

**City of Laconia**  
**Conservation Commission**  
Wednesday, February 4, 2026 - 5:00 PM  
City Hall in the Armand A. Bolduc City Council Chamber  
AGENDA

1. CALL TO ORDER
2. ROLL CALL
3. SALUTE TO THE FLAG
4. RECORDING SECRETARY
5. STAFF IN ATTENDANCE
6. ACCEPTANCE OF MINUTES FROM PREVIOUS MEETINGS

6.I. 1/21 Minutes

Documents:

[1.21.26 MINUTES.PDF](#)

7. NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES APPLICATIONS

8. OLD BUSINESS

8.I. Road Salt Information

9. NEW BUSINESS

9.I. Natural Resource Inventory Status By Sarah Sullivan, Project Manager At FB  
Environmental

Comparison to current 2022 NRI

Documents:

[NATURAL RESOURCE INVENTORY 2022 FINAL.PDF](#)  
[NRI PROPOSAL - FBE\\_RFP\\_P25-08-02\\_NRI](#)  
[PROPOSAL\\_3SEPTEMBER2025.PDF](#)

9.I.i. Using INaturalist To Build A Laconia Wildlife & Vegetation Inventory

[HOW TO GUIDE](#)

[HOW TO MAKE AN OBSERVATION \(APP\)](#)

9.II. Milfoil Grant From NHDES

9.III. Climate Cafe 2/12/26

9.IV. Lake Opechee Watershed Management Plan Grant Application

10. LIAISON, SUBCOMMITTEE REPORTS, AND UPCOMING EVENTS

11. OTHER BUSINESS

12. STAFF REPORT

13. ADJOURNMENT

This meeting facility is ADA accessible. Any person with a disability who wishes to attend this public meeting and needs additional accommodations, please contact the department at (603) 527-1264 at least 72 hours in advance so necessary arrangements can be made.

**City of Laconia**  
**Conservation Commission**  
Wednesday, XXX XX, 2015 - 6:00 PM  
City Hall in the Armand A. Bolduc City Council Chamber  
*Draft Minutes*

1/21/2026 - Minutes

1. CALL TO ORDER

The meeting was called to order at 5:01pm.

2. ROLL CALL

The following members were present Rod Cameron, Dean Anson, Jennifer Kreitzer, Peter Nagel, and Dan Hooberman via zoom.

D. Anson elected both Rod and Peter as full time members for this meeting.

3. SALUTE TO THE FLAG

4. RECORDING SECRETARY

Savanna Brunelle, Administrative Assistant.

5. STAFF IN ATTENDANCE

6. ACCEPTANCE OF MINUTES FROM PREVIOUS MEETINGS

6.I. Draft Minutes

7. NEW BUSINESS

7.I. SE2026-008; East Coast Water Cross Rounds

Shawn Dudek was present to summarize the event of jet ski races. Last year there was regional race on Opechee for jet skis. S. Dudek came to the commission to make sure he hears their concerns and recommendations. The race will take place on the first weekend of June at Opechee lake. DES had already provided comments, and Shawn is working off those comments. Shawn ran down the protocols that the racers must go through before getting into the water. D. Anson brought up concerns from last year. D. Anson would like to see the skis get launched from the boat ramp rather than the beach. There was discussion as to why this wouldn't work because of traffic, race setup, and logistics. D. Anson also recommended a designated refueling station. D. Anson also suggested reaching out to the Lake Opechee Preservation Association and speaking with them about suggestions/concerns. There was also discussion about stirring up sediment from the bottom of the lake. D. Anson had concerns about other boaters when races are going on. The racers have designated warm up areas. D. Anson also discussed not transporting invasive species both coming in and out of the water. J. Kreitzer asked about the lake level. S. Dudek explained this was an issue last year, but it was worked out with the Dam Society and DES makes the final call. There was discussion about fire suppression in case of an emergency.

7.II. FB Environmental Presentation

Fb Environmental presentation was postponed until February 4th. Fb Environmental will not be writing the entire natural resource inventory, but that Conservation Commission will have to do it.

### 7.III. Natural Resource Inventory 2022

D. Anson asked that commissioners review the inventory from 2022 so they can get familiar with the contents. FB Environmental will also not handle the aquifer protection districts. Once the commission gets back the NRI that information will help right the Natural Resource section of the Master Plan. Staff is going to send out the contract of what FB Environmental was hired to do as well as what Resilience is doing with the Master Plan. R. Cameron offered to pull information to help with the process of the NRI. There was discussion about how to get the public engaged with the NRI and the Master Plan chapter. D. Anson mentioned reaching out to get help with writing an article to get public outreach and Prescott Farm for a project area. The commission would like to have programs to have the public come out to and hear their concerns and educate people. D. Anso also asked commissioners to send staff area that are special and should be conserved.

### 7.IV. Great Day Of Caring

D. Anson also asked to keep in mind projects to submit for Day of Caring.

## 8. NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES APPLICATIONS

## 9. OLD BUSINESS

## 10. LIAISON, SUBCOMMITTEE REPORTS, AND UPCOMING EVENTS

## 11. OTHER BUSINESS

Peter Nagel discussed salt usage and its effect on streams and brooks. P. Nagel referred to UNH best practices for winter maintenance. He is interested in discussing this with DPW. D. Anson discussed water shed management and trying to resubmit it this year. J. Kreitzer reminded the commissioners about the Master Plan meeting next to submit comments and that it's open to the public.

## 12. STAFF REPORT

## 13. ADJOURNMENT

The meeting was adjourned at 6:54pm.

Minutes submitted by Savanna Brunelle, Planning Department Administrative Assistant.



# Natural Resources Inventory

Laconia, New Hampshire

February 2022



Prepared by:  
The Laconia Conservation Commission and  
City of Laconia Planning Department

## DISCLAIMER

This report is an update from the 2009 Laconia Natural Resource Inventory that was conducted by John C. Severance and Elise J. Lawson of Watershed to Wildlife, Inc. Content and data were updated by the City's Conservation Tech, Taylor Daigle.

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	4
1. INTRODUCTION AND PROJECT OBJECTIVES .....	6
2. METHODS .....	6
a. Gathering & Analysis of Existing Data .....	7
3. NATURAL RESOURCES .....	9
a. TOPOGRAPHY & GEOLOGY .....	9
Elevation .....	9
Steep Slopes .....	9
Bedrock Geology .....	10
b. SOILS .....	11
Agricultural .....	13
Forested .....	14
Hydric .....	15
c. WATER RESOURCES .....	15
Watersheds & Subwatersheds .....	16
Surface Waters .....	18
Lakes & Ponds .....	18
Rivers & Streams .....	21
Wetlands & Vernal Pools .....	23
Aquifers/Groundwater .....	26
Floodplains & Riparian Zones .....	26
d. WILDLIFE & HABITATS .....	27
Wildlife Action Plan .....	28
Habitat Types .....	29
Forested Lands .....	32
Permanent Wildlife Openings .....	33
Unfragmented, Roadless Areas .....	34
Rare Species and Exemplary Natural Communities .....	34
Non-Native & Invasive Species .....	35
4. SCENIC RESOURCES .....	36
5. CONSERVATION LANDS .....	37
6. CLIMATE CHANGE .....	38
7. HISTORIC & CULTURAL RESOURCES .....	39
a. The History of Laconia .....	39
b. Cultural Resources .....	40
8. RESOURCE & CONSERVATION RECOMMENDATIONS .....	41
9. REFERENCES .....	47
10. MAPS .....	49

## EXECUTIVE SUMMARY

The City of Laconia will benefit greatly from the sound management of its natural resources. These natural features directly impact the City's economy, health, and liveliness. The intertwined matrix of waterbodies, wildlife, forests, and wetlands (along with considerable human development) requires that the City keep up to date on the quality and quantity of its natural resources and take action to ensure the sustainable use of them. The creation, implementation, and upkeep of a natural resource inventory is critical to doing so.

The 2021 Natural Resource Inventory (NRI) is a well needed update to the 2009 edition of the City's NRI. This project updates and expands upon the previous, using the most current spatial data to delineate various natural resources and adding considerations for climate change. Based on these updates, the following recommendations for resource management were identified and stood out as actionable on which to work. Additional ideas for each of these recommendations/goals can be found in the "Resource & Conservation Recommendations" section at the end of the report.

1. **Wetland and Vernal Pool Protections:** The protection of these unique and vital habitats should continue to be a priority for the City of Laconia. Additional efforts to understand and protect them may include conducting inventories and prime wetland designations.
2. **Aquifer Protection:** The limited number and size of aquifers within Laconia indicates that they should be protected before it is too late. Recharge rates vary from aquifer to aquifer, and they may become a vital source of clean drinking water in the future; efforts should be made to protect the quality and quantity of them. Zoning regulations would be a good opportunity for protecting these resources from contamination and degradation.
3. **Invasive Species Management:** Invasive species threaten the livelihood of Laconia's natural resource community and economy. A management plan that addresses early detection, prevention, and control mechanisms would allow Laconia to begin addressing problem areas and limit the future spread of invasive species.
4. **Viewshed Protection:** The scenery in Laconia is a major attraction for tourists' year-round. Zoning and conservation efforts should ensure that views are not being diminished beyond value. There are a number of opportunities that the City may pursue to protect these viewsheds, including additional zoning limitations and enhancing viewing areas
5. **Climate Change Mitigation:** Ever-evolving climate science indicates that the city should prepare for the effects of a warming environment. Mitigation strategies should be investigated and implemented to protect life and property within Laconia. This preparation should include mitigation strategies for the full range of environmental changes we may see (flood control, water quality, carbon storage, renewable energy, etc.).
6. **Interagency Cooperation:** Laconia should continue to work with community partners to address natural resource concerns – including neighboring communities, natural resource organizations, and regional planning efforts. These partnerships will help Laconia address resource problems that extend beyond the city boundaries, for example, watershed management. Interagency cooperation is also key to keeping up to date with the latest

data and best management practices.

7. **Conservation Land Acquisition:** Further acquisition of conservation land and easements with private landowners should be a primary focus for the Conservation Commission and City. The Commission may be interested in reviewing what characteristics they look for in a conservation land purchase or easement – for instance, what habitats are and are not currently protected, the proximity to existing conservation lands, and the resources available on those lands, among many others.

There are many long-term uses for the information collected and reported here in the natural resource inventory. Some of these uses include:

- ❖ Providing the city with resources and data to make wise development decisions
- ❖ Developing future Master Plan goals/objectives related to land-use and natural resources
- ❖ Supporting the City's efforts in protecting its natural resources
- ❖ Identifying important characteristics for conservation land/easement acquisitions
- ❖ Promoting the integration of climate change science into land and resource management
- ❖ Integrating the most current statewide spatial data into the City's GIS database



## **1) INTRODUCTION AND PROJECT OBJECTIVES**

This project is an update to the first Natural Resource Inventory (NRI) created in 2009 in partnership between the Laconia Conservation Commission and Watershed to Wildlife, Inc. While much of the information from the 2009 NRI is still valid, the data should be regularly updated and maintained as a “living” document.

A NRI serves as a preliminary planning tool/resource for City officials. The 2009 NRI was the first for Laconia and provided a base inventory of the natural resources in the City and made management recommendations to guide future land use and development, as well as GIS layers that could be incorporated into the City’s spatial database. The objectives of this initial NRI were:

1. To provide the City of Laconia with current, accurate, standardized overlays that can be integrated into the existing GIS database.
2. To consider natural resources, scenic vistas, cultural/historical resources, and other related elements in comprehensive land-use planning.
3. To create a document that can be updated and incorporated into Laconia’s Master Plan.
4. To increase awareness about the value of the natural resources in Laconia.
5. To prepare a presentation to the City’s residents.

The City of Laconia is committed to protecting and sustaining the quality of the rich natural resources within its boundaries by encouraging the sustainable use of its natural resources. This update is an effort to continue this commitment and further provide the City with the documentation needed to properly manage its natural resources, now and in the future. Major changes to the 2009 NRI in this update include the:

1. Incorporation of climate change and stormwater data, concerns, and potential resolutions into each applicable resource.
2. Integration of information from the State’s Wildlife Action Plan.
3. Acknowledgement of regional conservation efforts and their applicability to Laconia’s natural resources.
4. Prioritization of conservation lands/easements within the city.
5. Updates to the existing GIS database with the most current data possible.

## **2) METHODS**

The NRI is created by combining existing geographic spatial data with fieldwork to analyze the composition of natural resources. This section will detail the existing spatial data utilized, any fieldwork conducted, limitations faced, and any important disclaimers involved in the updating of the NRI.



### A) Gathering & Analysis of Existing Data

Existing maps and data were collected from the State of New Hampshire's GIS Clearinghouse (GRANIT) and the 2009 NRI. Table 1 shows the data sets, how they are used, and their sources. It is important to note that the accuracy of these datasets varies, and therefore any conclusions drawn should be verified with site-specific investigation prior to decisions about the resources are made.

Table 1: Existing Spatial Data Gathered

Data Set	Source	Usage
NH Conservation/Public Lands	GRANIT, Society for Protection of NH Forests	Conservation Lands
NH National Hydrology Dataset	GRANIT, US Geological Survey	Waterbodies, Wetlands, Streams/Rivers, Watersheds
National Wetlands Inventory	GRANIT, US Fish & Wildlife	Wetlands
Soil Survey Geographic (SSURGO)	GRANIT, Natural Resources Conservation Service	Steep Slopes, Farmland soils, Hydric soils, forested soils
NH Wildlife Action Plan 2020	GRANIT, US Fish & Wildlife	Wildlife Habitats
Laconia Vernal Pools	City of Laconia	Vernal Pools
Laconia Tax Map	City of Laconia	Parcels & boundaries
Land Cover (2019)	Multi-Resolution Land Characteristics Consortium	Land Cover
Landscape Scale Upland Invasive Plant Control Strategy	GRANIT, NH Fish & Game	Invasive Species Management Areas
NH Trails	GRANIT	Trails
NH Recreational Inventory	GRANIT	Recreation Areas
NH Bedrock Geology	GRANIT	Bedrock Geology
NH Public Roads	GRANIT, Department of Transportation	Roads
Orthographic Photos	National Agriculture Imagery Program	Wildlife Openings

Once collected, these datasets were compiled in ArcGIS to be analyzed. Spatial analyses such as overlay, intersection, and merging were used to draw conclusions about topography, geology, soil, water, and habitat resources. A more detailed description of how each natural resource was inventoried is described below. Maps are provided for each major resource at the end of this report and are overlaid on the City's parcels at: <https://www.axisgis.com/LaconiaNH/>

### **Topography & Geology**

The topography and geology section evaluates the City's elevation, slopes, and depth to bedrock. The Soil Survey from GRANIT/NRCS was queried to separate and identify areas with a slope greater than 15% but less than 25%, as well as those greater than 25%. The NH Bedrock Geology dataset was clipped at the Laconia boundary and delineated based on bedrock type.

### **Soils**

Agricultural, forested, and hydric soils are evaluated by querying the Soil Survey dataset to identify those soils categorized as prime farmland, farmland of state importance, and farmland of local importance. Forested soils were delineated by classification group. Hydric soils were delineated by identifying those categorized as "poorly drained" and "very poorly drained." The most up-to-date soil data may be found at: <https://datagateway.nrcs.usda.gov/>

### **Water Resources**

Water resources were delineated using the National Hydrology database and the National Wetland Inventory (NWI) dataset. Subwatershed boundaries were delineated using the HUC-12 Level in the hydrology database. Lakes, ponds, stream, and rivers were also pulled from the hydrology database. Vernal pool and aquifer data was pulled from the City's database. Wetlands in Laconia were delineated using the NWI, land cover data from the Multi-Resolution Land Characteristics Consortium (MRLC), and the Soil Survey. Each of these sources have their limitations on data collection:

- ❖ The NWI may underrepresent the number of wetlands in the City because its method of delineating is limited to using aerial photography, making the delineations of forested wetlands difficult.
- ❖ Soil survey data may overestimate wetlands because hydric soils are only one of the three requirements for classifying a wetland in New Hampshire.
- ❖ The MRLC's land cover data relies on Landsat imagery to remotely sense the various land cover types. The accuracy of this data is only as good as the training areas used to differentiate different land covers, and therefore the delineations of wetlands from land cover data may not be entirely accurate.

### **Wildlife & Habitats**

The wildlife content for the NRI was largely sourced from the Wildlife Action Plan for New Hampshire. Forested lands were also focused on as a significant habitat type in Laconia and land cover data from MRLC was utilized in delineating forest types. Permanent wildlife openings were also stressed as an important wildlife habitat and delineated using aerial photography. Finally, unfragmented, roadless areas were delineated using 500-foot buffers around all roads (Class 0-V) from the NH Public Roads dataset. The areas not covered by these buffers were turned into features on ArcGIS and represent areas in the City that are largely unfragmented by human development.



### 3) NATURAL RESOURCES

The City of Laconia is approximately 16,460 acres, including over 3,740 acres of inland waters, according to GRANIT data. Land use change plays a major role in the health of natural ecosystems and their resources, and land cover data can be used to analyze these changes in use over time. MRLC land cover change data from 2008 to 2019 indicates that Belknap County has seen some changes in land cover. The net changes in evergreen forests (- 4.89%), deciduous forests (- 1.28%), herbaceous/grasslands (- 8.77%), shrublands (+ 62.91%), and emergent herbaceous wetlands (+ 25.95%) are of particular interest to conservation efforts. These numbers show that land use decisions heavily impact our natural resources, both positively and negatively. Table 2 and Map #2 detail the land cover data for the City of Laconia as of 2019. The remainder of this natural resources section will evaluate the specific resources within the city.

Table 2: Land Cover Assessment of Laconia, NH (as of 2019)

Land Cover Type	Acreage	% Land in Laconia
Barren	32.9	0.2
Deciduous forest	2,177.1	13.2
Evergreen Forest	733.7	4.5
Mixed Forest	3,656.3	22.2
Hay/Pasture	445.1	2.7
Emergent Herbaceous Wetlands	84.4	0.5
Woody Wetlands	515.9	3.1
Shrub/Scrub	145.8	0.9
Herbaceous	64.8	0.4
Open Water	3,747.8	22.8
Developed (High Intensity)	439.2	2.7
Developed (Medium Intensity)	1,335.1	8.1
Developed (Low Intensity)	1,608.4	9.8
Developed (Open Space)	1,473.5	8.9

#### A) TOPOGRAPHY & GEOLOGY

##### Elevation

On average, the City of Laconia is 506 feet above sea level. The highest elevation in Laconia is an unnamed, 960-foot hill west of Paugus Bay near Parade Road. The lowest elevation (500 feet) is in Lake Winnisquam, where the Winnepesaukee River enters it in the southern portion of the City. Laconia has a mesic temperature regime indicating that the mean annual temperature ranges from 45 to 52 degrees Fahrenheit and the frost-free season ranges from 105 to 180 days.

##### Steep Slopes

Slope represents the amount of rise or fall in feet for a given horizontal distance and is typically represented by a percent. For example, a 15% slope means that for a 100-foot horizontal distance, the rise or fall in height is 15 feet. Slope is an important component of an area's landform and influences the plants and animals living there. Steep slopes tend to have shallower soils, higher runoff volume and velocity, and greater erosion potential than flatter areas. The

consequences of erosion are loss of soil and productive capacity of the land. In severe cases, visual scars from erosive efforts can be seen from far distances. These conditions may create a unique habitat where in some cases plants and wildlife have special adaptations for dealing with the limitations associated with steep slopes.

Slopes provide opportunities for panoramic views and tend to be sought after for residential development. There are several limitations to building on steep slopes due to structural concerns and the increased chance of erosion. As slope becomes steeper, the expenses associated with building also increase. In general, slopes between 15% and 25% are considered areas where development would be restricted and slopes greater than 25% are considered too steep to provide adequate sites for structures such as roads, homes, and septic systems.

GRANIT's Soil Survey Geographic database was used to identify areas in Laconia with slopes categorized as "precautionary" and "prohibitive" steep slopes. Using this database, it was found that approximately 1,390 acres have precautionary steep slopes, and 155 acres are classified as prohibitive steep slopes. This translates to about 8.4% and 0.9% of Laconia's land, respectively. These areas of steep slopes can be found on Map #7.

#### **City Ordinance 235-44.2: Steep Slope Protection**

The purpose of this protection is to "promote responsible stewardship of development and protect streams and lakes from the consequences of stormwater runoff and erosion resulting from excessive and improper construction on steep slopes; to preserve the natural topography, drainage patterns, vegetative cover, scenic views, wildlife habitats; and to protect unique natural areas."

Steep slopes are defined as:

- ❖ Precautionary: between 15% - 24%
- ❖ Prohibitive: greater than 25%

#### **Bedrock Geology**

Twelve thousand years ago, receding glaciers formed the rivers, lakes, stratified aquifers, and wetlands that are present throughout Laconia and New England today; the quartz diorite (primary rock of the Winnepesaukee basin) was decomposed in place before and during the glacial period, and the power of the ice toward the end of the Pleistocene Epoch gouged out the loosened rock leaving lakes and islands in its wake.

Table 3: Bedrock types found in Laconia

<b>Bedrock Code</b>	<b>Formation</b>	<b>Rock Type</b>
Dc1m	Concord Granite	Plutonic
Dk2x	Kinsman Granodiorite	Plutonic
Dw3a	Winnepesaukee Tonalite	Plutonic
Sp	Perry Mountain	Metamorphic
Srl	Lower Rangeley	Metamorphic
Sru	Upper Rangeley	Metamorphic

There are six types of bedrock found in Laconia, which are listed in table 3. Each of these bedrocks are either "plutonic" or "metamorphic". Plutonic bedrock (igneous) forms from magma that slowly cooled and crystalized under the Earth's surface and are the most commonly found

rocks on Earth. Metamorphic rocks, however, form after other rocks undergo high pressure and/or high temperatures deep below the Earth's surface. The two most abundant types of bedrock in Laconia are the Upper Rangeley Formation and the Kinsman Granodiorite Formation. Map #3 shows Laconia's types of bedrock and their approximate locations within the city.

Soil variations found throughout a given area exist because of the parent material (or bedrock) that lies beneath the surface and the deposits of materials left by these retreating glaciers. These parent materials influence the land formations, hydrology, and vegetation occurring above them based on a number of characteristics, including mineral and nutrient composition, erodibility, and fracture density.



*The exposed ledge shown here is mostly granite and is located in the northern part of Laconia, nearly 1 mile west of Lake Winnepesaukee*

New Hampshire's nickname (The Granite State) aptly suggests an abundance of granite and acidic soils. The bedrock mapping for New Hampshire indicates there are two bedrock types in Laconia with pockets of acidic parent material – the Upper and Lower Rangeley Formation. These formations contain pods of calcium rich areas that, in the right conditions, may result in the presence of rare plant communities.

New Hampshire Bedrock Geology data is available for download from the GRANIT data system. Further details about NH geology are available through the State Geologist – [www.des.nh.state.us/geology/](http://www.des.nh.state.us/geology/) and [www.nhgeology.org](http://www.nhgeology.org).

## **B. SOILS**

The nature of soil has a profound effect on plant growth. Soil characteristics like acidity, texture, and permeability, all play a role in the species composition of both vegetation and wildlife in an area. As a result, understanding soil conditions and characteristics is important in identifying

critical areas like wetlands, agricultural lands, forest lands, and habitat types. The NRCS evaluates soils according to their capacity for agriculture, woodland, community development, recreation, and wildlife habitat. Certain soils are better suited for certain land uses. For example, residential development should be located away from areas with unstable soil conditions, such as high-water tables and slow percolation rates, due to constraints for building foundations and septic system placement.



*Henniker fine sandy loam is classified as a farmland soil of statewide importance. It is well suited for blueberry and grape crops as shown here on Roller Coaster Road.*

One of the common soils in Laconia is the Marlow series. It consists of fairly deep, well drained soils that are fertile and moist on moderately steep slopes, making them good for high quality hardwood forests. This soil is also considered to be a prime farmland soil if the slope is not too steep. The presence of hard pan (an impervious layer restricting drainage and plant growth) might limit development and building uses but proper timing and implementation of Best Management Practices (BMPs) for logging should provide a continuum of use as productive forestland and wildlife habitat.

Another common soil in Laconia is Henniker fine sandy loam. This soil series consists of well-drained soils that formed in a loamy mantle overlying sandy dense till or loamy dense till, characterized by a sandy component on drumlins and glaciated uplands. They are very deep to bedrock. Henniker soils are mostly forested and generally contain tree species like sugar maple, red oak, white oak, yellow birch, paper birch, white pine, and eastern hemlock. Areas cleared of trees and stones are used primarily for hay and pasture as well as apple orchards and cultivated crops.

While it has been well-established that different soils support different land uses, there is one overarching role that soils play, no matter the landscape: carbon storage and climate change



mitigation. As climate change continues to unfold and opportunities for intervention arise, the heart of our fight against climate change may lie just below our feet. Soils across the world contain more organic carbon than that stored in the atmosphere and all the plants combined. When plants die, their carbon is returned to the soil below, which removes carbon from the atmosphere and improves the structure of the soil – including its nutrient release and water retention. On the other hand, increasing temperatures and the effects of extreme precipitation events (and droughts) will negatively affect the soils’ ability to store carbon through erosive efforts and variable soil moisture levels. It is, therefore, important to consider how changes in landscape and land use may impact the ability for soil to function as a tool in fighting climate change.

Soil information for this section was collected using ArcGIS and GRANIT’s Soil Survey Geographic database. This database delineates agricultural soils into prime farmland, state importance, and local importance soils. Additionally, it identifies forested soil types and hydric soils within Laconia. More information about the Soil Survey data is available at:

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/>

### **Agricultural Soils**

Laconia is in the center of one of the most fertile farming regions in the state, and once served as the trading center for the surrounding farms, villages, and towns. As true with many New England towns and cities, Laconia had several family farms in the 1800s and early 1900s, one of which being the “Prescott Farm Audubon Center”, a historic family farm on 160 acres of land. This farm is designated as an official NH wildlife viewing area and offers a variety of environmental educational opportunities for all ages.

The U.S Department of Agriculture makes three key distinctions when categorizing farmland. These are prime farmland, farmland of statewide importance, and farmland of local importance:

- Prime farmland is the land with the proper physical and chemical characteristics for sustaining the short- and long-term needs of the nation’s food supply. It includes land with the soil quality, growing season, and moisture supply to produce high yields of crops economically and sustainably. This land is permeable to air and water, not excessively eroded, does not frequently flood, and has a slope of 0-6%. The detailed criteria for soils to be designated as “prime farmland” may be found at local NRCS offices.
- Farmland of statewide importance includes land that nearly meets the criteria for the prime designation, with slope typically being the limiting factor. For instance, most farmland soils of statewide importance in New Hampshire meet the quality of soil needed for prime farmland but contain slopes of 8-15%.
- Farmland of local importance are those that do not meet the criteria for either prime or state designation, but local agencies have designated them as having agricultural significance to the area. In Belknap County, farmland of local importance has slopes less than 25%, are not extremely stony/boulder, and are not poorly/very poorly drained, among other criteria.

Generally, farmlands that hold state and local importance may not be as ideal for producing the highest possible sustainable yield as prime farmlands, but these soil types have been determined to be of agricultural importance on a more localized scale.

Out of the 16,460.1 acres of land within Laconia, 602.3 acres (3.7%) of land have been classified as USDA prime farmland soils, 236.4 acres (1.4%) as farmland soils of statewide importance, and 7,336.8 acres (44.6%) as farmland soils of local importance. Most of the soils that make up the prime and state importance categories are located north of Lake Opechee and west of Paugus Bay, with a few exceptions. Locally important farmland soils are more evenly spread throughout the City. Some areas of prime and state farmland have been lost to development, but approximately 12% of these farmlands are located on conservation lands and are therefore permanently protected from development. Farmland soils can be seen on Map #5 at the end of this report.



*This field in Opechee State Forest contains prime farmland soils. It is a productive hay field and is co- leased by the Belknap Conservation District for public gardens. Several pairs of bobolinks were observed breeding and nesting in this field. The open fields also offer scenic views towards Opechee Bay.*

### **Forested Soils**

Forested soils are categorized by the NRCS based on their potential for commercial forest products, suitability for native tree growth, and their use and management. Considerations for the groupings include depth to bedrock, texture, saturated hydraulic conductivity, available water capacity, drainage class, and slope. More information on forested soil types is available at: [www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs144p2\\_015050.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_015050.pdf). The general information for each of these six groups can be found below in table 4. These groups are also mapped for Laconia at the end of this report (Map #6).

Table 4: Forested Soil Acres in Laconia

Soil Group	Soil Characteristics	Supported Vegetation in Belknap County	Acres	% Land in Laconia
IA	Deep, loamy soils that are moderately-well-drained to well-drained. Very fertile with favorable soil moisture relationships	Shade-tolerant, variable hardwood stands (beech, sugar maple, etc.)	4549.2	27.6
IB	Sandy or loamy-over-sandy soil that are moderately-well-drained to well-drained. Less fertile than group IA	Shade-tolerant hardwoods (beech, red maple, etc.), with some softwoods present (red spruce, balsam fir, etc.)	3962.3	24.1
IC	Soils are outwash sand and gravel and are moderately-well to excessively drained	Significant softwood growth with limited hardwoods (red spruce, white pine, etc.)	569.5	3.5
IIA	Similar soils to groups IA and IB but have limiting features like steep slopes, outcrops, etc.	Shade-tolerant hardwoods with softwood presence	154.7	0.9
IIB	Poorly drained soils with low productivity	Both hardwood and softwood (spruce, balsam fir, red maple)	709.3	4.3
NC	These soils have too much variability to be classified into the above five categories		6515.1	39.6

### **Hydric Soils**

Hydric soils are those that experience saturation, flooding, or ponding for enough time in the growing season to develop anaerobic conditions. Hydric soils are classified as either poorly or very poorly drained and are often associated with wetlands. Poorly drained soils are defined as soils where water is removed from the soil so slowly that the soil is periodically saturated during the growing season or remains wet for long periods. In very poorly drained soils, water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Laconia has 709.3 (4.3%) acres of “poorly drained” soils and 477.1 (2.9%) acres of “very poorly drained” soils spread throughout the city. Hydric soils can be found on Map #1 at the end of this report.

## **C. WATER RESOURCES**

Laconia is in the heart of New Hampshire’s Lakes Region, with ample groundwater and surface water resources in its boundaries. Four major bodies of water are situated in Laconia: Lake Winnepesaukee, Paugus Bay, Lake Opechee, and Lake Winnisquam. Each of these waterbodies provides a number of services to the city and its inhabitants, including extensive contributions to

property values, a foundation for recreational and tourism industries, and access to a safe drinking water supply. While these resources have served us well, both naturally and economically, they are sensitive and heavily impacted by the changing global climate and local land use policies.

Groundwater and surface water resources should not, and cannot, be evaluated without recognition of the effects that rising global temperatures has on them. These rising temperatures are expected to contribute to increasing evaporation rates, rain events, and water temperatures, decreasing snowfall, and changing runoff seasons. There are two major outcomes from these changes that are of concern for Laconia:

1. ***Flooding:*** A flood risk evaluation conducted by the group “Flood Factor” indicates that Laconia is categorized as “at major risk” of flooding over the next 30 years, with a heavy concentration of “at risk” properties located in the southern tip of the city, in between Lake Opechee and Lake Winnisquam (Flood Factor, 2021).
2. ***Water Quality:*** Water quality in Laconia is directly related to public health and economic conditions in the area. Any impairments to this water quality would have detrimental financial, health, and ecological impacts within the city. Therefore, preserving our water resources and utilizing them to the best of our ability should be of top priority to the City.

Understanding the true value of the water resources at our disposal in Laconia is imperative for making the wisest decisions about conservation and development efforts. Just this year, a valuation study found that Lake Winnepesaukee is valued at over \$17 billion USD. This valuation includes over \$284 million in tourism, \$109 million in boating and fishing, and \$42 million in summer camp revenues (Chandra, et al., 2021). The Winnepesaukee valuation study also attributed \$1.5 million in water supply revenues and \$42 million from the Lakeport Dam in Laconia into its final figure. This information confirms that the surface water quality in Laconia is a major concern for the city, businesses, and residents. Protective efforts should be approached with careful and intentional actions to minimize the potential harmful impacts from development and allow for sustainable use of the lakes.

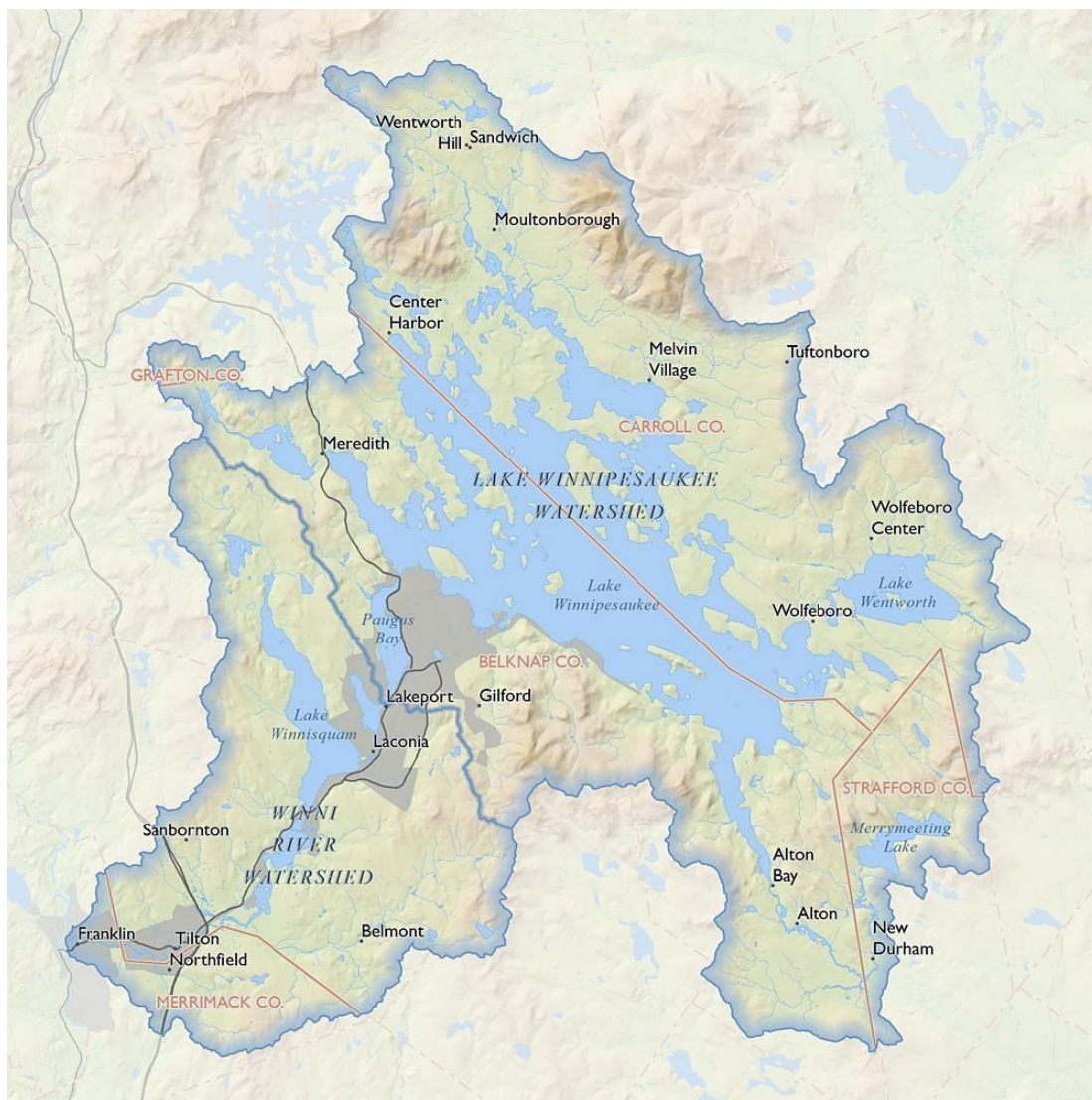
### **Watersheds & Subwatersheds**

The ability to view the landscape from a watershed or sub-watershed perspective helps to understand drainages, flows, and associated habitat throughout the City. When analyzing watershed and subwatershed boundaries as a planning or conservation tool, it is important to recognize that neither watershed nor subwatershed boundaries stop at municipal boundaries. Rather, these boundaries are determined by ridgelines and topography. The importance of a regional approach to watershed management cannot be understated, as all things downstream are affected by management upstream. Cooperation among abutting towns and regional efforts will help to ensure that the goals of the watershed area are met.



At the Hydrologic Unit Code (HUC) 8 level, Laconia is a part of the Winnepesaukee River Watershed, which encompasses over 480 square miles of land in New Hampshire. This land is bordered to the north by the Ossipee Mountains, to the southeast by floodplains, and to the south by the Belknap Mountains.

The City also contains sections of four sub-watersheds when broken down to the HUC-12 level. The largest subwatershed in Laconia is the Lake Winnisquam subwatershed (8,993 acres), which covers the southern and western half of Laconia. The Pausus Bay subwatershed is the next largest in Laconia covering, 5,495 acres in the north-central portion. The third and fourth subwatersheds are both part of Lake Winnepesaukee: Meredith Bay (1,666 acres in the northeast) and Sanders Bay (306 acres in the northeast). These catchments can be seen on Map #4 at the end of this report.



*A map of the Winnepesaukee River Basin*

A regional management approach to the Winnepesaukee River Watershed has been taken on by numerous local partners, including the Lakes Region Planning Commission (LRPC), the Winnisquam Watershed Network (WWN) and the Lake Winnepesaukee Association (LWA). While a management plan establishes what must be done regionally, it is often up to individual municipalities to implement projects and policies that will contribute to those regional goals. There are two watershed management plans with significant relevance to Laconia:

1. **Lake Winnepesaukee, Plan 1: Meredith, Paugus, and Saunders Bays:** The goals of this phase are focused on long-term water quality protection, economic vitality, and natural beauty preservation. The objectives identified as necessary for completing these goals include setting a phosphorus goal, stabilizing and/or reducing nutrient inputs to the lake, documenting progress and achievements, and informing and involving the public. The plan may be reviewed at: <https://winnepesaukeegateway.org/lake-management/plan-1-meredith-paugus-and-saunders-bay/introduction/>.
2. **Lake Winnisquam Watershed:** The WWN has received an EPA & NHDES grant for funding and completing a watershed-based management plan for Lake Winnisquam. The plan, when completed, will address sources of pollution, water quality goals, and best management practices for achieving pollution reductions within the Lake Winnisquam Watershed (which includes Opechee Bay). More information regarding the status of this plan is available at: <https://www.winnisquamwatershed.org/>

### **Surface Waters**

Laconia's surface waters are among the most valuable natural resources in the City. There are approximately 3,740 acres (22.7%) of lakes and ponds in Laconia and over 20 miles of streams and rivers. All surface water resources can be seen on Map #1 at the end of the report.

The City's drinking water supply is drawn from two intake pipes in Paugus Bay. In addition to serving as a drinking water source, the surface waters in Laconia provide wildlife habitat and recreational opportunities to the community. Development and recreation along the shorelines continue to bring about concern for the water quality; erosion, fuel spills, and increased runoff are just some of the risks associated with development in the area. Presently, the water quality of Laconia's lakes continues to be good but maintaining that quality will require sound management and diligence; not only on the part of Laconia, but of the entire Lakes Region, given the extents of the watershed area.

### **Lakes & Ponds**

The lakes and ponds of Laconia are vital to the City's economy and natural beauty, like many other Lakes Region municipalities. The four largest waterbodies in Laconia include the Meredith Bay/Weirs Beach portion of Lake Winnepesaukee (756 acres), Paugus Bay (1,234 acres), Lake Opechee (449 acres), and the eastern portion of Lake Winnisquam (1,299 acres). These large waterbodies are listed in order of drainage in a downstream direction, eventually flowing into the Winnepesaukee River. Despite the massive size of Lake Winnepesaukee, there are only 4.6 miles

**City Ordinance 235-19: Shoreland Protection District**

The goal of this ordinance is to “establish standard for the use and development of shorelands adjacent to public waters...to minimize the degradation of shorelands, protect water quality and assure the retention of benefits provided by shorelands”. The standards set forth in this ordinance prohibit certain uses, protect vegetative buffers, and control development with the SPOD. This district covers most shorelines in Laconia; exceptions include shores along the Weirs, Union Avenue, and the southern-most part of Lake Winnisquam.

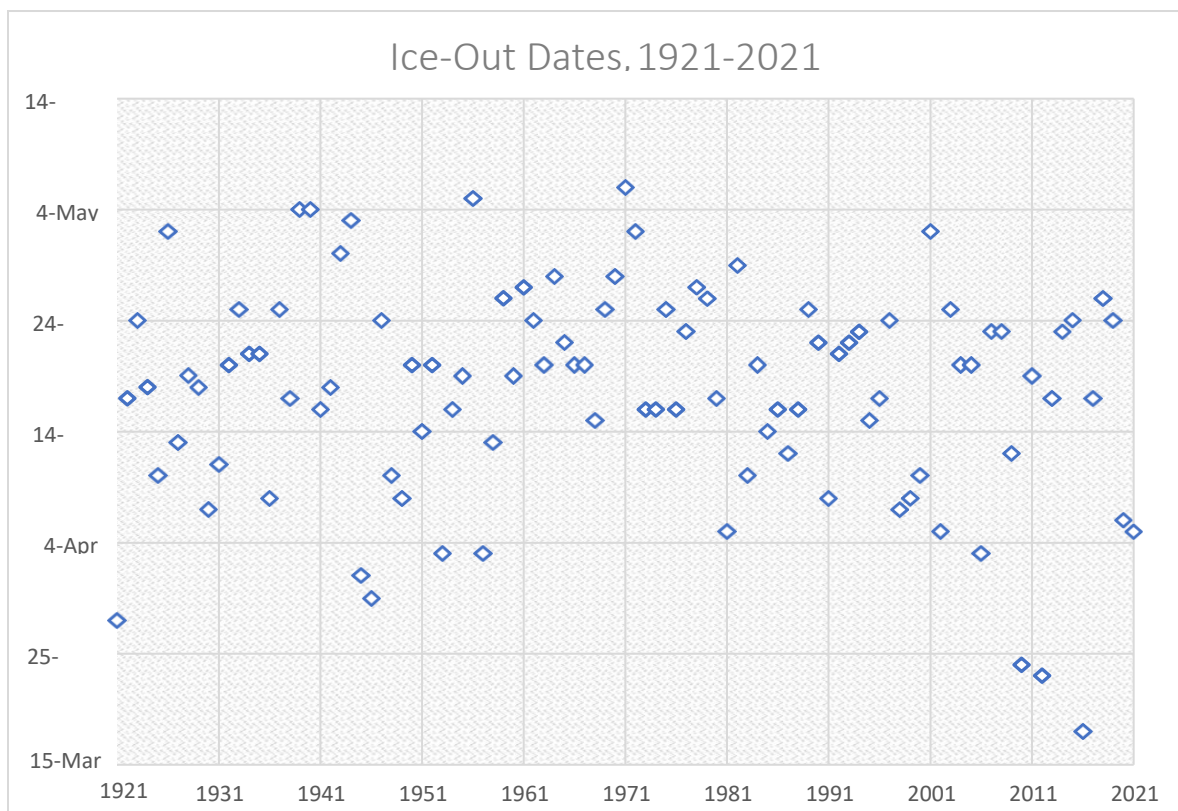
of shoreline from this body of water in Laconia. Additionally, there are 9.8 miles of shoreline along Paugus Bay and 7.5 miles along Opechee Bay. The shoreline of Lake Winnisquam is the largest, with nearly 10 miles of shoreline in Laconia. This calculates to a total of 31.9 miles of shoreline in Laconia, with additional shoreline footage around some of the islands.

Lake Winnepesaukee, Paugus Bay, Lake Opechee, and Lake Winnisquam are all listed as oligotrophic waterbodies by NHDES. An oligotrophic lake is one with low primary productivity and the result of low nutrient content. These lakes have low algal production, and consequently, often have very clear waters, with high drinking-water quality. The bottom waters of such lakes typically have ample oxygen; often supporting many fish species, like lake and rainbow trout, which require cold, well-oxygenated waters. The oxygen content is likely to be higher in deeper lakes, owing to their larger hypolimnetic volume. Lake Winnepesaukee has the deepest waters in Laconia; its maximum depth is 180 feet.

Water quality of the Lakes has been a concern since the 1930's, when sewage and other pollutants began degrading water quality. By the 1970's, closed sewage systems with treatment plants were implemented and water quality studies showed improvements. The long-term trend, however, predicts that water quality could continue to decrease due to increasing levels of phosphorus (and therefore, increases in chlorophyll-a). If these phosphorus levels continue to increase, it would be expected that communities will see more frequent algal blooms, decreased water clarity, increased cyanobacteria blooms, decreased oxygen levels in the water, diminished property values, and a decreased ability to use the waters for recreation and drinking water. For these reasons, it is important that the City continues to monitor water quality among its lakes. The City of Laconia currently utilizes a few water quality monitoring programs: the Volunteer River Assessment Program (VRAP) run by NHDES, the Lay Lakes Monitoring Program (LLMP), run by UNH's Cooperative Extension, and regular testing by the City's water department. Some of the parameters tested include dissolved oxygen, pH, specific conductance, and turbidity. Physical parameters tested include temperature, chloride, and total phosphorus. Water quality monitoring is currently conducted on select tributaries to Paugus Bay and Lake Winnisquam, and there are plans to begin testing on Lake Opechee as well. Annual reports from the NHDES VRAP program are available at: <https://www.des.nh.gov/resource-center/publications?keys=vrappannualreport&purpose=&subcategory>

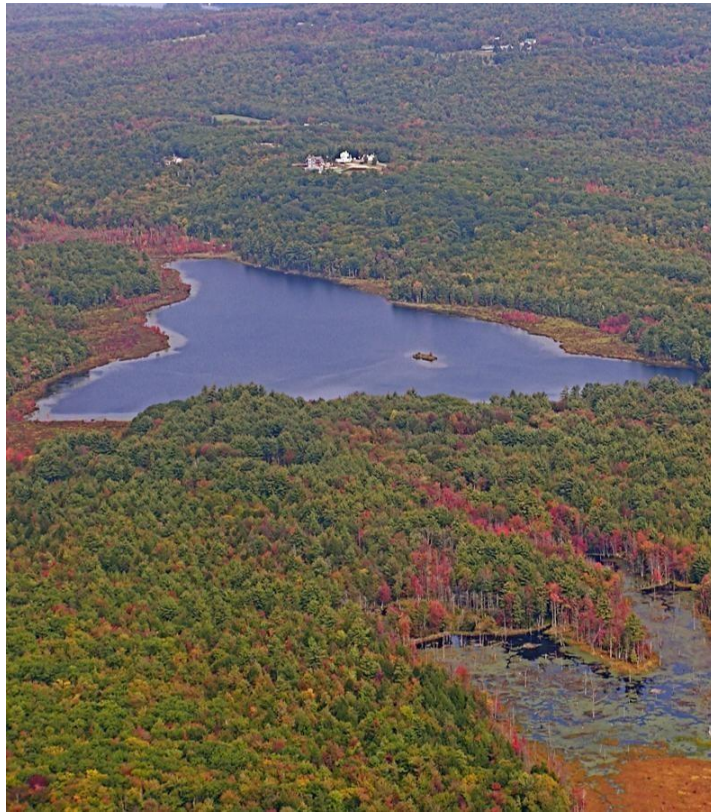


These large waterbodies offer many recreational activities throughout the year. The summer months see plenty of tourists looking for swimming, fishing, and boating opportunities. Laconia also has several public (and private) beaches along these waters including Bartlett, Ahern, Opechee, Bond, and Weirs. Large yachts, power boats, sailboats, and smaller crafts enjoy the vastness of these large waterbodies and the deep waters found within the lakes (up to 180 feet). A common summer recreational opportunity is the seasonal lake tours on the 230-foot-long M/S Mount Washington. Though its home port is in Center Harbor, a popular stop and loading location is at Weirs Beach. Winter recreation includes ice-fishing, skating, and cross-country skiing. A popular winter event is the annual “Ice-out” contest, in which people try to guess the date that the Mount Washington can safely leave her port at Center Harbor and motor to four other ports. Since records began being kept in 1851, ice-out has happened as early as March 29 and as late as May 12, although 90 percent of the time it is declared during April.” (Lake Winnepesaukee Historic Society, 2009). As of late, however, scientists in the region have acknowledged that ice-out dates are occurring earlier and earlier in the year – a clear sign of the effects climate change and warmer winters will have on the area. Below is a visual of the ice-out dates recorded for the last century.



The deeper waters are cold year-round and provide habitat for species of fish not adapted to smaller, shallow lakes and ponds (e.g., lake trout, landlocked salmon, rainbow trout, brown trout, whitefish). The shallower portions of these waters provide habitat for many warm-water species of fish like eastern chain pickerel, small and largemouth bass, yellow and white perch, bullheads, common white suckers, and the American eel.

In addition to the larger waterbodies in Laconia, there are several smaller ponds. Three key ones include Pickerel Pond (72 acres), Foote's Pond (3.6 acres), and Perley Pond (0.6 acres). There are also several unnamed ponds, many of which are influenced by fluctuating water levels from beaver activities. With few exceptions, these smaller waterbodies are surrounded by a diversity of habitats, with travel corridors and nesting/denning areas of high ecological value.



*Pickerel Pond is relatively undeveloped along its shoreline with good buffers. (Photo by Diane Hanley)*

Pickerel Pond, which is approximately 72 acres (with 69.2 located in Laconia), is in the northwestern portion of Laconia (1.5 miles west of Pickerel Cove). Though close in name and proximity, Pickerel Pond and Pickerel Cove are associated with separate subwatersheds – Pickerel Pond with the Lake Winnisquam subwatershed and Pickerel Cove with the Paugus Bay subwatershed. Most of this pond is in the City of Laconia with some additional acreage in the town of Meredith. This pond is relatively undeveloped with wide forested buffers, making it an exceptionally rich habitat. Both Laconia and Meredith have recognized the ecological significance of this well-buffered, largely non-impacted pond. Both municipalities have conserved portions of land surrounding the pond through city ownership or conservation easements. Laconia and its Conservation Commission have worked to increase public access to Pickerel Pond for recreational use by constructing a gravel parking lot on the city's property bordering the pond and there are plans to continue conservation/access efforts around the pond.

### **Rivers & Streams**

The Winnepesaukee River is a 10.5-mile-long river connecting Lake Winnepesaukee to the Pemigewasset River and forming the Merrimack River. The upper portion of this river is in

Laconia and has been incorporated into Paugus Bay with the construction of dams in the Lakeport region of the City. The river travels through Opechee Bay to another dam at City Hall known as Avery Dam, where it then makes its way to Lake Winnisquam. Eager Island is located 1,200 feet below Avery Dam. This small island is a unique feature to the river system and the City. Its floodplain environment supports scrub-shrub and herbaceous species as well as a variety of wildlife including beavers, ducks, sandpipers, and songbirds. The presence of dams and running water in the Winnepesaukee River provides an open water winter habitat and winter-feeding areas for wildlife.

The Winnepesaukee River is not the only running water in Laconia. Several tributaries are found in the City. Prominent ones include Durkee Brook, Jewett Brook, and Black Brook. There are many unnamed smaller streams located throughout Laconia where adequate-to-good buffers have been retained. These areas provide high-value plant and wildlife habitat and connectivity to forests, wetlands, and various other habitat types.



*Eager Island is in a portion of the Winnepesaukee River that contains some areas where open water remains throughout the winter. It is an important habitat for a diversity of waterfowl and bald eagles during the winter months. (Photo taken by Diane Hanley)*

Durkee Brook is in the southeastern portion of Laconia, with its headwaters near Route 107 and the Belmont town line. It flows northwesterly for approximately 2.2 miles through industrial and residential areas to its confluence in Lake Winnisquam. Durkee Brook experiences some flooding and erosion issues from a combination of increased runoff and the removal of



stabilizing shoreline vegetation along abutting properties. Beaver activity along Durkee Brook has enhanced the riparian floodplain zones surrounding it. Many local wildlife species depend on this habitat for cover, food, and travel corridors and the rich soil also supports a wide range of vegetation. The numerous areas along Durkee Brook with poorly and very poorly drained soils are also indicators of potential wetland habitats.

Jewett Brook (0.46 miles) enters central Laconia crossing the eastern border about 570 feet south of Route 11A, flowing in a westerly direction. Its confluence with the Winnepesaukee River in the southern part of Opechee Bay, is approximately 1,700 feet upstream from Avery Dam. Jewett Brook has a history of significant flooding, often impacting Laconia roads. A watershed management plan was developed for Jewett Brook in 2012. This joint effort between Laconia, Gilford, and the engineering group Dubois & King Inc. identified eleven projects across the two municipalities that will help reduce flood flows and stabilize the stream channel. Union Avenue is particularly susceptible to the flooding and dredging at this site is identified as a ‘high priority’ project within the watershed plan.

Black Brook, located in the central eastern portion of Laconia just south of Route 3, flows westerly into Paugus Bay. Though it contains a small floodplain wetland area, much of its ecological value appears to be compromised due to development, including significant impervious surfaces and wetland buffer violations. Concerns regarding the effects of sedimentation from Black Brook on the water quality of Paugus Bay has led to renewed focus on the stream’s restoration. In 2016, DuBois & King conducted a geomorphic assessment report and watershed plan for Black Brook. The report found that approximately 20% of Black Brook is confined to culverts, ultimately eliminating the benefits natural floodplains could provide to downstream water quality. Potential projects were identified to restore the stream and its associated floodplains including daylighting the brook by eliminating some culverts and replacing those that are undersized.

As mentioned above, increased flooding is a special concern for the rivers/streams and urban areas in Laconia. As precipitation events grow in intensity and frequency because of global climate change, we can expect these flooding events to get worse over time as well. Efforts to improve stormwater management, restore streams to their natural state, and protect floodplain habitats will be essential to managing flood events in the future.

### **Wetlands & Vernal Pools**

Wetlands are an essential habitat for most plant and animal species found in New Hampshire and serve as a transitional zone between land and water. It is estimated that riparian and wetland areas are used by over 90% of the region’s wildlife and serve as preferred habitat for 40% of local species. The EPA identifies four types of palustrine (inland, non-tidal) wetlands: marshes, swamps, bogs, and fens. These are extremely diverse depending on the hydrology, soils, topography, and climate of the area. New Hampshire state law requires three parameters be met to classify an area as a jurisdictional wetland. These parameters are the presence of hydric soils (discussed in earlier sections), sufficient hydrology, and hydrophytic vegetation (plants that are adapted to the conditions of wet habitats).

Wetlands are dynamic habitats. The general trend is that they slowly fill in overtime, through the process of lakefill. As time passes, submerged plants appear in the open waters, followed by floating-leafed plants and then emergent plants (reeds, sedges, wetland grasses). Next, shrubs like high bush cranberry and bog rosemary appear and eventually, trees like red maples and gray birch emerge. There are, however, several environmental and human-induced reasons that may cause wetlands to change in size. Some examples are:

- ❖ Human development, including damming and excavation
- ❖ Severe weather changes, such as increased rain or drought
- ❖ Wildlife influence, for example, regeneration of beaver impoundments
- ❖ Logging and landscape alterations that dredge wetlands or increase runoff

In addition to providing important plant and wildlife habitat, wetlands are essential to the protection of other water resources. The poorly drained soils and hydrophytic vegetation present in wetlands store significant amounts of floodwater and runoff, minimizing potential damages in times of high water. Wetlands also contribute to groundwater recharge and serve as a filtration source by allowing suspended sediments and particles to settle and be absorbed plant roots. This includes excess nutrients, toxicants, pollutants, and contaminants. These benefits derived from wetlands makes them especially important in maintaining the health of aquatic systems – an important note for Laconia considering its economic and public health ties to the lakes in the region.

Previous efforts to understand the status of wetlands in Laconia included an investigation of eleven wetland systems and their functional values in the early 2000s. This joint effort between the Laconia Conservation Commission, the University of New Hampshire, the Lakes Region Planning Commission, and others identified five major categories as follows:

1. **Major Wetlands with Multiple Values:** Hamel State Forest, Pickerel Pond, Lily Pond, and Pickerel Cove
2. **Wetlands Important for Pollution Attenuation:** Old North Main Street, Lily Pond, Black Brook, Maiden Lady Cove, and Pickerel Cove
3. **Wetlands Important to Laconia’s Water Supply:** Lily Pond, Black Brook, and Pickerel Cove
4. **Wetlands Important to Developed Areas (flood control and aesthetics):** Durkee Brook, South Down & Long Bay, and Pleasant Street School
5. **Wetlands Important for their Educational Potential:** Pickerel Pond, Pleasant Street School, and Maiden Lady Cove

One of the standout wetlands from this early 2000s report and the 2009 NRI fieldwork is the Hamel State Forest/Pickerel Pond Wetland system. This system is 76 acres of open water, emergent, scrub-shrub, and forested wetlands. The range of wildlife activity and excellent upland buffers indicate that this system is home to substantial biodiversity. For these reasons, this wetland system may be a good candidate for “prime wetland” designation. Prime wetlands are



those that are of highest functional value and are afforded more protective rules by the NHDES. As of 2021, the City of Laconia does not have any prime wetlands designated.

The State of New Hampshire recognizes vernal pools as an important habitat in the state; they are a unique and often isolated type of wetland. They fill annually from precipitation, runoff, and excess groundwater in the spring and fall. These pools typically dry up in the summer months, making them uninhabitable to many plant and wildlife species. These temporary waters provide essential breeding habitat for certain amphibians and invertebrates, such as wood frogs, spring peepers, spotted salamanders, and fairy shrimp. They also serve as important feeding areas in the early spring for species like Blanding's and spotted turtles. The 2009 NRI documented 23 vernal pools throughout Laconia.

An initial GIS analysis of the National Wetland Inventory (NWI) indicated that there are 451.4 acres of palustrine wetlands in Laconia boundaries. As noted earlier in the methods section, NWI data may not account well for forested wetlands. By also using land cover data from the Multi-Resolution Land Characteristics Consortium (MRLC), these wetlands can be added to the city's inventory for a more complete picture. This method found an additional 219.9 acres of wetlands, for a total of 671.3 acres (4%) of wetlands in the City. It is important to note that a full inventory of the wetlands in Laconia cannot be completed without significant field verification due to the nature of the limitations from existing data sources.

#### **City Ordinance 235-17: Wetlands Conservation & Water Quality Overlay District**

The intent of this Ordinance is to “ensure the protection of water wetland resources and vernal pools from activities that would adversely affect their functions and values, ensure the protection of wetland and waterbody buffer areas from activities that would adversely affect their ability to protect wetlands from degradation, and prevent the expenditure of municipal funds for the purpose of providing and/or maintaining essential services and utilities which might be required as a result of the destruction/degradation of wetlands and the loss of water quality” The ordinance establishes buffers, permitted and prohibited uses, and uses that require a conditional use permit.

Buffers established under this ordinance include:

- ❖ 100' from any designated prime wetland
- ❖ 75' from any brook/stream contiguous to public waters
- ❖ 50' from wetlands
- ❖ 100' from vernal pools
- ❖ 30' from intermittent or perennial streams
- ❖ 0' from any exempt wetlands

Details about exemptions to these buffers are discussed in detail in the city ordinance at:

<https://ecode360.com/15050211>

### **Aquifers/Groundwater**

Groundwater is a critical natural resource for the State of New Hampshire. An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be pumped for drinking. Approximately 98% of public water systems rely on groundwater. There are three types of groundwater aquifers: stratified-drift, till, and bedrock. The basic difference is that stratified drift and till aquifers are composed of unconsolidated glacial deposits (stratified materials are sand and gravel and till materials are a mixture of gravel, sand, silt, and clay), while bedrock aquifers are fractured rock.

Stratified drift aquifers are an important source of groundwater for commercial, industrial, residential, and public water supplies in the State of New Hampshire. They typically are the most productive sources of groundwater and therefore, the highest yielding public water supply wells tap these aquifers. They are also, however, directly influenced by surface waters and land-use activities, and therefore, the most susceptible to contamination.

Most of the aquifers in Laconia are in the southeastern portion of the City. About 9.7% of Laconia is underlain with stratified-drift aquifers. Those aquifers are listed below:

- ❖ 778.5 acres in the southern part of the City, extending from the Gilford/Belmont town lines to the border of Lake Winnisquam
- ❖ 345.6 acres just north of the previously described one and underlies Jewett Brook, extending towards the eastern shoreline of Lake Opechee the southernmost portion of Paugus Bay
- ❖ 274 acres located in northern Laconia along the Lake Winnepesaukee shore. This is a portion of a very large aquifer which lies mostly in Gilford
- ❖ 130.5 acres surrounding Pickerel Pond and extending into Meredith
- ❖ 67.1 acres just east of Paugus Bay and extending into Gilford

Data for aquifer boundaries has not been updated since the initial NRI's completion. To reference these aquifers on a map, please visit Laconia's online GIS system.

### **Riparian Zones and Floodplains**

Riparian zones are the interfaces between land and a stream. These zones may be found in grasslands, woodlands, wetlands, and floodplains and they serve an important role in aquatic ecosystems; they provide important birthing, mating, feeding, and nesting sites for many species, and are often used as travel corridors for wildlife. Floodplains are a type of riparian zone and are flat or nearly-level land adjacent to a stream or river that experiences occasional, seasonal, or periodic flooding. These are relatively narrow strips of land found along streams and wetlands, where sediment from upstream is transported and deposited across the floodplain terraces. These floodplains support rich and diverse ecosystems despite being affected by periodic flooding. Riparian zones also work to protect water quality by allowing infiltration and reducing the effects of flooding. Natural vegetation along these zones protects water temperatures and provide shade for wildlife. The vegetation is also important for erosion control and bank stabilization.



*Black Brook, near southern Paugus Bay, has sections that contain wetlands and riparian habitat, but also has been degraded by development.*

Laconia has limited riparian and floodplain areas due development and relatively low numbers of streams. Preserving riparian and floodplain areas in their natural state is essential for maintaining the benefits they provide to the area. Many portions of Laconia’s streams have not been impacted, indicating opportunity to maintain the riparian habitat present, such as along Black Brook, Jewett Brook, and Durkee Brook.

#### **D. WILDLIFE & HABITATS**

Laconia has a rich and unique variety of habitats within its boundaries; forested lands, steep slopes, open water, wetlands and riparian zones, and permanent wildlife openings meet the needs of many plant and animal species. There are ample opportunities to preserve wildlife habitat in Laconia, where just over 70% of the land is undeveloped, including significant forested land, agricultural fields, and early successional vegetation.

A common theme of this inventory is that no natural resource, including wildlife and habitat, is safe from the effects of climate change. Climate change is expected to alter the composition of species in certain habitats because of climatic/weather events outside the natural range of variation. Historically these species would migrate to where they can tolerate the climate, however, new obstacles such as habitat fragmentation and the spread of invasive species limits their ability to establish themselves in new areas. Additionally, species will have to adapt to shifting weather seasons (winters with less snow cover and ice, and summers with increased precipitation and flooding). These changes, along with the influence of human mitigation efforts surrounding climate change, will likely alter existing habitats significantly and may force many species to change their territory or range. Considerations for wildlife and their natural habitats should be included in resource management to mitigate the effects climate change may have on species composition.

### **Wildlife Action Plan**

In 2006, New Hampshire Fish and Game worked with select partners in the conservation community to create the State's first Wildlife Action Plan (WAP). The plan (mandated and funded by the federal government) provides a base tool for identifying and maintaining critical habitats and populations of New Hampshire's species of concern; some examples include the American marten, the New England cottontail, and the spruce grouse.

The WAP focuses on twenty-seven habitat types that serve the needs of these species of concern. These habitats were evaluated and given a score based on their ecological condition. This score is comprised of the average score of three variables:

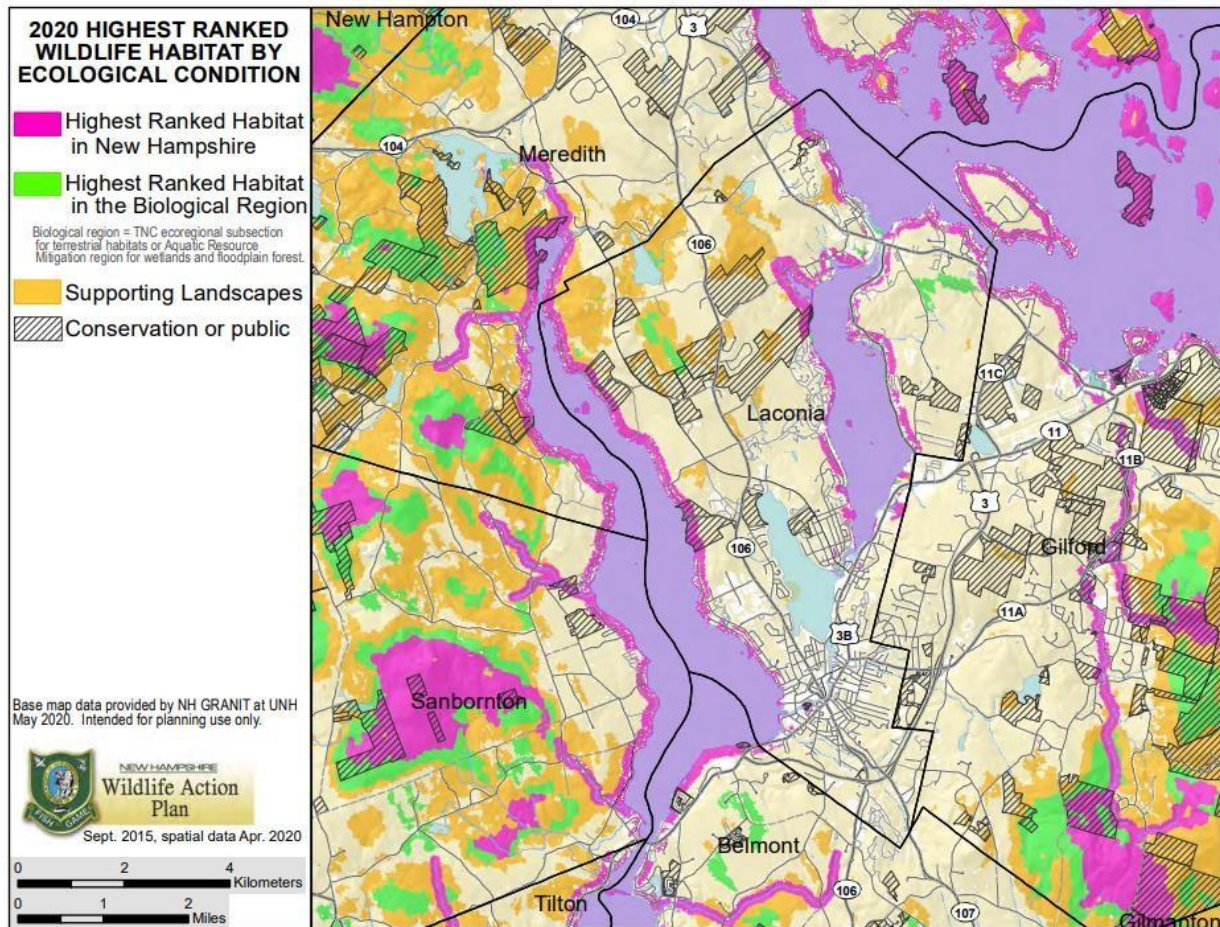
1. Biological diversity – measured by species richness of rare animals, species richness of rare wildlife within their dispersal distances, species richness of rare plants, and richness of exemplary natural communities.
2. Landscape context – measured with total area, wetland area, distance to and identity of nearest neighbor and other landscape features, and similarity of neighboring habitat types.
3. Impacts of human activity – evaluated using measures of relative intactness (unfragmented habitats) and trails (recreational impacts).

Once scores are established for a habitat, they are ranked at the state level as well as for each biological region. In this case, a biological region refers to an ecoregion for terrestrial habitats and watersheds for aquatic habitats. This ranking identifies the “Highest Ranked Habitat in NH”, “Highest Ranked Habitat in Biological Region”, and “Supporting Landscapes”. Table 5 lists the twelve habitat types found in Laconia and their acreage across the city, which are described in detail in the following section.

Table 5: New Hampshire WAP Habitat Type and Acreage for Laconia, NH.

<b>WAP Habitat</b>	<b>Acres</b>	<b>% of Laconia Land</b>
Open Water	3,872.0	23.5
Hemlock-Hardwood-Pine Forest	3,629.5	22.1
Appalachian Oak-Pine Forest	3,226.8	19.6
Developed, Impervious	2,955.4	18.0
Developed, Barren	1,791.7	10.9
Grasslands	502.8	3.1
Marsh & Shrub Wetland	218.6	1.3
Temperate Swamp	149.5	0.9
Peatland	68.5	0.4
Sand/Gravel	40.2	0.2





*The 2020 Fish & Game WAP Map of Laconia: Highest Ranked Habitats*

### **Habitat Types**

The following habitat descriptions are of those identified in Laconia from the 2020 WAP. These descriptions are direct excerpts from the NH Fish & Game's website and identify the unique aspects of each habitat type and provides brief strategies for their conservation. More information can be found at: <https://www.wildlife.state.nh.us/habitat/types.html>

#### **Appalachian Oak-Pine Forest**

Appalachian oak-pine forests are found mostly below 900 feet elevation in southern New Hampshire and along the Connecticut River in western New Hampshire. Laconia's Appalachian Oak-Pine Forests are largely located east of Paugus Bay (along White Oaks Road) as well as along much of the Parade Road corridor. The nutrient-poor, dry, sandy soils and warm, dry, climate influences the typical vegetation including oak, hickory, mountain laurel, and sugar maple. Many wildlife species use these forests for part or all of their life cycle including black bears, bat species, and snakes. The diverse age and structure of the forest help to promote wildlife diversity. Intense development pressure has dramatically increased fragmentation of this forest type. Incorporating habitat conservation into local land use planning, protecting unfragmented blocks, and adopting sustainable forestry are a few examples of conservation strategies for Appalachian oak-pine forests.

### **Hemlock-Hardwood-Pine Forest**

Hemlock-hardwood-pine forests are comprised of mostly hemlock, white pine, beech, and oak trees. Since this is a transitional forest, it can occur at different elevations and over different types of soil and topography, so the composition of vegetation can be variable. Laconia's Hemlock-Hardwood-Pine Forests are located across the city, but especially in the northwest quadrant. This forest type is the most common in New Hampshire and covers nearly 50% of the state and provides habitat for numerous wildlife species. Many of the species that use this habitat type require large blocks of unfragmented forest such as the northern goshawk and black bear. Since this forest type is so common, it is sometimes overlooked in conservation efforts. Development and fragmentation are huge threats to the continued existence of hemlock-hardwood-pine forest. Some conservation strategies for hemlock-hardwood-pine forests are incorporating habitat conservation into local land use planning, protecting unfragmented blocks of land, and educating landowners.

### **Grassland**

Grasslands are comprised of grasses, sedges, and wildflowers with little to no shrubs and trees. The most common grassland habitats are airports, capped landfills, wet meadows, and agricultural fields such as hayfields, pastures, and fallow fields. The numerous agricultural lands maintained by early European settlers provided ideal habitat for some wildlife species that need grassland habitat. Development and natural forest succession have reduced grassland habitat in the state. Grasslands require maintenance and must be mowed to prevent them from becoming shrublands or forests. Grasslands in Laconia may be found along Parade, White Oaks, and Meredith Center Roads. Only 8% of NH grasslands are currently under conservation easements. Reclaiming and maintaining grasslands are two important conservation strategies for grassland habitats. Many grasslands and potential grassland habitat are on private land and landowners can help restore and conserve them.

### **Developed Habitats**

Residential and commercial development in New Hampshire ranges from maintained gardens and manicured lawns to multi-story buildings in city centers. Some wildlife species have learned to use these areas for things like nesting or finding food sources. For example, peregrine falcons, which typically create nests on vertical cliffs to raise their young, have begun nesting in urban settings in the southeastern portion of the state. Tall buildings and similar man-made structures possess physical characteristics like cliffs. Many bee species frequent crop fields, orchards, gardens, and other locations with flowering plants maintained by humans in developed areas. Although development can cause problems for wildlife, some species have figured out how to adapt to certain conditions.

### **Peatland**

Peatland habitats are extremely important for carbon storage on a local and global scale. These habitats are terrestrial wetland ecosystems in which waterlogged conditions prevent plant materials from fully decomposing. The water in peatlands has low nutrient content and typically high acidity caused by limited groundwater input and surface runoff. These environmental conditions are such that plant and animal material take a very long time to decompose. This organic material contains carbon and other nutrients, storing it away and slowly releasing it into the atmosphere. Drainage and destruction of peatlands releases this carbon into the atmosphere

quicker, increasing greenhouse gases today. Conservation of the 11 different natural communities that comprise peatlands is also vital to the continued existence of many rare plant and wildlife species in New Hampshire. Typical vegetation in a peatland includes sphagnum moss, leather leaf, northern white cedar, and American larch. Threats to peatland habitats are development, altered hydrology, and unsustainable forest harvesting. Non-point source pollutants, such as road salt, lawn fertilizers, and pesticides, also threaten this habitat by altering the acidity and nutrients. Establishing buffers around this habitat is one conservation strategy that will help minimize the threats to peatland habitats.

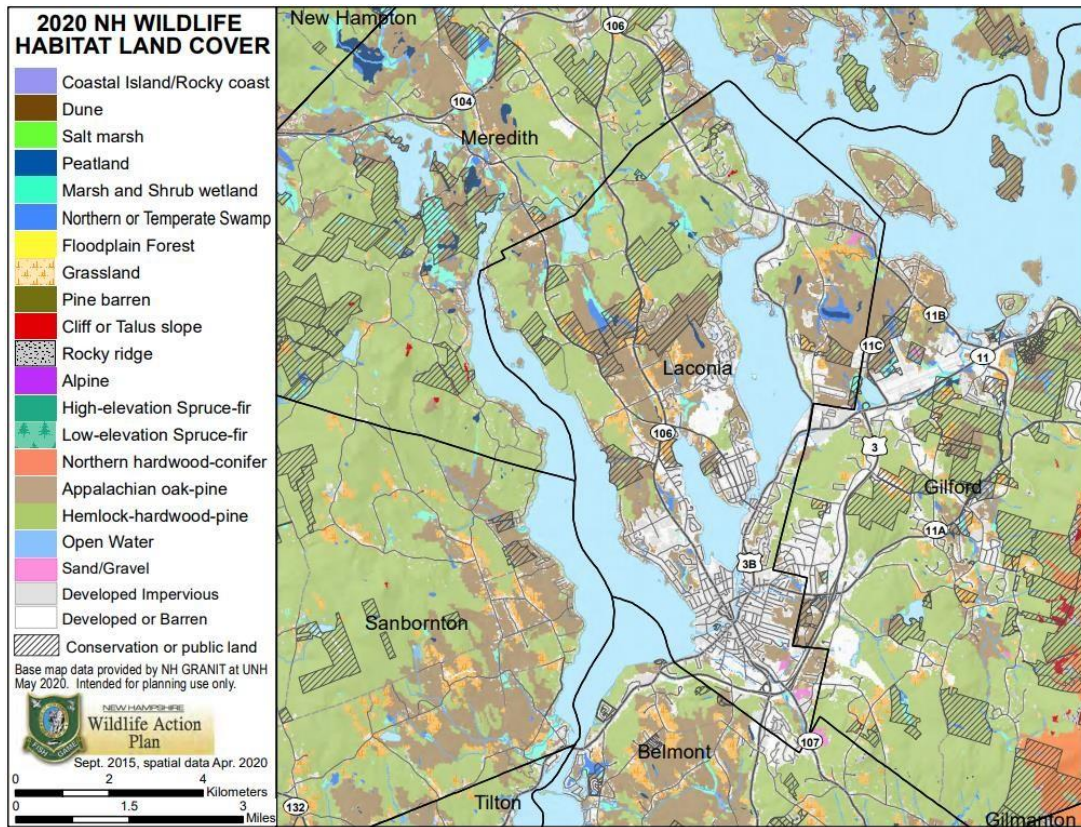
### **Temperate Swamp**

This habitat consists of forested wetlands found primarily in central and southern New Hampshire. Temperate peat swamps are typically found in isolated or stagnant basins with saturated, organic soils. This habitat may be found in wetland complexes off of White Oaks Road and south of Pickerel Pond. These wetlands provide several functions such as flood control, pollutant filters, shoreline stabilization, sediment retention and erosion control, food web productivity, wildlife habitat, recreation, and education. Threats to temperate swamps include habitat degradation from insect pests such as the hemlock woolly adelgid, since hemlock is a common component of temperate swamps across NH. Inputs of sedimentation, insecticides, and fertilizers are sources of pollution that threaten temperate swamp habitats. Actions to conserve temperate swamps include supporting the Division of Forests and Lands in the implementation of the hemlock woolly adelgid action plan and working with foresters to use Best Management Practices outlined in the document ‘Good Forestry in the Granite State.

### **Marsh & Shrub Wetland**

Emergent marsh and shrub swamp systems have a broad range of flood regimes, sometimes controlled by the presence or departure of beavers, but mostly controlled by groundwater. This system, which is an important food source for many species, is often grouped into three broad habitat categories: wet meadows, emergent marshes, and scrub-shrub wetlands. Marsh and shrub wetlands filter pollutants, preventing them from getting into local streams, and help hold water to reduce flooding. Many wildlife species use marsh and shrub wetlands including common species like red-winged blackbirds, beavers, and painted turtles. Marsh and shrub wetlands are also critically important for state endangered Blanding's turtles, New England cottontails, northern harriers, dragonflies, and sedge wrens plus state-designated threatened spotted turtles and pied billed grebes. Development is a threat to these habitats mostly from driveways and roads that fragment wetlands or change the flow of water. The loss of an upland habitat around a marsh or shrub wetland also increases the amount of pollution and sedimentation threatening the habitat. Another constant threat to marsh and shrub wetlands is invasive plants such as purple loosestrife and Japanese knotweed that compete with native vegetation. Some conservation strategies for marsh and shrub wetlands are restoration and protection of these important habitats. Many marsh and shrub wetlands are on private land and landowners can help restore and conserve them.





*The 2020 Fish & Game WAP Map of Laconia: Habitat Land Cover*

### **Forested Lands**

Forested lands make up much of the City of Laconia. According to the 2019 land cover data used, there are 6,567.1 acres (40%) of forested lands in the City. For this reason, the forested lands in Laconia should be highlighted as a significant natural resource of interest for the City. Forested areas include hardwood, white pine, hemlock, and mixed hardwood and softwood stands.

Laconia has several species of trees that are considered important because of their mast production. Mast are the fruits produced by woody stemmed plants and can be either hard (seeds and nuts) or soft (fruits and berries). These tree species include red and white oak, beech, maple, hickory, hemlock, black cherry, junberries, white ash, and pine. Wildlife species from nuthatches, chickadees, squirrels, and eastern chipmunks to white-tailed deer, black bears, turkeys, and wood ducks rely heavily on mast as a source of feed. Hard mast produced by oaks, beech, and some shrubs such as beaked hazelnut, is considered extremely important because it is able to persist for a longer amount of time than soft mast and is therefore accessible to wildlife during times of the year when other food sources are limited (like winter).

Dense softwood stands are a significant consideration when evaluating the quality of forested habitats. These stands provide cover and foraging habitat for a variety of wildlife species during harsh winter conditions by providing cover from snow and wind. Therefore, animals such as red squirrels, snowshoe hare, ruffed grouse, and white-tailed deer are often found utilizing them.



during the winter months. White-tailed deer are not well adapted for dealing with deep snow conditions and require dense softwood stands to survive New Hampshire's harsher winters. When they congregate in these stands, they are referred to as winter deer yards. For the stand to be considered a deer yard two basic elements must be met: (1) A core area is identified by concentrations of dense softwoods, and (2) Mixed hardwood and softwoods adjacent to, or within the core area to provide accessible forage. The original NRI found just over 600 acres of dense softwood stands in Laconia. This figure was not updated in this 2021 NRI due to in-house limitations on data collection and imagery analysis.

### **Permanent Wildlife Openings**

Wildlife openings have been declining in numbers over the past 50 years in part due to the loss of farmlands. Permanent wildlife openings are dominated by grasses, forbs, wildflowers, brambles, and fruiting shrubs. This includes hay land, pastureland, cropland, brush-hogged fields, and mechanically maintained transmission lines. It is estimated that they provide required habitat for about 22% of New England's wildlife species and are seasonally important for nearly 70% of species. Insects are not accurately incorporated into these figures, but many of these species occupy or use openings. They also create important edge habitat – a transitional area that will attract the largest diversity of species, both plants and animals. White-tailed deer, black bears, deer mice, meadow voles, shrews, and woodchucks commonly feed on the vegetation present in these habitats, and carnivores in turn feed on these species. Permanent wildlife openings are heavily used by bird species as feeding and nesting sites, specifically by the eastern bluebird, Bobolink, and northern harrier, which are species of concern in New Hampshire.

Agricultural lands are not the only source of permanent wildlife openings in Laconia. The State of New Hampshire encourages landowners to create and maintain permanent wildlife openings on their own. Some landowners routinely brush-hog former pastureland and hayfields to maintain them as openings for views and wildlife. Transmission lines are maintained mechanically rather than chemically, allowing them to serve as openings and miles of edge habitat. Finally, meadows created by beaver activities offer dynamic openings in various stages of succession. This provides characteristics of an open area surrounded by forested and wetland habitats, which is attractive for many wildlife species.

Wildlife openings were delineated in this inventory using orthographic photos from the National Agriculture Imagery Program (NAIP). Areas delineated included transmission lines, cemeteries, agricultural fields, among others. These openings range from approximately 0.5 to 30 acres per opening and total approximately 537 acres in Laconia. Many of these openings are located in the northern areas of the City along Route 106 (Parade Road), Meredith Center Road, and White Oaks Road. Wildlife openings are mapped on Map #7 at the end of the report.

### **Unfragmented, Roadless Areas**

Habitat fragmentation is the process where large and contiguous habitats are divided into smaller, isolated habitats in a region. This reduces connectivity in an area, ultimately effecting biodiversity and wildlife behavior. The number of roadless areas or unfragmented blocks of land has been in steady decline with the increase in development in Laconia and across New Hampshire. The increasing number of roads has impacted wildlife directly through road kills and

indirectly through loss of habitat and cutting off travel corridors. Fortunately, Laconia has several large tracts of land which are not impacted by roads ranging from 7 to over 1,300 acres. The largest of these blocks is in the northern-central area of the City, between Parade Road, Endicott Street North, and Rollercoaster Road. A map of all unfragmented, roadless areas in Laconia (ranging from less than 50 acres to over 1,000) is located at the end of this report.

### **Rare Species and Exemplary Natural Communities**

The City of Laconia is home to some of the State's endangered and threatened animal species, as identified by the NH Fish & Game Department. Endangered species are those that are native to New Hampshire but whose habitat is facing over-exploitation, predation, competition, disease, disturbance, or contamination. Threatened species are those that are headed toward being endangered if the conditions surrounding them continue to decline. With its many acres of open and running water, Laconia is home to bald eagles and common loons, both of which are considered threatened at either the state or national level. Occurrences of these species are reported to and documented by the New Hampshire Natural Heritage Bureau (NHB), which can be reviewed below.

Natural communities are distinguished by their plant species composition, vegetation structure, and a specific combination of physical conditions. The NHB ranks the quality of habitats based on an evaluation of their ecological significance and considers all occurrences of a rare (and some of the best quality common ones) natural community as "exemplary". These exemplary communities are typically ones with relatively little human impact and are desirable to many wildlife and plant species, making them an excellent focus for conservation efforts. As of July 2020, no specific exemplary natural communities have been documented for Laconia. Potential exemplary natural communities in Laconia include the Rocky Ridge, Talus, and Peatland habitats, which may serve as habitat for a number of rare and/or endangered species within the State. To learn more about threatened or endangered species or the unique communities that are focused on by the NHFG or NHB, please visit <https://www.wildlife.state.nh.us> and <https://www.nh.gov/nhdfl/about-us/natural-heritage-bureau.htm>.

Town	Species or Community Name	Listed?		~ reports last 20 yrs	
Flag		US	NH	Town	State
<u>Laconia</u>					
<b>Plants</b>					
~	Beck's water-marigold - <i>Bidens beckii</i>	--	T	Historical	12
~	dragon's-mouth - <i>Arethusa bulbosa</i>	--	E	Historical	24
~	greater fringed-gentian - <i>Gentianopsis crinita</i>	--	T	Historical	30
~	northern shore quillwort - <i>Isoetes septentrionalis</i>	--	E	Historical	16
~	ram's-head lady's-slipper - <i>Cypripedium arietinum</i>	--	E	Historical	13
~	Sago false pondweed - <i>Stuckenia pectinata</i>	--	E	Historical	9
~	small whorled pogonia - <i>Isotria medeoloides</i>	T	T	Historical	56
~	three-birds orchid - <i>Triphora trianthophoros</i> ssp. <i>trianthophoros</i>	--	T	Historical	26
<b>Vertebrates - Birds</b>					
**	Bald Eagle - <i>Haliaeetus leucocephalus</i>	T	SC	3	140
**	Common Loon - <i>Gavia immer</i>	--	T	2	339
**	Purple Martin - <i>Progne subis</i>	--	T	1	22

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.

July 2020

*Rare Plants, Rare Animals and Exemplary Natural Communities in New Hampshire Towns,  
Natural Heritage Bureau, July 2020*

### **Non-native and Invasive Species**

Invasive species are plant and wildlife species that are not native to an area but take up residency and outcompete native species. The presence of invasives often reduces natural biodiversity, impacts water quality, and stresses forests and soils. Additionally, as the climate continues to warm globally, invasive species are likely to exploit chemical, physical, and biological changes in ecosystems and further establish themselves in the region. These species tend to be more common in wet areas such as lakes, wetlands, riparian habitats, and areas of recent disturbance including roadsides. They can also be found at old farm sites, where people have planted various fruiting and ornamental plants for agricultural purposes.

There are several invasive species present in the City of Laconia. Some of these species include Japanese barberry, Japanese knotweed, reed phragmites, purple loosestrife, and multiflora rose. One of the most concerning invasives for Laconia, however, is Variable-leaf milfoil. This plant is more robust than the native water-milfoil species, with a very thick stem and the potential to grow an inch per day; it is very difficult to control once fully established. The effects of variable-leaf milfoil on water resources are profound; milfoil displaces beneficial native plant life, it makes swimming difficult, and it may devalue waterfront property. The City of Laconia works with the State of New Hampshire and local organizations to treat Milfoil in public waters (Lake Opechee, Winnisquam, and Paugus Bay) through mechanical (dive & pull) and chemical (herbicide) methods. In addition to Milfoil treatments, the Laconia Conservation Commission requests that

planning board applicants who come before them for conditional use permits remove and properly dispose of any invasives species found on their sites. There are a number of ways to do so, so that they do not establish at the disposal site. The method of disposal depends on the species of plant, for example, burning may be a viable option for some plants, but not those whose seeds are easily airborne. Other disposal methods include bagging, tarping and drying, chipping, composting, and occasionally, burying.

There is an increase in public awareness and concern about the rapid growth of invasive species in New Hampshire and throughout New England. Efforts to understand the risks associated with invasive species and their establishment are important at both the local and state levels. New Hampshire Fish & Game and other community partners have developed a spatial layer that addresses these concerns by identifying “priority areas” for invasive plant management. This research is preliminary and may be best utilized in conjunction with field verification of conditions, however, it is a valuable tool to use in initial investigations for problem areas. Priority areas are determined by “combining areas of high ecological significance, areas that provide ecological services to human activities, and areas that would pose a high risk of spreading with the presence of invasive species”. According to the metadata, areas listed with a higher score are those where management would best prevent invasive plants spreading and protect critically sensitive areas. Priority areas for Laconia are displayed in Map #9 at the end of this report.

#### 4) SCENIC RESOURCES

Laconia has many scenic views throughout the City, overlooking waterbodies, knolls, ridgelines, and mountains. There are two main designations for scenic roads: Scenic Byways (State) and Scenic Roads (local). Currently, there are no designated Scenic Roads within Laconia. There is, however, the “Lakes Region Tour”. This 97-mile scenic byway borders Lake Winnepesaukee and includes the following roads in Laconia: NH Route 3, Parade Road, Rollercoaster Road, Scenic Drive, White Oaks Road, and NH Route 11B.

There are many roads and vistas that offer great views and preserve the character of the city, making them strong examples of potential Scenic Roads. While these roads are not locally designated as scenic roads, the City has made efforts to protect them.

Aside from local and state roads, there are many other scenic resources within the City. The Winnepesaukee Scenic

Railroad travels between Meredith and the Lakeport neighborhood of Laconia, offering excellent views of the Lake. The Laconia Railroad Station also offers “Rail Bike Adventures” – a guided rail bike tour of the area, including sights along Winnepesaukee River, Durkee Brook, and Lake Winnisquam.

##### **City Ordinance 235-14: Districts Established**

This ordinance establishes a “Residential Rural Corridor” (RR2) zone in which it “recognizes the historic, scenic and agricultural values of the areas associated with Parade, Meredith Center, and White Oaks Roads”. The district is defined as the area extending 400 feet from either side of the center line of the right-of-way of the above-mentioned roads.

## 5) CONSERVATION LANDS

Securing conservation lands and easements across the City is one of the means available to the Conservation Commission to protect our natural resources. Many protected lands are owned by federal, state, and local governments. Laconia is the home to a number of state-owned conservation properties, some of which are state parks and forests. These lands are often required to remain in the natural state but allow for some recreational activities and/or timber harvesting. More information about state forest lands can be reviewed at:

[https://www.nh.gov/nhdfl/documents/nh-stateforestactionplan\\_2020.pdf](https://www.nh.gov/nhdfl/documents/nh-stateforestactionplan_2020.pdf)

A conservation easement on private land is another means to protect property. It creates a legally enforceable land preservation agreement between a landowner and a municipality, or a qualified land protection organization or trust. It restricts real estate development, commercial and industrial uses, and other activities on a property to a mutually agreed upon level. The decision to place a conservation easement on a property is strictly a voluntary one where the easement is sold or donated. The restrictions, once set in place, are binding on all future landowners. The restrictions are spelled out in a legal document that is recorded in the local land records, and the easement becomes a part of the chain of title for the property. The landowner who gives up these development rights continues to privately own and manage the land and may receive significant state and federal tax advantages with their land for future generations. The easement holder has a responsibility to monitor future uses of the land to ensure compliance with the terms of the easement and to enforce the terms if a violation occurs.

The City of Laconia has just over 1,300 acres (8%) of protected conservation lands. These conservation lands are either state or city owned property or privately owned with conservation easements granted towards the city, state, or an organization. The conserved properties range from less than one acre to just over 250 acres in size. Many of these properties abut one another, particularly those located between Lake Winnisquam, Opechee, and Paugus Bay, in northern-central Laconia. Other parcels are scattered across the city, with three being located along White Oaks Road, with over 450 acres of hemlock-hardwood-pine and nearly 600 acres of Appalachian oak- pine forests conserved. Table 6 list all conservation lands within the City and they are delineated on Map #7.

Table 6: Conservation Lands in Laconia

<b>Name</b>	<b>Acreage</b>	<b>Conservation Ownership</b>
Charland	5.0	Easement with City
Hamel State Forest	40.3	State Owned
Paugus Bay State Forest	253.1	State Owned
Prescott State Forest	115.8	State Owned
Swain State Forest	102.9	State Owned
Huston-Morgan State Forest	160.4	State Owned
Opechee Bay State Forest	48.1	State Owned
Ahern State Forest	129.4	State Owned
Puleo Farm	52.6	Private - Easement with State
Bond Park	36.2	City Owned
Eager Island	2.4	City Owned



Taylor Community	10	Easement with City
Perley Pond	1.1	City Owned
Tardif	11.1	City Owned
Wilkins – Southdown	0.25	Easement with City
Bonum – Southdown	2.5	Easement with City
Akwa Vista	14.5	Easement with City
Fuller	0.5	Easement with City
Prescott Farm	74.5	Private – Prescott Conservancy Inc.
Harrington East	53.5	Easement with City
Harrington	15.5	Easement with USDA, NRCS
Shad Path (Rice)	195.4	Private – Easement with Lakes Region Conservation Trust
Pickerel Pond	15.3	City Owned
Hilliard Rd (16-107-2)	3.1	City Owned

## 6) CLIMATE CHANGE

The International Panel on Climate Change’s (IPCC) latest report unequivocally states that human influence has warmed our atmosphere, land, and oceans (IPCC, 2021). Climate change is a complex issue that will undoubtedly impacts our natural resources, the services they provide us, and the interactions between people and their environment. Rising global temperatures, sea level rise, and extreme weather patterns are among some of the most pressing concerns. Impacts on specific resources include:

1. **Water:** Warmer temperatures will increase evaporation rates and limit the ability for regions to hold water; precipitation levels will continue to increase in the form of more rain and less snow; water-dependent energy generation will likely slow; changes in precipitation levels will likely increased the severity of flooding and drought events; water quality may suffer from increased runoff and erosion.
2. **Soils:** A warming climate will alter soils moisture conditions and increase soil temperatures; changes in moisture levels and precipitation events will lead to more erosion of soils; mineral composition of soils may change, impacting the productivity of soils for farming.
3. **Forests:** Warming global temperatures will generally increase the length of growing seasons; geographical ranges of tree species may shift, most likely moving north; certain species/stands could be at risk from increased droughts; increases in intensity and frequency of disturbances like drought, wildlife, disease, and insect outbreaks could damage forest stands.
4. **Wildlife & Habitats:** Changes to the global climate will alter the geographical range of many species, aquatic and terrestrial; sea level rise may put freshwater sources at risk from saltwater intrusion; shifting seasonal cycles could result in changes in animal behavior, such as migrating and reproducing; changing ranges and resources will disrupt the natural food chain; shifts in ecological conditions will impact animal-to-animal and animal-to-human pathogen spread, therefore impact human health and fisheries and agricultural industries.

The abovementioned impacts on the environment are only some of the ways in which we can expect

climate change to influence the world around us. Here in New Hampshire, we can already see the impacts of warming temperatures; spring tends to arrive earlier and bring more precipitation and summers are hotter and drier than they have been on record. We can expect that flooding and drought incidents will increase, winter recreation will be impacted by less snow and more rain, and invasive species can spread more easily in areas where native species are struggling to survive.

These changes cannot be ignored; the best approach is to act now and design mitigation and adaption strategies to control the effects of climate change within the community and increase overall community resilience. Resource concerns of particular importance to Laconia include the issues of flooding, water quality, and invasive species spread. Some questions that should be answered include: what areas in the community are at higher risk for flooding events? How might we protect our current water quality for the long-term? What areas of the community are at greater risk for invasive species infestations? These are just some of the things that need to be considered in planning efforts in Laconia.

There are a number of resources available for municipalities and states to utilize in planning for climate change impacts. The United States Environmental Protection Agency and the National Oceanic and Atmospheric Administration are reliable sources for understanding the science of climate change and its impacts. Laconia may also be interested in reviewing climate action plans from similar communities in the state and region to get an understanding of feasible projects for a city to take on in the fight against climate change.

## **7) HISTORIC AND CULTURAL RESOURCES**

### **The History of Laconia**

The City of Laconia has a rich history based on natural resources, dating back to Native Americans who utilized the diverse natural resources for navigation, shelter, and sustenance. The earliest single radiocarbon date (9,615 years ago in 1995) for any Paleo-Indian site in New Hampshire comes from Weirs Beach (formerly called Aquadoctan). This was a great meeting place [of several tribes] for miles around (Mulligan, pg. 27).

In 1620, King James I of England allowed a council to form, of which Sir Fernandino Gorges and Captain John Mason were members. A large section of land (now portions of Maine, New Hampshire, and Vermont) was granted to them in 1622. Seven years later, Gorges and Mason split the granted land. Mason owned “Laconia” but died without ever setting foot on the land, and it went to the Masonian Heirs. For over 150 years no one knew just where this New Hampshire land was. Once the estate was settled, a group called the Masonian Proprietors purchased the land and became the first New Hampshire real estate developers. Part of the purchase settlement gave quit claim to squatters who had improved their lands (Mulligan, pg. 43).

Settlement in the area was delayed by the wars with the French and Native Americans and did not occur until the early 1760’s. Deep agricultural soils and abundant waterpower attracted many settlers to ‘Meredith Bridge’ (now known as Laconia). By 1794, settlements had spread to what we now know as the Lakeport area and Weirs Beach. By the late eighteenth century, these areas (and Belmont) became known as the Gunstock Parish (with Belmont designated as the Upper

Parish). In 1893 these two areas were separated into the town boundaries we have today. Dramatic landscape changes occurred when dams built in Lakeport flooded Paugus Bay, forming the landscape we are familiar with today.

In 1848 the “Boston, Concord, and Montreal Railroad” line reached Meredith Bridge, stimulating commercial vitality of the village and area. This sparked shoreline development including hotels, summer cottages, boarding houses, and camps. The last “Lake Shore” run took place in 1934, when the invention of the automobile killed the railroad. Industry flourished in Laconia with knitting mills and machine shops, and the City boasted that it was the largest manufacturer of streetcars in the US. The population of Laconia grew 22% between 1930 and 1940 and the effects of increasing development and activity that came with this growth had dramatic effects on the natural resources.

The City of Laconia has changed significantly from its original settlement. Many people were drawn to Laconia due to its gentle knolls, large waterbodies, and the powerful flow of the Winnepesaukee River as a source of power. Laconia was, and still is, a land of abundant opportunity because of its natural resources. The changes in ways of life and its effects on land use and natural resources can be found throughout the landscape.

### **Cultural Resources**

Laconia’s community and character is rooted in its scenery, which has persisted through generations of development. Several community initiatives exist that highlight some of these features in Laconia, such as the “River Walk” and the “Lakes Region Tour Scenic Byway”. A standout initiative known as the “Winnepesaukee-Opechee-Winnisquam (WOW) Trail” offers the community a multi-use rail trail open to non-motorized activity like biking, walking, and running. Old farms, stonewalls, and abandoned roads are evidence of land use change over many years, where once developed areas have now reverted back to forests.

Other cultural efforts include the designation of several buildings to the National Register of Historical Places and the protection of archeological sites predating modern settlement, such as Weirs Beach. In addition, Laconia is home to a 400-year-old oak tree named “The Perley Pond Oak” for its location on the City’s Perley Pond conservation area. This tree continues to live, with its diameter at just over 6 feet and a circumference of 20 feet.

The City of Laconia has made strides to protect and enhance the historic and cultural resources through the Heritage Commission, which was established “to ensure the proper recognition, use, and protection of resources that are valuable for their historic, cultural, and aesthetic significance.” This includes the natural community as well. Other organizations in Laconia like the Conservation Commission, the Planning Board, and various Lake Associations have recognized the need to protect and sustain the quality of life offered by the rich natural resources within the City. These groups, among others, have devoted their time, money, and effort towards maintaining and improving the City’s management of natural resources as an element of the historic character of Laconia.



*This stone archway at the start of a trail in Weirs Beach Community Park is an example of past activities.*



*The Perley Pond Oak has witnessed over 400 years of history in Laconia. Photo by Russell Tibeault*

## **8) RESOURCE & CONSERVATION RECOMMENDATIONS**

Based on the inventory of natural resources summarized above, a number of recommendations can be made to the City of Laconia to support the goal of preserving the City's natural resources and community character. Since the initial natural resource inventory was conducted in 2009, the

City of Laconia has worked hard to address the management of its natural resources in an effort that is compatible with its development. Some of the standout efforts include:

1. Increasing the wetlands buffer from 30 feet to 50 feet
2. Implementing a “Shoreland Protection District” along many of the waterfront areas
3. Conducting water quality monitoring efforts with the State and other community partners
4. Preserving viewsheds by implementing the “Residential Rural Corridor District” along key scenic routes in the City

Working to protect the community’s natural resources is an ever-evolving project. While previous efforts have been effective, it is essential to continue reviewing best practices and opportunities for further protection of these resources. The following recommendations are meant to be incorporated into planning efforts and provide the City and its Conservation Commission with a tangible list of projects and goals to accomplish in the future. Laconia can also benefit from analyzing the effects that climate change may have on its natural resources and how those resources can be used as a source of mitigation against those effects as well.

### **Resource & Conservation Recommendations**

The ultimate goal of developing and maintaining a natural resource inventory is to identify actionable items that protect the use and management of those resources. With Laconia’s wide range of resources, it is key that any changes to the City’s ordinances or development practices consider the effects it may have on the environment. The following recommendations are made with this in mind and should be considered moving forward.

1. **Wetland & Vernal Pool Protections:** It has been well-established that wetlands and vernal pools provide excellent habitat for wildlife and valuable ecosystem services to people. The City has taken multiple steps to protecting these habitats with increased buffer distance and the additional measures in the review of conditional use permits. The city also continues to identify vernal pool locations found in other environmental investigations (CUP applications, field studies, etc.). These resources should continue to be explored and protected.
  - **Vernal Pool Inventory:** The City should regularly update the inventory of vernal pools within in Laconia. The Planning Department and Conservation Commission may want to consider incorporating a subdivision plan requirement that includes the coordinates of any vernal pools identified in the application, so that it may be readily added to the City’s GIS database.
  - **Prime Wetlands Designation:** The City should continue to explore the possibility of designating prime wetlands. This would further protect wetlands of substantial size and value through the enforcement of a larger buffer zone. The Pickerel Pond wetland complex may be a good candidate for this designation.
  - **Directional Buffers:** Directional buffers around vernal pools may be an attractive, science-based alternative to a 100-ft radial buffer in some applications. The Conservation Commission should consider setting requirements that would enable a developer to use this approach. These requirements should consider the site’s specific conditions and value of the land to be protected.



2. **Aquifer Protection:** Although the aquifers in Laconia are not largely used as a water source to the City (Paugus Bay provides the city's public drinking water), they should be protected in case of future need. Primary concerns include potential contaminations that may come from development, impervious surfaces, and point/non-point pollution sources. Currently, there are a number of zoning districts that overlay the aquifers in the City, including industrial and urban commercial, which may allow for uses that could negatively impact these resources.
  - **Aquifer/Groundwater Protection District:** Aquifer/groundwater protection districts are aimed at preserving and protecting existing and potential future sources of drinking water supply. An overlay district for these resources would restrict land uses that may contaminate the water and increase public awareness of these unseen resources. The City and Conservation Commission should consider the impact of an overlay district of this kind within Laconia. Neighboring communities, such as Gilford, have implemented overlay districts for aquifers and can be utilized as a guide for developing such in Laconia.
  
3. **Invasive Species Management:** As invasive species continue to ravage the land and waters of the Lakes Region; the City of Laconia should take action to protect and restore our native species by developing an invasive species management plan. A management plan can help restore native biodiversity and protect the City's recreation and tourism industries from any further decline related to invasive infestations. Two key actions for this plan may include:
  - **Invasive Species Inventory:** In order to develop a management plan, Laconia needs an up-to-date assessment of invasive species within its borders. The City should consider conducting an invasive species inventory that documents the types of species present and the extent of their infestations.
  - **Priority Areas:** Along with an inventory, the City should work to identify priority areas for management opportunities. This may simply involve field-verifying the locations identified by NHFG as high priority (Map #9) or could include local input on areas of high infestation. Management areas might include parks, waterbodies, and roadways.
  
4. **Viewshed Protection:** The natural beauty of Laconia's landscape attracts visitors year-round, contributing heavily to the city's economy. Additional measures to protect the views in and around Laconia should be considered:
  - **Expansion of the Residential Rural Corridor (RR2) Zone:** As private property owners continue to face pressure to sell land for development, it may be beneficial for the City to consider extending the restrictions of the RR2 to other scenic roads/areas.
  - **Scenic Road Designation:** The City may want to consider formally designating roadways through the voting process identified in NH RSA 231:157. This designation would limit the impact of road and utility maintenance on vegetation and stonewalls and would not affect landowners' rights beyond the vegetative requirements.

- **Site-Seeing Pull-offs:** The City owns a number of properties along scenic routes, such as Parade and Meredith Center Road, that would be ideal for designated scenic pull-offs. Scenic pull-offs can be relatively small, accommodating for 3-5 vehicles and could be accompanied by signage or informational boards.
- 5. **Climate Change Mitigation:** Unprecedented changes in the global climate will certainly have impacts on natural resources. Soil moisture levels, changing runoff seasons, and increased water temperatures are just a few of the major impacts we can expect to see from the warming climate. These changes will affect the life and property in Laconia and mitigation strategies need to be considered for future protection. The following recommendations are not a comprehensive list of actionable items, but rather a starting point for the City.
  - **Hazard Mitigation Plan:** Laconia should consider developing a “Hazard Mitigation Plan” that identifies, assesses, and reduces the long-term risks to life/property from natural hazards – such as flooding and hurricane events. This may be an excellent opportunity for working with local partners, like lake associations and other municipalities. Potential considerations could include the following:
    - **Flood Hazard Mapping:** A comprehensive study of the flood risks across the city would allow us to identify areas at high risk of flooding. Risk of flooding should consider natural flood zones, like floodplains and riparian zones, as well as areas where human development has increased the risk (improperly sized or failing infrastructure and impervious surfaces). This product would be beneficial in identifying at-risk areas and therefore guide development across the City.
    - **Water Storage:** Existing water storage areas (lakes, ponds, reservoirs, wetlands, detention ponds, etc.) should be prepared to be utilized as flood water storage. The City may also want to consider working with developers on incorporating water storage into their plans, whether that be through wetland restoration work or the construction of detention ponds.
    - **Stream Restoration:** Stream restoration projects in Laconia should be pursued with the intent of restoring them to their natural state. This can include bank stabilization, floodplain restoration, and revegetation efforts. Black Brook, Jewett Brook, and Durkee Brook are prime examples of streams in need of restoration in the City.
- 6. **Interagency Cooperation:** Laconia should continue to partner with and support other organizations, towns, and agencies within the region. Local partners to consider working with may include various Lakes Associations, neighboring towns, the Lakes Region Planning Commission, Winnepesaukee Gateway, NHDES among others. The importance of working with these groups cannot be understated – these partnerships foster communication and cohesive action across municipality and industry lines. This cooperation can lead to innovative ways to manage our resources and keep the city up to date on regional efforts. Some key opportunities could include:
  - **Watershed Management:** Watershed management is an opportunity for the City

to work with other communities in the region on protecting water quality and quantity. Laconia should have special interest in the work occurring upstream in the Winnepesaukee Watershed based on the drainage of the watershed coming through Paugus Bay. Additionally, the city abuts Lake Winnisquam, and Lake Opechee is entirely within the city's borders.

- **Water Quality Monitoring:** Water quality is essential to the success of the City and the region. Laconia should continue its monitoring processes with the State, LWA, WWN, and UNH Cooperative Extension to keep an eye on current quality as well as future trends. It would be valuable to share this data with neighboring towns, and vice versa.
- **Stormwater Management:** Discussions with other municipalities and natural resource organizations could prove beneficial in ensuring that the City is using the best management practices available for surface water protection and stormwater management.
- **Trail Development:** The potential for recreation opportunities in Laconia is vast. Developing a comprehensive trail system for human-use, aimed at various types of use, could be an excellent opportunity for the city to work with the state, neighboring communities, and recreational groups within the region.

### **Conservation Land Recommendations**

One of the major focuses prompted by this NRI update is the prioritization of conservation lands and easements within the City. Conservation land ownership and easements are an excellent way for a municipality to conserve the natural resources most important to and vulnerable in the area. The City aims to set an example of natural resource stewardship on city-owned conservation properties in the hopes of educating and encouraging landowners to follow suit.

7. **Conservation Land Acquisitions:** Over the last 10 years or so, Laconia has increased its conservation lands from just 6% to 8% of the total acres within the City. The City should continue these efforts to acquire conservation land and easements by identifying parcels of significant interest. When investigating land for potential acquisition, Laconia should consider the following features:
  - **Habitat Conservation:** When evaluating a parcel for a conservation easement or purchase, the City should consider what habitat types are present. Currently, the majority of conservation lands and easements are either Appalachian oak-pine or hemlock-hardwood-pine forests. Conservation lands that include wetlands, peatlands, meadows, and swamps could be prioritized over additional forested lands.
  - **Fragmentation:** Unfragmented, roadless areas should be considered in the acquisition of additional conservation lands and easements. Fragmentation reduces essential habitats and travel corridors for many species. There are a number of parcels within Laconia that would conserve the unfragmented areas and should be considered for conservation purposes, many of which are along Parade, Meredith Center, and White Oaks Roads.

- **Connectivity:** It is beneficial for the City to consider the location of current conservation lands and easements in the acquisition of future lands. Properties adjacent to existing conservation lands/easements should be considered a priority for their contribution to reducing habitat fragmentation.
- **Exemplary Resources:** While investigating opportunities for conservation lands, each parcel should be fully evaluated for the resources it offers. This may include cross comparing the parcel with its WAP habitat, soils characteristics, farmland potential, and potential rare plant and wildlife species, among other potential characteristics.

## 9) REFERENCES

- Chandra, Zoe, et al. The Class of 1964 Policy Research Shop, 2021, Valuation of Lake Winnepesaukee, [https://rockefeller.dartmouth.edu/sites/rockefeller.drupalmulti-prod.dartmouth.edu/files/2021-13\\_lake\\_winnepesaukee\\_final\\_paper.pdf](https://rockefeller.dartmouth.edu/sites/rockefeller.drupalmulti-prod.dartmouth.edu/files/2021-13_lake_winnepesaukee_final_paper.pdf).
- City of Laconia, NH and DuBois & King Inc. 2012. “Jewett Brook Watershed Plan”. <https://www.laconianh.gov/ArchiveCenter/ViewFile/Item/368>
- City of Laconia, NH and DuBois & King Inc. 2016. “Geomorphic Assessment Report and Watershed Plan Black Brook”. <https://www.laconianh.gov/DocumentCenter/View/2382/Black-Brook-Geomorph-Assessment-and-Plan-20160707-PDF>
- “City of Laconia, NH: Zoning.” City of Laconia, NH Code, <https://ecode360.com/15050211>. Accessed 21 Sept. 2021.
- “Climate Change.” EPA, Environmental Protection Agency, 19 Jan. 2017, [https://19january2017snapshot.epa.gov/climatechange\\_.html](https://19january2017snapshot.epa.gov/climatechange_.html).
- “Climate Change Impacts.” Climate Change Impacts | National Oceanic and Atmospheric Administration, NOAA, <https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts>.
- “Climate Change’s Impact on Soil Moisture Could Push Land Past ‘Tipping Point.’” Carbon Brief, 23 Jan. 2019, <https://www.carbonbrief.org/climate-changes-impact-on-soil-moisture-could-push-land-past-tipping-point>.
- Department, NH Fish and Game. Wildlife | New Hampshire Fish and Game Department. <https://www.wildlife.state.nh.us/wildlife/index.html>. Accessed 21 Sept. 2021.
- Department, NH Fish and Game. Wildlife Action Plan | Wildlife | New Hampshire Fish and Game Department. <https://www.wildlife.state.nh.us/wildlife/wap.html>. Accessed 21 Sept. 2021.
- “Flood Risk Overview for Laconia.” Floodfactor.com, Flood Factor, [https://floodfactor.com/city/laconia-newhampshire/3340180\\_fsid](https://floodfactor.com/city/laconia-newhampshire/3340180_fsid).
- GRANIT. <https://www.granit.unh.edu/>. Accessed 21 Sept. 2021.
- IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M.Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.
- Laconia Conservation Commission. 2002. Laconia Wetland Evaluations. Data compiled from 1992 to 2002 on several wetland complexes throughout Laconia. City of Laconia, Laconia, NH.



Laconia Planning Board. 2007. City of Laconia Master Plan. City of Laconia, NH.

Lake Winnepesaukee Historical Society. 2009. Information retrieved from the worldwide web on April 2009. (<http://www.lwhs.us/>).

Lobdell Associates Inc. February 2000. Planning Study For Weirs, Paugus Bay, Opechee Bay, and Winnepesaukee River Watersheds for City of Laconia Planning and Community Development Department.

Mulligan, Adair D., 1995. The Gunstock Parish – A History of Gilford, NH, Published for the Thompson-Ames Historical Society, Gilford, NH. By Phoenix Publishing, West Kennebunk, Maine.

New Hampshire Department of Environmental Services. 2009. Information retrieved from the worldwide web on August 2009.  
(<http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm>)

NHB Data Requests | Land Conservation | NH Division of Forests and Lands.  
<https://www.nh.gov/nhdfl/land-conservation/natural-heritage-bureau.htm>. Accessed 21 Sept. 2021.

Soil Survey | NRCS Soils. <https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/>. Accessed 21 Sept. 2021.

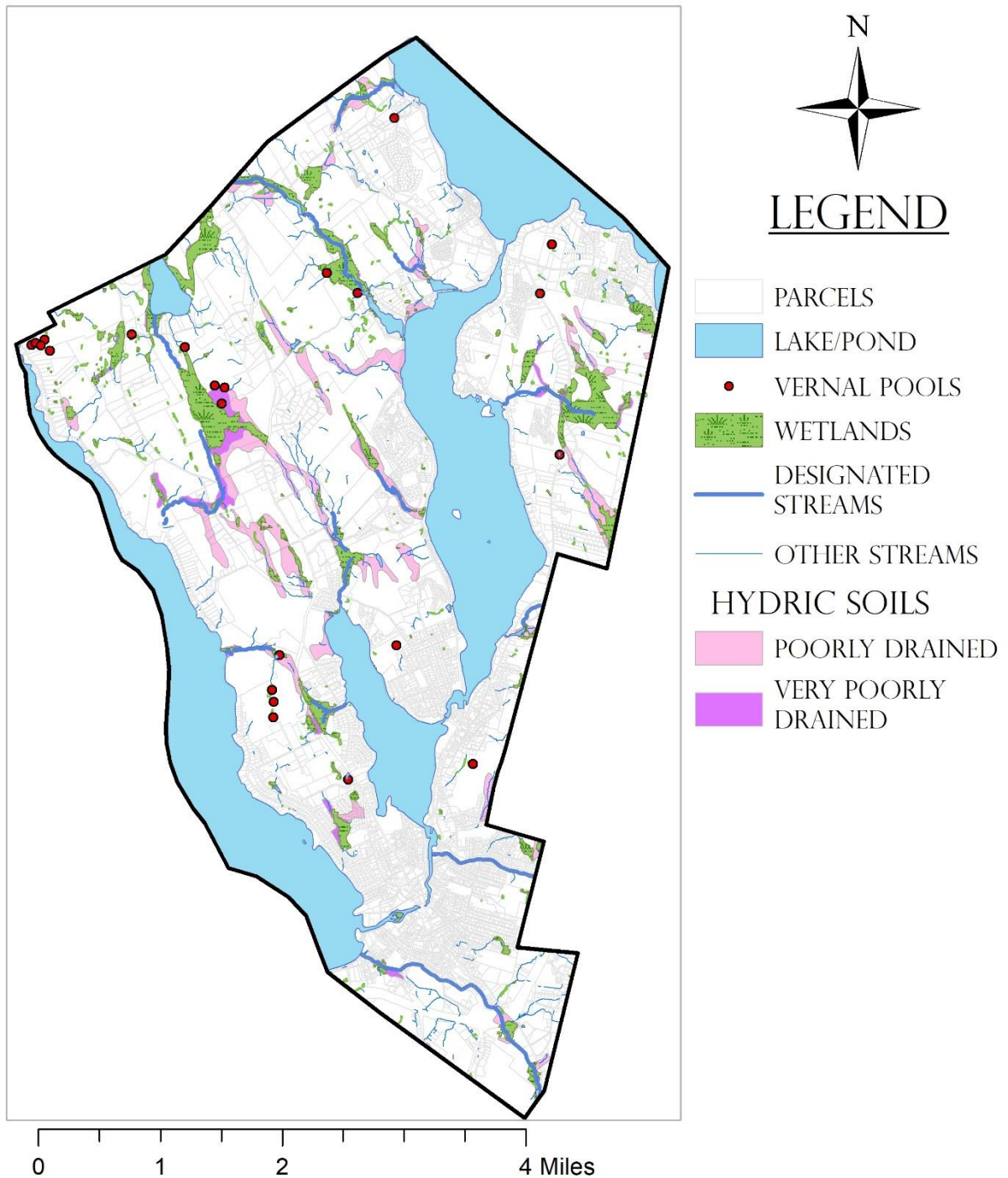
University of New Hampshire. 2005. Natural Resource Inventory for the City of Laconia. NR775, Department of Natural Resources, UNH. Consulting team: Kendra Gurney, Erin Milling, Julie Barber, and Kristen Lamb.

## 9) MAPS

All data and sources for the maps provided here can be reviewed in the methods section of this report.

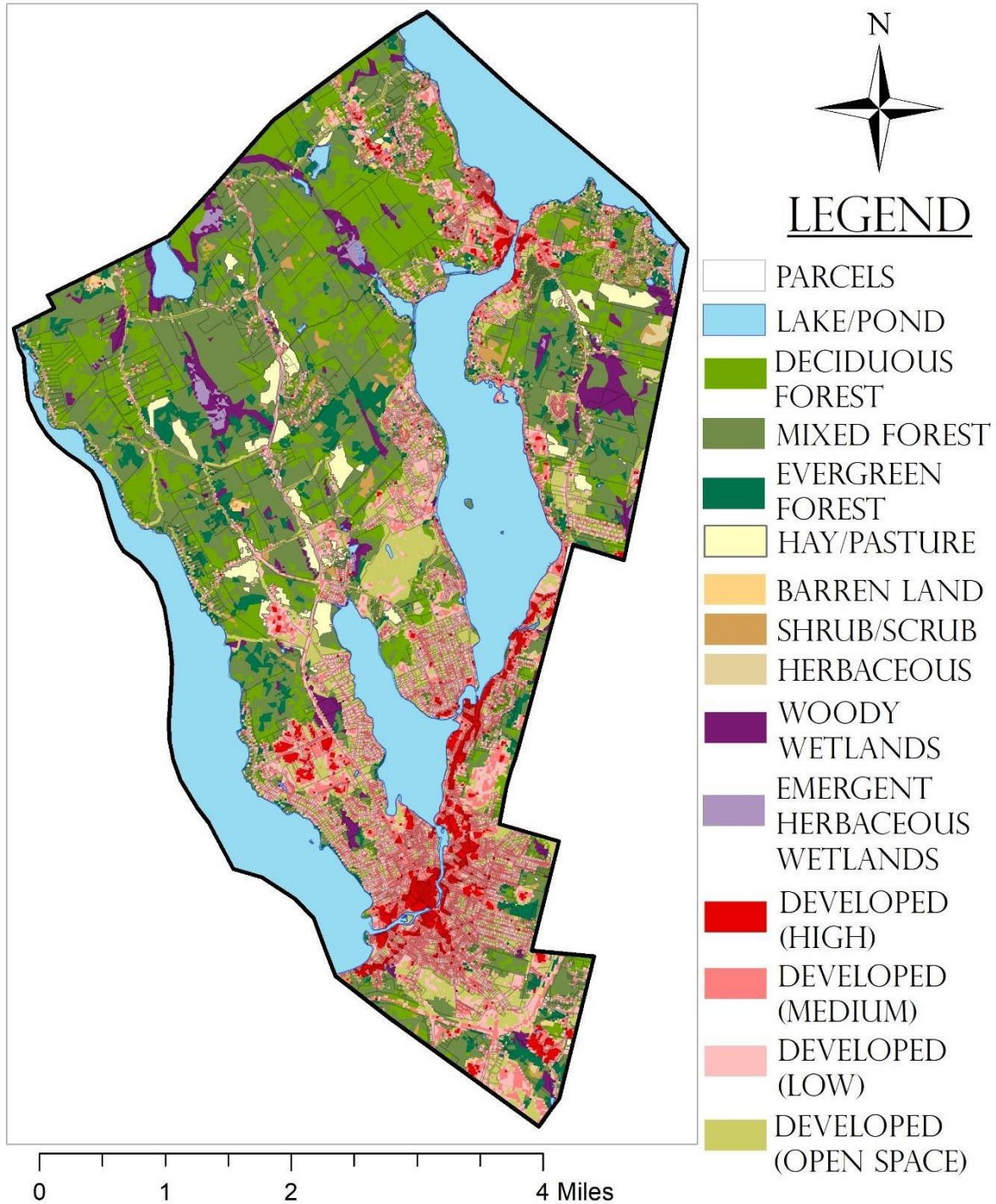
- ❖ Map #1: Water Resources
- ❖ Map #2: Land Cover
- ❖ Map #3: Bedrock Geology
- ❖ Map #4: Subwatersheds
- ❖ Map #5: Farmland Soils
- ❖ Map #6: Forested Soils
- ❖ Map #7: Conservation Lands, Wildlife Openings, and Steep Slopes
- ❖ Map #8: Unfragmented, Roadless Areas
- ❖ Map #9: Invasive Species Priority Management Areas

# WATER RESOURCES



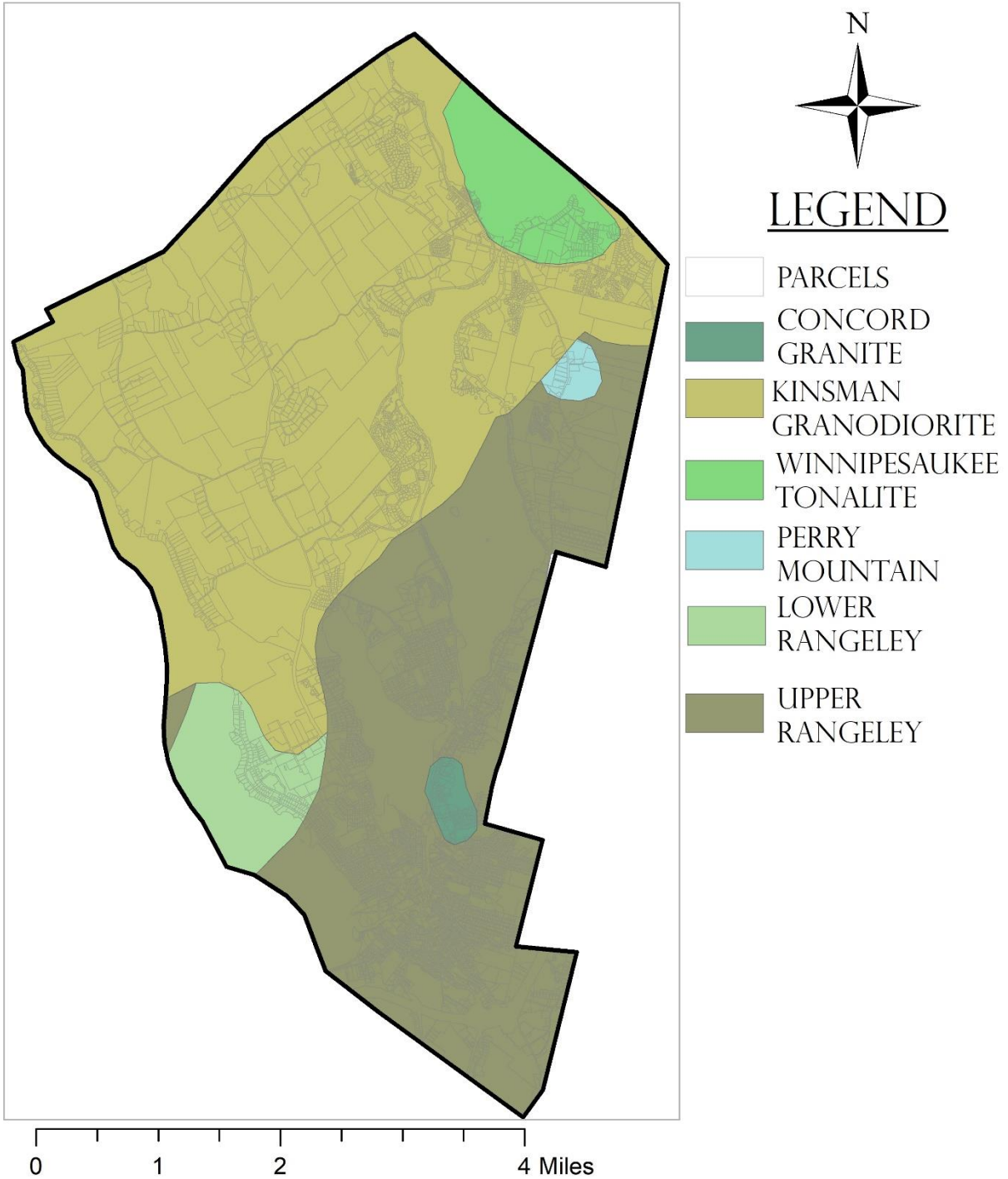
*Map #1: Water Resources*

# LAND COVER



*Map #2: Land Cover*

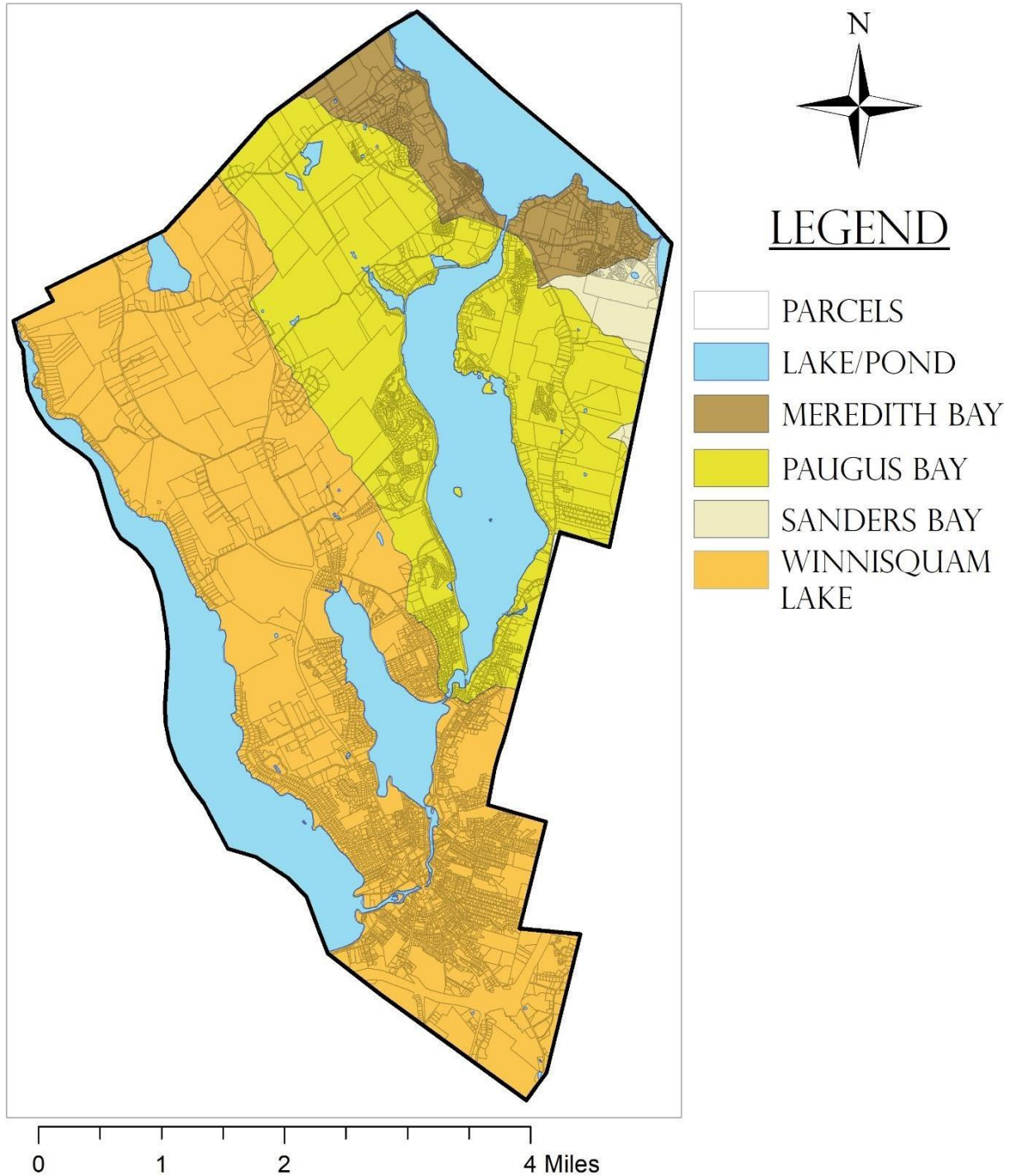
# BEDROCK GEOLOGY



*Map #3: Bedrock Geology*

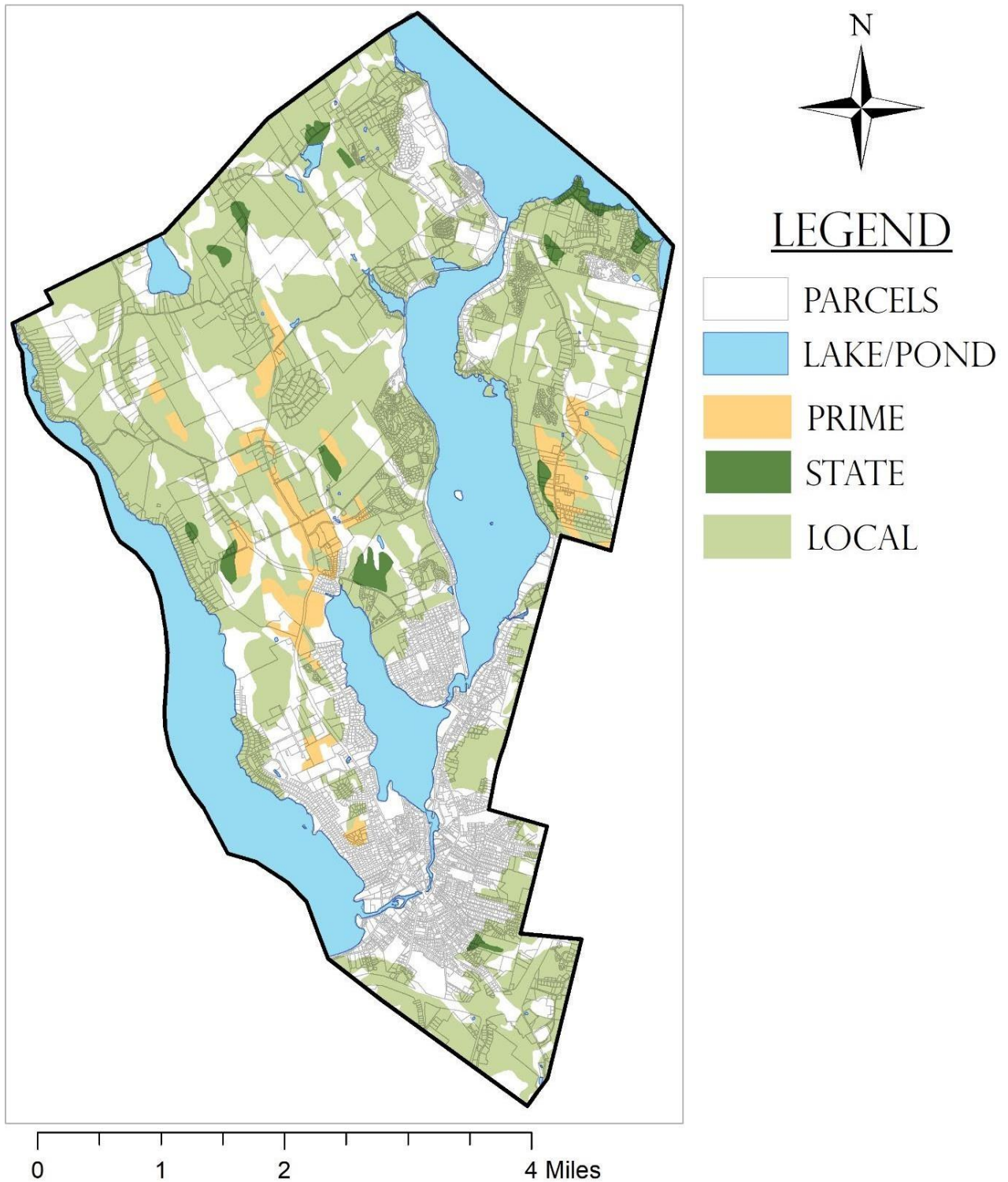


# SUBWATERSHEDS



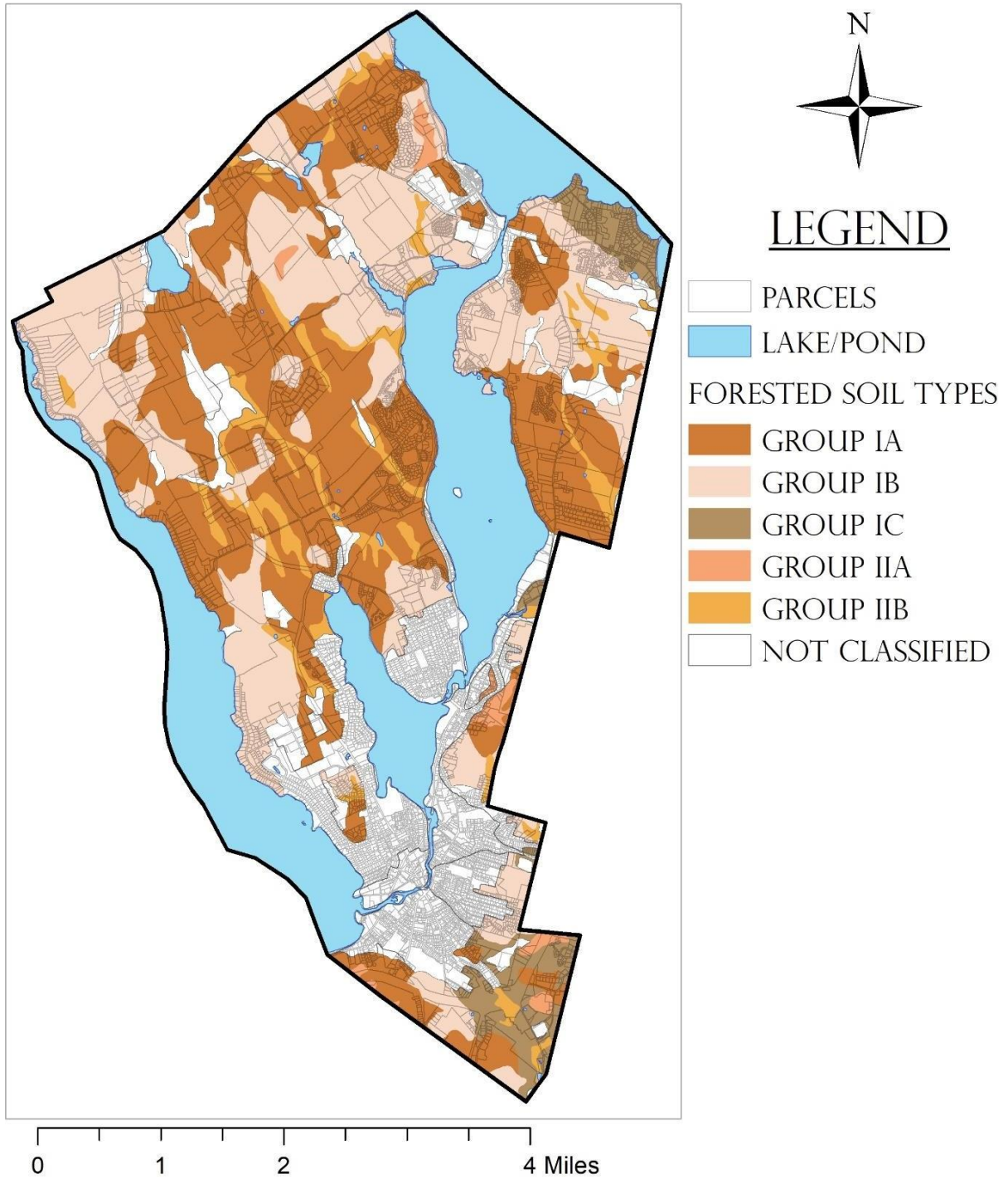
*Map #4: Subwatersheds*

# FARMLAND SOILS



*Map #5: Farmland Soils*

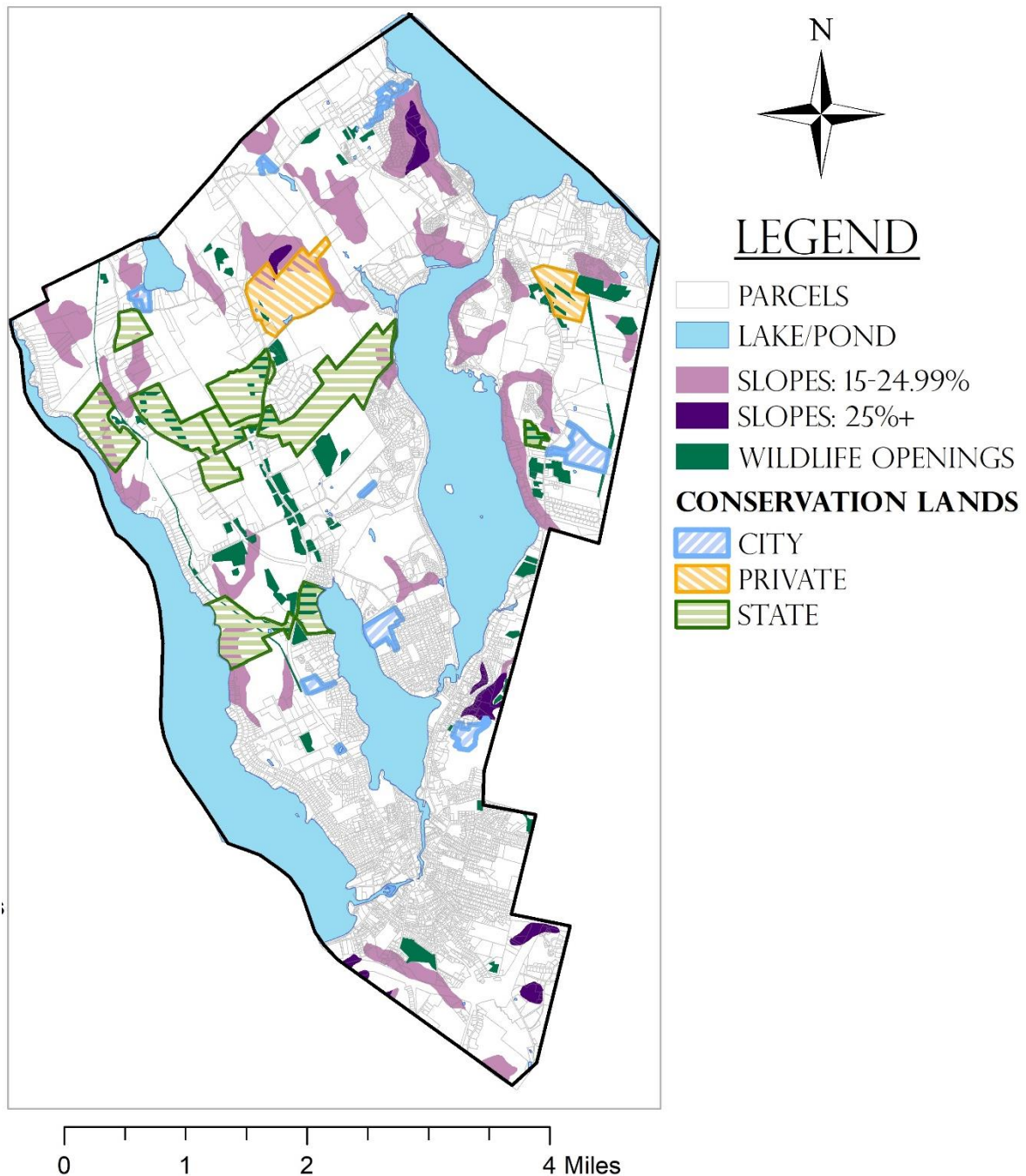
# FORESTED SOIL TYPES



*Map #6: Forested Soils*

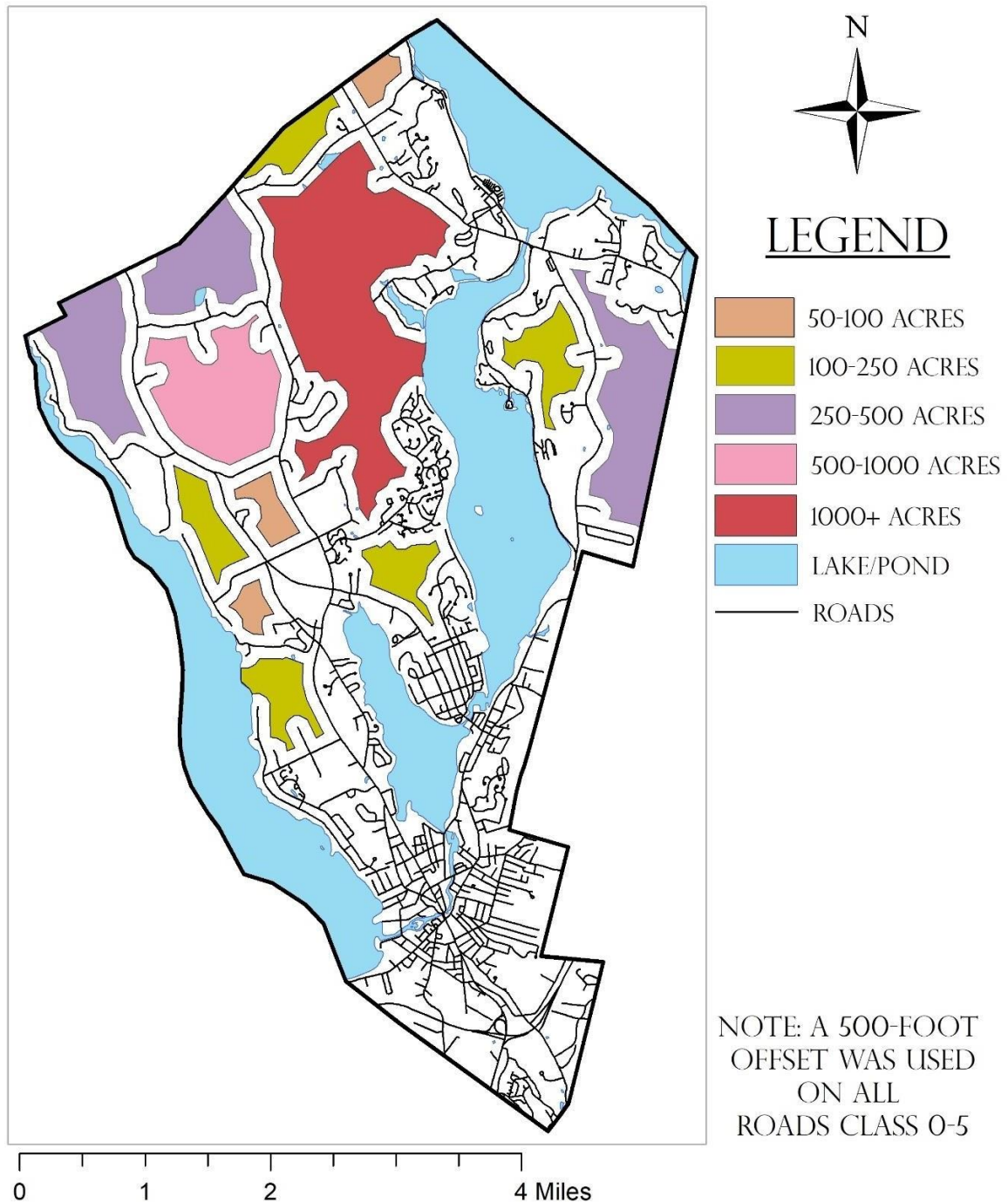


## CONSERVATION LANDS, WILDLIFE OPENINGS, & STEEP SLOPES



*Map #7: Conservation Lands, Wildlife Openings, and Steep Slopes*

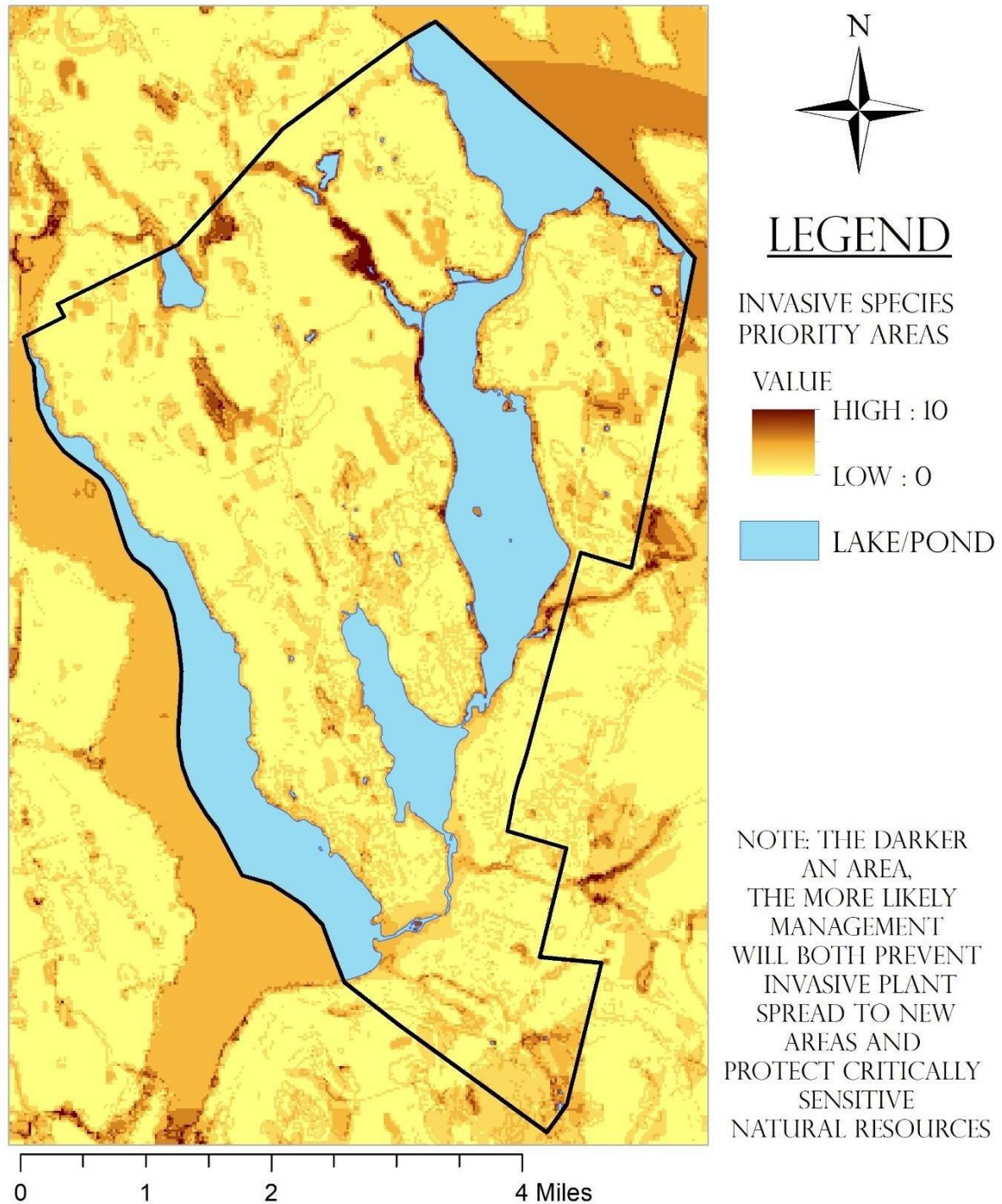
## UNFRAGMENTED ROADLESS AREAS



*Map #8: Unfragmented, Roadless Areas*



## PRIORITY AREAS FOR INVASIVE SPECIES MANAGEMENT



***Map #9: Invasive Species Priority Management Areas***



# NATURAL RESOURCES INVENTORY UPDATE

FOR THE CITY OF LACONIA, NEW HAMPSHIRE



**FB Environmental Associates**

97A Exchange Street, Suite 305 Portland, ME 04101

383 Central Avenue, Suite 267 Dover, NH 03820

[www.fbenvironmental.com](http://www.fbenvironmental.com)



**Gina Mastine**

45 Beacon Street East  
Laconia, NH 03246

September 5, 2025

Dear Ms. Mastine,

FB Environmental Associates (FBE) is pleased to submit this proposal in response to the City of Laconia's request for a natural resource inventory (NRI) and to help identify and prioritize areas of high environmental and ecological value that should remain undeveloped. This effort will build on our proven experience across New England communities, work in the Lakes Region, and prior work with the City.

FBE is an environmental consulting firm with offices in Portland, ME, and Dover, NH, staffed by 19 experienced natural resource scientists and planners. Since 2001, we have focused on evaluating natural areas and helping communities mitigate human impacts on aquatic, terrestrial, and wetland ecosystems. Our work spans across New England, from individual property assessments to town-wide evaluations.

- **We are deeply familiar with the natural resources of New Hampshire's Lakes Region, the challenges they face, and the strategies needed for their protection.** Our experience includes completing NRIs for Moultonborough (2016, updated 2025), Rye (2021), Hampton (2024), Dover (2024), Lee (2024), and Hampton Falls (2025).
- **We understand the opportunities and pressures on natural resources in Laconia.** We are currently working with the City on a NHDES Drinking Water Grant project for Paugus Bay and completed a hydrologic assessment of Langley Brook in collaboration with the Lake Winnepesaukee Association (2023). Additional projects include watershed management planning in the Lakes Region and natural resources site assessments and permitting for proposed solar development project in Laconia.

With our extensive experience and strong local connections, FBE is well-positioned to provide Laconia with a strong understanding of high ecological value areas for protection. If awarded the contract, I will serve as Principal-in-Charge, ensuring project success. Sarah Sullivan will serve as Senior Project Manager and lead Ecologist and will be responsible for timely and quality project deliverables. Sarah will work closely with a team of GIS specialists and ecologists. Together, they will execute technical project tasks and prepare maps and report.

We look forward to the opportunity to work with the City of Laconia to complete an NRI that enhances the City's understanding of natural resources. If you have any questions, please feel free to call me at (207) 221-6699 or email me at [info@fbenvironmental.com](mailto:info@fbenvironmental.com).

Sincerely,

Forrest Bell  
FBE Owner & CEO



## 2. Firm/Team Background

### Our Mission

*FB Environmental is dedicated to practical stewardship of our natural world. We work to restore and protect ecosystems through science and community collaboration. We focus on clean water and biodiversity conservation, serving both public and private clients. We strive for sustainable solutions, resilience, and environmental justice in every project.*

FB Environmental (FBE) is a leading consulting firm specializing in ecosystem services, natural resource planning, and conservation strategies. With offices in Dover, NH and Portland, ME, FBE works at the intersection of science, policy, and community engagement to support sustainable land and water management throughout New England. Forrest Bell is the founder and CEO.

Our expertise includes watershed and habitat assessments, ecological restoration, and climate resilience planning. We assist municipalities, conservation commissions, and state agencies in identifying and protecting critical ecological resources through conducting natural resource inventories, rare and endangered species surveys, and wetland delineations to guide responsible land-use planning and conservation efforts.

With over two hundred years of combined staff experience, FBE integrates GIS mapping, technical site assessment, and ecosystem function evaluation to develop data-driven strategies that enhance



biodiversity and ecosystem resilience. In addition, our work includes urban watershed restoration, regulatory compliance support, and green infrastructure implementation, ensuring that conservation initiatives align with both local environmental goals and broader climate adaptation efforts.

Recent projects include municipal natural resource inventory updates, statewide wetland delineations, and habitat conservation strategies that support sustainable development. An independent U.S. Government evaluation awarded FBE 95 out of 100 performance score, including a perfect 100 for staff professionalism and expertise. Our commitment to ecosystem services ensures that communities can make informed decisions that balance economic development with long-term environmental sustainability.

## Project Team

### **Forrest Bell** *Principal-in-Charge*



Over the past 24 years, Forrest has become a regional leader in watershed assessment, planning, and restoration. He has directed over 1,000 environmental projects, ranging from small (<\$5,000) to large (>\$1,000,000), for federal and state agencies, municipalities, and nonprofits. Since founding FBE in 2001, he has grown it into a respected consulting firm with 19 expert staff. Forrest specializes in helping communities assess natural resources and make science-based policy decisions. A skilled presenter and facilitator, he excels at communicating complex land and water resource issues. **Forrest will serve as Principal-In-Charge and will ultimately be responsible for ensuring project success.**

### **Sarah Sullivan** *Senior Project Manager & Wetland Scientist*



Sarah's expertise includes project management, wetland delineations, natural resources inventories, natural community identification, stream habitat assessments, as well as technical and permit writing. Sarah joined FBE in July of 2021 with five years of experience at the NH DOT's Bureau of Environment, as the Wetlands Program Analyst where she conducted wetland delineations, permitting, as well as desktop and in-field natural resources inventories of state-owned properties. She holds a bachelor's degree in Environmental Studies with a focus on Ecology from Colby College, where she double majored in Physics. At FBE she serves as the firm's Permitting Lead and is a Senior Wetland Scientist. **Sarah will serve as the project manager for this project.**

### **Christine Bunyon** *GIS Specialist*



Christine is FBE's lead GIS specialist, managing projects requiring geospatial analyses, data organization, land-use modeling, fieldwork, and technical writing. Christine began working at FBE in 2018 and rejoined in 2023 following completion of her graduate degree specializing in remote sensing from UNH. She is a Certified Remote Pilot of (FAA Part 107)-drones. Christine has an M.S. in Natural Resources and the Environment. Her research focused on using remote sensing technology capturing imagery from an unmanned aerial system (UAS) to study and monitor cyanobacteria blooms in New Hampshire waterbodies. **Christine will provide technical support for GIS analysis and will perform the co-occurrence analysis for the Laconia Conservation Commission.**



**Johanna Szillery    *Senior Soil Scientist, CPSSS***

Johanna has 15 years of experience in the soil science and natural resources field. She is a wetland scientist and a Maine Certified Soil Scientist (ME LSS 494). Johanna specializes in wetland and natural resource delineation, planning, and permitting, soil surveys and soil suitability assessments. Johanna has worked with a variety of clients and with State and Federal regulators to meet the goals of each through the permitting process. As a soil scientist, Johanna has performed soil surveys throughout Maine, from general planning level soil surveys to high-intensity soil surveys specific to the proposed development. **Johanna will serve as a Senior Ecologist and Soil Scientist for this project.**

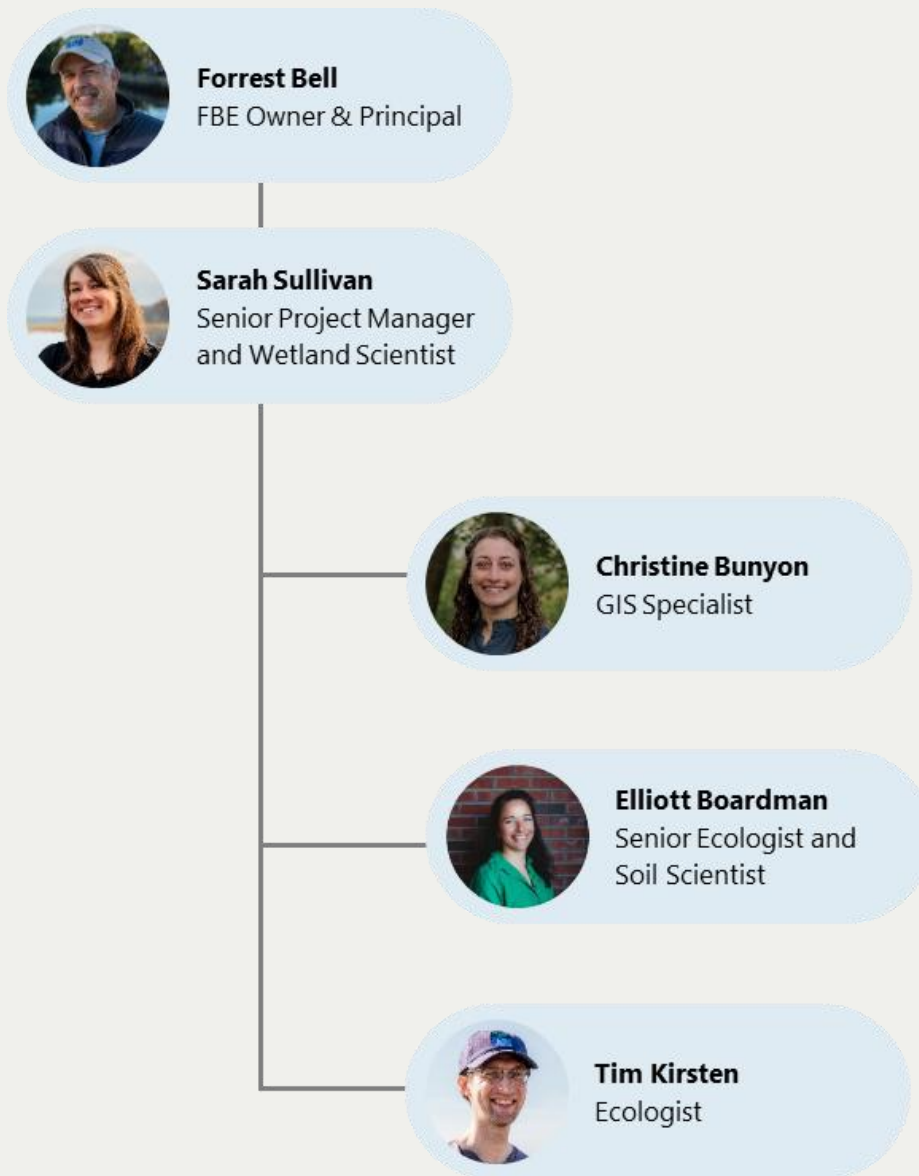
**Tim Kirsten    *Ecologist***

Tim joined FBE in 2024 and specializes in ecological services, including wetland delineations, natural resource inventories, vegetation monitoring, and vernal pool surveys. He also assists with watershed-based management plans, water quality monitoring, and MS4 permitting. Originally from South Africa, Tim has developed a deep passion for botany and the natural world, which he continues to apply in his role at FBE after relocating to the U.S. Tim completed an M.S. at the University of Cape Town where he mapped the spatial extend of land degradation for a large agricultural region in South Africa, applying machine learning statistical analyses to satellite imagery and habitat assessment data he collected. He has experience conducting biodiversity, vegetation and soil assessments in a variety of ecosystems, and has previously consulted on climate change adaptation projects throughout Africa. Tim additionally volunteered in the Buzzards Bay region of southern Massachusetts during the summer of 2023, assisting with trail maintenance and invasive plant control. **Tim will provide ecological expertise and support for the Laconia Conservation Commission.**

***Please see Appendix A for Staff Resumes***

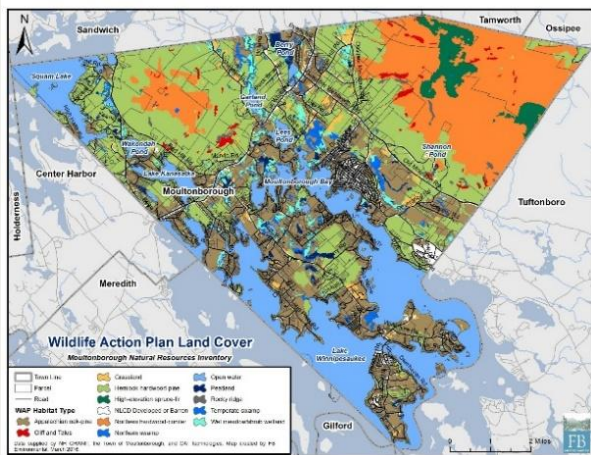
## Organizational Chart

FBE is owned and founded by Forrest Bell. Forrest is supported by a leadership team, comprised of five additional senior staff members. The leadership team members and bios can be found at our website, available [here](#). The following organizational chart outlines the project team that will support the City of Laconia with the NRI, if selected.



### 3. Professional and Technical Qualifications

The projects listed below highlight our experience in environmental planning, natural resource inventories, GIS analyses, and management plan development for local municipalities and conservation commissions.

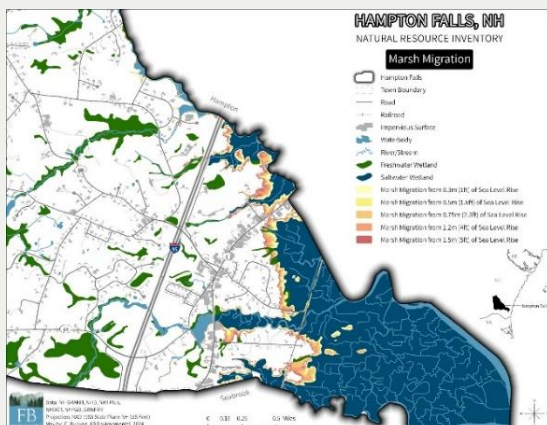
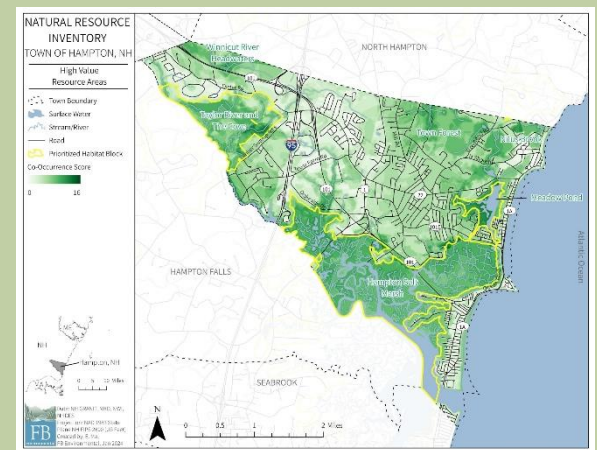


#### Moultonborough NRI Update

FBE completed a town-wide [NRI](#) (2016, 2025 update in progress) for Moultonborough, NH, a 75-square-mile town in the Lakes Region of NH. The Town contains several large waterbodies, mountains, and other natural resources that attract many visitors and seasonal residents. FBE identified rare plants, animals, and exemplary natural communities using the Natural Heritage Bureau database. FBE created maps of terrestrial and wetland communities throughout the Town, identified and described soil types and locations, and developed recommendations for both a management plan and public outreach.

#### Hampton NRI Update

FBE collaborated with the Town of Hampton Conservation Commission to develop an [NRI](#) (2024) for the Town of Hampton, NH. This 14.6-square-mile town in the Seacoast Region of New Hampshire has over 2,439-acres of conserved land which includes many of the Town's marshes and wetlands. As part of the NRI, FBE created twenty maps depicting terrestrial and wetland resources, flood prone areas, sea level rise and marsh migration zones, beach migration, and a co-occurrence analysis of high value resource areas throughout the town.



#### Hampton Falls NRI Update

FBE recently developed an [NRI](#) and [Story Map](#) (2025) for the Town of Hampton Falls, a 12.4-square-mile community in New Hampshire's Seacoast Region. This project includes creating comprehensive GIS maps and a detailed report to enhance understanding of the town's natural resources. Key deliverables focused on identifying resource-rich areas, co-occurrence analyses, and addressing climate change vulnerabilities.

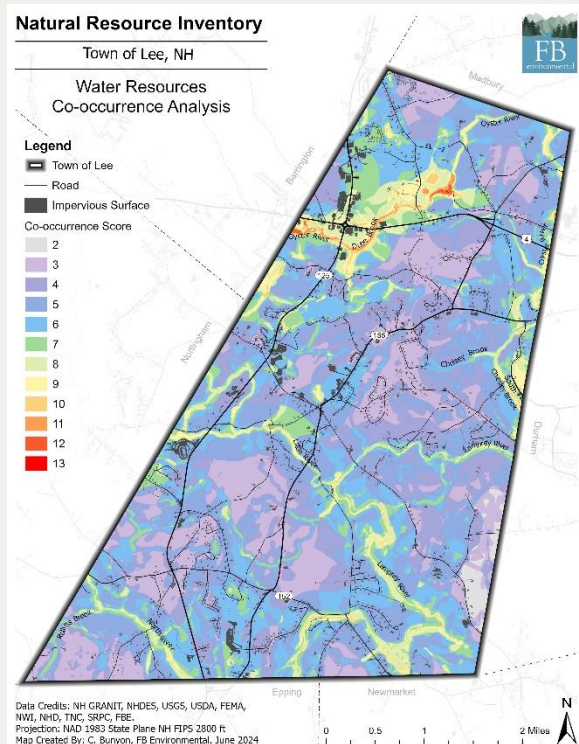


## Peaks Island Natural Resource Management Plans

FBE developed comprehensive natural resources management plans (2023/2024) for seventeen properties owned or under conservation easement by the Peaks Island Land Preserve (PILP). The management plans incorporated hands-on fieldwork and GIS mapping techniques to assess and document the diversity of natural resources present across these sites.

FBE expertly identified and mapped various features, including wetlands, geology/soils, land use/land cover, as well as significant plant and animal habitats. Furthermore, we conducted thorough field assessments to identify and map natural resource elements such as wetlands, watercourses, natural community types, and wildlife habitats. The resulting reports are of significant utility to PILP, offering detailed insights into the properties' natural attributes and presenting targeted recommendations for natural resource-focused management.

Through these management plans, PILP and FBE made significant strides towards the conservation and sustainable management of these exceptional properties. By gaining a comprehensive understanding of the properties' natural resources, PILP can work to ensure their long-term preservation, protecting their scenic landscapes, providing important wildlife habitats, and securing low-impact recreational opportunities for future generations to enjoy.



## Lee NRI & Water Resources Analysis

As part of the townwide Natural Resource Inventory developed by the Strafford Regional Planning Commission (2024), FBE conducted a GIS-based co-occurrence analysis of water resources in the Town of Lee. This analysis identified areas within a high density of water sources – such as streams, rivers, wetlands, aquifers, and flood zones – to guide conservation efforts focused on drinking water protection. FBE mapped overlapping resource areas using 19 spatial data layers from state and federal sources. The maps serve as a tool to prioritize conservation areas, enhance municipal zoning and ordinances, and guide planning efforts to protect high-priority water resources.

## 4. References

### Marie Samaha

Chair, Moultonborough Conservation Commission  
Town of Moultonborough, NH  
(603) 476-2347; [marietsamaha@yahoo.com](mailto:marietsamaha@yahoo.com)

### Brianna Hagan

Conservation Coordinator  
Town of Hampton, NH  
(603) 929-5808; [bhagan@hamptonnh.gov](mailto:bhagan@hamptonnh.gov)

### Dawn Genes

Chair, Lee Conservation Commission  
Town of Lee, NH  
(603) 659-5414; [dawn.genes@comcast.net](mailto:dawn.genes@comcast.net)

### Sara McNamara-Gagnon

Coastal Conservation Coordinator  
Seabrook-Hampton Estuary Alliance  
[sgagnon@shea4nh.org](mailto:sgagnon@shea4nh.org)



“

*"It is with great pleasure that I recommend FBE for ecological services. The services offered by FBE bring a unique blend of professionalism and high level of coordination and expertise. Their demonstrated ability to problem solve when posed with challenging situations makes them above the rest."*

**Todd Janeski**, Senior Planner Formerly with the Maine State Planning Office/Maine Coastal Program

”



## 5. *Client Support*

FBE has assembled a highly qualified team that will remain readily available throughout the duration of the project.

- **Forrest Bell, Principal-in-Charge**, will communicate frequently with Sarah to ensure project deliverables are completed in a timely and quality manner for the City. Forrest will complete monthly project tracking and administrative duties with FBE's Business Manager. Forrest is available on an as-needed basis for support to the City.
- **Sarah Sullivan, Senior Project Manager & Wetland Scientist**, will serve as the primary point of contact and will be available for all project meetings, including up to three Conservation Commission meetings, as well as site visits as requested by the City. Sarah's project management oversight ensures consistent communication, timely deliverables, and responsiveness to the Commission's needs. Based in Dover, NH, Sarah is readily available for in-person meetings.
- **Christine Bunyon, GIS Specialist**, will be available for technical meetings, presentations, and coordination regarding GIS analyses. Based in Dover, NH, Christine is available for in-person meetings.
- **Johanna Szillery, Senior Ecologist**, will be available to provide support virtually at project meetings and is well-positioned to participate in site visits where additional senior ecological expertise is required.
- **Tim Kirsten, Ecologist**, will be available to support targeted field investigations and attend site visits, particularly those involving vegetation monitoring, vernal pool surveys, or broader ecological assessments. Based in Dover, NH, Tim is available for in-person meetings.

Collectively, the FBE team maintains a flexible schedule and is committed to aligning with the City of Laconia's project timeline. Our staff are based in New England, which allows for efficient coordination, in-person presence when requested, and timely completion of fieldwork during appropriate seasonal windows.

## ***6. Additional Information***

### **Scope of Work**

The following outlines FBE's approach to achieving the City's goal of identifying and prioritizing areas of high environmental and ecological value to remain undeveloped. FBE understands that the City intends to use and reference this information when making decisions on development projects and reviews of land use applications and site plans to ensure that areas of high value are protected from disturbance and development. FBE provided the following scope of work and approach to the City in the Spring of 2025 for their consideration.

The following scope of work is intended to provide the City of Laconia's Conservation Commission with a follow-up study to augment the information provided in the 2009 City-wide NRI and 2022 NRI update. The goal of this analysis would be to use GIS spatial mapping techniques to identify existing areas of high environmental and ecological value. The City can then refer to this information when making decisions on development projects, to ensure that areas of high value are protected from disturbance and development. FBE is flexible and able to adjust this Scope of Work upon project initiation, if selected.

### **Project Management and Administration**

FBE will work closely with the City of Laconia's Conservation Commission to complete the tasks listed in this scope of work. Project management and administration includes invoicing and internal administration, project scheduling, project coordination, and project tracking. Additionally, FBE anticipates a project kick-off meeting with the Conservation Commission.

### **Review of Existing NRI Documents**

FBE will review the existing City of Laconia Natural Resources Inventory ([2009](#)) report and NRI update ([2022](#)) for pertinent information and previously identified areas prioritized as having high environmental and ecological value (i.e., priority areas) to fold into FBE's study and analysis.

### **Co-Occurrence Analysis and Mapping**

Utilizing available desktop natural resources GIS data and conducting a co-occurrence analysis in GIS, FBE will create a PDF map identifying areas of high environmental and ecological value. In addition, FBE will identify and create a spatial data layer for areas of unfragmented land throughout the city, a contributing factor in identifying areas of high environmental and ecological value. FBE will provide the City with GIS shapefiles to integrate into Axis GIS, or an equivalent platform, for ease of use and overlay with other City features.

The purpose of this analysis is to identify areas in the city where natural resources are concentrated, and the co-occurrence map will depict these high density natural resource areas. These maps will serve as a valuable tool and guide for the Commission for project review, and planning efforts, and prioritizing the protection of and/or limiting development of land in the city.

***Deliverables:*** Required GIS Data and Shapefiles

## **Summary Report**

FBE will prepare a report summarizing our methods and findings of the co-occurrence analysis and highlighting key resources and features within each area of high environmental and ecological value. Areas will be coded so they can easily be matched to locations on the map. FBE will provide the report to the commission for review and a round of edits prior to presenting the findings.

***Deliverables:*** Draft and Final Natural Resources Inventory and Executive Summary (print and digital versions)

## **Conservation Commission Meetings**

FBE anticipates up to three (3) meetings with the Conservation Commission to brainstorm and gather anecdotal knowledge of priority areas, discuss the co-occurrence methodology, and gain input on the analysis approach. Additionally, FBE will present the findings of the co-occurrence analysis and areas identified as high environmental and ecological value. For budgetary purposes, FBE anticipated virtual meetings and did not include travel time or mileage in this scope. FBE would be happy to meet in person and adjust the scope and cost estimate to include in-person meetings.

***Deliverables:*** 3 meetings with Conservation Commission

## **Field Investigations**

FBE can conduct targeted field investigations at sites identified as having high environmental and ecological value. These investigations would serve to strengthen the NRI and clearly document the reasons why each site should remain undeveloped and/or conserved. Depending on the site, investigations could include classification and description of natural resources; mapping of natural communities and cover types; evaluation of suitable wildlife habitat; vernal pool surveys; and surveys for rare, threatened, and endangered wildlife and plant species.

It is important to note that field investigations will be undertaken if requested, funding is available, at municipally owned parcels, or if individual property owners provide written consent granting access to their land for this purpose.



# 7. Cost Proposal

## Estimated Budget

It is expected that Tasks 1 through 5 will cost up to **\$17,955** to complete as shown in Table 1. Field investigations can be completed at a **\$2,730/day plus \$2,200 for data post proccing and summarizing** (time, materials, and expenses included) and the number of days depends on the number of properties and size of the properties. FBE's estimated overhead is approximately 16%.

Table 1. Project tasks and budget table.

Project Task	Budget
<b>2.2</b> Project Management and Administration	\$2,023
<b>2.3</b> Review of Existing NRI Documents	\$1,848
<b>2.4</b> Co-Occurrence Analysis and Mapping	\$5,265
<b>2.5</b> Summary Report	\$5,072
<b>2.6</b> Conservation Commission Meetings (3 virtual)	\$3,747
<b>Total</b>	<b>\$17,955*</b>
<b>OPTIONAL 2.7</b> Field Investigations	*\$2,730/day + \$2,200

\*The total does not include field investigations.

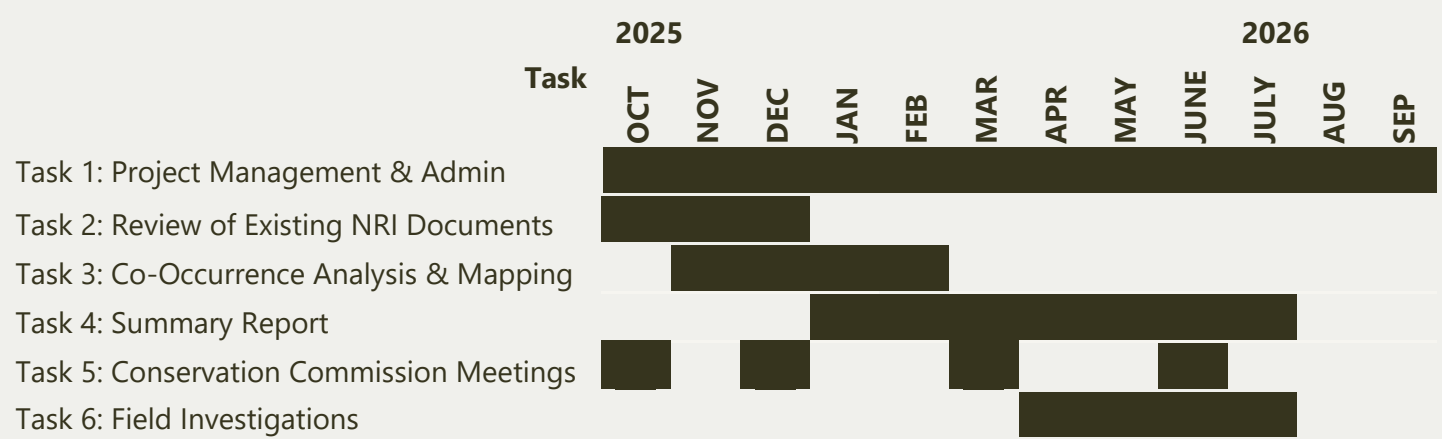
Table 2. Individual staff labor rates.

Staff Member	2025 Rate	2026 Rate
Forrest Bell, Principal-in-Charge	\$182	\$189
Sarah Sullivan, Senior Project Manager & Wetland Scientist, CWS	\$125	\$130
Christine Bunyon, GIS Specialist	\$116	\$121
Johanna Szillery, Senior Soil Scientist, CPSSS	\$155	\$161
Tim Kirsten, Ecologist	\$93	\$96

Timeline

FBE developed a timeline (Table 3, below) with an anticipated start date of October 2025 and a completion date in September 2026 based on the 12-month project timeline provided in the RFP. This schedule is designed to meet project milestones efficiently, but we are flexible and can adjust the timeline to align with the Commission’s needs or expedite specific tasks if feasible. Final adjustments will depend on the timing of the project award and any additional requirements from the City.

Table 3. Estimated project timeline for completion based on the 12-month timeline provided in the RFP.





# ***Appendix A: Staff Resumes***

The following pages contain resumes of the FBE staff who will work on this project.



# FORREST BELL

## Owner & CEO

As the founder and owner of FBE, Forrest is a regional leader in environmental assessment and restoration projects. With over 33 years of experience, he has led more than 950 successful projects for a diverse range of clients, including federal and state resource agencies, municipalities, and non-profits. A skilled presenter and facilitator, Forrest excels at conveying the complexities of land and water resources to New England's communities.

### EXPERTISE

- BMP Design & Implementation
- Community Development
- Conservation & Land Use Planning
- Lake, River, & Stream Assessment
- River & Stream Geomorphology
- Natural Resource Evaluations
- Watershed Management
- Water Quality Monitoring & Modeling

### EDUCATION

M.S. coursework completed, Natural Resource Administration & Management  
*University of New Hampshire (2002)*

B.A. Geography & Land Use Planning  
*University of Southern Maine (1991)*

### VOLUNTEER BOARDS

Executive Board Member, Piscataqua Regional Estuaries Partnership (2011-2016)

Executive Board Member, Saco Headwaters Alliance (2019 – 2021)

### MEMBERSHIPS

North American Lake Management Society

American Planning Association

### PROFESSIONAL HIGHLIGHTS

- Proven success with clients including the US Environmental Protection Agency, US Army Corps of Engineers, Maine Department of Marine Resources, New Hampshire Department of Environmental Services, Rhode Island Department of Environmental Management, Piscataqua Regional Estuaries Partnership, Casco Bay Estuary Partnership, numerous private companies, and **over 50 municipalities** in ME and NH.
- Technical expertise in geomorphic processes, river and stream restoration, water quality monitoring, BMP design, and pollutant load modeling.
- Engaged face-to-face with over **5,000 landowners and industry employees** in fishing and agriculture to develop conservation strategies.
- Advises nonprofits, government agencies, municipalities, and professional associations on compliance with environmental programs and laws.
- Delivered **100+ formal presentations** at national, state, regional, and local conferences on water resources, watershed management, and land management.
- Secured **over \$20 million** in environmental project funding from 1995 to 2024 to support water resource protection and improvement initiatives.

### SELECT PROJECTS

#### Watershed Planning & Restoration

##### Megunticook River Watershed Project (2022-Present)

Camden, ME | Role: Senior Project Manager | [Website](#)

Multi-year, \$1.6M National Fish and Wildlife Foundation-funded project supporting Megunticook River restoration. Tasks include collaboration with the Town of Camden and Inter-Fluve to oversee the grant, coordination with landowners, public outreach, and management of a Town advisory committee.

##### Saco River Watershed Projects (2018-Present)

Conway, Bartlett, Jackson, Albany, Hart's Location, NH | Role: Senior Project Manager  
Helped establish the Saco Headwaters Alliance to oversee long-term water assessment and restoration, collaborating with conservation organizations, agencies, and municipalities. Currently managing multiple projects in the Saco River watershed focused on water quality, groundwater protection, floodplain mapping, and climate resiliency.

##### Watershed Management Plans (1991-Present)

Principal-in-Charge over fifty watershed management plans across New England, with specific expertise in EPA nine-element plans for lakes, rivers, streams, and estuaries. Provides senior oversight to FBE staff on plan writing, data collection and analysis, stakeholder outreach, and pollutant load modeling.

##### Select plans:

Lake Winnepesaukee (multiple) | NH | 2014-Present | [Plans](#)

Lake Kanasatka | Moultonborough, ME | 2022 | [Plan](#)

Long Creek | Portland, ME | 2009 | [Plan](#) ★ **U.S. EPA Merit Award Winner**



# FORREST BELL

FBE Owner & CEO

## SELECT PROJECTS CONTINUED

### Water Quality Assessment and Reporting

#### U.S. EPA Region 1 Blanket Purchase Agreement (2008-2013; 2019-Present)

*New England | Role: Principal Scientist & Senior Project Manager*

*Two five-year, multi-million-dollar contracts focused on detailed assessments of impaired waterbodies across all six New England states. Responsibilities included directing staff, technical writing, river and stream mapping, impervious cover analysis, pollutant load modeling, and water quality monitoring for multiple parameters. Forrest successfully led eleven large-scale projects under these contracts.*

#### MA DEP Total Maximum Daily Load & Nonpoint Source (2017-Present)

*Massachusetts | Role: Senior Project Manager*

*Assist MA DEP with multiple projects under two blanket contract agreements to deliver TMDL and NPS services for Massachusetts watersheds. Tasks include developing TMDLs for bacteria- and nutrient-impaired waters, creating watershed management plans, and conducting water quality data analysis.*

### Natural Resources Conservation Planning & Management

#### Peaks Island Land Preserve (2022) ★ *Northern New England American Planning Association 2024 Plan of the Year*

*Peaks Island, ME | Role: Principal-in-Charge | [Report](#)*

*Developed large-scale natural resources inventory and conservation management plans for eighteen properties on Peaks Island. Tasks included cover type mapping, invasive plant management, and plan development, in collaboration with Mohr & Seredin Landscape Architecture of Portland, ME.*

#### Multiple Maine and New Hampshire Land Trusts (2012-Present)

*ME & NH | Role: Principal-in-Charge*

*Collaborate on multiple projects with Maine and New Hampshire land trusts, including development of Natural Resources Inventories, conservation planning, easement monitoring, buildout studies, invasive species management, GIS mapping, and wildlife surveys.*

#### Upper Saco Valley Land Trust Conservation Planning (2013-2015)

*Saco Valley, NH | Role: Project Manager & Lead Scientist*

*Project tasks included interpreting regional co-occurrence modeling, leading presentations to eleven municipalities, modeling future development patterns, hosting a community forum, and engaging communities in land protection efforts.*

## PRESENTATIONS, ETC.

Bell, F. (2022). NH Lakes Congress, Meredith, NH. Empowering Lake Associations to Develop Watershed Management Plans.

Bell, F. (2022). Town of Moultonborough, ME. Lake Kanasatka Watershed Management Plan Final Community Presentation.

Bell, F. (2019). Maine Stormwater Conference, Portland, ME. Innovative Restoration Efforts on Dole Brook & Riverside Golf Course.

Bell, F. (2019). Town of Alton, NH. Implementing the Merrymeeting River & Merrymeeting Lake Watershed Management Plan.

Bell, F. (2018). Green Mountain Conservation Group: Multiple Public Presentations for the Ossipee Lake Watershed Plan.

Bell, F. (2017). Lake Winnepesaukee Association. Multiple Public Presentations for Lake Winnepesaukee Watershed Plan Development.

Bell, F. (2016). New Hampshire Lakes Conference, Meredith, NH. Watershed Plan Development.

Bell, F. (2016). Penobscot River Watershed Conference, Northport, ME. Culvert Assessment for Climate Change Adaptation



# SARAH SULLIVAN CWS

## Wetland Scientist & Permitting Lead

Sarah brings over ten years of expertise in wetland delineations, natural resource permitting, agency consultation, and technical writing. At FBE, Sarah is a lead wetland scientist and permitting specialist. Prior to FBE, Sarah served as Wetlands Program Analyst at the NH Department of Transportation, managing over 100 state and federally funded wetland and stream-related projects. She has a proven track record of working with federal, state, municipal, and private clients, delivering high-quality environmental solutions tailored to diverse project needs.

### EXPERTISE

- Wetland Delineation & Functional Assessments
- Geomorphic & Stream Habitat Assessments
- Natural Resources Inventories
- Vernal Pool Surveys
- Rare, Threatened, & Endangered Plant Surveys
- Natural Resource Permitting
- Agency Consultation
- GIS Mapping & Spatial Analyses
- Scientific & Technical Report Writing
- Water Quality Monitoring
- Data Synthesis & Analysis

### EDUCATION

B.A. Environmental Science, Ecology, & Physics  
Colby College (2014)

### CERTIFICATIONS

NH Certified Wetland Scientist  
License No. 00334

### MEMBERSHIPS

New Hampshire Association of Natural Resource Scientists  
Board of Directors (2022-Present)  
Member (2016-Present)

### SELECT PROJECTS

#### Wetland Delineation, Vernal Pool Survey & Stream Crossing Assessments

*Performs wetland and watercourse delineations for solar power and transportation projects in ME and NH using U.S. Army Corps of Engineers methodology. Identifies Wetlands of Special Significance, Priority Resource Areas, and vernal pools, and conducts functional assessments. Complete NH stream crossing assessments under NHDES Env-Wt 900 rules, evaluating geomorphic and habitat features, sediment, bank conditions, and riparian vegetation to support state and federal permitting.*

#### Wetland Delineations

Livermore Falls, ME | 2025 | 20-acres | Role: Technical Staff  
Oxford, ME | 2025 | 29-acres | Role: Technical Staff  
Ossipee, NH | 2024 | 17.5-acres | Role: Project Manager & Technical Staff  
Bristol, NH | 2024 | 45-acres | Role: Project Manager  
Troy, NH | 2023 | Three sites ranging 25 to 85-acres | Role: Project Manager  
Lamoine, ME | 2023 | 84-acres | Role: Project Manager  
Pembroke, NH | 2023 | 129-acres | Role: Project Manager

#### Vernal Pool Surveys

Bristol, NH | 2024 | 45-acres | Role: Project Manager  
Troy, NH | 2023 | Three sites ranging 25 to 85-acres | Role: Project Manager  
Richmond, ME | 2022 | 104-acres | Role: Project Manager

#### Stream Crossing Assessments

Bristol, NH | 2024 | 45-acres | Role: Project Manager  
Troy, NH | 2023 | Three sites ranging 25 to 85-acres | Role: Project Manager  
Chester, NH | 2022 | 18-acres | Role: Project Manager & Technical Staff

#### NH DOT Statewide on Call Wetland Services Contract

Warner, NH | 2024 | Role: Project Manager & Technical Staff  
Loudon, NH | 2023 | 150-acres / 3-miles | Role: Project Manager  
Albany, NH | 2022 | 110-acres / 4.4 miles | Role: Project Manager  
Enfield, NH | 2022 | 77-acres / 1.5-miles | Role: Project Manager & Technical Staff  
Warner & Sutton, NH | 2022 | 2-miles | Role: Project Manager & Technical Staff

#### Natural Resources Permitting

*Since 2016 prepared and filed over 100 NH Standard Dredge and Fill Wetlands, Shoreland, and Permit-By-Notification applications for transportation, stream crossing, shoreline water quality improvement, and solar development projects. Submitted multiple Maine Natural Resources Protection Act (NRPA) Permits-By-Rule and is knowledgeable about NRPA regulations. Ensured compliance with federal and state environmental regulations and developed strong working relationships with state and federal natural resource agency staff.*

#### Solar Development Wetlands Permitting

Troy, Bristol, & Laconia, NH | Role: Project Manager | 2024-2025 | Wetlands Permits

#### Eastman Community Association Shoreland Permitting

Grantham, NH | Role: Project Manager | 2021-2022 | Shoreland Permit & Shoreland PBN



# SARAH SULLIVAN CWS

Wetland Scientist & Permitting Lead

## SELECT PROJECTS CONTINUED

### Rare, Threatened, & Endangered Botanical Surveys

*Assisted in rare, threatened, and endangered (RTE) plant species surveys for development projects such as large-scale solar power projects across ME and NH. Conducted habitat assessments using meander path methodology, compiled comprehensive plant inventories, and mapped natural community cover types. Prepared protocols, field reports, and coordinated with state agencies to present findings and develop conservation measures.*

#### RTE Surveys

Standish, ME | 2025 | small whorled pogonia (*Isotria medeoloides*) | Role: Project Manager & Technical Staff

Raymond, NH | 2024 & 2025 | small whorled pogonia (*Isotria medeoloides*) & chestnut oak forest/woodland exemplary natural community | Role: Project Manager & Technical Staff

Pelham, NH | 2023 | meadow garlic (*Allium canadense*), river birch (*Betula nigra*), & Swamp White Oak Floodplain Forest exemplary natural community | Role: Project Manager & Technical Staff

Nottingham, NH | 2023 | climbing hempvine (*Mikania scandens*) | Role: Project Manager

Roxbury, ME | 2021 & 2022 | eleven state listed rare, threatened, & endangered plant species | Role: Project Manager

### Mitigation Monitoring

*Develop monitoring plans and protocols, and conduct on-site surveys of compensatory mitigation sites for projects with wetland permit obligations requiring mitigation and monitoring due to unavoidable impacts to wetlands, vernal pools, floodplains, and associated upland buffers. Work includes evaluation of impacts to wetland resources, establishment of created wetlands and floodplain storage, the success of native vegetation establishment, invasive species management, and overall stability and ecological function, value, and life of the project.*

#### NHDOT Keene Year 1 & 2 Monitoring

Keene, NH | 2024 & 2025 | Floodplain & Wetland Creation | Role: Project Manager & Technical Staff

#### NHDOT Walpole-Charlestown Year 1 & 2 Monitoring

Walpole, NH | 2023 & 2024 | Wetland & Riverbank | Role: Project Manager & Technical Staff

### Natural Resources Inventories

*Developed and led natural resources inventories for municipalities and conservation organizations, integrating desktop analysis, GIS mapping, and field assessments to document wetlands, streams, soils, habitats, and land use. Produced detailed maps, identified priority conservation areas, and provided actionable recommendations for master plans and management strategies.*

#### Dover NRI Rapid Ecological Assessment

Dover, NH | Role: Project Manager and Ecologist | 2024 | [Report](#)

#### Lee NRI Water Resources Analysis

Lee, NH | Role: Project Manager | 2024 | [Report](#)

#### Hampton Natural Resources Inventory

Hampton, NH | Role: Project Manager | 2023-2024 | [Report](#)

#### Peaks Island Natural Resources Inventory & Management Plans

Peaks Island, ME | Role: Project Support | 2022-2023 | [Report](#)

#### Rye Natural Resources Inventory

Rye, NH | Role: Project Manager | 2021 | [Report](#)

### Grant Writing

#### NH Department of Environmental Service's Aquatic Resource Mitigation Fund Grants (2016-2021)

*Managed three projects for NH DOT seeking ARM grant funding. Completed required field work and data collection, collaborated with project engineers, state natural resource agencies and organizations including the NH Department of Fish and Game and The Nature Conservancy. Wrote pre-proposal reports and final grant applications submitted to NH DES for review and selection.*





# CHRISTINE BUNYON

## Project Manager, GIS Specialist, & Water Resource Scientist

Christine leads a breadth of watershed planning and management projects at FBE, coordinating support staff for field data collection and analysis, watershed modeling, and plan development. With expertise in geospatial analyses, she transforms spatial data into actionable visualizations for clients, including high-quality maps and geodatabases for watershed management plans, natural resource inventories, buildout analyses, and more.

### EXPERTISE

- Geographic Information Systems
- ArcMap, ArcGIS Pro, geodatabases, Arc Online, Collector, FieldMaps
- Data analysis: Excel, R, Python, eCognition, Agisoft Metashape
- Buildout Analyses
- Hydrologic and Watershed Modeling

### EDUCATION

M.S. Natural Resources & the Environment,  
Remote Sensing  
University of New Hampshire

B.S. Environmental Conservation &  
Sustainability  
University of New Hampshire

### CERTIFICATIONS

Graduate Certificate in Geospatial Sciences  
University of New Hampshire

Certified Remote Pilot in Charge  
FAA Part 107

### PUBLICATIONS

Bunyon et al. (2023). Using Imagery Collected by an Unmanned Aerial System to Monitor Cyanobacteria in New Hampshire, USA, Lakes. *Remote Sensing*, 15(11), 2839. Fraser et al. (2022).

Analysis of Unmanned Aerial System (UAS) Sensor Data for Natural Resource Applications: A Review. *Geographies*, 2(2), 303–340.

### PRESENTATIONS

Using Imagery from an Unmanned Aerial System to Study Cyanobacteria in New Hampshire Waterbodies.  
*ASPRS Conference, Denver, CO; February 2023*

Using GIS technology to improve watershed management planning and implementation tracking of surface waters.  
*New Hampshire Water & Watershed Conference, Plymouth, NH; March 2019*

### SELECT PROJECTS

#### Geospatial Analyses

*Extensive experience conducting spatial analyses and creating mapping products to support environmental planning, watershed management, and community resilience initiatives across New England. Proficient in ArcGIS Pro, remote sensing, and UAS-collected imagery for water quality monitoring. Regularly create mapping products and conduct spatial modeling for municipal master plans, natural resource inventories, and regulatory TMDLs. Experienced in teaching GIS applications and leading GIS-focused workshops and labs.*

#### Watershed Planning & Modeling

*Supports watershed planning and water quality monitoring efforts through spatial data creation, GIS analysis, and mapping. Projects include creating community resilience data layers for climate adaptation, building spatial data repositories, compiling regional water quality datasets, modeling pollutant loads, and developing a high-resolution, multi-state database of hydrologic response units to assess stormwater nutrient runoff potential by town and watershed. Exemplary projects include Spatial Analyst Consultant for The Nature Conservancy's Merrimack River Watershed Planning (Present), US EPA Southeast New England Program Hydrologic Response Unit Analysis (2025), Saco Headwater Alliance Water Resource Monitoring (2021), and Palmer River Watershed Water Quality Analysis (2019).*

#### Municipal Planning

*Performs geospatial analyses and mapping for municipal planning projects such as Master Plans and Build-out Analyses. Responsibilities include assessing existing conditions, evaluating zoning and natural resource protections, and developing maps for master plan updates related to transportation, infrastructure, and coastal resiliency. Exemplary projects include Tamworth, NH Build-out Analysis (2024) and Rye, NH Master Plan Update and Build-out Analysis (2025).*

#### Total Maximum Daily Load Development

*Conducted GIS-based analyses to support statewide TMDL development for nutrient- and pathogen-impaired waterbodies in Connecticut and Massachusetts. Responsibilities included watershed characterization, land use and impervious cover analysis, DCIA calculation, and spatial data visualization across hundreds of lakes and stream segments.*

#### Natural Resource Planning

*Develops mapping products including sea level rise, marsh migration, floodwater storage, flood risk mitigation and pollutant attenuation, scenic resources, prioritized areas for conservation and more for Natural Resource Inventories. One exemplary project includes the Rye, NH Natural Resource Inventory (2021).*

#### Academic Experience

*Completed a graduate thesis on Using Imagery Collected by an Unmanned Aerial System to Monitor Cyanobacteria in New Hampshire, USA, Lakes (2023), which involved linking drone imagery with water quality data, collected through rigorous field work and laboratory analyses, to quantify cyanobacteria concentrations. Also served as a Lead Teaching Assistant for Intro to GIS and Remote Sensing class, and held open workshops for students to learn about the use and application of GIS (2023).*



# JOHANNA SZILLERY

## Senior Soil Scientist

Johanna has over 20 years of experience in natural resource assessment, permitting, and environmental project management across New England. She specializes in wetland delineation, soil science, botany, and water chemistry, with extensive expertise in habitat evaluation, site suitability analysis, and compliance with state and federal regulations. As a leader and technical expert in her field, Johanna has directed projects from proposal development through fieldwork, permitting, reporting, and agency coordination, including conservation initiatives, alternative energy development, and commercial, residential and industrial development.

## EXPERTISE

- Wetland Delineation & Protected Habitat Assessment
- Soil Science, Mapping, & Chemistry
- Botany & Plant Ecology
- Water Chemistry & Watershed Analysis
- Natural Resource Permitting & Compliance
- Environmental Site Assessment & Monitoring
- Risk Assessment
- Field Sampling & Laboratory Analysis (soils, water, vegetation)
- GPS Data Collection

## EDUCATION

M.S. Plant, Soil, & Environmental Sciences  
University of Maine, Orono

B.A. Biology  
Minor in Environmental Sciences  
Drew University

## CERTIFICATIONS

State of Maine Soil Scientist (CSS #494)

## MEMBERSHIPS

State of Maine Board of Licensure for Soil Scientists & Geologists  
Member (2014-Present)  
Chairperson (2022-Present)

Maine Association of Professional Soils Scientists  
Member (2008-Present)  
President (2011- 2013)

Maine Association of Wetland Scientists  
Member (2008-Present)

## PROFESSIONAL EXPERIENCE

### Senior Project Scientist & Project Manager

*New England | 2013-2025 | Affiliation: Haley Ward, Inc.*

*Supervised a team of two to six environmental scientists, providing mentoring and technical guidance to support professional growth. Served as technical lead for natural resource identification, assessment, planning, and permitting, managing all phases of projects from proposals and budgeting through fieldwork, reporting, and quality assurance. Directed natural resource planning, permitting, and compliance for conservation, wetland and habitat alteration, and alternative energy projects, while coordinating with regulatory agencies and reviewing environmental risk assessments and due diligence for real estate transactions.*

### Soil & Wetland Scientist

*Maine | 2006-2013 | Affiliation: S. W. Cole Engineering, Inc.*

*Performed wetland delineations, natural resource and protected habitat assessments, and soil mapping and suitability evaluations on properties ranging from 5 to 45,000 acres across Maine. Managed projects from proposal development and budgeting through coordination, fieldwork, and technical reporting. Conducted permit research, prepared documentation, and coordinated with regulatory agencies on wetland, habitat alteration, and alternative energy projects. Supported company-wide initiatives through geotechnical borings, soils laboratory work, environmental site assessments, and long-term environmental monitoring.*

### Forest Soils Research Technician

*Maine | 2003-2006 | Affiliation: Department of Plant, Soil, & Environmental Sciences, University of Maine*

*Coordinated field sampling and laboratory analyses for a multi-site forest soils research project, working with project leaders, faculty, and student workers. Designed and implemented data collection, analysis, and quality control procedures for a new research discipline, and performed preliminary analyses to inform future studies. Established protocols for data management and equipment maintenance, while overseeing student workers and coordinating project activities across the research team.*

### Early Professional Experience

*Gained foundational experience in natural resource monitoring, vegetation assessment, and soil science through roles with the USDA Natural Resources Conservation Service and Shenandoah National Park. Responsibilities included soil compilation and mapping, vegetation monitoring, and development of protocols for a new non-native vegetation monitoring program. Supported long-term ecological monitoring efforts by collecting and analyzing vegetation data, and assisted with avian and fisheries monitoring programs. Recognized by NRCS with a Certificate of Appreciation for outstanding work.*



# TIM KIRSTEN

## Project Scientist II

Tim specializes in ecological services, contributing to fieldwork, technical writing, GIS, and data analysis across various projects, including wetland delineations, natural resource inventories, vegetation monitoring, and vernal pool surveys. He also assists with watershed-based management plans, water quality monitoring, and MS4 permitting. Originally from South Africa, Tim has developed a deep passion for botany and the natural world, which he continues to apply in his role at FBE after relocating to the U.S.

### EXPERTISE

- Scientific & Technical Writing
- Natural Resource Inventory
- Plant Identification
- Water Quality Sampling
- GIS Analysis & Mapping
- Data & Statistical Analysis
- Ecological Restoration
- Climate Change Adaptation

### EDUCATION

M.S. Biological Science  
University of Cape Town (2023)

B.S. Applied Biology & Environmental & Geographic Science  
University of Cape Town (2018)

### PUBLICATIONS

Kirsten et al. (2023). A regional, remote sensing-based approach to mapping land degradation in the Little Karoo. *Journal of Arid Environments*. 219: 105066. [Report](#)

Bell et al. (2023). Modelling land degradation to augment Land Degradation Neutrality assessments: the Succulent Karoo biome of South Africa as a case study. *Journal of Arid Environments*. 219: 105066. [Report](#)

Bell et al. (2022) An evaluation of different approaches which use Google Street View imagery to ground truth land degradation assessments. *Environmental Monitoring & Assessment*. 194: 1–12. [Report](#)

### SELECT PROJECTS

#### Ecological Services

*Provides support to wetland delineations, vernal pool surveys, natural resource inventories, vegetation monitoring, stream crossing assessments, and rare, threatened and endangered species surveys. Assists in fieldwork, GIS analysis and report writing.*

##### Solar Energy Permitting (2024)

*Troy, Bristol, and Laconia, NH*

##### Wetland Delineations (2024)

*Ossipee and Troy, NH*

##### Natural Resource Inventories (2024)

*Rapid Ecological Assessment | Dover, NH  
Natural Community Type Mapping | Biddeford, ME  
Perkinstown Wildlife Commons Land Management Plan | Wells, ME*

##### Vegetation Monitoring (2024)

*Floodplain Mitigation Monitoring | Keene, NH*

##### Rare and Threatened Species Surveys (2024)

*Small Whorled Pogonia Survey | Laconia, NH  
Roaring Brook Mayfly & Spring Salamander Surveys | Saddleback Mountain, ME*

#### Watershed Planning

*Assists in development of watershed management plans in NH and ME. Tasks include GIS analysis, data analysis, nonpoint source pollution surveys and report writing.*

##### Lake Winnepesaukee Watershed Management Plans (Present)

*Alton Bay, Center Harbor & the Broads, NH*

##### Shaws Pond Watershed Management Plan (Present)

*New Durham, NH*

##### Capisic Brook Watershed Management Plan (Present)

*Portland, ME*

#### Water Quality Monitoring

*Conducts water quality sampling in various weather conditions for bacteria and pollutant analysis.*

##### Parsons Creek Monitoring (2024)

*Rye, NH*

##### Ogunquit River Monitoring (2024)

*Ogunquit, ME*

##### International Paper Wastewater Sampling (2024)

*Auburn, ME*



# TIM KIRSTEN

Project Scientist II

## SELECT PROJECTS CONTINUED

---

### MS4 Permitting Support

*Provides assistance to Towns in meeting their MS4 permitting requirements, including mapping stormwater infrastructure, writing stormwater pollution prevention plans, and reviewing ordinances relating to stormwater management.*

Stratham Year 6 MS4 Permitting Support (2024)

Stratham, NH | [Outfall Map](#)

## PREVIOUS RESEARCH & PROFESSIONAL EXPERIENCE

---

### Climate Change Adaptation

*Worked at a climate change consulting firm in Cape Town, South Africa, assisting UNEP and UNDP in the design of large-scale climate change adaptation projects in Africa. Provided support in the research of climate change impacts and the designing ecosystem-based adaptation interventions.*

Building the capacity of Rwanda's government to advance the National Adaptation Planning process (2020-21)

Rwanda | [Report](#)

Enhancing the Resilience of Vulnerable Coastal Communities, Sinoe County (2020-21)

Liberia | [Report](#)

Jordan Integrated Landscape Management Initiative (2020)

Jordan | [Report](#)

## PRESENTATIONS

---

Kirsten T. 10/2024. A regional, remote sensing-based approach to mapping land degradation in the Little Karoo. Arid Zone Ecology Forum, Vredendal, South Africa.

Kirsten T. 10/2021. A regional, remote sensing-based approach to mapping land degradation in the Little Karoo: preliminary analysis. Arid Zone Ecology Forum, Worcester, South Africa.

Kirsten T. 10/2019. Topographic complexity drives high floral diversity in the Greater Cape Floristic Region, South Africa. Biological Sciences Department, University of Cape Town, South Africa.

Dai S, Kirsten T, Rehmann J & Rehmann E. 5/2019. Rhino Middens and Biodiversity. Skukuza, Kruger National Park [presentation given to South African National Parks on research conducted with Organization for Tropical Studies].