the other hand, impacts may include decreased productivity and yield, and an increased number of insect pests, noxious weeds and plant diseases formerly not found in this region. Crops may require more irrigation in dry years, while there can also be damaging consequences from excessive rainfall.

Some of our favorite trees and shrubs, such as New England's iconic sugar maples, apple trees, and lilac bushes may have lower tolerance to climatic change, and therefore face increasing mortality, decreasing germination, and decreasing production of blossoms and sap. Farm animals may also be affected by a greater number of hot summer days. Dairy cows reflect

At Echo Hill Farm on Grimes Hill Road, we have been growing fresh produce on a small commercial scale for nearly 30 years. Recently we've been joking that it feels as though we're growing in a completely different climate; have we moved to North Carolina?!

A recent summer topped the trend of hotter temperatures, and there have been consequences in how crops perform. That growing season was our best ever for peppers; peppers love heat – to a “degree”! Too hot at the wrong time means plants in the pepper/tomato/eggplant family will drop blossoms without setting fruit. This may have been a factor in our reduced tomato production in the warm environment of the tomato hoophouse.

Warmer temperatures are also reflected in a longer growing season, which has its advantages: more crop options for the Northeast! These same factors also bring us new pests. Mexican Bean Beetles arrived at our farm for the first time this year.

It seems that one of the most worrisome effects of climate change is “extreme weather events”. Torrential downpours can ruin crops; more subtle effects result from saturated soils, which tend to promote disease and reduce growth rates. Extremely dry soils can be equally limiting.

Weather is always challenging for farmers, but long-term changes in the climate affect how well crops will perform, requiring shifts in growing techniques. Organic growing practices can be important strategies in mitigating those effects, by increasing porosity while at the same time making moisture more available in dry times – much like a sponge. Planting cover crops between seasons and during fallow periods is a valuable method for minimizing soil erosion, adding organic matter and improving soil structure. A new cover crop we are trialing is “tillage radishes” which have very long tap roots, effective in breaking up hard-pan, thus improving drainage and growth potential.

Climate change is already challenging agricultural producers; farmers in Orford are using innovative as well as tried and true methods for addressing these new challenges.

– Sarah and Craig Putnam

heat stress in decreased milk production. Farm animals – not just people – must contend with the consequences of greater numbers and more varieties of ticks.

Recommendations for resource protection

The basic natural resource regarding agriculture is, of course, the soil. We all depend on our soil. And we all interact with the soil, whether it is through gardening, farming, building houses, or building driveways and roads to get to work. We all have an interest, as well as direct choices we can make to protect this valuable resource.

Soil is our landscape. It is the underlying fabric of our connection to the earth. Gardeners know that exposed soil is vulnerable to erosion; mulch and grassed walkways safeguard your precious topsoil! Growing our gardens - both vegetable and flower- helps build our sense of investment in protecting this resource. Our farmers, too, work conscientiously to adopt methods that minimize soil disturbance and maximize soil conservation, through such measures as no-till seeding, and cover crops. [See sidebars.]

The Orford Conservation Commission plays an important role in Resource Protection by working with Orford landowners who are interested in permanently protecting their land through land conservation easements.

The severe rainfall of July 2017 reminded us forcefully that our roads are built on soil, and when culverts are inadequate, soil erodes. The Conservation Commission will continue working in partnership with the Selectboard and the Town Road Department to assess the adequacy of our culverts. As town residents, we individuals can have a positive impact as well, by monitoring our own driveways and ditches to insure safe discharge of even major downpours.

There is an intricate interplay between agriculture and nature: soil is teeming with life and it is these living organisms that enable soil to grow food. Beneficial insects – particularly the pollinators - are absolutely critical for most agricultural crops. Limiting or completely avoiding harsh and persistent chemicals is a step each of us can take in helping to preserve the web of life that is at the heart of agriculture, and - ultimately – our source of food.

While people have the capacity to adapt, plants and animals are more vulnerable in the face of change. Although soil loss, declining numbers of pollinators, invasive plants and insects are all significant challenges agriculture faces in Orford, we citizens can and do have a positive impact in resource protection when we care for soil around our homes and gardens, refrain from using harsh and persistent chemicals in the environment, work to contain the spread of invasive species, and plant pollinator friendly gardens!

11 Forest Resources



Figure 1 View Southwesterly from Mount Cube

Forests comprise 75% of the landscape in Orford. Our forests are an important part of the history and character of Orford, are part of the essence of Orford, and an important

part of the economy of Orford, from timber to firewood, and sugaring to Christmas tree farms.

Forests are a critical component of the overall ecosystem. They provide food and shelter for wildlife, including mammals, birds, reptiles and amphibians, and are home to many native plants. Forests prevent soil erosion, filter water, supply oxygen and store carbon. Forests are a resilient resource, with a tendency to fill in nature's gaps.

Today, the Town of Orford is dominated by a forested landscape. Like much of New England, as Orford's hill farms were abandoned 150 years ago, their open fields and pastures have largely reverted to forest. In 2009, 75% of Orford's land area (22,249 acres) was enrolled in current use as forestland, either managed or unmanaged. In 2016, the number of acres is slightly reduced, with 22,101 enrolled in current use as forestland. Sixty-three percent of the 22,101 acres have

documented stewardship plans which help to ensure that the forests are managed using sustainable forest practices. In addition to land enrolled in current use, the backlots of many residential and publicly owned parcels are wooded. These backlots are an important part of our forested landscape.

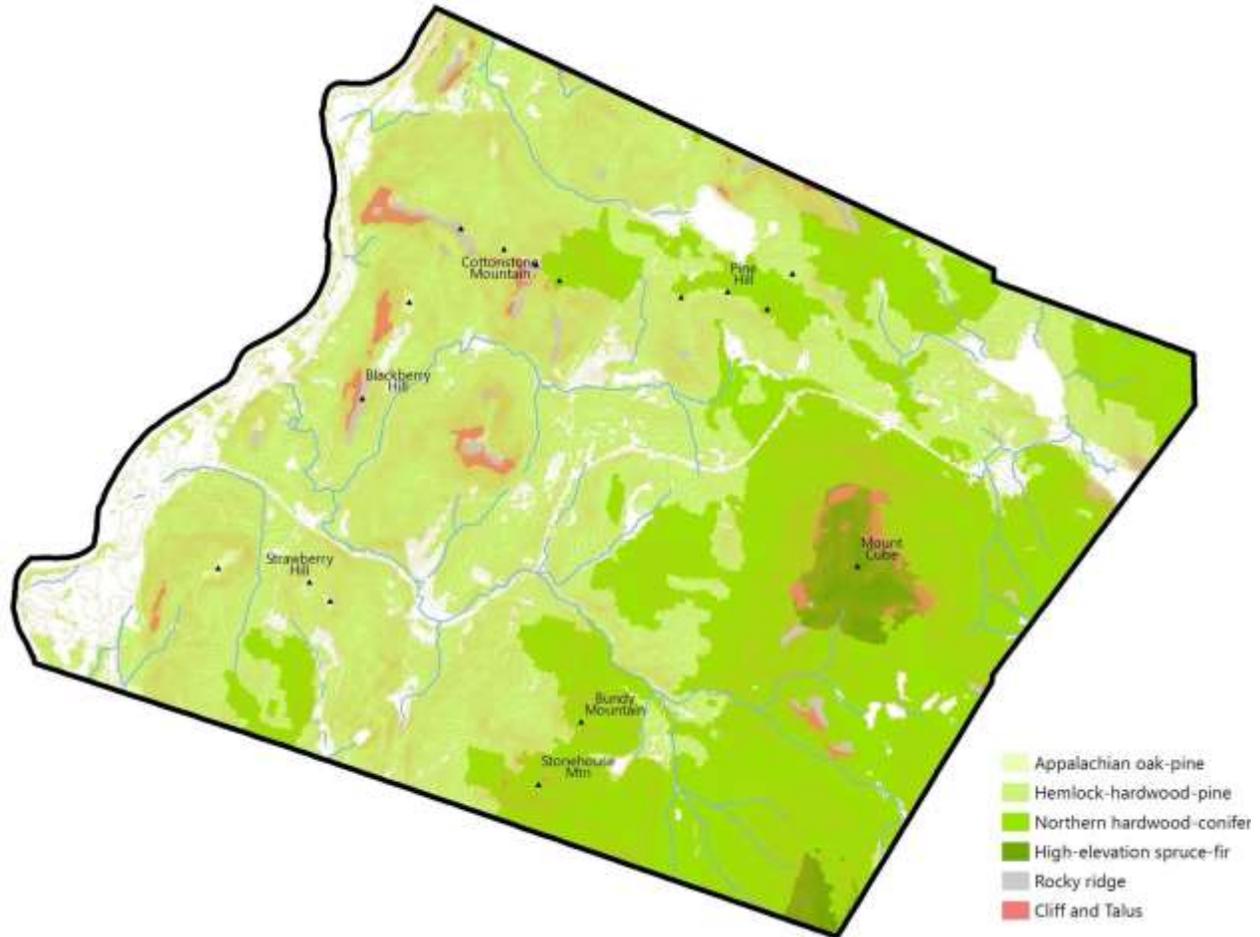
Most of Orford's forests are hemlock-hardwood-pine (approximately 15,000 acres) which is the most widespread forest-type in New Hampshire. It is considered a transitional forest habitat between lower elevations of Appalachian oak-pine forest habitat (less than 400' elevation) and northern hardwood-conifer forests (greater than 1,500' elevation).¹⁴ Common trees of this forest are white pine, eastern hemlock, American beech, sugar maple and white ash with occasional red oak on the drier slopes. The northern hardwood-conifer forests in Orford cover approximately 9,780 acres. Northern hardwood-conifer forests comprise nearly all of the forestland in the eastern half of Orford between 1,500' and 2,500' in elevation.¹⁵ Sugar maple, American beech and yellow birch are the dominant tree species, as well as red maple, white ash and eastern hemlock at the lower elevations, transitioning to red spruce and balsam fir as elevations increase.

Sarah and I have been Orford forestland owners since 1983. We love becoming educated about the many considerations that go into being outstanding stewards of our land. We are convinced we can continue learning about our natural world our entire lifetime. "Sustainable forest practices" describes the ethic we try to achieve.

—Bruce Schwaegler 1-16-2017

¹⁴ <https://extension.unh.edu/Hemlock-Hardwood-Pine-Forests>

¹⁵ <https://extension.unh.edu/Northern-Hardwood-Conifer-Forests>



Did you know that forested watersheds provide clean water to over 180 million Americans,¹⁶ and that forests act as water pumps? Water vapor from oceans can only travel about 400 miles from the coast to produce rain. Without forests, land beyond that range would be dry and bleak. However, in the summer trees use up to 8,500 cubic yards of water per square mile, much of which they release into the air through transpiration. This water vapor helps to create new clouds that travel further inland to release their rain. As this water cycle continues, rain reaches even the most remote areas.¹⁷

¹⁶ "Farming Magazine," July 2017

¹⁷ "The Hidden Life of Trees," by: Peter Wohlleben, Greystone Books Ltd, 2015

Protecting forests also means protecting the soils. Soils are an essential part of the life of a forest that is often overlooked. There are many different soil types, each with specific properties that influence the landscape. Soil function is the capacity different soil types have to support plant growth. For forests, this is measured in the volume of trees produced – the greater the soil fertility, the greater the productivity and the greater the volume or number of trees that grow in an area.

The Grafton County soil survey classifies soil types into groups based on their capability to support sufficient tree growth for commercial forestry operations. Each soil group supports different types of trees and tree productivity. For example, group IA soils are the best soils for hardwood production because they are relatively deep, fertile, and well-drained. Group IB soils are slightly less fertile and sandier. Over half of Orford’s soils are classified as forest soil groups IA and IB (Table **).

Table *. Important forest soil groups in Orford

<i>Forest Soil Group</i>	<i>Acreage</i>	<i>Percent of Town</i>
IA	8,345	28%
IB	7,697	26%
IC	758	3%
IIA	9,839	33%
IIB	2,637	9%
Non-Forest Soils	439	1%
<i>All Land in Orford</i>	<i>29,715</i>	<i>100%</i>

Current management and protection

New England has been losing forestland to development at a rate of 65 acres per day at the same time public funding for land preservation has been on the decline. That’s according to Harvard Forest, a research institute of Harvard University, in a recent report covering 2004-2014. After 150 years of forests reclaiming open farm land, all six

Image of Tom Thomson overlooking lupines that he planted beginning in 1991 to help prevent soil erosion on his tree farm. Image credits: Mac Snyder, Valley News 9/17/2016

New England states are again losing forestland, but this time to development, not agriculture. New Hampshire is losing about 5,000 acres of forestland to development per year, compared to only 1,500 acres per year in Vermont. New Hampshire ranks last in percapita state funding for land conservation at \$1.46, compared to a New England average of \$6.70 per person. Yet, New Hampshire has the highest percentage of its land conserved as forest or farmland with 30%, compared to Vermont with 23%. The dichotomy here is low New Hampshire state funding for land conservation, yet a comparatively high percentage of conserved forest and farmland. This is only possible with the help of generous, conservation minded landowners, private donors and non-profit conservation organizations such as the Upper Valley Land Trust and the Society for the Protection of New Hampshire Forests. Without their continued support, the loss of 5,000 acres of forestland to development in New Hampshire each year will most likely continue or accelerate.



*Tom Thomson overlooking lupines that he planted beginning in 1991 to help prevent soil erosion on his tree farm.
Image credits: Mac Snyder, Valley News 09/17/2016*

New Hampshire's Current Use program provides a monetary incentive to landowners through reduced tax assessments on farm and forestland that remains undeveloped. Forest landowners can also receive a further reduction in tax assessments for forestland that has been certified as a Tree Farm or has an approved forest stewardship plan. Current Use and stewardship incentives are critical for forest landowners to be able to afford to keep our important forests productive and undeveloped. Tree Farm and forest stewardship plans, filed with the Town of Orford, provide detailed information about the property, including landowner management objectives, property location and description, ownership and history, topography and soils, recreational resources, cultural features and aesthetic values, threatened and endangered species, unique natural communities, water quality and wetlands, fish and wildlife habitat, invasive species, past forestry practices and planned future forestry practices. Plans, updated at least every five years, help forest landowners protect this critical natural resource.

Stream crossings and wetlands impacts during timber harvesting operations are regulated by the State of New Hampshire through the Department of Environmental Services. In addition, the Department of Resources and Economic Development has

developed Best Management Practices for erosion control on timber harvesting operations and the University of New Hampshire's Cooperative Extension foresters provide technical assistance and information to forest land owners. These important regulations and technical assistance help forest land owners protect the soil and water quality during tree harvesting operations.

Timber is considered real estate and is assessed a tax at the time of harvest. Prior to a timber harvest, a landowner must file an "Intent to Cut" form with the Town, as required by RSA 79:10. After the harvest, the landowner must file a Report of Timber Cut form with the Town, which is used to calculate the Timber Yield Tax.

Existing and potential threats to the resource

Non-native and invasive plants make up at least 30% by species of all plants in New England and threaten the health of New Hampshire's forests according to John Gunn, a University of New Hampshire researcher.¹⁸ Species such as burning bush, glossy buckthorn, multiflora rose and Japanese barberry are likely to continue their expansion throughout the forests of New England as they thrive under the warming temperatures we have been experiencing this century. Gunn's current work will hopefully help us understand how non-native species are affecting forest health and forest ecosystem services such as timber product outputs and carbon sequestration.

Non-native diseases and nuisance insects, such as the Hemlock Woolly Adelgid, Asian Long-Horned Beetle, and Emerald Ash Borer pose a threat to the specific tree species they attack as well as the overall health and composition of forests.

Maintaining our forest resource is challenged, for those reliant on timber harvest income, by the pressure to convert this resource to development, much as is the case with agricultural land. Conversion of forest land to development eliminates the economic resource for timber harvesting and also degrades the quality of the surrounding forest to provide wildlife habitat and other ecosystem benefits.

Over-harvesting of forest products is another threat to forest resources. Proper forest management allows sustainable regeneration of forests and minimizes soil erosion and compaction. Soil compaction disrupts soil porosity and negatively affects root growth and the activity of soil organisms. Timber harvesting during the winter when the ground is frozen helps to minimize both soil compaction and erosion. County Foresters with the University of New Hampshire Cooperative Extension Service are an excellent resource to help landowners plan a sustainable timber harvest.

¹⁸ <https://www.unh.edu/unhtoday/news/release/2017/03/20/unh-scientist-takes-aim-invasive-non-native-plantsthreatening-nhs-forests>

Efforts by individuals or groups to change or eliminate Current Use would have a significant impact on forest land owners' ability to maintain this very important resource.

Current Use should be maintained in order for forest land owners to be able to afford to keep their forest land undeveloped. Forests are such a critical part of our ecosystem and our economy that we can't afford to lose them. A forest provides many benefits, including wood products, wildlife habitat, water resources, carbon storage, erosion control and flood mitigation, to name a few, and they are irreplaceable.

Recommendations for resource protection

- ✦ The Conservation Commission should work with landowners and local land trusts to identify forestland that should be protected with conservation easements.
- ✦ Citizens and visitors who use firewood should use local firewood to avoid transporting insects or diseases.
- ✦ Landowners should become familiar with invasive species, including identification and options for management. Many resources are available to help, including from the New Hampshire Department of Agriculture and the Society for the Protection of New Hampshire Forests.
- ✦ The Conservation Commission should work to control invasive species on town-owned or town-managed properties and be on the lookout for new invasive species coming into Orford.
- ✦ Landowners should follow best management practices during timber harvesting, particularly those that reduce soil erosion and compaction and protect water quality.
- ✦ Citizens should support public funding for land conservation.
- ✦ Citizens should support the continuation of Current Use taxation.

Climate Change and Orford's Forests

Generally, it is thought that the likely response of New Hampshire's forests to the climate's warming temperatures is an acceleration of species shift, or migration, over time. Northern hardwood species are more likely to shift northerly and/or upslope and be replaced by hemlock and warmer climate hardwood species.

A greater frequency of ice storms is expected to affect our region in the future, as well as other disturbance events like hurricanes and tornados. These weather events can have local but significant impact on a forest's successional rate. The species that emerge after such events could increase the transition to tree species that favor warmer climates at a faster rate at affected locations.

Exotic and invasive insects such as the Emerald ash borer and the hemlock wooly adelgid are currently affecting forests in neighboring states and in some cases, southern towns in New Hampshire. With warmer winters these species may not experience the normal rate of mortality and could increase the threat to our forests into the future.

Unfortunately, severe and "wonky" weather is becoming the new normal. Trees are budding two weeks earlier than historic averages. Snowfall is declining thus reducing the thermal blanket that protects delicate roots from cold temperatures. A series of recent experiments at Hubbard Brook Experimental Forest in Thornton and Woodstock, New Hampshire showed that reduced snowpack extended soil frost down to a foot or more compared to only an inch or two when there is sufficient snowpack. At the end of the experiment tree core samples revealed that tree growth declined by 40 percent after two years and growth remained suppressed for the rest of the five-year study period. The additional root freezing triggered several negative responses,

Bracket Brook Farm

The Pease family has been producing maple syrup in East Orford for over 150 years. In recent years we have observed that sugaring seasons are starting earlier, lasting longer and daily temperatures fluctuate more. From 1960 to 1979 the earliest sugaring season began March 16 and the latest sugaring season began April 4, with a median start date of March 24. The earliest end date for the sugaring season was April 10 and the latest end date was April 29, with a median end date of April 21. The average sugaring season lasted 25 days during those two decades. In dramatic contrast, the 2016, 2017 and 2018 sugaring seasons began February 22, 23 and 21 and ended April 6, 12 and 3, respectively. These start dates are 3 weeks earlier than the earliest start date in the 1960s and 1970s, and a month earlier than the median start date.

(Continued, next page)

including a reduced capacity for trees to take up water and nutrients, shorter branch growth, and a decrease in soil insect diversity and abundance. Resources that trees would have used for growth were instead allocated to regrowing root systems.¹⁹

In recent years we have experienced high winds, heavy rains and drought conditions, which have negative impacts on our forests. These types of extreme weather events are predicted to occur more regularly in the Northeast. In a recently completed fourteen-year ecosystem study at Hubbard Brook Experimental Forest researchers discovered that forest soils are absorbing less methane than they did historically. Atmospheric levels of methane, a potent greenhouse gas, are rising. “Forests can remove methane from the atmosphere through the activity of soil bacteria. But increasing precipitation—a symptom of climate change—is making it harder for forest soils to trap greenhouse gases, creating a feedback loop that exacerbates global warming.”²⁰

As our forests change, this will impact a significant number of forest song bird and mammal habitats. Some species are likely to migrate and breed in different locations, decreasing or disappearing from New Hampshire altogether over time.

As citizens of Orford, we see forests every day, and we are very fortunate in that regard. Whether you appreciate our forests for the products they produce, the functions they perform, or simply their aesthetic beauty, they are a resource that needs and deserves protection.

¹⁹ *No Snow, No Grow: Northern Woodlands/Winter 2019*

²⁰ *Cary Institute of Ecosystem Studies*
(<https://www.caryinstitute.org/newsroom/thanks-climate-change-and-weatherforest-soils-are-absorbing-less-methane>)

Bracket Brook Farm (Continued)

The sugaring season end dates in 2016, 2017 and 2018 were about the same as the earliest end date of April 10 in the 1960s and 1970s but were 1 to 3 weeks earlier than the median end date of April 21. The average sugaring season in 2016, 2017 and 2018 was 43 days compared to only 25 days in the 1960s and 1970s. However, this 70 per cent increase in the length of the sugaring season did not significantly change the maple syrup yield. It is probably no coincidence that the early start to the 2016, 2017 and 2018 sugaring seasons and the fluctuating temperatures correspond with three of the hottest years on record. By contrast, the 2019 maple sugaring season began March 21 and ended April 16, for a total of 26 days, and compares very closely with the decades of the 1960s and 1970s. The future of maple sugaring in New England is uncertain. Some predictions are that, due to climate change, there will not be any sugar maples in New Hampshire within 100 years.

Harry and Linda Pease, 1220-2019

12.0 Wildlife and Native Plant Resources



Figure 1 Wild Strawberry, Purple and White Violet

The undeveloped nature of Orford provides abundant habitat for wildlife. The Connecticut River and its associated wetlands, such as Reeds Marsh and the outlet of Jacobs Brook, provide important aquatic habitat as well as a stopover point for migratory waterfowl. Agricultural fields and pastures can provide bird nesting sites, habitat for small mammals and food supplies for turkey, white-tailed deer, black bear, snakes and birds of prey. The edge habitats between open fields and woodlands serve another group of wildlife species, including white-tailed deer. Deep forest provides shelter and space for large mammals including bobcat, white-tailed deer, moose and black bear as well as owls, songbirds and smaller mammals. Wetlands support a unique assemblage of wildlife, including beaver, moose, songbirds, waterfowl, and a variety of amphibians.



Figure 2 Barred Owl

Local resident Bry Beeson has documented 33 species of dragonflies and damselflies in the Mud Turtle Pond area of Orford (see Appendix B for a complete list). The collection of data in Orford is part of an ongoing, five-year study by the New Hampshire Audubon. <http://www.nhaidubon.org/conservation-2/wildlife-projects/> Dragonflies and damselflies are in the insect order Odonata, and represent a most interesting group of widely seen “bugs.” There are about 165 Odonata species in the State of New Hampshire, and they serve as indicators of a clean, toxic-free environment. Clean water in ponds, lakes, vernal pools, and brooks is extremely important for all of us. Sampling continued into 2011 with the hopes of finding more species in Orford. <http://www.nhaidubon.org/conservation-2/reports-publications/>

Jeff MacQueen and Bill McKee both provided lists of birds seen in Orford (Appendix B). Jeff MacQueen’s lists contain nearly 200 bird species identified here over the past twenty years, indicating that Orford’s landscape provides an unusually rich habitat for birds in comparison to many other New Hampshire towns. This is likely due to the town’s diversity, ranging from the Connecticut River as a very significant migration corridor, to the higher altitudes of Mt. Cube and other uplands, and including forests, open fields, extensive wetlands at Reed’s Marsh and elsewhere, and relatively large ponds. Records from long-term residents also help to document the recovery or decline of bird populations. Bill McKee reports that he spotted a Bald Eagle on Indian

Pond in 1953 and did not see another until 2000 on the Connecticut River. More currently, nesting pairs are routinely sighted along NH Route 10.

Currently, there are over 72 breeding pairs of Bald Eagles in New Hampshire, and the numbers are rising. The Bald Eagle was removed from the federal Threatened and Endangered Species List in 2007, and down listed from Endangered to Threatened on the New Hampshire T&E List in September and finally removed from the list in Spring 2017. <https://granitegeek.concordmonitor.com/2019/11/22/bald-eagles-attack-loons-but-thats-not-whyloons-are-struggling/>



Figure 3 Bald Eagle, October 2019

New Hampshire Fish and Game Department coordinates a volunteer Reptile and Amphibian Reporting Program (RAARP)

<https://www.wildlife.state.nh.us/nongame/reptilesamphibians.html> to report sightings of reptiles and amphibians around the state. Through this program and other state records, there are documented occurrences in Orford of two turtles, three snakes, six salamanders, and eight frog/toad species. Jeff MacQueen has also compiled a listing of reptiles, including in Appendix B.

Table 11: Reptiles and amphibians documented in Orford

<i>Turtles</i>	<i>Salamanders and Newts</i>	<i>Frogs and Toads</i>
Snapping turtle	Dusky salamander (H)	Bullfrog (H)
Wood turtle	Eastern red-spotted newt	Green frog
	Redback salamander	Northern leopard frog
<i>Snakes</i>	Spotted salamander	Pickerel frog
Common garter snake	Spring salamander (H)	Wood frog
Smooth green snake (H)	Two-lined salamander (H)	Gray tree frog
Redbelly snake		Spring peeper
* H – last recorded sighting prior to 1988		American toad

Several Orford residents have kept lists of animals seen on their property or other locations around town; their lists are included in Appendix B. David Coker reported 32 mammal species seen on the Settlement Farm in Orfordville in the past twenty years, including two species of bat and bobcat tracks. Bill McKee reports 25 mammal species, including a lynx on Eastman’s Ledges on Mount Cube in 1950 and 1965.

NH Fish and Game in concert with UNH maintains a website for collection and management of citizen wildlife sightings <https://nhwildlifesightings.unh.edu/>

Things you can do on NH Wildlife Sightings site:

- Report Wildlife observations including all reptiles and amphibian species.
- Report vernal pool locations and associated wildlife species.
- Use interactive map to locate observation.
- Upload photos to observation.
- View town distribution maps for all species eligible for reporting.
- See all of your wildlife observations and vernal pool reports on a map and table located on your home page (see image below as example).
- Download all of your observations.

The New Hampshire Fish & Game Department maintains a database of occurrences of rare, threatened, and endangered species.

<https://www.wildlife.state.nh.us/nongame/documents/endangered-threatened-wildlife-nh.pdf>



ENDANGERED



Endangered wildlife are those native species that are in danger of extinction in New Hampshire because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance or contamination. Assistance is needed to ensure these species' continued existence as viable members of the state's wildlife community.

INVERTEBRATES

- Dwarf wedgemussel, *Alasmidonta heterodon***
- Brook floater mussel, *Alasmidonta varicosa*
- Cobblestone tiger beetle, *Cicindela marginipennis*
- Puritan tiger beetle, *Cicindela puritana**
- Frosted elfin butterfly, *Callophrys irus*
- Kamei blue butterfly, *Lycaeides melissa samuelis***
- White Mountain fritillary, *Boloria titania montinus*
- Persius duskywing skipper, *Erynnis persius*
- Rusty Patched Bumblebee, *Bombus affinis***

FISH

- American brook lamprey, *Lethenteron appendix*
- Shortnose sturgeon, *Acipenser brevirostrum***

AMPHIBIANS

- Marbled salamander, *Ambystoma opacum*

REPTILES

- Blanding's turtle, *Emydoidea blandingii*
- Eastern box turtle, *Terrapene carolina*

- Eastern hognose snake, *Heterodon platirhinos*
- Timber rattlesnake, *Crotalus horridus*

BIRDS

- Northern harrier, *Circus cyaneus*
- Golden eagle, *Aquila chrysaetos*
- Common nighthawk, *Chordeiles minor*
- Piping plover, *Charadrius melodus**
- Upland sandpiper, *Bartramia longicauda*
- Roseate tern, *Sterna dougallii***
- Least tern, *Sterna antillarum*

MAMMALS

- Eastern small-footed bat, *Myotis leibii*
- Little brown bat, *Myotis lucifugus*
- Northern long-eared bat, *Myotis septentrionalis**
- Tri-colored bat, *Perimyotis subflavus*
- New England cottontail, *Sylvilagus transitionalis*
- Canada lynx, *Lynx canadensis**
- Eastern wolf, *Canis lupus***

* Federally Threatened ** Federally Endangered



THREATENED



Threatened wildlife are those native species that are likely to become endangered in the near future, if conditions surrounding them begin, or continue, to decline.

INVERTEBRATES

- Eastern pond mussel, *Ligumia nasuta*
- Pine pinion moth, *Lithophane lepida lepida*
- Ringed boghaunter, *Williamsonia lintneri*
- White Mountain arctic, *Oeneis melissa semidea*
- Hessel's hairstreak, *Callophrys hesseli*

FISH

- Bridle shiner, *Notropis bifrenatus*
- Atlantic sturgeon, *Acipenser oxyrinchus*
- Round whitefish, *Prosopium cylindraceum*

AMPHIBIANS

- Fowler's toad, *Anaxyrus fowleri*

REPTILES

- Spotted turtle, *Clemmys guttata*
- Black racer, *Coluber constrictor*

BIRDS

- Pied-billed grebe, *Podilymbus podiceps*
- Common loon, *Gavia immer*
- Peregrine falcon, *Falco peregrinus*
- Common tern, *Sterna hirundo*
- Red knot, *Calidris canutus**
- Cliff swallow, *Petrochelidon pyrrhonota*
- Purple martin, *Progne subis*
- Cerulean warbler, *Setophaga cerulea*
- Eastern meadowlark, *Sturnella magna*
- Grasshopper Sparrow, *Ammodramus savannarum*

Nongame and Endangered Wildlife Program • NH Fish and Game Department

The diversity of plant species in Orford sustain the natural communities of different forest types, floodplain areas, wetlands, and meadows. These natural communities sustain the habitat of the wildlife described in the paragraphs above, and contain a

wide array of individual plant species, each a valuable component of the community. Sarah Schwaegler has been documenting the botanical richness of Orford over many years and has compiled an impressive listing of ferns, wildflowers, vines, shrubs and trees, both native and non-native, that she has seen in Orford. She reports that most species are adapted to grow well in the acidic soils of New Hampshire. Her findings are summarized and listed in Appendix C.

The Natural Heritage Bureau also catalogues rare, threatened, and endangered plant species in its database. In Orford, there have been four documented species included in the Bureau's database; they are all listed as endangered under the New Hampshire Native Plant Protection Act of 1987 (NH RSA 217-A). Sarah Schwaegler has also identified several other species of rare plants in Orford (listed in Appendix C).

The Natural Heritage Bureau has not exhaustively surveyed the state, so it is possible that more rare species do occur within Orford. If town residents have information about rare species occurrences, they should contact the Natural Heritage Bureau. Their website is <http://www.nhdfi.org/about-forests-and-lands/bureaus/natural-heritage-bureau/>

Town Flag	Species or Community Name	Listed?		~ reports last 20 yrs	
		US	NH	Town	State
Orford					
Plants					
**	American climbing fern - <i>Lygodium palmatum</i>	--	E	1	5
~	greater fringed-gentian - <i>Gentianopsis crinita</i>	--	T	Historical	30
~	greater yellow lady's-slipper - <i>Cypripedium parviflorum</i> var. <i>makasin</i>	--	E	Historical	10
~	long-headed windflower - <i>Anemone cylindrica</i>	--	E	Historical	11
**	northern arrowhead - <i>Sagittaria cuneata</i>	--	E	1	12
~	northern shore quillwort - <i>Isoetes septentrionalis</i>	--	E	Historical	16
~	purple virgin's-bower - <i>Clematis occidentalis</i> ssp. <i>occidentalis</i>	--	E	Historical	25
~	ram's-head lady's-slipper - <i>Cypripedium arietinum</i>	--	E	Historical	13
~	resupinate bladderwort - <i>Utricularia resupinata</i>	--	E	Historical	15
~	Sago false pondweed - <i>Stuckenia pectinata</i>	--	E	Historical	9
**	walking spleenwort - <i>Asplenium rhizophyllum</i>	--	E	1	7
Vertebrates - Birds					
**	Bald Eagle - <i>Haliaeetus leucocephalus</i>	T	SC	2	140
**	Common Loon - <i>Gavia immer</i>	--	T	1	339
**	Marsh Wren - <i>Cistothorus palustris</i>	--	--	1	37
~	Pied-billed Grebe - <i>Podilymbus podiceps</i>	--	T	Historical	35
Vertebrates - Reptiles					
**	Wood Turtle - <i>Glyptemys insculpta</i>	--	SC	1	280
Vertebrates - Amphibians					
**	Northern Leopard Frog - <i>Lithobates pipiens</i>	--	SC	1	18
Invertebrates - Mollusks					
***	Dwarf Wedge Mussel - <i>Alasmidonta heterodon</i>	E	E	1	14

Listed? E = Endangered T = Threatened SC = Special concern

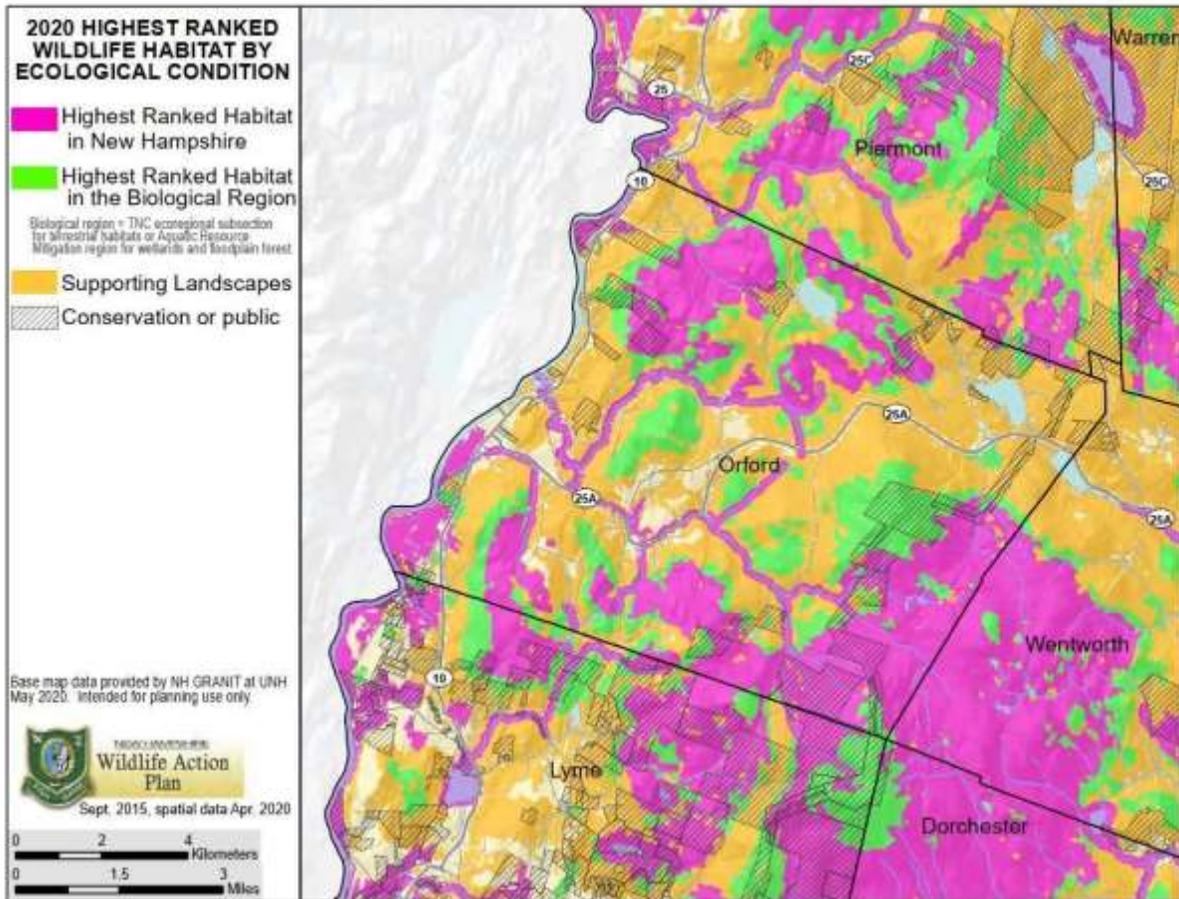
Flags **** = Highest importance
 *** = Extremely high importance
 ** = Very high importance
 * = High importance
 -- = Historical Record

These flags are based on a combination of (1) how rare the species or community is and (2) how large or healthy its examples are in that town. Please contact the Natural Heritage Bureau at (603) 271-2215 to learn more about approaches to setting priorities.

May 2020

The New Hampshire Fish and Game Department recently updated an analysis of habitat condition, which was published in the New Hampshire Wildlife Action Plan (first published in 2006, updated 2010). Habitat types were mapped and then ranked according to their condition and risk of degradation. Measuring habitat condition entailed a lengthy analysis of various factors that impact wildlife, 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 New Hampshire Wildlife Action Plan available online at the Fish and Game website:

<https://www.wildlife.state.nh.us/nongame/index.html> and
<https://www.wildlife.state.nh.us/wildlife/wap.html>



The analysis resulted in four classes:

- Tier 1 - Highest ranked habitat in the state (top 10-15%) – 10,272 acres in Orford;
- Tier 2 - Highest ranked habitat in the biological region – 4,794 acres;
- Tier 3 - Supporting landscapes important to highest ranked habitats – 13,768 acres;
- Habitat not highly ranked – 1,744 acres.

Tier 1 wildlife habitat is of greatest conservation priority because it represents 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; an example of Tier 3 habitat is the watershed surrounding a high-quality stream corridor.

Tier 1 habitat in Orford consists of aquatic, wetland, and terrestrial habitat. The Connecticut River and its tributaries in Orford (not including those streams that flow

southward into Lyme) as well as Indian Pond were highly ranked for their outstanding aquatic habitat and adjacent riparian habitat. Wetland habitats ranked as Tier 1 included three areas of marsh complexes on the south branch and north branches of Jacobs Brook and an unnamed tributary to Jacobs Brook east of Route 25A. In addition, a riparian area south of Reeds Marsh was ranked as Tier 1 because of an occurrence of a rare, threatened or endangered species. Tier 1 terrestrial habitat in Orford is the matrix forest, which describes large blocks of forested land; in Orford, the most common matrix forest type is hemlock-hardwood-pine forest on the western and northern side of Orford and northern-hardwood-conifer forest on the eastern side of town. Other less prevalent matrix forest types include Appalachian oak-pine forest in lower elevations, high-elevation spruce-fire forest on Mount Cube and Smarts Mountain, and lowland spruce-fir forest scattered throughout town. The largest areas of Tier 1 matrix forest habitat in Orford occur in the general vicinity of Mount Cube, Indian Pond, Quinttown, and Upper and Lower Baker Pond.

Tier 2 habitat in Orford is comprised of aquatic and terrestrial habitats. The aquatic habitats are ranked Tier 2 for the Connecticut River tributaries draining southward into Lyme and 15 small ponds scattered throughout town, including Mud Turtle Pond, Archertown Brook and the east side of Rt 10 on the southern edge of town. Terrestrial habitats ranking Tier 2 include numerous areas of grasslands and a few isolated areas of floodplain forest along the Connecticut River. Matrix forest comprises a large area of Tier 2 habitat in multiple areas around Orford.

Descriptions of the Tier 1 and Tier 2 habitats in Orford are included in Table 14. It is important to note that some of the highly-ranked habitats in Orford overlap, e.g. riparian areas and wetlands also located within a matrix forest block.

Table 14: Important wildlife habitat types and areas in Orford

Tier 1 Habitat in Orford		
<i>Habitat Type</i>	<i>Acreage</i>	<i>General Location(s)</i>
Rivers and riparian areas	4,479	Connecticut River and tributaries entering river in Orford
Marsh complexes	140	Jacobs Brook tributaries (south/north branches, unnamed)
Lake and riparian area	242	Indian Pond and its shoreline
River and riparian area	73	Location on Connecticut River south of Reeds Marsh
Matrix Forest	7,149	Central and eastern sections of Orford

Tier 2 Habitat in Orford		
<i>Habitat Type</i>	<i>Acreage</i>	<i>General Location(s)</i>
Rivers and riparian areas	359	Connecticut River tributaries draining to Lyme
Floodplain forest	15	Connecticut River and tributaries in NW and SW corners (3 sites)
Grasslands	740	4 areas near Connecticut River
Grasslands	219	3 areas in central Orford, near 25A and Archertown Rd
Grasslands	39	1 area near Quinttown
Small Ponds	88	15 ponds throughout Orford
Matrix Forest	3,684	Central and eastern sections of Orford

Existing and potential threats to the resource

Habitat loss and degradation are the primary threats to wildlife in New Hampshire. It is not just the loss of forest or other habitat that harms wildlife, but the cumulative effects of landscape fragmentation. Landscape fragmentation describes the process of human development dividing undeveloped lands into increasing small and disconnected pieces, through the clearing of native vegetation and the building of roads, utility lines, buildings and other structures.

- Landscape fragmentation has many effects on the quantity and quality of wildlife habitat:
- Decrease in the acreage of undeveloped areas,
- Loss of connectivity between habitats,
- Increased potential for movement of invasive or damaging species into native plant communities, which degrades food resources and nesting sites,
- Increased potential for vehicle-wildlife collisions, and
- Increased potential for undesirable human-wildlife interactions, e.g., nuisance bears and flooding of residential areas by beaver activity.

Vehicle-wildlife collisions are dangerous for both humans and large wildlife but not always fatal; however, mortality may be exceedingly high for reptiles and amphibians crossing roadways in order to reach their spring breeding grounds.

Invasive species can crowd out native plants and diminish the value of wildlife habitat. Sarah Schwaegler reports that Common Buckthorn, non-native Honeysuckles, and Barberries, Purple Loosestrife, and Japanese knotweed are established in Orford, and has also identified Wild Chervil and Garlic Mustard.

Each plant and wildlife species has its own habitat requirements and is susceptible to a unique set of threats. The New Hampshire Wildlife Action Plan contains more information on the threats specific to each wildlife habitat/natural community type and to species of concern.

Current management and protection

As of March 2010, the New Hampshire Fish and Game Department calculated that 9.3% of the

Tier 1 habitat, 12.3% of Tier 2 habitat, and 8% of Tier 3 habitat in Orford is conserved land, in either private or public ownership. The Reeds Marsh Wildlife Management Area helps protect an important wetland complex. All conservation lands provide undeveloped spaces for wildlife habitat.

New Hampshire Fish and Game Department, US Fish and Wildlife Service, New Hampshire Audubon, The Nature Conservancy, The Loon Preservation Committee, and numerous other non-profit organizations work to protect wildlife. The Silvio Conte National Wildlife Refuge, established in 1991, works to protect the wildlife and its habitat in the Connecticut River watershed. UNH Cooperative Extension coordinates the Coverts Program, which teaches volunteers to promote wildlife habitat conservation and forest stewardship.

Current use tax assessment helps to maintain forest lands, agricultural lands and wetland areas and serve to protect against the fragmentation of the landscape.

A unique partnership called the Quabbin-to-Cardigan Collaborative is working to conserve large, undeveloped blocks of land between the Quabbin Reservoir in central Massachusetts to the forests around Mount Cardigan. Orford is at the northern end of this initiative's focus area and could benefit from the conservation of regional wildlife corridors and large forested habitats.

Recommendations for resource protection

- The Conservation Commission should work with landowners and land trusts to protect important habitat areas and unfragmented forest habitat.
- The Conservation Commission should manage town-owned properties for wildlife habitat and seek to control invasive species on town-owned properties. Grant funding may be available through the US Department of Agriculture or New Hampshire Fish and Game.
- The Conservation Commission should encourage participation in volunteer wildlife monitoring and stewardship activities, such as the Volunteer Reptile and Amphibian Reporting Program, Coverts program, and bird and insect counts organized by New Hampshire Audubon.
- The Conservation Commission should educate landowners about the importance of protecting and enhancing migratory and resident wildlife habitat, by providing workshops and/or displaying wildlife maps, handouts, and publications in the Town offices and library. New Hampshire Fish and Game has developed a series of informative habitat stewardship brochures for floodplain forests, grasslands and other habitat types.
- The Conservation Commission should educate the public and town highway staff on invasive species so that the control of these plants can be done at the landowner level along with other property maintenance. The New Hampshire Department of Agriculture can provide technical assistance on proper roadside mowing techniques and other invasive species control methods.
- The Conservation Commission should examine culverts to ensure proper drainage and aquatic habitat connectivity, in coordination with the Town Road Agent. The Town should ensure that culverts are properly engineered and installed when replacing them during road work.

13.0 Scenic Resources

From the open fields and historic East and West Common in the Connecticut River Valley to the peak of Mount Cube and Upper and Lower Baker Ponds, Orford provides a wide array of scenic viewpoints and vistas. The scenic value of natural landscapes and open spaces is an important factor in the character and attraction of Orford. Each landowner, resident and visitor to Orford has his own special set of views, whether visible only on private property or accessible to all travelers on the state highway system. For the purposes of this inventory, the Orford Conservation Commission has focused on important scenic features visible from public roadways, public lands such as boat launches and natural areas, the Cross Rivendell Trail, and the Appalachian Trail and associated spur trails.

The 2011 Master Plan identified several outstanding examples of scenic beauty in Orford; the Orford Conservation Commission reviewed this list and added other significant scenic views.

Notable scenic landmarks include:

Indian Pond, particularly as viewed from the town beach and boat launch



Figure 1 Indian Pond Beach & Boat Ramp

Upper Baker Pond, particularly the forested lakeside on the pond's eastern side



Figure 2 Upper Baker Pond Image courtesy UVLT

Beaver bog on Orfordville Road



Figure 3 Orfordville Road Bog & Wetland

Mount Cube, the Mount Cube ledges



Figure 4 View from Mount Cube, West – Northwest



Figure 5 View of Mount Cube from Mountain View Farm

Sunday Mountain and Cottonstone Mountain



Figure 6 Sunday Mountain is a 1,823 foot tall peak., image courtesy of NewEnglandSkiIndustry.com

Tillotson Falls

The Town Common and historic homes on the Ridge.



Figure 7 Historic Ridge Homes, Main Street

Although Mount Moosilauke does not lie within the Town of Orford, this impressive 4,802-foot mountain can be seen from several viewpoints, including the summit of Mount Cube, Upper Baker Pond, Dame Hill Road and the Dame Hill Road cemetery, and Route 25A. Another outstanding natural feature that may be viewed from Orford is the series of cliffs known as the Palisades across the Connecticut River in Fairlee, Vermont. The Richmond and Eck conservation lands provide excellent views of the Connecticut River.



Figure 8 Mount Moosilauke, Elevation 4,802 feet

Scenic roadways include:

- Route 10, recognized as part of the Connecticut River Scenic Byway,
- Route 25A, recognized as the Meldrim Thomson Scenic Highway,
- Bridge Street, with views up and down the Connecticut River and west to Fairlee's Palisades,
- Orfordville Road, particularly for the views of large beaver pond wetlands,
- Dame Hill Road, for views of Mt. Moosilauke and Sunday Mountain. Bean Brook Road and Grimes Hill Road, where views are protected by the Bunten easement,
- Indian Pond Road, with views to Indian Pond, wetlands and Mount Cube,
- Cole Farm Road, with views westward to the Connecticut River Valley, and
- Archertown Road, with its extensively wooded roadside and views of Sunday Mountain.

Existing and potential threats to the resource

The beautiful scenery of Orford serves to attract new residents to town and leads to increased development pressure. New development has the potential to degrade the integrity of scenic vistas; for example, Archertown Road has experienced new development along the roadside in the past ten years. Wireless telecommunications towers, utility/transmission lines and commercial wind farms also have the potential to diminish scenic value, particularly on ridgelines. These concerns must be balanced against the significant benefits of current technologies, such as solar arrays which are helping combat climate change and reduction in our carbon footprint.

Current management and protection

The Connecticut River Scenic Byway runs along Route 10 through Orford. This byway is a three-state (New Hampshire, Vermont and Massachusetts) initiative to highlight the historic, cultural, scenic and recreational resources along the Connecticut River. The Scenic Byway program can provide funding for scenic view preservation through land acquisition or easement.

The Orford Conservation Commission (OCC) has been assisting with a large ongoing conservation project to protect the shoreline of Indian Pond and surrounding forestland. This will help to encourage protection of the scenery, provide wildlife habitat and allow for recreation.

Permanent land protection has helped to protect scenic views, especially along Route 10 and the

Appalachian Trail corridor. Mountain View Farm and Bracket Brook Farm have been added as Conservation Lands via Upper Valley Land Trust working in concert with OCC and other agencies.



Figure 9 Mountain View Farm, Image courtesy UVLT



Figure 10 Bracket Brook Farm, Image courtesy UVLT

The Town of Orford had adopted a telecommunications ordinance, limiting the height of wireless telecommunications towers and requiring camouflaging. Applicants proposing new towers must apply for a Conditional Use Permit through the Planning Board.

Recommendations for resource protection

- The Conservation Commission should consider scenic resources when evaluating land conservation projects, particularly those scenic areas visible from public roadways, public land or recreational trails.
- The Planning Board should encourage developers to preserve scenic resources by establishing forested buffers and encouraging interior roads.
- The 2018 Master Plan includes the following strategy to address siting of Wireless Service Facilities:

Ordinance-6. Performance and Design Standards:6.3 Camouflage. Groundmounted PWSFs (*Personal Wireless Service Facilities*) shall be camouflaged to the satisfaction of the Planning Board using such methods as compatible building materials and colors, screening, landscaping, placement in the midst of trees and the use of camouflage technology. PWSFs located in open spaces shall be camouflaged, using such methods as color, material finish, landscaping, concealment in "stealth" structures and placement on site to exploit concealment by adjacent objects. PWSFs mounted on existing structures shall be so configured as to preserve the character and integrity of those structures. If an antenna is installed on a structure other than a tower, the antenna and supporting equipment shall be visually (un)obtrusive.

14.0 Outdoor Recreation Resources

Hiking, boating, hunting, horseback riding, skiing, snowshoeing, snowmobiling, and birdwatching are just a few of the recreational opportunities in Orford. Outdoor recreation provides an opportunity for town residents to experience nature first-hand and increase appreciation for the natural world, and also promotes an active, healthy lifestyle.

Existing trails or trail networks in Orford include:

- The Appalachian Trail and connecting trails on Mount Cube,
- The Cross Rivendell Trail, a 36-mile trail connecting Flagpole Hill in Vershire, VT, past Rivendell School and over Sunday Mountain to Mount Cube in Orford,
- The Indian Pond Heritage trail,
- The Stonehouse Mountain trail,
- Class VI roads, and
- The snowmobile trail network maintained by Lyme Pinnacle snowmobile club.

Access to the Connecticut River is provided at the boat launches at the Orford Boat Launch and

Reeds Marsh Wildlife Management Area. There are also boat launches on Indian Pond, Upper Baker Pond and Lower Baker Pond. The Town maintains a beach adjacent to the boat launch on Indian Pond.

Commercial campgrounds include Jacobs Brook Campground and The Pastures Campground. There are two summer youth camps, Camp Merriwood and Camp Moosilauke, on Upper Baker Pond.

The Town also owns and manages a community field across Route 25A from the Rivendell School as well as Flat Rock, a small natural area off Quinttown Road.

The Connecticut River Birding Trail lists Mount Cube and Reed's Marsh Wildlife Management Area as two good birdwatching locations. The Richmond Conservation Land offers excellent opportunities for birding as well as insect, plant, and mammalian study.

Existing and potential threats to the resource

Hiking trails, boat launches, and other recreational resources require good stewardship by both the landowner and the public. In Orford, most of the recreational trails are privately owned and many landowners generously allow public trail access over their lands. Unauthorized uses, such as ATVs, mountain bikes, or horses, can cause damage to trails designed for other purposes, and illegal dumping, vandalism or trespassing may convince landowners to close their land to public access.

Further development in Orford also threatens recreational resources. As the landscape is divided into lots and more land is posted against trespassing, trail connections can be severed and opportunities for hunting or other recreational pursuits become more limited.

Current management and protection

Since the Appalachian Trail was first completed in 1937, the National Park Service has acquired lands along the Appalachian Trail for much of its 2,181-mile length to protect the integrity of the trail in perpetuity. The Dartmouth Outing Club (DOC) maintains the trail section from Vermont Route 12 to Kinsman Notch, including the section in Orford.

Many of the other trails in Orford pass through private land, and it is imperative to maintain the trust and goodwill of the landowner for these trails to continue. Volunteers also play a crucial role in the maintenance of existing trails and establishment of new trails.

The Cross-Rivendell Trail connects the Towns of Vershire, West Fairlee, Fairlee and Orford and the public schools of the four-town Rivendell Interstate School District via a 36-mile hiking trail. The western terminus is Flagpole Hill in Vershire and travels eastward, crossing the Samuel Morey Bridge across the Connecticut River, and ending at the summit of Mount Cube in Orford.

The Cross-Rivendell Trail is maintained as a partnership between the Rivendell Interstate School District and the non-profit Rivendell Trails Association, and with the generosity of sixty landowners who have granted permission for the trail to cross their lands. The Trail is used both as a recreational resource and an outdoor classroom.



Figure 1 <https://www.trailfinder.info/trails/trail/cross-rivendell-trail>

The Orford Heritage Trail is a new trail through the north-central part of Orford, generously donated as a trail easement by the Schwaegler family. The Orford Heritage Trail follows a path that was traveled by early settlers as well as Native Americans. It is believed that this path was a main travel route and portage path for early Americans from the Lakes Region of New Hampshire to the shores of the Connecticut River. Several cellar holes and a schoolhouse indicate substantial habitation in the past. The Orford Heritage Trail follows the path of the old Grimes Hill Road. The trail's western terminus is located off the current Grimes Hill Road. It then travels approximately three miles as it crosses Indian Pond Road and ends roughly one mile past the junction. The old roadbed continues until its eastern terminus at the junction with Route 25A.

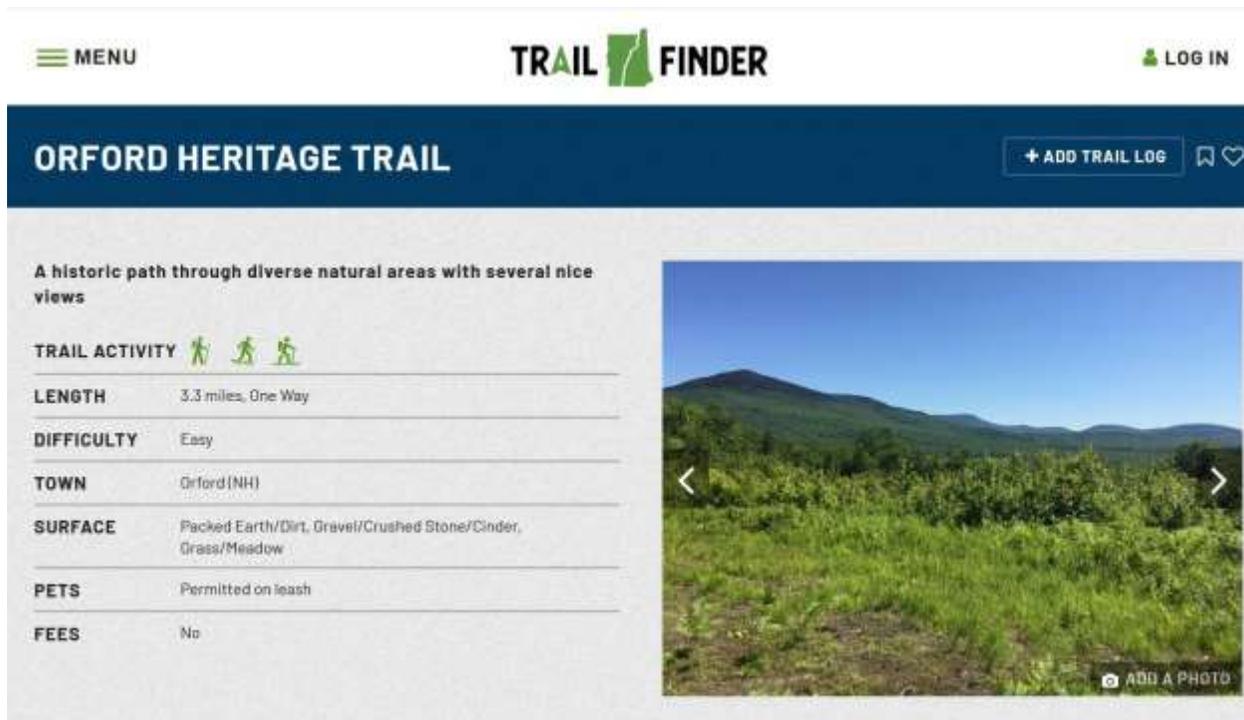


Figure 2 <https://www.trailfinder.info/trails/trail/orford-heritage-trail>

Owners of land enrolled in the Current Use program are eligible for a 20% reduction in property assessment if they allow public access to their land. In Orford, this adjustment is widely used; as of 2009, about one-half of all land in Current Use (12,637 acres) was open for recreational access.

Recommendations for resource protection

- The Conservation Commission should consider publishing a map of hiking trails in Orford, including walks along Class VI roads. Information on allowed uses of public trails and rights-of-way should be included.
- The Town and Conservation Commission should continue to protect and manage public recreation areas, including trailheads, boat launches and parking areas.
- The Conservation Commission should work with local trails groups, such as the Upper Valley Trails Alliance and Cross-Rivendell Trail group to develop links between existing trail networks.

- The Planning Board should encourage developers to incorporate trails or recreation access into subdivision designs, especially for land near existing trail networks.
- The 2018 Master Plan includes the following: Residents enjoy access to abundant natural resources including hiking, snowmobiling, skiing, and horseback riding trails, boating, swimming, hunting and fishing. In town, the Appalachian Trail traverses Mount Cube's summit, there are also the Indian Pond Heritage trail, Stonehouse Mountain Trail and local class VI roads providing multiple venues for recreational activities. A Cross Rivendell Trail over 36-miles long connects four towns of the Rivendell Interstate School District in Vermont and New Hampshire. This trail starts at Flagpole Hill in Vershire, VT and ends at Mount Cube. Boat launches on the Connecticut River, Reeds Marsh Wildlife Management Area, Indian Pond, and Upper and Lower Baker Ponds each provide public access to local water resources. Maintained beaches can be enjoyed at Indian Pond and Upper Baker Pond

15.0 Cultural and Historic Resources



Figure 1 Billy Brown Barn & Outbuilding

Orford's natural resources and its hilly topography have played a major role in how the town has developed over history. Evidence indicates that Native Americans frequented the area, in particular the Connecticut River valley. From the start of colonial settlement, farming has been advantaged by rich alluvial, well drained soils in the river valley, and Orford soon became known for its agricultural output. Cascading Jacobs Brook and other streams provided waterpower for early mills.

Largely due to its hills and mountains, early Orford developed into four village-type settlements. First, Orford Village grew up in the 1780s along an ancient bank of the Connecticut River. Soon thereafter, a settlement began to the east of Mt. Cube and near Upper Baker Pond, which became known as East Orford or Davistown. In addition to hill farms, this separate community had two schoolhouses, a lumber mill on Bracket Brook, and a tavern near the entrance to present-day Camp Moosilauke. Then, in the early nineteenth century, water powered mills and houses began to concentrate at

Orfordville, and, for a period in the mid-nineteenth century, also in Quinttown in the remote southeastern part of town. The area's widespread "sheep boom" in the early decades of the 19th century promoted the settlement of hill farms and widespread clearing of forest land.

Although in recent years the number of "working farms" in Orford has declined significantly, the views, for example, along NH Rte. 10 (designated as part of the *Tri-State Connecticut River Scenic Byway*) continue to include extensive land under cultivation.

Natural resources in the form of soapstone, granite, limestone and mica have been quarried here, and the deep forests continue to provide lumber, pulp, and other wood products. Orford's pristine ponds are the site of summer homes and a number of youth camps. The town's highest points – Sunday Mountain and Mount Cube (the latter crossed by the Appalachian Trail) – enhance the rural, forested scene and offer impressive views and hiking destinations.

Modern-day cultural resources are also tied to the natural resources of the town. Recreation and public events are an important part of community culture in Orford, such as the annual flea markets, old car shows and open-air concerts on the spacious East Common, and competitive sporting events at the Community Field located on a broad ancient river terrace. Public boat launches permit access to the Connecticut River, Indian Pond, and Upper and Lower Baker Ponds. The Indian Pond Heritage Trail follows an historic pathway, while the Cross Rivendell Trail crosses both of the town's highest points.

Cultural and historic sites help to define and instill a true "sense of place" for local residents and visitors alike, which is a valuable component of any community's character.

For the purposes of this Inventory, the Orford Conservation Commission identified the following historic and cultural sites:

- Orford Street Historic District (*National Register of Historic Places*, as of 1977)
- Orfordville historic area, including the church, former Grange Hall
- former Grammar School (now the Town Offices building)
- Free Library, and Town Hall Heritage Center (*N.H. State Register of Historic Places*, as of 2014)
- East Common and West Common

- West Cemetery, Dame Hill Cemetery, and East Cemetery
- Samuel Morey Memorial Bridge (*National Register of Historic Places*, as of 1997) see *Figure 2*
- Soapstone quarry remains on Cottonstone Mountain
- Granite quarry remains near Lower Stonehouse Mountain Road
- Concrete silo and lime kiln off Quinttown Road see *Figure 4*
- Billy Brown's *Mountain View Farm* in Quinttown (conserved in 2016 by the Upper Valley Land Trust) see *Figure 1*
- Camps Merriwood and Moosilauke
- Indian Pond Heritage Trail and Cross Rivendell Trail
- The Mall Walk see *Figure 3*
- Old stone walls
- Historic houses, farmsteads, barns and outbuildings throughout the town, including former one-room schoolhouses



Figure 2 Samuel Morey Memorial Bridge



Figure 3 Orford Mall Walk (Orford 250th Celebration)



Figure 4 Quinttown Silo (OHS Cellar Holes Tour)

Existing and potential threats to historic areas and sites:

- That they are forgotten, and their importance is lost to the community and to its history.
- That they are changed in ways that impair their historic character and integrity.
- That they are overused or exploited to the detriment of the public's enjoyment of these resources.
- That traditional agricultural lands, especially along main roads, are converted to residential or commercial development.

Forests can grow up around old cellar holes, mill sites and stone walls, and over time, these resources can become buried under the forest floor. On the other hand, these same sites can become too popular and visitors can damage fragile artifacts, or become illegal trash dumping grounds. Cultural sites, such as boat landings, trailheads and playing fields, can be prone to litter, illegal dumping, and vandalism.

Historic farmsteads and the fields that surround them face many specific challenges, outlined in detail in the Agricultural Resources section. Protecting historic farmsteads can be achieved by protecting the natural resources that help to sustain the farm operations.

Current management and protection

Education, conservation and preservation go hand in hand in protecting historic resources. The Connecticut River Scenic Byway helps to showcase and interpret the historical importance of the Connecticut River Valley and the towns along the river. The National Register of Historic Places and the New Hampshire State Register of Historic Places bring important recognition to special places and historic structures, such as the Orford Street Historic District, the Samuel Morey Memorial Bridge, and Orford's original Town Hall. The Orford Historical Society performs important work in promoting understanding and appreciation for Orford's history through its public programs, publications, and exhibits at the Town Hall Heritage Center.

ValleyQuest, an initiative of the regional organization Vital Communities, is an education program designed to collect and share a community's natural and cultural heritage. Each "quest" is a "treasure-hunt made by children and adults working together, leading to a treasure in the community." Local schoolchildren and community members have created several of these "treasure hunts" in Orford that

have been published in ValleyQuest books and available online at the Vital Communities website <http://www.vitalcommunities.org>.

Recommendations for resource protection

- The Conservation Commission and the Orford Historical Society should work together to encourage the preservation of old stone walls and the town's barns and other historic agricultural structures, such as by further use of New Hampshire's barn preservation tax incentive (RSA 79-D).
- The Conservation Commission should work with the Orford Historical Society and the Rivendell Interstate School District to foster public and school-focused educational presentations of mutual interest.
- The Conservation Commission should continue to involve Rivendell School District students and faculty in "hands on" and place-based learning activities as part of local conservation projects.
- The Planning Board, Conservation Commission and the Historical Society should identify potential links between the cultural, historic and natural resources of the Town and incorporate strategies to strengthen these inter-related resources in the Master Plan.
- The Conservation Commission should cooperate with the Upper Valley River Subcommittee of the Connecticut River Joint Commissions to encourage effective maintenance of the Orford Boat Landing.
- The Town should promptly address any problems with littering, illegal dumping, or vandalism on public property.

16.0 Air Quality, Peace and Quiet, and Dark Skies



Figure 1 Night Sky (Courtesy UVLT - Star Gazing Party)

As stated in the 2001 Master Plan, residents of Orford place high value on the natural setting in which they live -- "The small town, rural setting of Orford, with its open, uncluttered feeling, is of major importance." As a rural community, Orford generally experiences good air quality, low noise levels and low levels of light pollution. These contribute to good public health and a serene and natural living environment.

Existing and potential threats to the resource

Air pollution may be caused by regional activities out of the control of local communities, such as smoke and particulates from large forest fires in Canada or nitrous oxides from coal-burning power plants in the Midwest. Air pollution can also be produced locally, through vehicle emissions, local industries, or the open burning of residential trash, which is now illegal in New Hampshire. The open burning of leaves and brush, which is allowed with a local fire permit, produces several air pollutants,

including particulates that can spur asthma attacks and carbon monoxide that prevents oxygen from being absorbed into the human body. In 2010, no air quality action days were announced for Grafton County; air quality alerts are typically called for the southern sections of New Hampshire as well as high elevation areas (over 3,000 feet).

Air pollution can also create regional haze, where fine particles suspended in the atmosphere degrades visual clarity and obscures scenic views.

Noise may be defined as a sound that is loud, unpleasant or causes a disturbance. Noise may be caused by local industrial or commercial uses, vehicle traffic, public gatherings, and residential maintenance.

Artificial lights that cast light upward diminish the view of the night sky and may also contribute to problems of glare or “light trespass” onto neighboring property. Bright artificial lights may also disrupt wildlife predation, migration or reproduction.

Current management and protection

The New Hampshire Department of Environmental Services Air Resources Division monitors air quality around the state and issues Air Quality Action Days when the air quality may impair public health. The two pollutants monitored by the Air Resources Division are ground-level ozone (or summertime smog) and fine-particle pollution. These warnings are first targeted at limiting outdoor activity for people with heart or lung disease, older adults and children, although the more serious warning levels recommend that all people restrict outdoor activity.

The Air Resources Division also regulates air pollution emissions through a Statewide Permitting Program, and is involved in reducing air pollution from vehicles. The Division is also responsible for managing regional haze in two wilderness areas in the White Mountain National Forest.

In Orford, the forested landscape buffers sound from the road and adjacent properties for many residents. In other communities, noise ordinances have been adopted at the local level to place restrictions on specific activities that produce excessive amounts of noise.

Recommendations for resource protection

- The Conservation Commission should disseminate information on what residents can do to minimize air, noise, and light pollution. In rural areas, clean air, quiet environs and dark skies at night are often taken for granted. Some topics of particular interest may be clean-burning woodstoves and outdoor wood boilers, residential trash burning, and dark skies lighting options.
- The Conservation Commission should encourage the use of best practices at Town facilities, such as dark skies lighting and clean-burning diesel engines. It may be possible to work with the local electric utility company on replacing streetlights and/or floodlights.
- The Planning Board should encourage developers to follow the recommendations laid out for dark skies in the Innovative Land Use Guide published by the New Hampshire Department of Environmental Services and the Regional Planning Commissions.