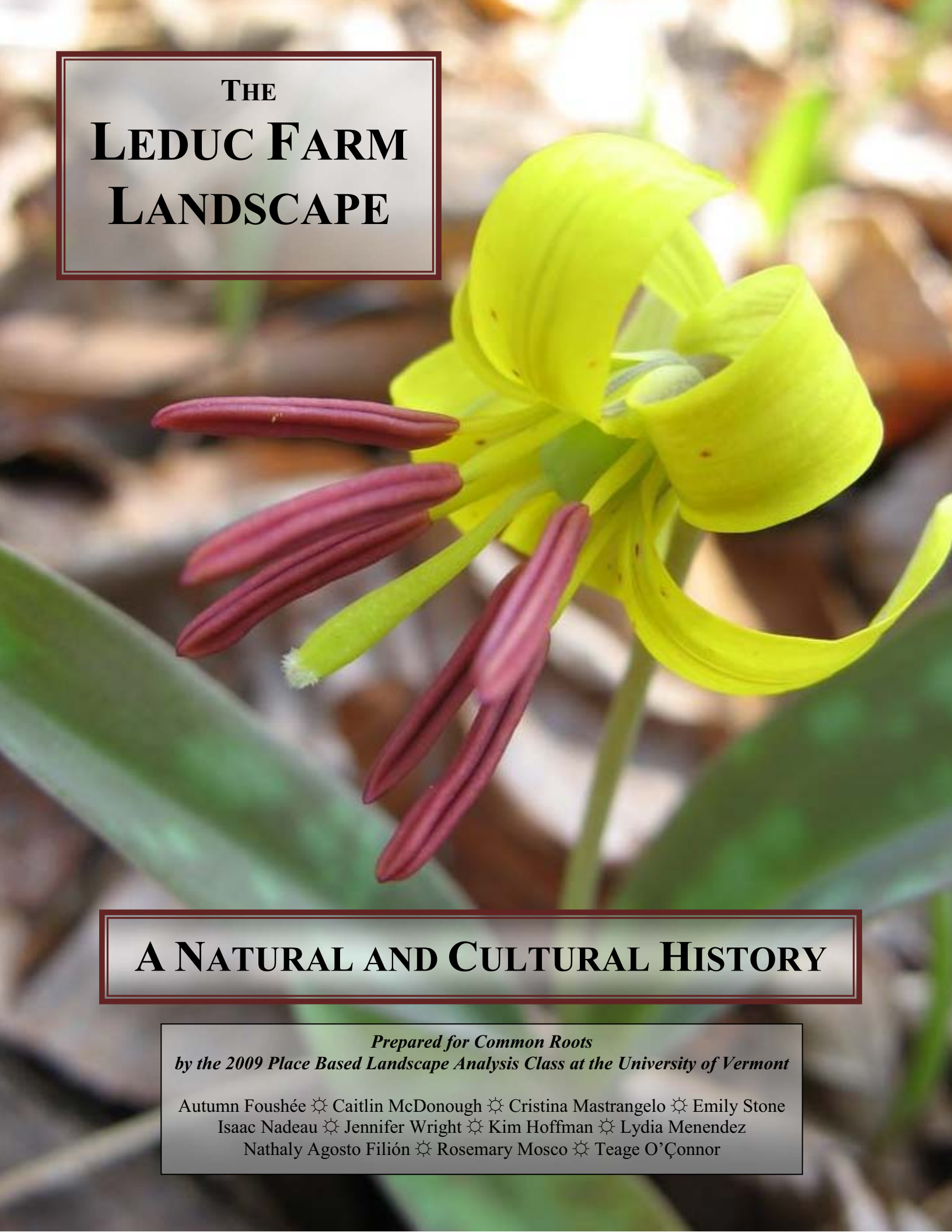

THE LEDUC FARM LANDSCAPE

A NATURAL AND CULTURAL HISTORY

Prepared for Common Roots
by the 2009 Place Based Landscape Analysis Class at the University of Vermont

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"There are two lasting bequests we can give our children. One is roots. The other is wings."

-- Holding Carter II

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Leah Mital-Skiff and Carol McQuillen of Common Roots were fantastically inspiring, helpful and appreciative of our work. We wish them the best as Common Roots takes wing!

Thanks to Jeffrey Hughes, Deane Wang, Alicia Daniels, Elizabeth Thompson and Cathy Paris for preparing us well for this experience. Many thanks to Walter Poleman for his boundless energy, inspiring speeches, constant coordination of the class, and many wonderful emergent qualities.

And finally, thanks to the coyotes, trout lilies, pileated woodpeckers, beeches, rocks, streams, and all the other living and non-living beings that allowed us to make their home our place.

THE
LEDUC FARM LANDSCAPE
A NATURAL AND CULTURAL HISTORY

EXECUTIVE SUMMARY

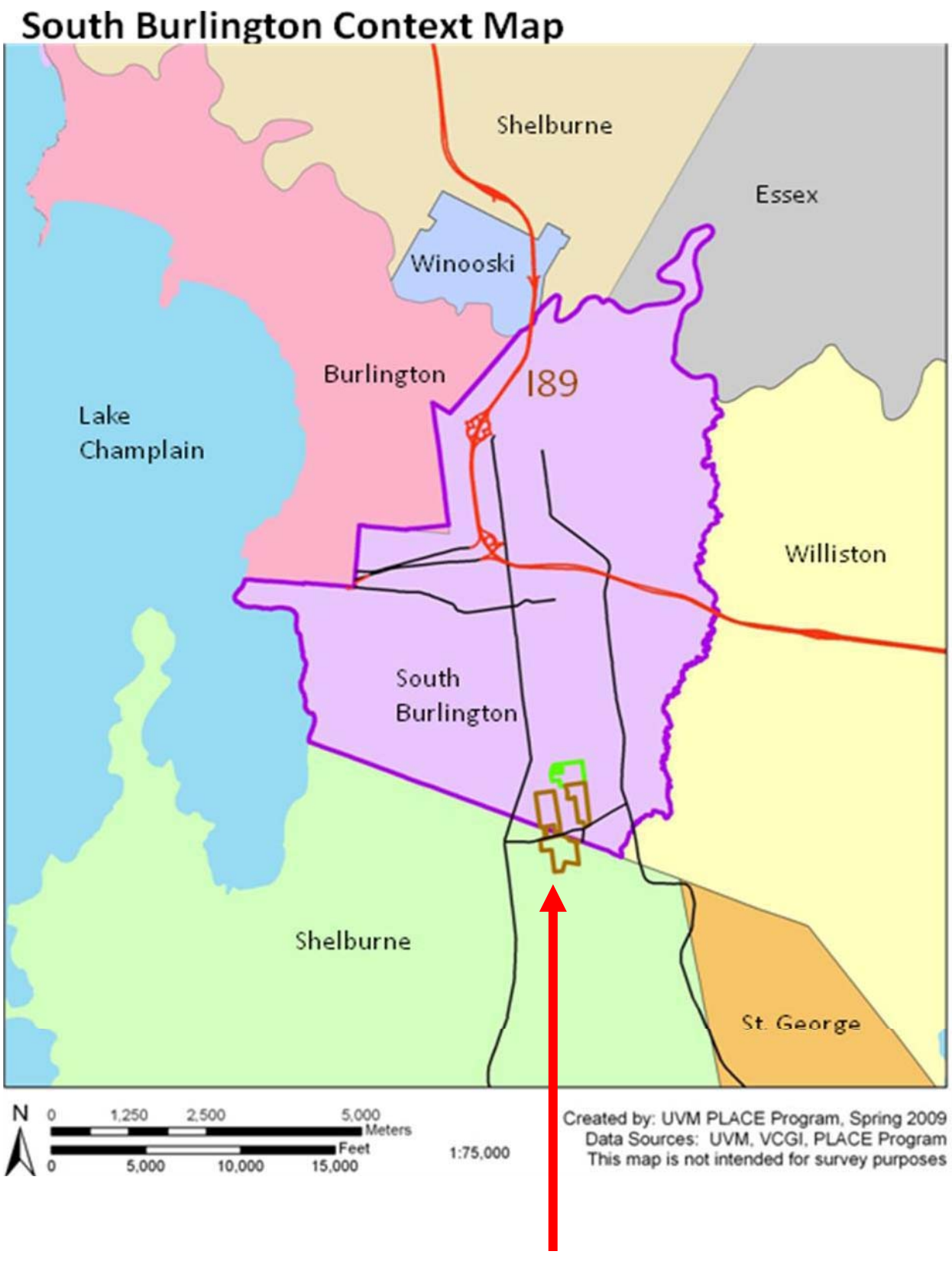
This document was created for Common Roots by the 2009 Place-Based Landscape Analysis class at the University of Vermont. With the help of the Vermont Land Trust, Common Roots is working to acquire a parcel of land straddling the boundary between South Burlington and Shelburne. The Leduc Farm Landscape that this document is based on broadly includes all of South Burlington, and more specifically focuses on the Leduc parcel, which is named after the family that has lived and farmed on the land for decades; the adjoining Bandel/Dopp parcel; and the city-owned Scott parcel.

Our study can be characterized as an attempt to place this land in context, including both a historical and a landscape perspective in our analysis. Throughout the four months of this process, we have attempted not only to describe each of the "layers" present on the land – the geology, hydrology, vegetation, wildlife, and cultural elements – but also to reveal the intricate connections between those various entities. Where appropriate, we have offered management recommendations based on our field work and background research.

Additionally, we have attempted to pay special attention to the educational component of Common Roots' activities. Throughout the text, we have made an effort to highlight interesting stories, locations, and background information that we hope will prove useful as Common Roots looks to develop the educational aspects of its programs on the land.

The work presented here is intended to provide foundational information on each of the elements of the Leduc parcel and its surrounding lands. We hope that this document will serve as a resource as Common Roots undertakes the development of land-use planning and envisioning the future of the land. By no means is this document presented as the final word. Like the land itself, our understanding of the land is always evolving. Our hope is that this can be a living document that Common Roots can add to, take notes on, get dirty, pass around, and make use of in any way that furthers the mission of the organization.

We hope you enjoy using this document as much as we have enjoyed creating it. The Leduc Farm Landscape is a unique mix of wildness, history, farming and exciting possibilities. Getting to know this landscape was an incredible privilege, and an unforgettable experience.



Leduc and Scott Parcels

SUBSTRATE

Overview

Substrate refers to the underlying foundation – the bedrock, surficial geology, and soils – on which the natural communities, agricultural operations, and dwellings of the Leduc property are built. This section summarizes some interesting aspects of these three components of the substrate of the Leduc property. The information here should provide a useful starting point for further investigation.

The Leduc property is underlain by bedrock known as the Bascom Formation. Various outcrops of this formation are visible in eastern parts of South Burlington, and each one has a different appearance from the others, depending on the parent material and the degree of metamorphosis it has undergone. There are exposures on and immediately adjacent to the Leduc property. These have the classic grey, rounded, and channelized weathering pattern of dolomite.

The Bascom Formation was formed during the Ordovician Period, about 450 million years ago. As with all of the bedrock of South Burlington, the sediments that make up this rock were deposited in a shallow sea known as the Iapetus Ocean. This formation is an amalgamation of limestones and calcareous sandstones and quartzites. This calcium-rich parent material is one of the qualities that provide fertility to the property's agricultural soils. Calcium is an essential nutrient for plant growth and metabolism. The calcium also acts as a buffer to soil acidity, helping to maintain the soil closer to a neutral pH and creating a better environment for nutrient uptake by most plants.

The bedrock of the Leduc property is overlain by till, a mix of rock from clay-sized particles to car-sized boulders being bulldozed across the land at the base of the ice sheet that covered the property – and all of New England – until about 15,000 years ago. These rocks were left behind

Some of the rocks in rock walls originated in the mountains north of Montréal, brought south by the advancing ice sheet.

on the land when the ice sheet melted northward. The till is most easily seen in the rock fences found in various places on the property.

The soils of the property, like much of South Burlington, have a high clay content. These clays were deposited during two periods when the area was covered by water. In the wake of the retreating ice sheet, Glacial Lake Vermont was formed from the melting water. The ice sheet formed a dam to the north, and the shores of the lake rose to over 600 feet, covering all of South Burlington. Streams running off of the surface of the glacier as well as from the surrounding mountains carried sediments down into the lake. Sands and clays settled to the bottom. Later, when the Champlain Sea covered the lowlying parts of the Leduc property, particularly along the east branch of Seeley Brook, more clays were deposited. These clays help improve soil fertility by increasing the cation exchange capacity, allowing the soil to hold more nutrients and make them available for uptake by plants and soil organisms.

Bedrock

Five-hundred million years ago, the land that is now South Burlington was beneath a shallow, tropical ocean. Thousands of streams etched the surrounding land. Because the land at that time was free of plants (as well as animals), there were no roots, and no fungi, to hold the particles of sand, silt, and clay together. This meant that the streams had free reign, pulling huge amounts of sediments with them as they flowed across the face of the land, cutting deep gullies and carrying the sediment down to the sea. Layers of sediment miles thick piled up in the oceans, the product of the wearing down of mountains miles high.

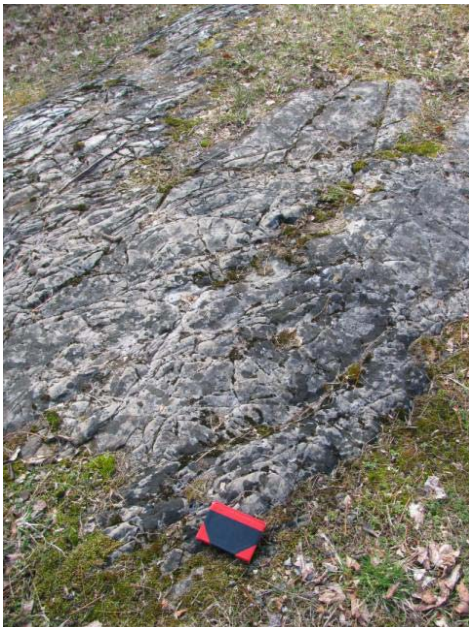
At this time in earth's history, the North American continent was tilted 90 degrees clockwise from its present orientation and straddled the equator, so that the shore of the ancient Iapetus Ocean ran from east to west, rather than north to south as the present day Atlantic seaboard does. South Burlington was on the continental shelf. To the north (what is now the west), the ancient Grenville Mountains, whose roots are now exposed in the Adirondacks, had been worn away by

When water comes into contact with calcareous bedrock, the calcium is dissolved into solution and becomes available to plants.

400 million years of wind and rain. The sea rose and fell over the area several times over millions of years, with different kinds of sediments deposited depending on the depth and environment. Heavy sand particles in beach environments closest to shore would form the basis of the area's sandstones. The finest particles – clays – were carried farthest from shore, where they eventually sank to the bottom.

The youngest bedrock in South Burlington is interbedded limestone, calcareous sandstone, and quartzite called the Bascom Formation, covering about the eastern half of the map. Outcrops near its eastern boundary are metamorphosed as a result of the Hinesburg Thrust that occurred during the uplift of the Green Mountains.

Outcrop of the Bascom Formation at I-89 and Hwy. 116



Bascom Formation outcrop near vernal pool. Notebook is 5" long.

The whole of the Leduc property is underlain by the Bascom formation. A small exposure is on the old road immediately north of the old dump, just north of the vernal pool. This would be a good place to bring school groups to talk about the bedrock. Dropping a few drops of hydrochloric acid and watching it fizz might be a good lead-in to the buffering effects of calcium in soil. From the picture, you can see the channelized weathering pattern characteristic of limestones. The rock here is not metamorphosed because it was far enough west of the Hinesburg Thrust Fault to be spared the heat and pressure to which the easternmost parts of the formation were subjected.

The earliest fossil evidence of plants on land dates back to 475 million years ago. That's roughly the same time that the rock that makes up Brownell Mountain was formed.

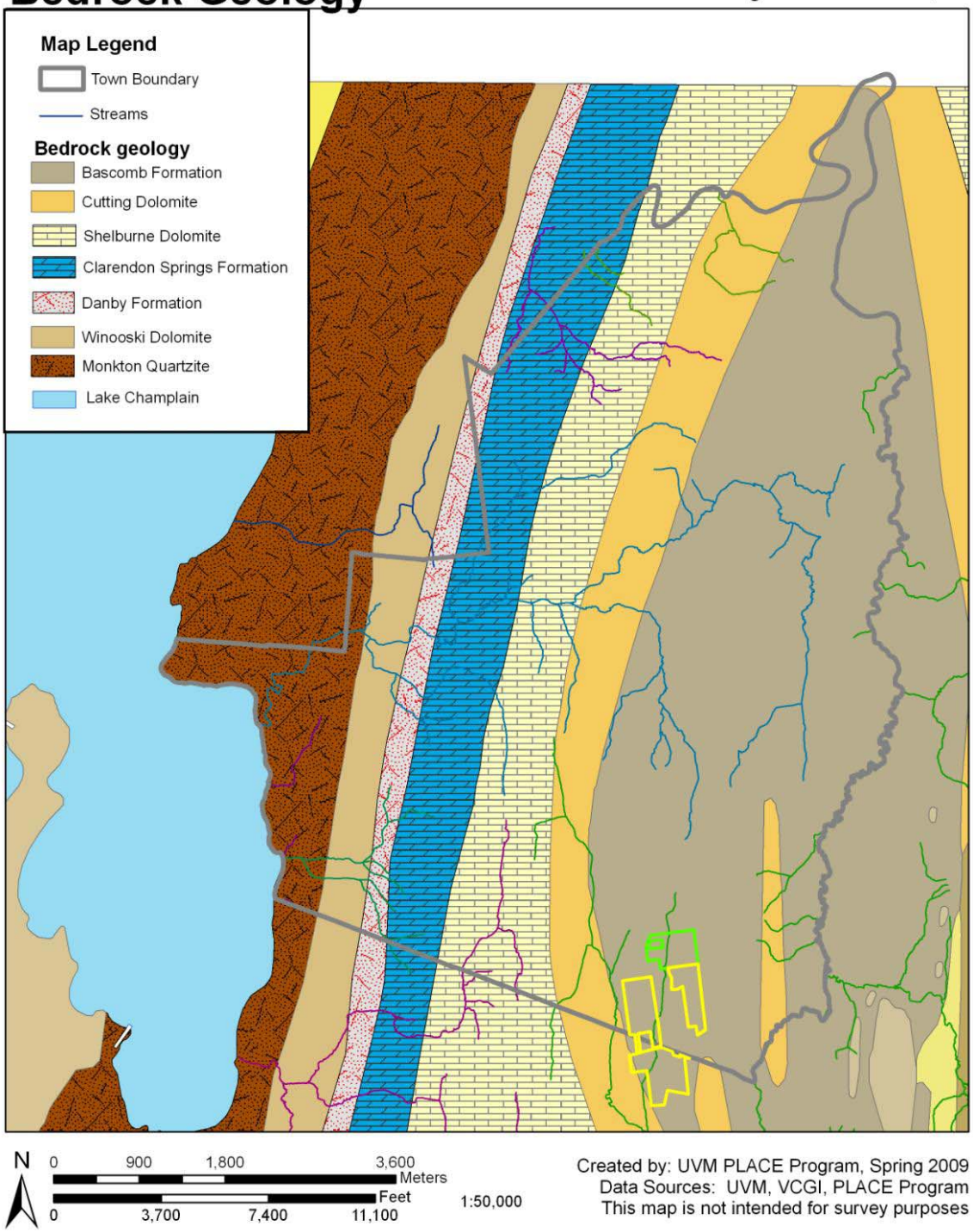
A second nearby outcrop can be found where the power line crosses the brook. This is less accessible to field trips because of the piles of logs and slash from the clearing of the power line corridor, but it can be safely viewed from below.

The exposed bedrock in South Burlington becomes progressively older and older from east to west. As the map shows, the bedrock formations are oriented in thin north-south trending bands. This pattern is a visible reminder that the big squeezes that uplifted the mountains of Vermont came from what is now east (what was then south). The north-south trend of the Green Mountains reflects this same phenomenon. The oldest formation – the Monkton Quartzite, is metamorphosed sandstone, laid down over 500 million years ago. This is most easily seen at Red Rocks Park.

Monkton Quartzite contains fossils from five brachiopods, one unnamed new gastropod, two species of Hylithes, and six species of trilobites.

South Burlington Bedrock Geology

Leduc Parcels
South Burlington & Shelburne, VT



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Data Sources: UVM, VCGI, PLACE Program
This map is not intended for survey purposes

Surficial Geology

After the deposition of the bedrock over 400 million years ago, the next major addition to the substrate of the Leduc property and surrounding landscape was the work of the last ice age. Beginning about 2 million years ago, northern North America was subjected to repeated advances and retreats of a massive ice sheet. Greenland remains largely covered in ice to this day, and resembles what New England may have looked like as recently as 20,000 years ago. At this time, the land occupied by the Leduc parcel was beneath ice about 3 kilometers thick. In its slow grinding expansion southeastward into Vermont, it plucked rocks of all sizes from the ground and dragged them across the land. This material, known as till, covers almost the entire state of Vermont. It is well known to farmers in the form of rocks pulled from the soil and piled in rock walls. The rock walls dividing the fields and in parts of the forest throughout the Leduc parcel are a legacy of the continental ice sheet that covered the area as well as the hard work of generations of farmers.

Till removed from fields and piled between fields southwest of the barn

In most of South Burlington and throughout the Leduc parcel, the till is overlain by finer sediments – sand, silt, and clay – that make up the bulk of the soils. These sediments were deposited after the ice sheet melted and withdrew northward out of the area by about 13,500 years ago (Wright 2003). In the wake of the retreating glacier, torrents of meltwater poured off

Till comes from a Scottish word for “stubborn,” no doubt because of farmers’ experience digging in it.

its face, joining streams from the surrounding uplands and flooding the land. The result was a huge lake, known as Glacial Lake Vermont, that incorporated all of present day Lake Champlain and the Champlain Valley. The retreating ice sheet acted as a dam, preventing the water from flowing northward, and the lake expanded northward as the glacier continued to melt. The shores of this lake reached areas that are now over 600 feet in elevation. The Leduc parcel was underneath about 300 feet of water, and silt and clay being washed into this lake drifted slowly to the bottom, and would eventually hold the roots of beech trees and alfalfa. Brownell Mountain, just to the east of the property, would have been an island at this time.

Glacial Lake Vermont lasted only about 1,500 years. At this time, about 12,000 years ago, the ice dam broke, and the pent up waters of the lake rushed northward into the St. Lawrence and out to sea. In his description of the event, Stephen Wright (2003), a geologist at the University of Vermont, writes that the water level in the Burlington area fell by about 300 feet in a matter of a few days at most!

When all of that freshwater flushed out into the Atlantic Ocean, the ocean reciprocated by flushing seawater back up the St. Lawrence and into the Champlain Valley. This was possible because the Champlain Valley was below sea level. The weight of the ice sheet had literally pushed the crust of the earth into the mantle, the way a heavy load makes a barge ride low in the water. It took thousands of years for the crust to rebound to its current level. For a couple of thousand years, the land that is now on the Leduc parcel was below sea level. The whimsical whales' tails diving into the median of Interstate 89 in South Burlington are a comment on this interesting period in the area's history. The shores of the

Former seashore and future CSA?

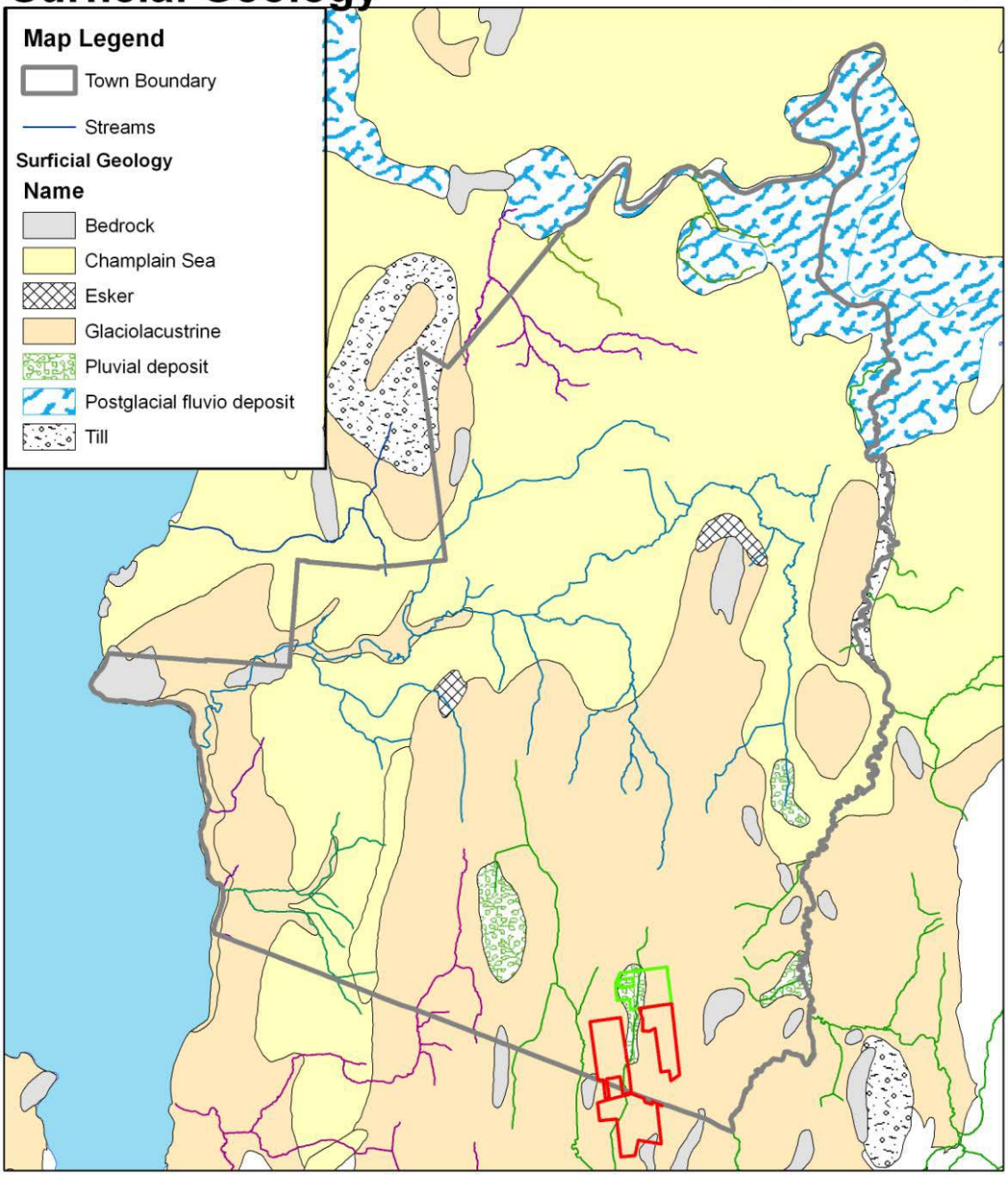
Limestone is made up of tiny skeletons and shells of animals that lived in shallow seas. They precipitate calcium carbonate from the sea water.

Champlain Sea lapped at areas that are now at about 320 feet in elevation. This means that only the lowest elevations on the Leduc and surrounding properties were beneath the sea, including those lands immediately bordering Seeley Brook. As with Glacial Lake Vermont, the waters of the Champlain Sea received sediments from surrounding rivers. The airport lies on sands deposited in this sea by the Winooski River. On the Leduc parcel, these sediments were mostly clays. The loam in the hay meadow immediately west of the barn is a good mixture of these clays and coarser silts and sands, making it an excellent texture for growing vegetables. This part of the field was probably just above the level of the Champlain Sea. Immediately downhill and to the west, the soil becomes clay as you approach Seeley Brook. This clay was probably deposited at the margin of the Champlain Sea.

Most terrestrial plants have mutualistic relationships with fungi, called mycorrhizae. The fungi bring nutrients from the soil into plant roots, and the plant provides the fungus with sugars.

South Burlington Surficial Geology

Leduc Parcels
South Burlington & Shelburne, VT



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Soils

The soils of the Leduc parcel are derived primarily from sediments deposited in Glacial Lake Vermont. Both the calcium-rich parent material and the high clay content contribute to the fertility of these soils. Calcium is an essential plant nutrient, playing an integral role in processes such as cell devision and metabolism. In addition, calcium serves as a buffer to the acidity in the soil, helping to maintain a soil pH closer to neutral. While most of the soils on the property could be suitable for conversion to vegetable crops, the best candidate is ideally situated near the barn.

Prime farmland in Vermont is defined by USDA's National Resource and Conservation Service (2006) as having

> "the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to acceptable farming methods. These soils have an adequate and dependable water supply from precipitation, a favorable temperature and growing season, acceptable acidity or alkalinity, and few or no surface stones or boulders. They are permeable to water and air, are not excessively erodible or saturated with water for a long period of time, and don't flood frequently or are protected from flooding."

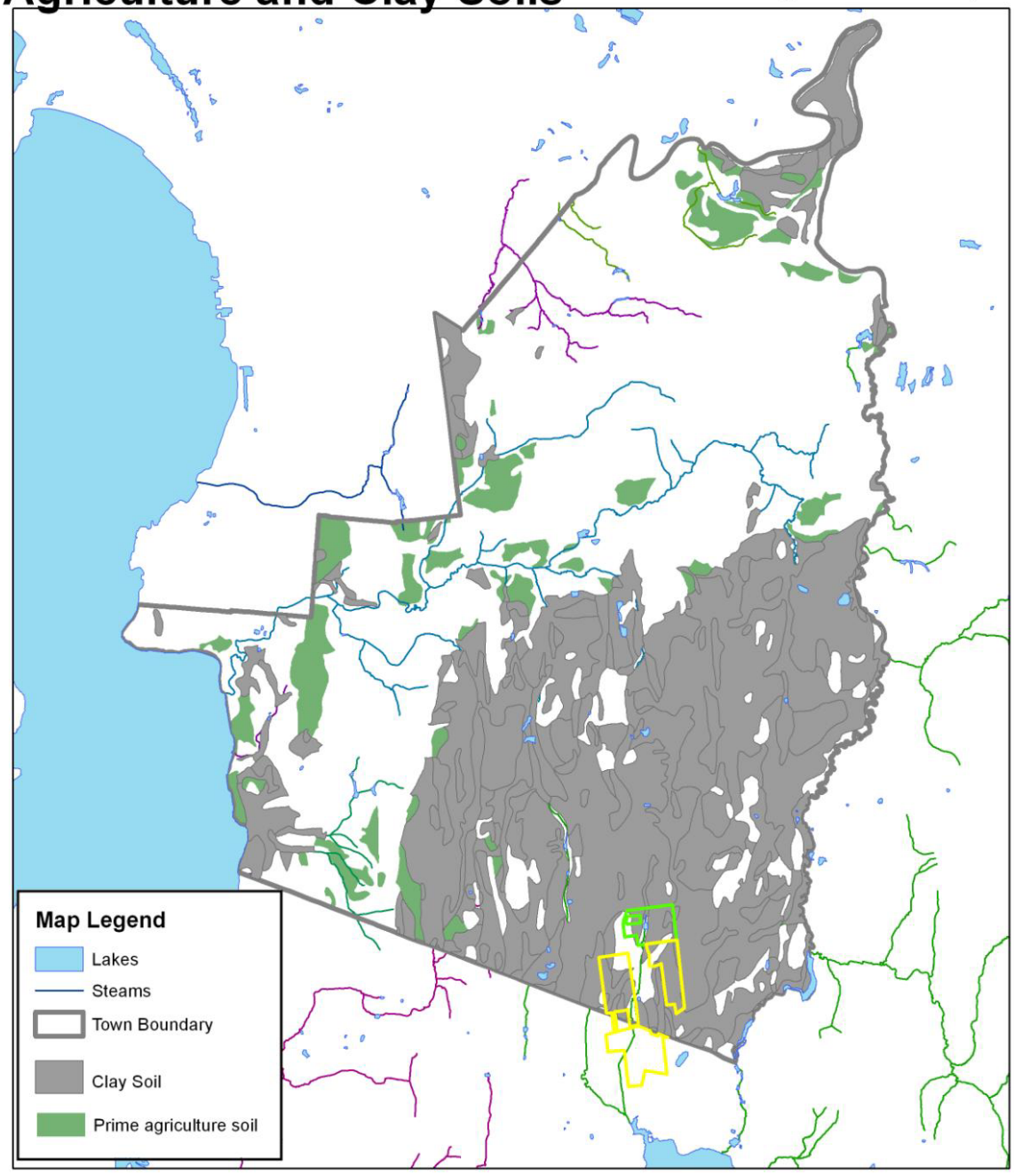
As shown on the soils map put together by the Vermont Land Trust, the property includes two areas of Stockbridge and Nellis Stony Loams (SuB), classified as prime farmland. These areas include the northwest portion of the hayfield in the northwest portion of the property and, more importantly, the fields immediately west and southwest of the barn. The latter fields show excellent potential for conversion into vegetable production for the planned CSA.

Soil samples conducted on the field immediately west of the barn indicate promising conditions for vegetable production. This soil has a pH of 7.4 and contains high levels of potassium (432 ppm), magnesium (341 ppm), and calcium (2,153 ppm) and adequate levels of available phosphate (1.7 ppm). Micronutrients such as sodium, iron, and sulfur are adequate, and the soil appears to be somewhat well-drained. However, this small, triangular field is perched above a

Depressions in flat areas with clay soils are a good place to look for vernal pools. The life in vernal pools, in turn, contributes to the high organic matter of the soil beneath them.

South Burlington Prime Agriculture and Clay Soils

Leduc Parcels
South Burlington & Shelburne, VT



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Data Sources: UVM, VCGI, PLACE Program
This map is not intended for survey purposes

section of Vergennes Clay (VeB) bordering the brook to the west. This soil shows pH and nutrient levels in the same ballpark as the SuB. However, the clay soil appears to be less well-drained than the stony loam uphill. This may inhibit the drainage of the portion of the field immediately west of the barn, where the stony loam is located. Based on our sampling, the division between these two soil types in this field appears to be accurate as currently drawn.

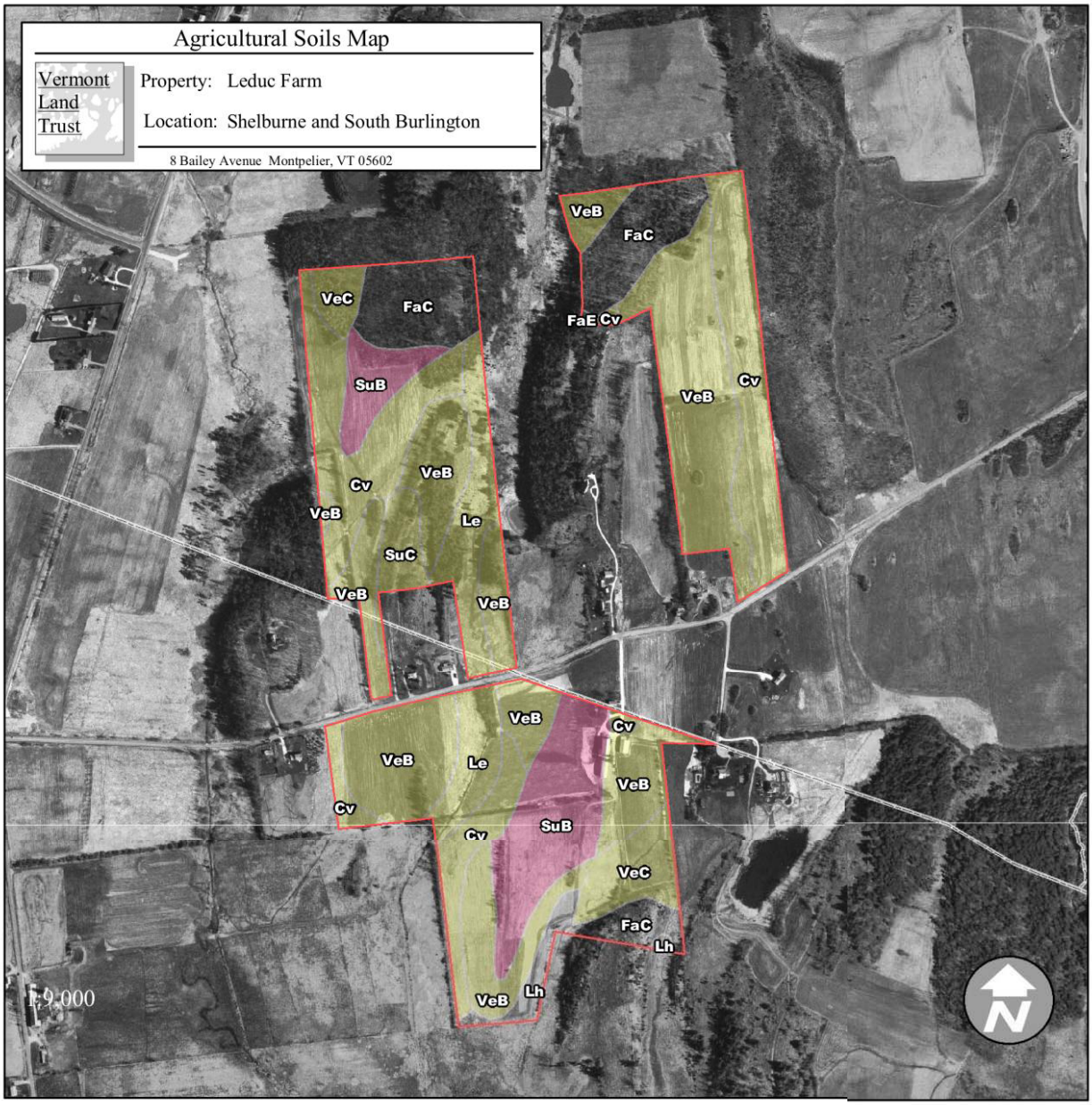
Stockbridge and Nellis Stony Loam in field west of barn

Vergennes Clay in field west of barn

Morris Leduc reports that, while the soil in this field is quite good, the field immediately south, which is on a small rise and is also of the SuB type, is better drained.

In addition to testing the SuB and VeB soils in the field immediately west of the barn, we looked at these same soils in two different forested areas in the northern portion of the property. The most interesting results are that the forested soils of both SuB and VeB have much lower pH (5.2 and 5.0 respectively) and higher organic matter than their hayfield counterparts. Complete soil test reports are included as an appendix.

Soil structure is a key component of soil health. In general, the more variety of pore spaces and soil aggregates, the greater the diversity of soil organisms. The greater diversity of soil organisms leads to nutrients being made more quickly available to plant roots.



Symbol	Acres	Name	Ag Value	Status
Cv	30.7236	COVINGTON SILTY CLAY	6d	Statewide
FaC	16.9130	FARMINGTON EXTREMELY ROCKY LOAM, 5 TO 20 PERCENT SLOPES	8e	Not Rated
FaE	0.1082	FARMINGTON EXTREMELY ROCKY LOAM, 20 TO 60 PERCENT SLOPES	11	Not Rated
Le	11.9051	LIMERICK SILT LOAM	4d	Statewide
Lh	2.5110	LIVINGSTON CLAY	6d	Not Rated
SuB	17.6205	STOCKBRIDGE AND NELLIS STONY LOAMS, 3 TO 8 PERCENT SLOPES	1	Prime
SuC	3.2815	STOCKBRIDGE AND NELLIS STONY LOAMS, 8 TO 15 PERCENT SLOPES	5	Statewide
VeB	53.5922	VERGENNES CLAY, 2 TO 6 PERCENT SLOPES	6	Statewide
VeC	7.4191	VERGENNES CLAY, 6 TO 12 PERCENT SLOPES	7	Statewide

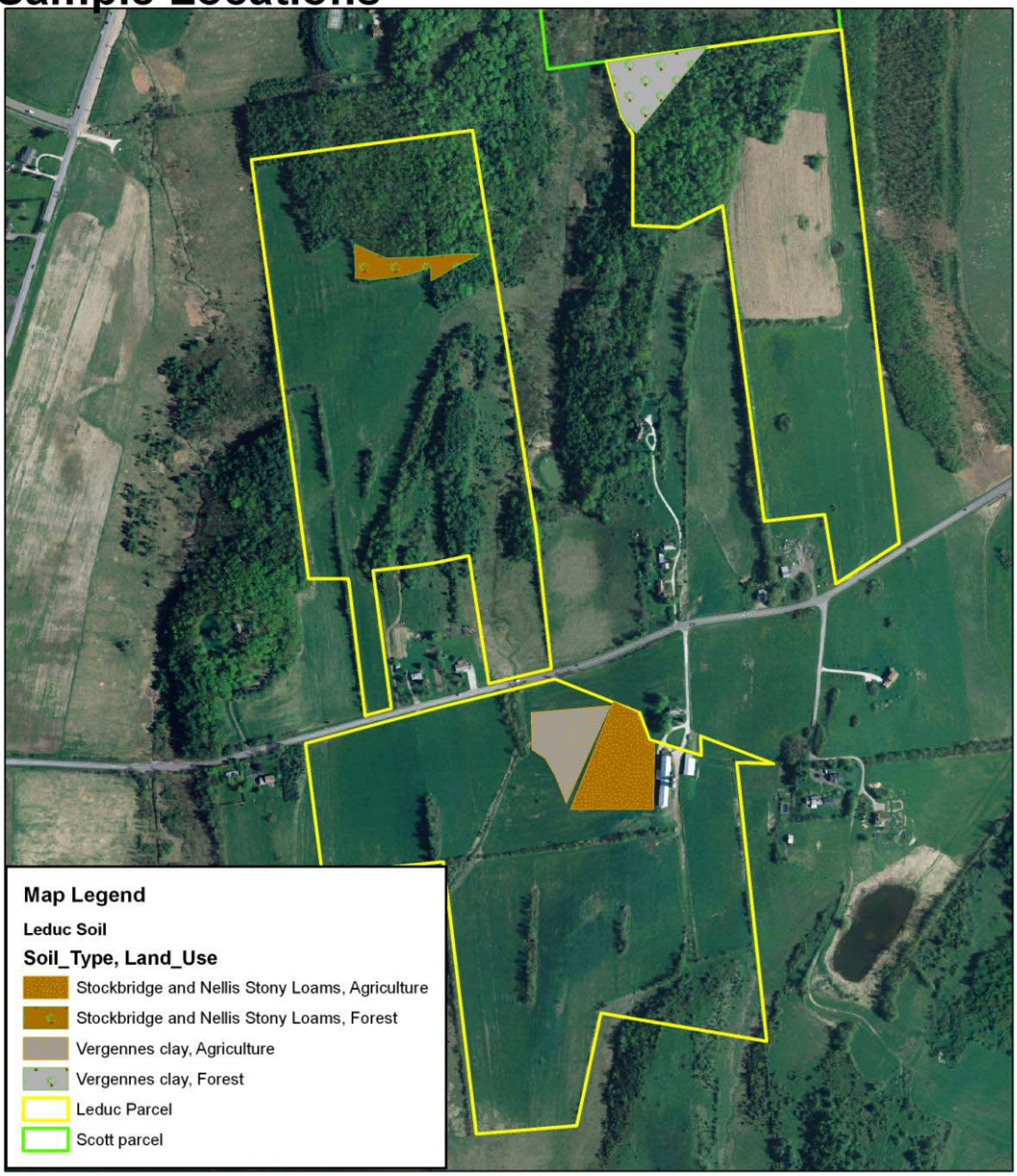
Prime

Statewide

	Total Acres	%
Prine	17.6	12
Stae	106.8	75
Otler	19.2	13
TCTAL	**143.6**	

Leduc Property Soil Sample Locations

Leduc Parcels
South Burlington & Shelburne, VT



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Management Recommendations

The soil to the west of the barn should be excellent for vegetable production. In the clay soil of the western part of this field, organic amendments may be added to improve soil structure and drainage. Otherwise, the soil in the eastern portion of the field may be oversaturated during periods of high rainfall. The field immediately south of this should also be considered for vegetable production, as it is better drained. This field has excessive potassium and magnesium; consider planting K and Mg-heavy feeders in the eastern part of this field, where the SuB soil type is located.

Follow-up soil tests should be conducted every few years to monitor soil health. Further soil tests should be conducted on other fields under consideration for crop production.

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WETLANDS

Overview: Wetlands in the Context of South Burlington

Wetlands are often thought of as open water surrounded by reedy, water-loving plants. However, there are many types of wetlands, each with defining hydrological traits, landscape positions and ecosystem functions. “Broadly defined, a wetland is a transitional zone between dry land and water” (Braddock 2007). The type and distribution of wetlands in any landscape is tied directly to the topography, substrate and human land uses in that area.

The historical mosaic of wetlands in South Burlington included palustrine, riverine and lacustrine types. Palustrine wetlands are inland wetlands that lack flowing water, such as marshes, swamps, bogs and fens. Riverine and lacustrine wetlands are wetlands associated with rivers and lakes, respectively. It is likely that the historical distribution of wetlands in South

We couldn't find an agreed upon name for the water flowing through the Leduc. The 1869 DeBeers Atlas calls it Seeley Brook. That name is not used today.

Burlington was dominated by palustrine wetlands, specifically the clay plain forest wetlands that once filled this area. Much of the area was forested wetlands, but shrub-scrub or shallow emergent wetlands were also quite common (Braddock 2007).

Nested within these wetlands were also riverine wetlands, which occurred along streams such as Potash Brook, Muddy Brook and Seeley Brook. Historically, there were probably lacustrine wetlands due to beaver activity—there is still a large beaver pond along Muddy Brook today.

Hinesburg Rd. Stormwater Utility

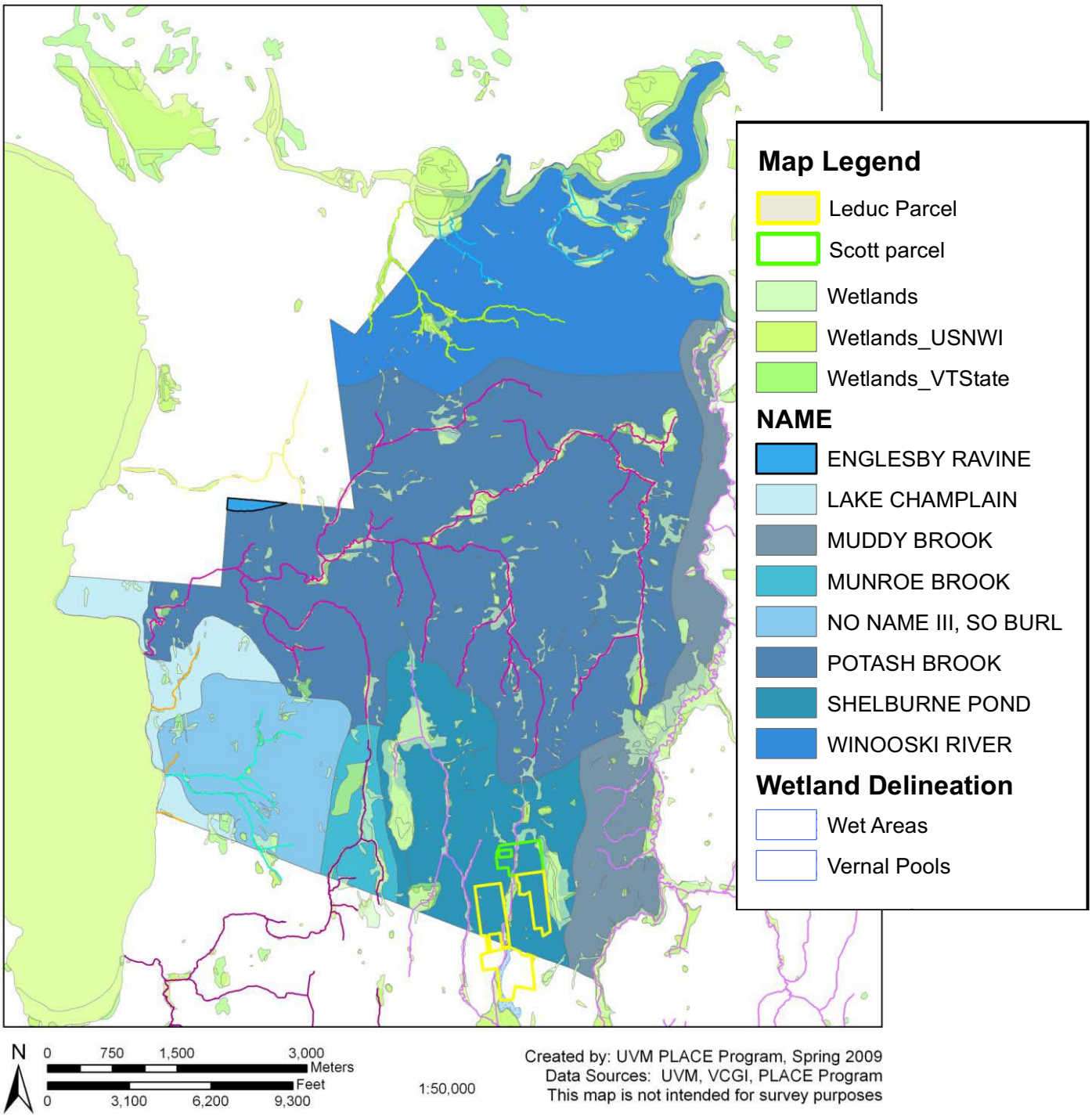
Many streams have been straightened or channeled for stormwater infrastructure, which has also changed the mosaic of riverine wetlands in South Burlington (Bowden 2008). Along with these developments, the South Burlington Stormwater Utility has built or required landowners to build man-made constructed wetlands or stormwater retention ponds to handle stormwater run-off. Wetlands of this type are either fabricated lacustrine or palustrine wetlands. Lacustrine types hold water in a retention basin surrounded by reedy plants, while palustrine types might be built to slow stormwater run off and would contain trees, shrubs or other emergent wetland plants.

The future wetland mosaic in South Burlington will likely include more man-made wetlands. The natural wetlands still present in South Burlington may also be changing due to the increased water flow from urban development. These naturally occurring wetlands will require protection at many levels in order to maintain their quality and function, which are important not only to South Burlington, but also to surrounding communities, as they help control storm runoff, erosion, groundwater recharging, and nutrient and pollution filtration.

Clay soils have tiny pore spaces between the tiny clay particles, making it difficult for water to pass through the clay. Clay soils are commonly associated with wetlands.

Sub Watersheds

South Burlington, VT



Five streams and rivers in South Burlington are stormwater impaired: Potash Brook, Engelsby Brook, Centennial Brook, Monroe and Bartlett Brooks. These watersheds comprise more than fifty percent of the land area of South Burlington. The Leduc parcel, in the Southeast quadrant of South Burlington, is an important conservation priority for maintaining the ecological integrity of Shelburne Pond, Muddy Brook, and adjacent land, which all fall outside of the impaired watersheds.

Wetlands on the Leduc and Bandel/Dopp Parcels

The Leduc parcels frame the Bandel/Dopp property and a major water corridor. Part of the watershed for Shelburne Pond, and the drainage of the Southeast Quadrant of South Burlington, depends on the flow of water through these properties. North of the Leduc and Bandel/Dopp parcels is the city-conserved Scott Parcel, and north of that is a housing development. Stormwater from the housing development drains to a catchment basin then down a narrow stream to the Scott Pond. The catchment basin retains sediments and mitigates peak flow from storm events.

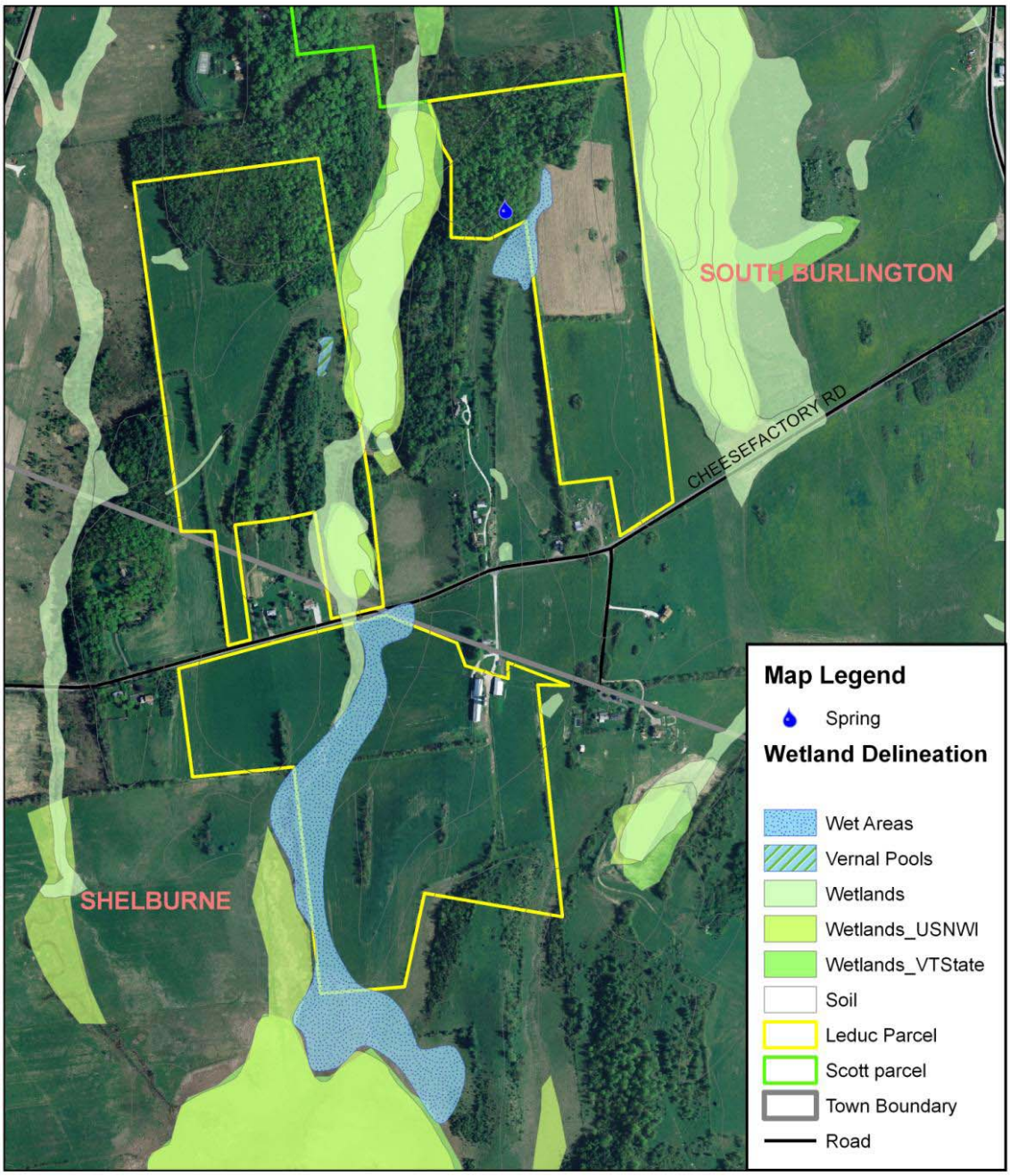
Scott Pond drains into the Bandel/Dopp property by way of a culvert and feeds the wetland system between Scott Pond and Shelburne Pond. The wetlands north of Cheesefactory Road are state classified by the vegetation, hydric soils, and hydrology characteristics. The wetland vegetation includes non-native reed canary grass (*Phalaris arundinacea*), marsh marigold (*Caltha palustris*), several varieties of sedges, rushes and grasses, and water-loving trees like red maple, black ash and green ash.

Reed canary grass, black and green ash

Marsh marigold

Leduc Hydrology & Wetlands

SB Southeast Quadrant Study Area
South Burlington & Shelburne, VT



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Data Sources: UVM, VCGI, PLACE Program
This map is not intended for survey purposes

The wetlands on the Leduc and Bandel/Dopp parcels are in part restricted to the lowland by the surrounding bedrock outcrops and topography. The Limerick soils that underlie the wetlands are deep, poorly drained loamy soils. The soils and bedrock outcrops also create a large vernal pool. This vernal pool is not recognized by the state wetlands maps, but it is an integral feature of the landscape as it contributes to water retention, biodiversity and natural community diversity.

Vernal pool

South Pond and Wetlands

In addition to state classified wetlands, the properties are characterized by forested and agricultural land cover, in which springs and wet fields are present. The field area near the channelized southern portion of the Leduc drainage shows where the water may have extended or flooded prior to channelization. Seasonal floods can benefit the soils by dropping nutrient rich sediments onto the adjacent tillable agricultural fields, supplying them with rich nutrients, while also ensuring that suspended sediments are not carried all the way to Shelburne Pond.

Humans have altered the hydrological features of the property by creating a man-made pond, ditches and culverts. Retaining water is a valuable practice as it helps minimize peak storm water flow and helps capture sediments. Additionally, how the fields are plowed, planted and managed have impacts on the soil, sediment loading, and hydrologic flows. Careful plowing on wet fields is essential to avoid compaction, rutting, and flooding. Historically the fields have been managed very well. The lack of undue rutting or compaction is evidence of a knowledgeable and skilled tractor operator.

Vernal pools are seasonal pools of water that provide homes for frogs and salamanders.

The hydrological importance of the wetlands draining into Shelburne Pond cannot be overlooked. By reducing sediment and pollution loading of the pond, Shelburne Pond is better able to maintain healthy nutrient and oxygen levels. In the summer of 2003 the pond experienced a major algae bloom, a semi-regular occurrence due to the pond's shallow depths. While Shelburne Pond is slowly infilling due to natural sediment and peat accumulation, as evidenced by the increasing size of wetlands surrounding the pond, it remains a vital and beautiful aspect of the South Burlington and Shelburne landscape that could be sensitive to major changes in the surrounding land use patterns, which highlights the importance of conserving the land around the pond.

120 Gallons a Minute!

Groundwater is present under all of South Burlington – but most people don't know much about how groundwater works, probably because it is out of sight. Groundwater is the water underground, and the areas of saturated soils are called aquifers. Water enters the aquifers by percolating down through the spaces between soil particles, or by flowing through the fissures in bedrock. Water flows underground in the direction of higher to lower pressure. Water leaves the aquifers in places where pressure is released, such as the sides of stream banks and natural springs (like Porcupine Spring on the Leduc parcel, picture below). Shelburne Pond is mostly fed by groundwater from an underwater spring. Drilled wells pump water up out of the aquifers for human use. A well in the southeast corner of the Leduc parcel flows at the rate of 120 gallons per minute!

Management Recommendations

The conservation of the Leduc parcels is an important step in ensuring the continued health of the watersheds in the Southeast Quadrant of South Burlington. Once the land is protected by conservation easements, the land management can continue to build off and improve the historical land use patterns established by the Leduc family and their predecessors. The Leducs and others have carefully planted and plowed the areas of wet fields, ensuring that no undue rutting or soil compaction occurred. These practices help ensure that water is able to permeate the soil, and they help minimize erosion.

Because the water flow south of Cheesefactory Road has been restricted to a channel, monitoring this area is especially important. The water flow has only flooded Cheesefactory Road twice since 1959, however this occurrence may become more common with the larger storm events brought on by climate change. Channelization creates faster water flows, prevents natural flooding (as exists above Cheesefactory Road), minimizes wetland vegetation, and could contribute to increased erosion of soil banks if the stream isn't allowed to move across the landscape naturally. Increasing the number of trees and shrubs on the banks of the stream will increase the stability of the banks, create shade to help keep the water cool in the summer, and increase the potential for woody debris to enter the stream, which increases the diversity of the stream's physical characteristics. Forested riparian buffers are beneficial to in-stream and down-stream water quality, biodiversity, and stability.

The Original Cheesefactory Road

The original cheese factory was located on the Leduc parcel, south of Cheesfactory Road. Today, the channelized stream that creates a property boundary between the Leducs and their neighbors is adjacent to a peculiar land formation. The bank next to the channel is about eight feet wide, very flat, and has young trees and shrubs growing on it. It is not part of the tilled hay field, and seems irregular on the current landscape. That's because it's the old road that connected the cheese factory to Shelburne Pond. The cheese factory needed ice from the pond, and the road served as the means of getting the ice from the pond to the ice house, where the blocks of ice were stored in sawdust to help keep them frozen. The ice helped keep the cheese and milk refrigerated, and the proximity to Shelburne Pond and nearby dairy farms made this a perfect site for a cheese factory. Today, the road would need a lot of clearing to be useful to humans, but it does serve as a rabbit road!

Non-native invasive species are important to monitor in wetland areas. Reed canary grass is an example of how well a non-native invasive species can grow in a suitable habitat without natural competition. Because it does so well in wet areas, it has overgrown the hydric soils and covered the wet areas of the properties. Removing Reed canary grass is not recommended because of its pervasive hold on both the Bandel/Dopp property and its strong foothold in New England. However, monitoring and removing any non-native invasive species that are introduced from this point forward is an important tool in retaining the biodiversity of the property. Common wetland non-native invasive species to monitor for include: Japanese knot weed, phragmites, and purple loosestrife.

Working in collaboration with the city of South Burlington will be a large component of managing this parcel, especially as it relates to the Scott Parcel. Because there may be interest in developing public access to the Scott Parcel, this collaboration may be active. Observing and discussing the possible sediment infilling of Scott Pond is crucial for planning and maintaining the health of the downstream wetland corridor. The sediment infilling of Scott Pond may be occurring because it is in part constructed to capture sediment from the stormwater up stream. Whereas infilling is also occurring in Shelburne Pond and may eventually convert it entirely to wetland complex, Scott Pond is a constructed system that's function and enjoyment relies on open water.

In developing the Common Roots mission and infrastructure, minimizing impervious surface construction and constructing permeable ground surfaces are important ways to minimize stormwater runoff and maintain the Southeast Quadrant's watershed health. Demonstrating ecological design principals can be incorporated into the educational elements of teaching about the water cycle on the Leduc, Scott and Bandel/Dopp parcels.

All the water from the Leduc and Bandel/Dopp parcels ultimately drains to Lake Champlain via Shelburne Pond, Muddy Brook, and the Winooski River.

Resources

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Kent, Donald, ed. 2001. Applied Wetlands Science and Technology. Lewis Publishers, Boca Raton, FL.

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80% of the earth's surface is water. More than 97% of this water is in the oceans; 2% is locked in polar icecaps; and less than 1% is in freshwater lakes, streams and groundwater.

VEGETATION

Overview

The forests, wetlands and fields of the Leduc, Scott and Bandel/Dopp parcels are classic examples of vegetation in the Champlain Valley region. To tell the story of vegetation in the Champlain Valley requires a close look at the themes of climate, clay, and culture.

A number of variables are required to explain why a certain plant grows in a certain spot. Climate is at the top of that hierarchy of variables, controlling the regional distribution of plants and natural communities. The Champlain Valley has a warm, dry climate; it is jokingly nicknamed the "banana belt" of Vermont. Lake Champlain has a mitigating effect on the extreme New England weather, keeping the valley warm and the growing season long. The low elevation of the valley (at only 95 feet about sea level it is the lowest part of the state) accounts for the warm summers, but the lake stores heat well into autumn, extending the frost-free season. Hickory and oak trees, for example, reach the northern limits of their range in the Champlain Valley.

Zooming in from the regional climate, substrate and soils determine the distribution of plants and natural communities on a finer scale. In the Champlain Valley, geologic history has draped the land with rich clay soils. Following the retreat of the Wisconsin Ice Sheet, glacial Lake Vermont filled the entire Champlain Valley and melt-water rushed in from the swollen rivers. These rivers were full of debris — rocks, till, sand, and fine clay particles roared into Lake Vermont. The larger particles fell out as the rushing streams slowed in the open water — large, sandy deltas are scattered across the Champlain Valley today, landmarks of where a glacial river met the Lake. But the tiny clay particles were carried far out into that ancient lake, and deposited close to where the shoreline is today. The rich clay soils host unique natural communities, like the Valley Clayplain Forests. Further inland from Lake Champlain, where sand and till dropped out of the melting glaciers, the soil is not as fine, and Valley Clayplain Forests do not exist.

Forests and grasslands help mitigate climate change by sequestering carbon. One of the best ways to get carbon stored in the ground is for roots to grow and die. Then, if the soil is not disturbed, most of the carbon will stick around as soil organic matter.

While climate and clay shaped the natural vegetation of the Champlain Valley over thousands of years, culture has more recently influenced natural communities here. The Abenaki and first white settlers were guided by the natural vegetation; rich clay soils led to good agricultural yields, but rocky loamy soils did not. But as much as the land influenced the settlers, the settlers exerted control on the land. Homesteaders introduced vegetation from southern New England and Europe for example, planting stands of black locust trees to be harvested and used as fence posts. They also brought unintentional species: earthworms, invasive grasses, and pathogens.

Their stonewalls and barbed wire divided the land and changed the shape landscape from a nebulous patchwork of natural communities to one of right angles, open fields and pastures. While many of those field and pastures are no longer in use, they leave behind a legacy of cleared land and old field succession. The matrix community or dominant vegetation in the Champlain Valley used to be Valley Clayplain Forests. Today there is an overwhelming pattern of white pine, a species closely associated with abandoned fields and pastures.

Climate, clay and culture will continue to shape the landscape of the Champlain Valley. The natural vegetation of the Leduc, Scott and Bandel/Dopp parcels, and greater South Burlington, has its roots deep in these three forces.

Current Vegetation

After years of being a working landscape, an interesting mosaic of agricultural land, mature forests, young forests and wetlands patterns the land. The Current Vegetation Map highlights the general stage of succession that stands are currently in. For example, the description *early old field succession* indicates a field that has been mowed within the past few years, and not much woody vegetation has had time to invade. *Old field succession* indicates that the field was abandoned several years ago, so white pines, juniper, and other woody plants have been able to gain a foothold. The label *early successional forest* denotes a dense stand of pole-sized and smaller trees. A *mature forest* describes a community where the trees are large, and there has not

The old brick house on the Bandell-Dopp land has floorboards up to a foot and a half wide. These were hewn from local white pine and oak – imagine the size of those trees!

been a major disturbance in many years. There are just a few *wet forests* in the area. These swamps have been set apart from the other forests because of their unique hydrology. The current vegetation types of *shrubs, wet meadows, agriculture-current*, and *residential* are pretty self-explanatory.

Natural Communities

According to *Woodland, Wetland, Wildland* by Thompson and Sorensen, a natural community is "an interacting assemblage of organisms, their physical environment, and the natural processes that affect them." While a specific area on the ground is a *natural community*, a *natural community type* is "a composite description summarizing the characteristics of all known examples of that type (Thompson and Sorensen 2000)."

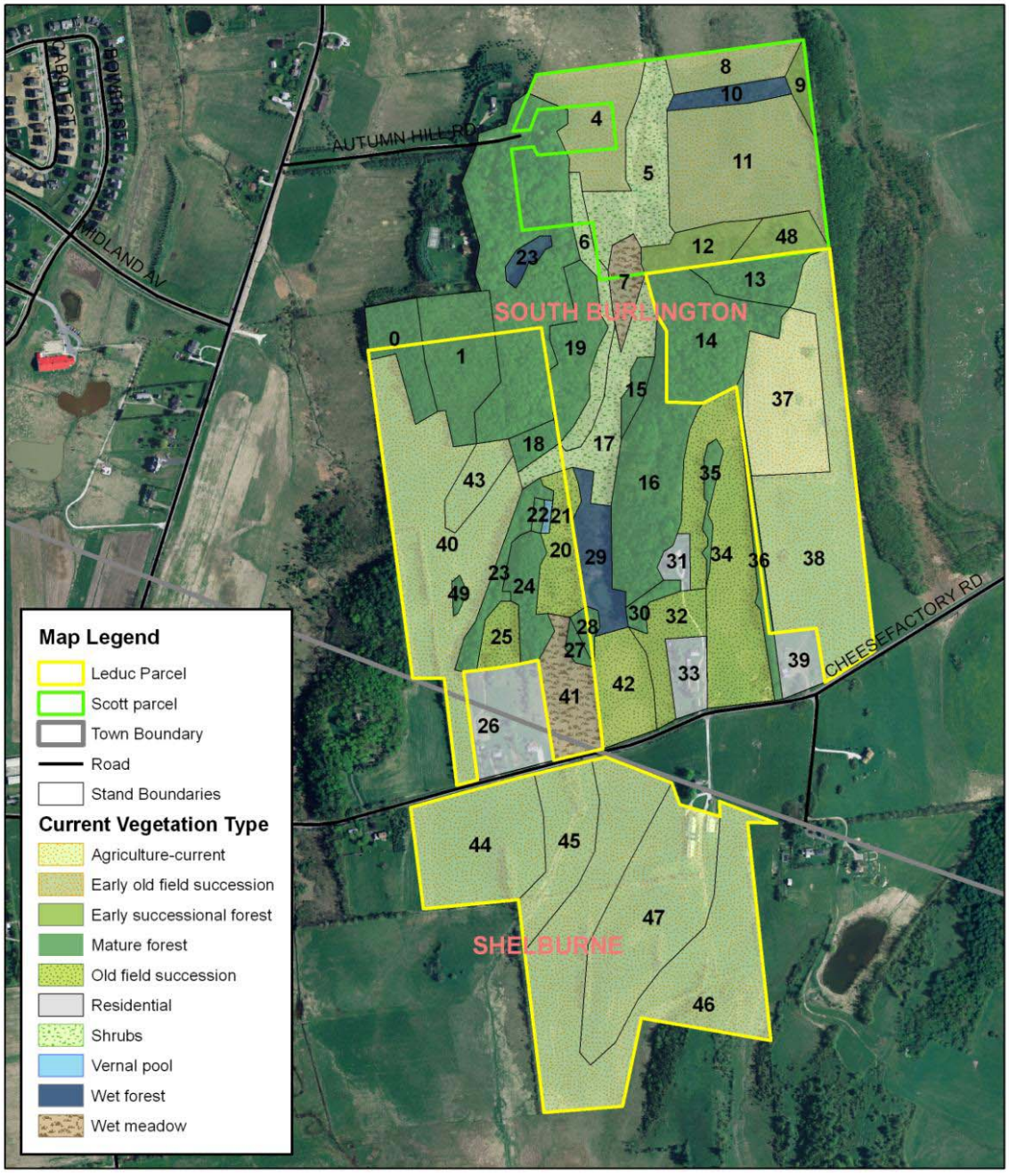
Although natural communities are defined as having minimal human alteration or having sufficient time to redevelop under primarily natural processes, we created our maps with the *potential* natural community in mind. Many of the currently forested areas have had relatively little human impact, and their composition is very close to the natural community we expect to find there. Other areas have been more heavily impacted and are in the very early stages of succession. Still others are still in agricultural use, and will not have a chance to succeed toward a natural community anytime soon. For these last two groups we mapped the potential natural community of the area based largely on soil type and hydrology.

Descriptions of the natural communities found on the Leduc, Scott, and Bandel/Dopp parcels follow. We have included a general overview of the natural community type based on the information in *Woodland, Wetland, Wildland* by Thompson and Sorensen, and a more specific description of the best examples of that community in the study area. Next to the title of each natural community is a list of the stand numbers that are mapped as that community type. These numbers correspond to the Current Vegetation and Natural Community Maps.

Polygon 11 is a "day field." It is as much as one man and a team of oxen could plow in one day. Even though a farmer on a tractor could plow much more quickly today, the outlines of old "day fields" can still be seen on the mosaic of the landscape.

Current Vegetation

SB Southeast Quadrant Study Area
South Burlington & Shelburne, VT



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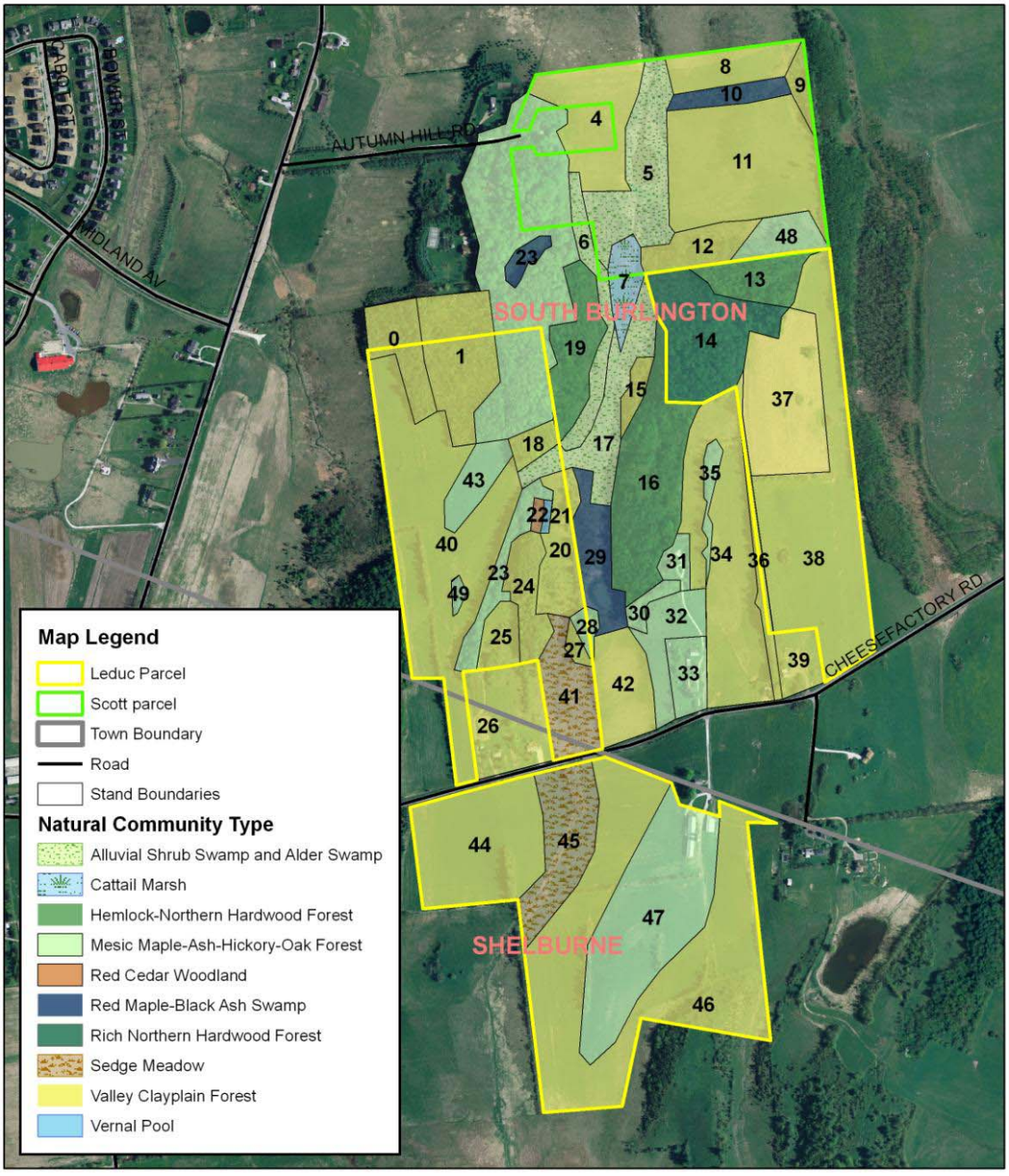
This map is not intended for survey purposes

Natural Communities

SB Southeast Quadrant Study Area
South Burlington & Shelburne, VT



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Natural Community Types Represented on the Leduc, Scott, and Bandel/Dopp Parcels

Wetland Communities

The floodplain that bisects the Leduc Parcel supports a variety of wetland communities. Over the years, flood waters have deposited a mix of sand, silt, and clay. This silt-loam soil is rich, moist, and saturated for a good part of the year. It takes special adaptations for plants to survive in such soggy soil; but plants in the Cattail Marsh, Alluvial Shrub Swamp, Alder Swamp, Red Maple-Black Ash Swamp and Sedge Meadow communities are up to the challenge.

Alluvial Shrub Swamp and Alder Swamp *(Stands: 5, 6, 17)*

The Alluvial Shrub Swamp and Alder Swamps are both dominated by speckled alder. The Alluvial Shrub Swamp tends to grow near streams on the sandy natural levee formed when a river first exceeds it banks and deposits its load of heavier sediments. The sandy nature of the soil allows it to dry out for quite a bit of the year. In some areas of Vermont, black willow and boxelder trees are interspersed with the shrubs, but those trees are not common on the Leduc, Scott and Bandel/Dopp Parcels.

Silky dogwood is a common species in Alder Swamps.

In contrast, Alder Swamps tend to form on wetter soils that vary from being seasonally to permanently flooded. An anaerobic environment is formed when soils are saturated with water; under these conditions gas exchange is hindered. A lack of oxygen slows the decomposition of organic material, and results in a higher organic matter content in the soils. Although the name suggests that this community is dominated by speckled alder, it is not always the case. Silky dogwood, red osier dogwood, and willow shrubs are common members of this community in the study area. Alder Swamps may be declining in abundance across the state. They often occur as successional communities on wet, abandoned farm land and will eventually become forested. This may be true in the study area, as some sections of Alder Swamps are already being taken over by white pine.

Marsh marigolds are hydrophytes, meaning that that they grow in water or on a substrate that is at least periodically deficient in oxygen (anaerobic) due to excessive water content. With hollow stems and floating seeds, these early-blooming flowers are well-adapted to their soggy home.

Sedge Meadow *(Stands: 41, 45)*

Interspersed with the shrubs in permanently saturated soils on the floodplain are open areas filled with hummocks of sedges and grasses. Tussock Sedge is most often the dominant species in these Sedge Meadows, and it forms characteristic raised mounds of dead leaves around the base of the living plant. These somewhat squishy and wobbly mounds surrounded by wet soils can make walking though a Sedge Meadow an awkward and ankle-twisting experience! Step carefully as you look for mink hunting meadow voles among the tussocks, and listen for the territorial calls of swamp sparrows and the rare sedge wren as they defend their nests among the sedges.

This old drainage tile in a wet meadow now dominated by reed canary grass is an indication that this area used to be mowed for hay.

In dry years, Sedge Meadows can be cut for marsh hay, but it is too coarse for cows to eat, and is used as bedding. A Sedge Meadow near the South Burlington/Shelburne Town Line shows signs that it may have been harvested for marsh hay at one time. In the absence of mowing, Sedge Meadows may succeed into a shrub swamp or forest over time.

Unfortunately, there are few native plants left in the wet meadows of the study area. Reed canary grass has almost completely taken over most of the riparian area, greatly reducing the native diversity. This invasive species is sometimes planted as a hay crop. It thrives in disturbed areas and can tolerate both drought and flooding. Once reed canary grass is established, it is difficult to eradicate.

Cattail Marsh *(Stand: 7)*

Although cattails marshes are often overlooked as being boring, they are productive ecosystems that provide important ecosystem services. Besides storing flood waters, maintain water quality and providing habitat, many parts of the cattail plant are edible or useful throughout the year.

The large trees that have grown around barbed wire must date to after 1867 – the year of the first patent for barbed wire in the United States.

Standing water, or at least saturated soils, is their preferred habitat. Cattails reproduce aggressively by rhizomes, and their density can make it hard for other plants to get established. The small patch of cattails in the study area is ringed by reed canary grass, but hopefully the cattail can hold its own against another equally aggressive species.

Red Maple-Black Ash Swamp *(Stands: 3, 10, 29)*

Not many trees can tolerate having their feet wet as long as red maples, black ashes and American elms. These three trees compose most of the canopy in Red Maple-Black Ash Swamps. This common wetland type is extremely variable, with substrate, topography and hydrology all playing a roll. Generally, the soils are not saturated for the entire year, which allows decomposition to proceed. Even so, the high water table keeps most of the roots growing near the surface where they can exchange gasses more easily. The shallow root systems and soggy soils mean that wind is the primary natural disturbance. Beavers are another common form of disturbance.

The East Fork of Seeley Brook winds its way through the red maples, black ashes and elms just north of the pond on the Bandel/Dopp land.

In the study area, Red Maple-Black Ash Swamps are centered around the south pond. The creek winds its way through their slender trunks, and reed canary grass carpets the ground. Tall shrubs are also an important part of this community, with gray dogwood and silky dogwood filling this niche in the study area.

Plow furrows and field ditches concentrate water on the edges of agricultural fields.

Upland Communities

Hemlock-Northern Hardwood Forest *(Stands: 13, 16, 19)*

Pure stands of hemlock pepper New England's matrix of Northern Hardwood forests. Where hardwoods comprise 25 to 75 percent of the canopy, this community is called a Hemlock-Northern Hardwood Forest. These mixed stands of hemlock, pine, and hardwoods tend to grow in steep-sided ravines and along ridges below 1,800 feet. Hemlocks are a slow-growing and shade-tolerant late-successional species, so hemlock stands reflect mature forest. The darkness under a hemlock canopy evokes images of forests primeval: a Cooper's hawk settles on a low branch, a line of deep pileated wood-pecker holes decorates a dead snag, branches with green needles lie underfoot where a porcupine discarded them.

There are not many understory plants in the deep shade of this hemlock grove.

On the Leduc parcel, the eastern ridge that rises above the central wetlands houses the best example of a Hemlock-Northern Hardwood forest. There are some very large hemlock trees growing in the rocky Farmington soil and between the bedrock outcrops. Among the hemlocks there are a few deciduous species including sugar maples, paper birch, and basswood. In the midst of the ridge, hemlock probably accounts for more than 75% of the canopy: an island of a pure Hemlock Forest community in the midst of a Hemlock-Northern Hardwood Forest. At the edges of this forest, white pines and aspen (early successional species associated with Hemlock-Northern Hardwood Forests) hint at more recent disturbances. Even under the largest hemlocks barbed wire fence line runs through the forest, bisecting an old road cut. Rusted garbage piles litter the ground beneath bedrock outcrops.

In the winter, deer and other animals seek hemlock forests and other areas with evergreen canopies to provide some thermal shelter from deep snow, penetrating cold and bitter wind.

Other forests throughout the Leduc parcel boast understories thick with hemlock saplings. As forests on the parcel mature, the shade-tolerant hemlocks will slowly grow into the canopies. But that does not mean that every forest with hemlocks in the understory is destined to become a pure hemlock stand – hemlocks are an important component of many other natural communities, including Northern Hardwood Forests and Mesic Maple-Ash-Hickory-Oak Forests.

Mesic Maple-Ash-Hickory-Oak Forest *(Stands: 2, 23, 28, 30, 31, 32, 33, 35, 43, 47, 48, 49)*

Although the abundance of beech, sugar maple, and yellow birch in the Mesic Maple-Ash-Hickory-Oak Forest (MMAHOF) resembles the Northern Hardwood Forest that is so common in Vermont, the addition of more typically southern species like shagbark hickory, bitternut hickory, red oak and white oak sets the MMAHOF apart. Only found in the warmer, drier areas of Vermont, such as the Champlain Valley, Taconic Mountains and Southern Piedmont, this forest type contains the northern-most range for some tree species. Soils tend to originate from glacial tills and be well-drained.

The patterns on trout lily leaves reminded someone of the patterns on trout.

On the Leduc Parcel, the MMAHOF is best represented by the large stand in the western section that extends north onto the neighbor's land. Here, a wide variety of trees, including bitternut hickory, American basswood, red maple, sugar maple, hophornbeam, American beech and musclewood compose the canopy, while herbs such as trout lily poke up through the thick leaf litter. A grassy old road cuts into this forest from the field corner to the south, and various fence lines and boundary lines also cut through. This forest contains a significant number of nut trees, and is good wildlife habitat.

Many of the beech trees on the Leduc parcel are suffering from beech bark disease; a loss of beech nuts could affect the diets of local red squirrels, jays, turkeys, and black bears.

In addition to this large stand of MMAHOF, many of the smaller patches of trees growing in fence lines and rock piles have a similar composition, with maples, hickories and oaks in addition to early successional trees like white pine, black cherry, paper birch and aspen.

Red Cedar Woodland *(Stand 22)*

While most Red Cedar Woodlands grow on sunny, windswept cliffs in the Champlain Valley, the study area contains a tiny example of this rare community on a bedrock outcrop near the Vernal Pool. Several medium-size Eastern redcedar trees (which are actually in the *Juniperus* genus) and a few white pine trees cling to the steep bedrock slope, with an almost-lawn like cover of grass beneath. Redcedar trees are also common in areas of old field succession nearby, but we believe that because of the shallow, dry soils in this spot, redcedar will remain the dominant tree.

A small Red Cedar Woodland perches on a bedrock outcrop just above the Vernal Pool.

Rich Northern Hardwood Forest *(Stand: 14)*

This early shoot of blue cohosh is an indicator of rich soils.

Rich Northern Hardwood Forests are often the backdrops for Vermont postcards. The "richness" in this forest community refers to a wealth of nutrients, a result of colluvial processes (minerals collecting downslope) or mineral-rich calcareous bedrock, or a combination of the two. These forests of sugar maples, basswood, and white ash are common all over Vermont. Spring ephemerals like spring beauties and hepatica blossom in the enriched soil before the deciduous canopies leaf out. Maidenhair fern and blue cohosh are other common herbaceous species.

Blue cohosh (*Caulophyllum thalictroides)* is an indicator of rich soils. Native Americans brewed a bitter tea from blue cohosh root to ease childbirth pains; that is why they called this plant "papoose root."

Rich Northern Hardwood Forests may be found in smaller patches, where colluvial processes or calcareous outcrops provide localized enrichment. Often, a large swath of Northern Hardwood Forest will contain sections of Rich Northern Hardwood Forest, depending on the geology, hydrology and topography of the landscape. These rich sites are especially valuable for their high productivity — animals appreciate the wealth of food available from butternuts, beechnuts, wild leeks, and striped maple saplings. Humans too, have appreciated the timber and sugaring trees that grow exceptionally well in these forests. Though this is a common natural community in Vermont, most examples of it are small.

Spring beauties carpet the Rich Northern Hardwood Forest in the early spring

The Northeast corner of the Leduc parcel is home to a prime example of a Rich Northern Hardwood Forest. This relatively large patch of Rich Northern Hardwood Forest on the Leduc parcel seems very healthy despite beechbark disease, and does not contain any historic garbage dumping sites. Around the Porcupine Spring, the ground is carpeted with spring beauties and blue cohosh. Beech and sugar maple are the most prevalent trees, but butternut, hophornbeam, slippery elm and basswood also grow here. These trees are tall and straight, a reflection of the nutrient-rich soil.

Valley Clayplain Forest

(Stands: 0, 1, 4, 8, 9, 11, 12, 15, 18, 20, 24, 25, 26, 27, 34, 36, 37, 38, 39, 40, 42, 44, 46)

The Valley Clayplain Forest is a natural community in Vermont that occurs on clay soils in the Champlain Valley. It was the dominant forest type in the Champlain Valley prior to European settlement, but now is one of the most severely altered communities in Vermont (Thompson and Sorensen 2000). The clay soils of this forest type are deep and fertile, and lack the numerous stones that occur in glacial till-based soils that cover much of the state. Those attributes make the clay soils ideal for agriculture, especially when drained. Two variants of this natural

Valley Clayplain forests once stretched throughout the Champlain Valley, but early European settlers converted much of this land into agricultural fields, prized for their rich clay soils and lack of glacially-deposited stones.

community occur based on moisture and topography. The Mesic, or middle-moisture, Clayplain Forest, is better drained, and is preferred for agriculture. The Wet Clayplain Forest has more poorly drained soils, to the point that it is typically a wetland community, and often occurs in low pockets within the Mesic Clayplain Forest.

Soggy clay soils are sometimes less stable, and a high water table can discourage the deep rooting of trees because of reduced soil oxygen. As a result, wind throw is a common occurrence and the dominant disturbance type in clayplain forests. Tip-up mounds are a common sight, and the forest floor of an older Valley Clayplain Forest is often described as having "pit and mound" or "pillow and cradle" topography.

The fine roots in this tip-up mound still cling to clay soil. Wind throw is a common cause of mortality in Valley Clayplain Forests.

The trees that characterize Valley Clayplain Forests tend to reach their northern limits in the Champlain Valley because of its relatively low elevation, and warmer and drier climate compared the rest of the state. Some of the most common trees in the Valley Clayplain Forests include oaks, (white, red, swamp white and bur), red maple, shagbark hickory, white pine, and American elm. White ash, sugar maple, Eastern hemlock, basswood, hophornbeam, musclewood, and American beech are also members of the community. Unfortunately, invasive species are an increasing problem in clayplain forests, and non-native honeysuckles and buckthorns, as well as barberry, are now a significant part of some patches of forest.

Today, the Valley Clayplain Forest exists in scattered patches of disturbed forest throughout the clay soils of the Champlain Valley. Many fields in the study area that are still in use for agriculture have clay soils, and were probably once clayplain forests. The study area also

Humans aren't the only creatures who love maple syrup – red squirrels will make a small cut in the bark of a sugar maple tree to allow some sap to flow out. In a few days they'll come back to eat naturally evaporated maple syrup. Yum!

contains several small patches of early-successional clayplain forest. The patches are almost all dominated by large white pines, which is an early-successional member of the community. It is unclear why these forests are at such an early-successional stage. The three stands of clayplain forest that are not dominated by white pine (1, 12, 36) contain a mix of rich-soil loving hardwoods like sugar maple, basswood, beech, white ash, musclewood, hophornbeam, and white and red oak.

Restoration should be considered for the forests, because they are a rare community in Vermont, and not many prime examples remain. Invasive species removal and trash removal are the most pressing issues, while selective cutting could open up gaps that would allow oaks and other trees to begin the next stage of succession. For more information about this special forest community, see the box below and the appendix: *The Past, Present and Future of Valley Clayplain Forests in Vermont.*

The Beginning of Clayplain Forests

As the glaciers advanced and retreated, plant communities also advanced and retreated with the changing climate. At the maximum extent of glaciation, the plant communities were pushed far to the south, to the margins of the continents. The plants that now make up the Valley Clayplain Forest are no exception. During glaciation, many of the trees that are considered to be part of temperate deciduous forests survived in refugia in the lower Mississippi Valley and northern Florida.

The clays that compose the soils that define the Valley Clayplain Forest were deposited during deglaciation. As the water levels in the Lake Champlain basin shifted toward current lake levels, fresh soil was exposed for colonization by plants, and the development of the clayplain forest could begin.

A grass and sedge dominated tundra typically followed the retreating glacial margin most closely, and Vermont would have been covered by tundra just after Lake Champlain drained about 12,500 BP (Klyza and Trombulack 1999). Two of the first trees to move north were the red spruce and balsam fir, and by 10,000 BP, white pine, gray and paper birches, and oaks dominated the landscape. Ash, elm and hophornbeam show early increases in pollen, and then a later, stronger increase at 9,500 BP. These typically temperate species, which are now members of the clayplain forest, may once have grown with boreal species such as spruce, fir, and larch (Davis 1999).

Both hophornbeam (*Ostrya virginiana*) and musclewood (*Carpinus caroliniana*) now grow in clayplain forests, but hophornbeam probably arrived first, since today its range extends farther north. Because of its early arrival, hophornbeam may have been much more important in the relatively low-diversity post-glacial forests than it has been since (Davis 1981). By around 4,500 BP hemlock, beech and yellow birch moved in (Davis 1981) and the current forest type became dominant (Klyza and Trombulack 1999).

Management Recommendations

Recognize Special Communities:

We recommend that Common Roots approach management of the Leduc parcel with an appreciation for the special natural communities within this landscape.

Valley Clayplain Forests are one of the most severely altered natural communities in Vermont. Most remaining examples are small and isolated, and most of the Champlain Valley's clay soils are prized agricultural lands. The intact Valley Clayplain Forests on the Leduc parcel are special places, reminders of what the land looked like before settlement and agriculture. The Vermont Nongame and Natural Heritage Program ranks Valley Clayplain Forests as S2 – "rare in the state."

Red Cedar Woodlands share this "rare in the state" rank. Though there is only one small example of a Red Cedar Woodlands community on the Leduc, Scott and Bandel/Dopp parcels, it is a lovely spot perched above the vernal pool. While red cedar is a common early-successional old field tree in many areas, this is the only natural community in which it grows as a dominant mid- to late-successional species.

Rich Northern Hardwoods are not as rare in Vermont as Valley Clayplain Forests and Red Cedar Woodlands, but they are special in their role as an unofficial mascot of the state. The Rich Northern Hardwood Forest in the northeast corner of the Leduc parcel is in great condition. Though it has been selectively logged in the past, there are many large, healthy trees. Two uncommon tree species, butternut and slippery elm, grow among the more abundant sugar maples, beeches, and basswoods.

Spring beauties tubers are edible – if you are hungry. They are tiny, and supposedly taste like raw lima beans.

Small-scale Restoration:

In the short-term, we recommend that Common Roots focus on trash removal and invasive species control to benefit the natural vegetation.

There are quite a few large garbage dumps scattered across the Leduc and Bandel/Dopp parcels. It will take some serious man-power to remove the rusted washing machines, kiddie pools, and numerous tin cans. Some of these garbage piles are less accessible than others, for example, there is one deep in the Hemlock-Northern Hardwoods Forest. We have found old dumps in stands 16, 24, the northwest corner of 34, and 36.

While invasive honeysuckles and buckthorn are common throughout the Leduc, Bandel/Dopp and Scott parcels, we recommend focusing on buckthorn control in sensitive areas. The early successional Valley Clayplain Forest (stand 0) must be a priority, as buckthorn may be outcompeting the shagbark hickories, musclewoods, and hophornbeams that should be growing in the understory.

Trails and Education

We recommend that Common Roots highlight special communities and species along their trails and in their educational efforts. Along with the Valley Clayplain Forests, Red Cedar Woodland, and Rich Northern Hardwood Forests, the **Beech Grove** should be recognized as a special community. This stand of stately old beech trees is a snapshot of an older forest; it is a community that was once extremely common across Chittenden County (see box). The beeches here seem to be surviving beech bark disease with little bark scarring, and their beautiful crowns still dominate the canopy.

Two hikers enjoy a stately old tree in the Beech Grove.

Betulin, the chemical in birch bark that makes it waterproof and flammable, is being studied as an anti-melanoma drug. One natural way to extract the potent medicine is by making a tea from the chaga mushroom. This fungus grows in birch trees, and concentrates betulin from the birch bark.

Butternut and **Slippery Elm** were both mentioned as uncommon species in the Rich Northern Hardwoods. Butternut, or white walnut, trees are being decimated by an introduced fungus, and it is listed as an endangered species in Canada. The nuts are an extremely valuable food source for wildlife. Slippery elm trees also suffer from an introduced threat, though they seem to be less susceptible to Dutch Elm disease than American elms. Slippery elm has many traditional uses and its rough bark has been made into gruel, used as remedy for sore throats, and steeped as a tea. **Black locust** also has an important cultural history. This species is not native in Vermont, and was introduced by settlers looking for weather-resistant fence posts. Clumps of black locust trees often grow near the corner of old farms, where generations ago they were planted for their rot-resistant, hard wood.

Beech

The beech grove in the Northwest corner of the Leduc parcel is a beautiful stand of incredibly large, old trees. Slow-growing and shade tolerant, beech trees are often late-successional species. They can reproduce vegetatively from their roots, sending up cloned sprouts in their shade. In old, relatively undisturbed forest, large beeches preside over the canopy for generations. Such beech stands are rare in Vermont these days, though this was not always the case.

When early settlers first ploughed the fields around the Leduc beech grove, beech trees were much more common. Town-line surveyors in the late 18th and early 19th centuries recorded a tree at each mile along the town lines and at each township corner. From the data surveyors recorded on these trees, it is estimated that beech accounted for more than 60% of the trees on the upland mid-elevation soils in Chittenden County. As land was cleared for agriculture and development, the beech trees disappeared along with the rest of the forests. Though many acres of old farmland have returned to forest, these forests are young compared to a mature beech grove. In the meantime, beeches have had to contend with beech bark disease. Though this disease has not extirpated the species completely, like the chestnut blight or Dutch elm disease, it does seem to decimate the largest beeches, leaving scarred pole-sizes saplings. The Leduc beech grove is essentially a time machine, a look back to an older landscape.

BP hemlock, beech and yellow birch moved in (Davis 1981) and the current forest type became dominant (Klyza and Trombulack 1999).

Sugarbush:

If Common Roots is interested in maple sugaring, we recommend tapping the large sugar maples in the Rich Northern Hardwood Forest. There are many sugar maples here, especially along the south edge that runs along the field. Another possible area for a sugarbush may be the Mesic Maple-Ash-Hickory-Oak Forest on the northwest side of the Leduc parcel where another stand of large sugar maples grows.

Opportunities for Further Research

- What is the land use history in the study area, especially in Valley Clayplain Forests? They appear to be mostly early successional despite reports of only light selective logging in these areas
- More data on vegetation, soils and land use in Mesic Maple-Ash-Hickory-Oak Forests is needed in this poorly understood community.
- Succession and Restoration in Valley Clayplain Forests are timely topics where more research could benefit many landowners and natural areas.
- The vegetation of the Vernal Pool seems to be dominated by reed canary grass, but has not been surveyed in detail. More study could reveal that a wider variety of native species are present than is currently known.
- Reed canary grass is dominant in most of the wet areas. Are there any native sedges and grasses left? Are there ways to start eradicating reed canary grass and allow native species to gain a foothold?

Calcareous bedrock close to the surface often results in rich soils. As the rock breaks down, calcium is released into the soil. This raises the pH, and helps make other nutrients more available as well.

Resources

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Sylvanshine is a beautiful word that refers to the way light reflects off leaves that have drops of dew on them.

WILDLIFE

Overview

The Southeast Quadrant of South Burlington is a complex mix of residential, agricultural and forested land. Development pressures make the remaining wildlife habitat extremely important. The Leduc, Scott and Bandel/Dopp parcels (which we will refer to simply as the Leduc parcel) provide a vital piece of connectivity between open space parcels to the north and the Shelburne Pond area to the south. It contains a wide variety of natural communities and habitat features that allow both generalists and relatively sensitive species such as bobcats to thrive.

To examine the wildlife that use this parcel, we sought sightings, tracks and other sign. We chose to focus on mammals, amphibians and birds. This decision was made based on some of the study's constraints. Our wildlife survey took place across a very limited time period, from February through April. This period enabled us to observe mammal tracks, to explore breeding amphibian activity, and to observe winter birds and a small section of the spring bird migration. As these constraints limited the number of species we could observe, we compared our sightings to preexisting studies, including a survey of breeding birds of the Southeast Quadrant by Wings Environmental, a wildlife assessment by Arrowwood Environmental, and amphibian data from Jim Andrews of the Vermont Reptile and Amphibian Atlas.

We compared this data with species that are often associated with the natural communities demarcated by the vegetation study. We also observed and mapped important habitat features, such as mast trees and vernal pools. We chose six focal species based on their impact on the local ecology, sensitivity to disturbance, or game status.

Wood frogs breed in fish-free ponds such as vernal pools, which often form because soil or rocky substrate prevents drainage.

Comeback Kids

Everyone likes the underdog. It turns out that the history of Vermont's wildlife is full of incredible comeback stories. Early Vermonters managed to hunt and trap many species to extinction within the state, and some of those species, such as wolves, remain locally extinct. Other species have made amazing recoveries; they're the "Comeback Kids" that we all cheer for.

Fishers had been hunted almost to extinction in the state by the early 1900's. This led to a major increase in porcupine populations, since fishers are porcupine's main predator. In order to control the state porcupine population, fishers were re-introduced from Maine in the late 1950's and throughout the 1960's. Today fishers are well-established in Vermont, and their populations are stable.

Vermont was also deer-less at some points in its history. Deer were reintroduced from New York in 1878, and are now thriving. (As we all know, from the deer that eat from our lawns and gardens!) The same is true for beavers, which were reintroduced in the 1920's and 1930's after being hunted and trapped to virtual state-wide extinction.

Important Habitat Features and Wildlife Sign

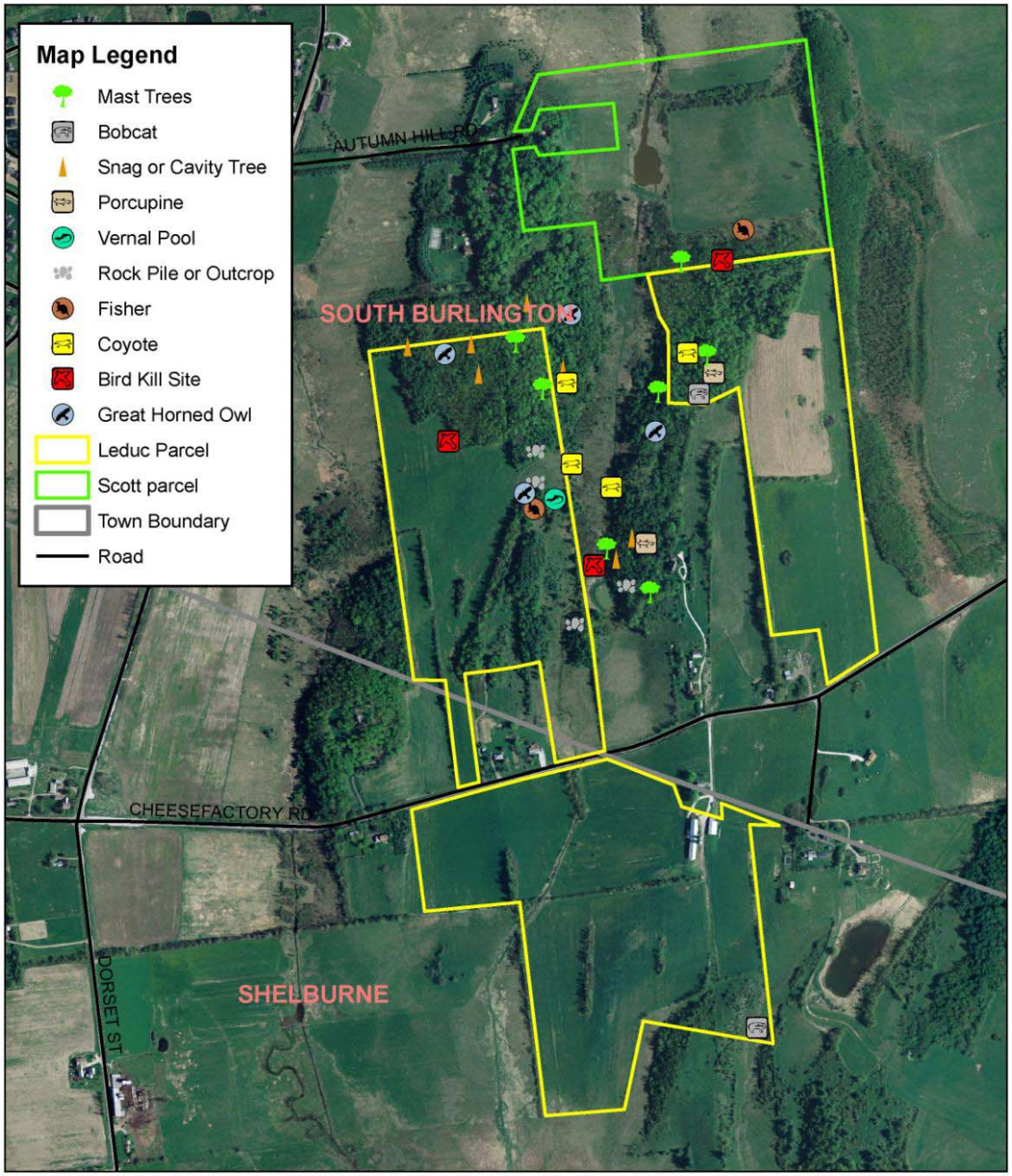
The map below shows where important habitat features and wildlife sign have been found on the Leduc and surrounding properties. The habitat features include rock outcrops, ledges and piles, mast trees, vernal pools, snags and cavity trees, and wetlands, and are described in this document. The wildlife points are the sites of animal sightings and sign, which include tracks, dens, scat, bedding areas, egg masses, kill sites and other features.

The map should not be interpreted as a complete picture of key wildlife areas on the Leduc parcel. The importance of each natural community on the parcel for the region's wildlife is discussed below.

Porcupines eat the tissue just under the bark of trees, sometimes killing the trees. By doing this, they can affect the composition of a forest.

Wildlife Habitat and Sign

SB Southeast Quadrant Study Area
South Burlington & Shelburne, VT



N

0 125 250 500 Meters

0 530 1,060 1,590 Feet

1:8,500

Created by: UVM PLACE Program, Spring 2009
Data Sources: UVM, VCGI, PLACE Program
This map is not intended for survey purposes

Natural Communities and Associated Wildlife

Much of the information in this section comes from *Woodland, Wetland, Wildland* (Thompson and Sorenson 2000).

Alluvial Shrub Swamp *(Stands: 5, 6, 17)*

This community is a key breeding area for many migratory birds. Species that have been seen in the area, such as the alder flycatcher and the veery, may breed here (Pfeiffer 2004). River otter, mink and beaver, which have been observed at nearby Muddy Brook, also take advantage of this community type. On the Leduc parcel this community is likely very important for amphibians; spring peepers, which need wetlands with standing vegetation, have been heard calling here.

Sedge Meadow *(Stands: 41, 45)*

Downstream of the cattail marsh, this community is also important for breeding amphibians. Swamp sparrows, which have been found in the area, may breed here (Pfeiffer 2004). Mink may be found here, as this community offers ideal hunting grounds for small mammal prey.

Cattail Marsh *(Stand: 7)*

This community is often found as part of a larger wetland complex. It provides important habitat for amphibians and reptiles, including green frogs, leopard frogs, bullfrogs and snapping turtles (Thompson and Sorenson 2005). It will be an important site for future amphibian surveys. Water birds also breed and feed here. The cattail marsh on the Leduc parcel likely serves an important role in maintaining water quality and buffering floods.

Red Maple-Black Ash Swamp *(Stands: 3, 10, 29)*

These swamps provide important breeding habitat for many birds, including brown creeper, red-eyed vireo, great-crested flycatcher, and veery, all of which have been sighted in the Southeast Quadrant (Pfeiffer 2004). They also provide essential habitat for amphibian species such as wood frogs, four-toed salamanders and blue-spotted salamanders.

Spring peepers need semi-permanent pools for breeding. In spring, these ponds resound with their peeping calls.

Hemlock-Northern Hardwood Forest *(Stands: 13, 16, 19)*

The abundance of hemlock in this community makes it ideal for porcupines**,** as they find it rich in food sources and potential residence sites. Many porcupine-clipped hemlock branches were found on the ground in these areas. These forest areas also have the potential to support a mix of songbirds. Wintering flocks, including black-capped chickadees, nuthatches and golden-crowned kinglets take advantage of the protection provided by hemlock stands, and all of these species have been observed on the parcel.

Mesic Maple-Ash-Hickory-Oak forest *(Stands: 2, 23, 28, 30, 31, 32, 33, 35, 43, 47, 48, 49)*

The oaks in these communities are important mast-producing trees, offering fall food for a variety of species including deer, turkey, and small rodents. Since the decline of the American chestnut and the subsequent loss of a valuable food source, oaks have become an increasingly important forest species for wildlife (DeGraaf and Yamasaki 2001).

Red Cedar Woodland *(Stand 22)*

Only one example of this community can be found on the Leduc parcel, and it is very small. In Vermont, this type of community generally occurs in small patches that are widely spread. Despite its size, this community is important on the Leduc parcel because it is directly adjacent to the vernal pool, providing connectivity between the pool and the woodlands where many amphibians live, and shading the pool so that the water does not dry up as rapidly.

Rich Northern Hardwood Forest *(Stand: 14)*

This forest community is typically very diverse in terms of vegetation, which means that it may support a diverse wildlife community. Additionally, recently disturbed sites in this community generally contain many black cherry and pin cherry trees, which are important soft mast species. Disturbed parts of this community often contain many aspen and birch trees, which are important food sources for game species such as the ruffed grouse.

Snapping turtles prefer shallow, slow-moving water, and have a relatively high tolerance for water pollution.

Valley Clayplain Forest

(Stands: 0, 1, 4, 8, 9, 11, 12, 15, 18, 20, 24, 25, 26, 27, 34, 36, 37, 38, 39, 40, 42, 44, 46)

This rare community provides habitat for mammals such as deer and gray squirrel, both of which have been found at the Leduc parcel. Wood frogs frequent this community type, as do birds such as the ovenbird and downy woodpecker, which have been sighted in the Southeast Quadrant (Pfeiffer 2004). Snags and mast trees such as oak and beech are found in large numbers in the northern clayplain forests on the Leduc parcel.

Habitat Features

Snags and cavity trees

Snags (standing dead trees) offer living space for many woodland species, including raccoons, bats and birds. Additionally, the insects in the snags provide food for many species, and the holes excavated by woodpeckers and chickadees are used as den sites for flying squirrels and other animals. The dead limbs on snags provide perching sites for many birds of prey (Stringer and Barnes 2007). We observed a Cooper's hawk perched on the limb of a snag on the parcel. Cooper's hawks are recognized as a species of special concern by the Vermont Nongame and Natural Heritage Program (NNHP),

Cavity trees are living trees which have internal cavities created by injury, disease, woodpecker activity, or the loss of large limbs. Actively used cavities can be identified by smoothly worn entrance holes (in the case of bird use), fresh gnawing around the entrance (indicating use as a mammal den) or, obviously, by observed use (Miller 1994). We found one cavity on the parcel that had obviously been used by porcupines, as evidenced by the scat found inside the cavity and on the ground near the entrance hole.

Rock Outcrops, Ledges, and Old Stone Walls

The forested ridgeline that runs from southwest to northeast through the northern part of the

Old stone walls often contain great hiding places for small mammals such as chipmunks.

Leduc parcel contains many rock outcrops and ledges. These features, along with the old stone walls and rock piles that dot the parcel, offer valuable habitat for many snakes and small rodents, as well as potential denning habitat for porcupine, fisher, and bobcat. Signs of these mammals have been seen on the parcel, and a porcupine den was found in an outcrop area.

Mast trees

Mast is the term for the seed and fruits of trees and shrubs. Mast is generally split into two types: hard and soft. The availability of both types is an important component in maintaining healthy wildlife populations. Oak, hickory and beech trees, for example, produce hard mast such as acorns, hazelnuts and beechnuts. Other trees and shrubs produce soft mast; these are foods such as catkins, blueberries, raspberries, and cherries. Some of the important mast trees found on this parcel include oaks, butternut, hickory, cherry and beech trees**.**

Vernal Pools

Vernal pools are considered to be both a habitat feature and a natural community, though unlike most natural communities, they are characterized more by their fauna than by their flora (Thompson and Sorenson 2005). These small pools form in forest depressions when runoff and rain are prevented from soaking into the soil by rock or hardpan. They do not have an inlet or outlet, and are usually dry by the summer. The temporary nature of vernal pools makes them important breeding grounds for amphibians, because predatory fish cannot become established.

Vernal pool on Leduc parcel where many animal signs were found, including fisher, wood frog, and great horned owl.

Roads that separate forests from water bodies are a huge threat to spotted salamanders, and many Vermonters stop to help them across the road on rainy nights in spring

Only one large vernal pool with amphibian breeding activity has been found on the parcel. The southern part of the pool is fairly deep and may remain wet for a longer period of time. The northern section, however, with its leaf-strewn, vegetation-free bottom, is a classic vernal pool, and wood frog eggs and spotted salamander spermatophores have been found here.

Other small temporary pools are located throughout the parcel. The Leduc parcel's clay soils are ideal for vernal pools because the clay restricts drainage. However, these other pools are not particularly large, and so far show no sign of breeding amphibians. More work is needed to characterize these pools.

Wetlands

Wetlands are vegetated areas that characteristically contain abundant water. These ecosystems have been defined many ways by different groups and agencies, but all definitions have three basic characteristics in common: first, wetlands are inundated by or saturated with water for at least part of the growing season; second, they have hydric soils, meaning that wetland soils have particular features that only develop in saturated conditions; and third, they are dominated by water-loving species that have evolved to survive in saturated soils (which would kill most other species).

Wetlands provide important habitat for many wildlife species. They offer nesting sites for many birds, including red-winged blackbirds and great blue herons, both of which have been sighted at the Leduc parcel. They also function as important stopover sites for migrating birds such as Canada geese and indigo buntings during the spring and fall migrations. They can provide shelter for prey species and essential habitat for various amphibian species.

Abandoned Agricultural Fields

These areas are an important habitat for grassland bird species, many of which have seen population declines throughout Vermont as farms have been abandoned and fields have been

Eastern garter snakes prefer wetter habitats, especially clearings near lakes, ponds or streams.

allowed to re-forest. Two grassland bird species with declining populations in Vermont are the bobolink and eastern meadowlark, both of which have been seen in the Southeast Quadrant (Pfeiffer 2004). On the Leduc parcel, small mammals such as deer mice and short-tailed shrews take advantage of this community, providing abundant prey for the area's great horned owls and other birds of prey.

Focal Species

Bobcat (Lynx rufus)

The bobcat has very specific requirements. This species prefers large parcels of untouched forest, and in the Southeast Quadrant it appears to tolerate at most moderately-fragmented forests (Arrowwood 2004). The bobcat prefers areas with wetlands and rocky ledges. The Leduc parcel offers a variety of interconnected forest types with access to wetlands and ledges, and bobcat tracks have been observed here, both in the southernmost tip near Shelburne Pond and in the northern forests.

Track found near Muddy Brook in February 2009. The C-like shape of the space between the toes and paw pad indicate a feline. The size indicates a bobcat.

The presence of bobcat also generally indicates the presence of prey species. Deer, squirrels, birds and cottontail are some of the bobcat's preferred prey (DeGraaf and Yamasaki 2001). All have been observed in the Leduc parcel. Turkey and grouse kill sites observed on the parcel may be the work of bobcats.

The Leduc parcel is home to some enormous beech trees. Wild turkeys, squirrels and many other species consume their nuts.

Because the bobcat relies on large forests with key habitat features and thriving prey populations, its presence at the Leduc parcel speaks for the quality of habitat and the importance of the area's protection.

Porcupine (Erethizon dorsatum)

Porcupines were selected as a focal species because of the impact they have on their environment. These mammals often eat tree cambium, which is the living layer of cells just under the tree bark. Eating a small amount of cambium doesn't seem to harm the trees, but the tree may die if porcupines eat too much of the cambium. Therefore, porcupines can strongly alter a forest's overall composition if their populations become large enough that they kill many trees.

We found evidence of porcupines in several places, including tracks that led to a den site within a rock outcrop area. Near that area was a hemlock stand that showed extensive evidence of porcupine activity. We also found signs of fishers on the parcel; they may help to control the porcupine population, as they are considered to be the only species to successfully prey upon porcupines in Vermont.

Pileated Woodpecker (Drycopus pileatus)

The pileated woodpecker was chosen because of its importance in the creation of tree cavities, which are used by many other species. A pileated woodpecker pair usually excavates a large new cavity every year for its nest, and they also produce holes as part of feeding. Abandoned cavities become homes for bats, fishers, owls, squirrels and other creatures. Other birds, such as the yellow-bellied sapsucker, create cavities that are more numerous, but these are often too small to serve as adequate secondary nests; the pileated's are larger. The pileated woodpecker's role in creating habitat for cavity-nesting species is so critical that it has been called a keystone species (Bonar 2000).

By the mid-1900s the eastern bluebird was in a critical decline. One of the main factors was the loss of nesting habitat -- the clearing of dead trees, and the loss of wooden fence posts in favor of metal ones.

Pileated woodpeckers were frequently observed in the wooded parts of the Leduc parcel, as were trees with their characteristic rectangular holes. Maintaining large snags is an important management practice for encouraging the pileated woodpecker to nest in the area.

Large pileated woodpecker excavation hole.

Ruffed Grouse (Bonasa umbellus)

The ruffed grouse was chosen because it is a game bird. It prefers forested areas over open fields, and requires dense undergrowth as brood cover. It also needs logs or rock features near dense cover as drumming sites --the birds stand on these features and make rapid loud wingbeats to attract mates and declare territories (DeGraaf and Yamasaki 2001). Grouse eat aspen, birch and alder catkins. To maintain a healthy grouse population, fallen logs and rock piles should not be removed, and preferred food sources should not be disturbed.

Ruffed grouse were encountered throughout the Leduc parcel. The birds were sighted in the north-eastern forests, a grouse kill was found in the north-western forests, and scat was found near the vernal pool.

Wood Frog (Lithobates sylvaticus)

Amphibian habitat requirements often change across the life cycle and through the seasons. The wood frog prefers areas with more mature, deciduous forests and fewer pastures, and for breeding purposes it requires a fish-free environment such as a vernal pool (Gibbs et al.2007). The wood frog is a relatively common species in Vermont, but, prior to this spring (2009) its presence in South Burlington had only been officially noted before 1980 (Andrews 2005).

Ruffed grouse will sometimes bed down under a rock overhang in order to stay out of the nighttime winter weather.

A wood frog egg mass in a large vernal pool on the parcel shows that wood frogs are still present in South Burlington. It also indicates that the pool is likely an important breeding area for other species that require fish-free environments, such as mole salamanders (*Ambystoma* sp.).

Wood frog egg mass found in the vernal pool on the Leduc parcel.

Spotted Salamander
(Ambystoma maculatum)

The spotted salamander is a member of the mole salamander family, so named because they spend most of their lives in underground burrows. This species is able to dig burrows itself, but generally dwells in small mammal tunnels. It requires fish-free ponds for breeding, though it will also exploit flooded swamps (Gibbs et al. 2007).

A spotted salamander was seen in the large vernal pool, along with spermatophores (sperm masses). The Leduc parcel offers pools with adjacent woods, as well as many short-tailed shrew burrows, which are the preferred homes of these salamanders (ibid). This species would benefit from a lack of disturbance of the vernal pool, and from a strong forested buffer around the pool.

Other Species

Habitat generalists are characteristic of the Southeast Quadrant area. These species can live in a variety of environments, have variable diets, and therefore tolerate more disturbance than habitat specialists (Arrowwood 2004). We encountered several generalists on the Leduc parcel, including the striped skunk and the common raccoon. However, habitat specialists, such as fisher

Groundhogs have prospered from the edge habitat created by human activity, enjoying grassy areas with nearby trees for cover.

and bobcat which have more narrow requirements, were also present. This parcel offers a diversity of habitats and natural areas that suit a variety of species.

Coyote beds and signs of estrus were found in the parcel's northern forests on both the east and west sides of the brook, and one coyote was spotted. We found signs of cottontail rabbits and white-tailed deer throughout the parcel. The earliness of the season limited our bird list, but we observed a few early songbird migrants, such as the white-throated sparrow and eastern phoebe. Eastern bluebirds were present in both the winter and the spring. Great horned owls were seen throughout the parcel. The Leduc parcel was also frequented by wild turkeys, particularly in the old fields. As for reptiles and amphibians, painted turtles were spotted in the largest pool, garter snakes were seen on rock piles, and spring peepers called from at least two wetland areas.

Amphibian Alert

The world's amphibians are in trouble. According to a 2004 report from the IUCN's Amphibian Assessment, a third of the known amphibian species are now severely endangered or extinct. The causes of this decline are complex and interrelated, but they include habitat destruction, pesticide use and other factors often associated with residential development.

The Vermont Reptile and Amphibian Atlas Project has recorded the presence of twelve amphibian species in South Burlington. These include eight frog species and four salamander species. American toads wander through the city's suburban backyards, and gray treefrogs scale trees near condominium complexes. Leopard frogs and pickerel frogs may haunt wet fields, while wood frogs wander the forests. Spring peepers call stridently from semi-permanent pools, and bullfrogs and green frogs can be found in more permanent waters. Four species of salamander have also been recorded: spotted salamanders, eastern newts, eastern red-backed salamanders, and northern two-lined salamanders. More species may simply have eluded discovery so far.

Only three amphibian species have been found on the Leduc parcel: the spring peeper, wood frog and spotted salamander. There is probably much more to the parcel's amphibian story, awaiting naturalists who are as patient as an amphibian traveling to a pond on a cold spring night.

Management Recommendations

For forest management, we recommend that mast trees not be harvested; these trees represent an important food source for many species. In fact, in densely forested areas it may be beneficial to trim or cut down some non-mast trees growing close to mast trees. This would give the mast trees more room to grow and more access to important resources (water, light, nutrients, etc.).

Additionally, we recommend that snags and downed trees be left within the forest in order to maintain or increase the structural diversity of the forest. However, snags should not be allowed to remain in areas where they pose a risk to property or people; where they are present near property, trails, or places regularly visited by people, they must be removed. If future management plans include trails or paths through the forest, they should be planned with connectivity in mind, so that bobcat and other wide-ranging species are still comfortable traveling through this parcel to Shelburne Pond or to northern forests.

We also recommend that at least some of the unused agricultural fields be maintained in their present state. They provide important habitat for grassland species, and create edge zones between the forests and fields that provide important habitat for many other species. Additionally, the edge habitat between the parcel's fields and forests offers important features and characteristics that are not present in either the fields or the forest interior. This edge habitat thus allows for greater animal diversity.

Similarly, the power line cut helps contribute to animal diversity. The electric company maintains this feature in a continual early successional state to keep the lines safe from large trees. This offers special habitat for a variety of species, including catbirds, chestnut-sided warblers, and rufus-sided towhees. In addition, the cut may offer an easy travel route for many animals.

Painted turtles prefer to lay their eggs in sandy or loamy soil.

The old rock walls and rock piles that dot the parcel should be allowed to remain in place. They provide habitat for small mammals, snakes and other species.

Old rock walls like this one on the Leduc parcel provide important habitat for many species.

Finally, care should be taken to ensure that the hydrology of the area is not altered substantially. In particular, we recommend that care be taken so as not to disturb the vernal pools on the parcel, especially the largest one. These provide such essential, specialized habitat for so many species that the loss of these features, although small in size, would have a large impact on the populations of animals that depend on them. Vernal pools need a buffer to provide access for amphibians living in the surrounding forests. No forest management should take place within 50 feet of the pool. A buffer of 500 feet with only light cutting is preferable (Thompson and Sorenson 2005).

Opportunities for Further Research

Given our study's short time period, there are many unanswered questions. Future studies could examine:

- Any conspicuously absent species, such as gray and red foxes.
- Whether the documented animals are breeding on the parcel.
- Whether populations of the different species are stable, increasing or decreasing.
- More detailed habitat assessment, possibly using guidelines developed for a particular species or set of species that are identified as being of interest.
- How animals move across the parcel and through the larger environment, particularly the large mammals such as coyote, deer and bobcat.
- Whether amphibians use the other vernal pools.
- Habitat use across the seasons.
- How the animal communities will change as the forests change (eg. as clayplain forests move to later successional stages).

Scarlet tanagers usually nest in deciduous trees, and build their nests of grasses, rootlets, twigs and strips of bark.

Resources

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Porcupine babies are called “porcupettes.” They are born in the spring with short, soft quills that harden in a few minutes.

CULTURAL HISTORY

Overview: The Leduc Farm in Historical Context

The Leduc parcel straddles what is now the town of Shelburne and the City of South Burlington. In the past this land has held other names given to it by its original human inhabitants. But before we launch into the history of South Burlington or the Leduc site, let's start with a general overview timeline of Vermont history:

Timeline of Vermont History

Prehistoric

- 12000ya - First people enter Vermont (Paleoindians)
- 9000 - 3000ya - Archaic Period in Vermont. Indians still nomadic, but increasingly dependent on plants for sustenance as climate warms, forests take root, and
- 8000ya - Spruce-fir replaced by mixed-deciduous forests
- 3000 - 400ya - Woodland Period in Vermont.
- 1500ya - agriculture begins in Vermont. Squash first, followed by beans and then corn.
- 1400-1500 - The Great Council Fire, The Seven Nations of Canada, Wabanaki Confederacy forms as peaceful alliance
    - would serve as intermediary between villages and European governments (declined by mid-18th century)
- 400ya – Modern Abenaki

Early European contact

- 1535 - Jacques Cartier, French explorer, first European to see Vermont
- 1609 - Samuel de Champlain first explores Lake Champlain

South Burlington's population in 2007 was almost 18,000.

French settlement

- 1759 - Robert Rogers leads 142 English soldiers from NH in a raid on Abenaki camps along Missisquoi River, killing 200 Abenaki and taking 20 captive. Helped support myth that Abenaki had been extirpated

British settlement

- 1763 - Treaty of Paris, France ends claims to N. America, English essentially take over, huge influx of settlers until about 1790 coming from CT and MA

Slocombe Farm

- 1790 - Asa R. Slocumbe (name later Slocum) buys the property
    - Builds original house, which is now the Vermont House at Shelburne Museum
- 1791 - Vermont joins the union as 14th state, UVM chartered
- 1830 - Slocum farm divided into three parcels after Asa R. dies
- 1865 - S. Burlington splits off as Burlington becomes chartered as a city.
- 1881 - Last official report of a catamount in VT

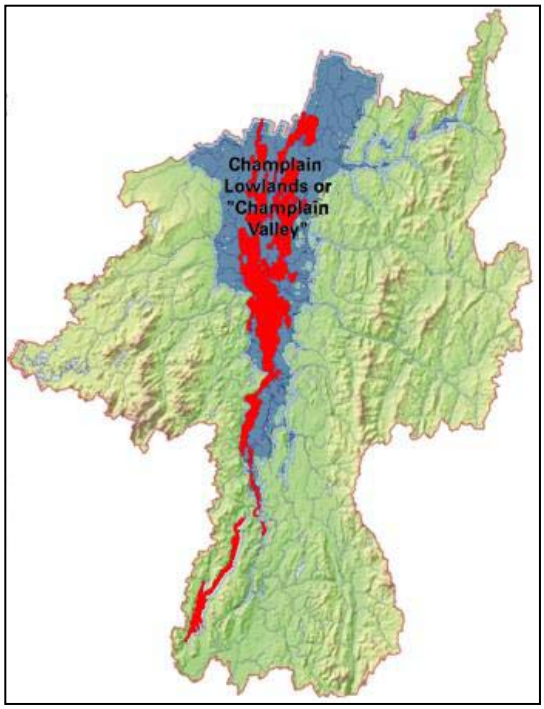
Leduc Farm

- 1900-1910 - Min Leduc's grandfather buys farm
- 1930 - Cattle in state outnumber people (359,611 people in Vermont)
- 1932 - Extirpated beaver reintroduced successfully
- 1948 - First Coyote seen in Vermont
- 1950 - Original Slocum house moved to Shelburne Museum (now known as the Vermont House)
- 1953 - South Burlington Police Department established with just one police officer
    - Chief problem facing town is traffic
- 1954 - Town requests a light at intersection of Hinesburg and Williston

Shelburne Museum's "Vermont House" was once the home of Asa R. Slocum. Originally a log house, the stone house was built around the wooden structure.

Bandel Farm

- 1955 - Betty Bandel buys her property (30 acres at $85/acre).
- 1959-1967 - Fisher cat reintroduced successfully to VT
- 1963 – South Burlington Kiwanis Ski Area built near the Sheraton, burned down in 1967
- 1968 - Last lynx killed, billboards banned in Vermont
- 1971 - Town of South Burlington incorporated as City of South Burlington
- 1977 - Power lines that cut through the Leduc and Bandel properties is built
- 1980 - St Francis/Sokoki Band of Abenaki Nation petition to DOI for status as federally recognized Indian tribe
- 1986 - Betty Bandel sells 10 acres of property for $3000/acre
- 2006 - State recognizes Abenaki people in Bill S.117
- 2007 - Department of Interior issue its final decision on the Abenaki's tribal status, denying them Federal recognition as an Indian tribe
- 2009 - Common Roots and Vermont Land Trust partner to purchase Leduc Farm



Map from the Lake Champlain Basin Atlas showing the extent of the salt water Champlain Sea 10,000 years ago in dark blue mapped over the modern day range of Lake Champlain in red.

Paleoindian history (12,000ya - 9,000ya)

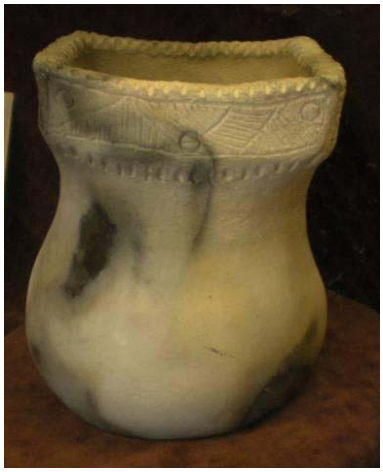
Twelve thousand years ago the ancestors of the Dawn people followed herds of elk, mastodons, and caribou northward through Massachusetts and into Vermont. These Paleoindians followed the gentle topography of the Connecticut River Valley and crossed over the rugged Green Mountains at places where rivers like the Winooski or Otter Creek had incised them. On the western slopes of the Greens,

Just over 1% of South Burlington's land area is protected as private or public conserved land.

they stood looking over the expansive horizon at a land engulfed by sea water. From the foothills, surrounded by stubby shrubs dotting the open tundra, they could only see scant peaks coming up through the flooded Champlain Valley (e.g. Mt Philo and the hill where UVM's campus now sits). Through the silence, a glossy white head of a beluga whale breaches the sea's surface over where Shelburne Pond now lays, then dips swiftly below, leaving circles rippling outward. It is August, and the sun is still high, but the air is frigid.

Archaic and Woodland Culture history (9,000ya - 400ya)

Reaching down, a woman digs her hardened nails into the surface of the soil. She wriggles her fingers around the thin roots of a spruce. She will use these to weave together the tanned moose hide around the spruce saplings for her family's shelter. The sea has closed up and spruce and fir forests have grown over where the tundra once lay - the tundra relegated to the upper peaks of the Green Mountains. Soon these forests will turn over in succession to the now abundant Northern hardwood forests, filled with beech, birch, and maples. These forests are thick and do not support the same large wildlife of the late Pleistocene in North America. An Indian camp along the Winooski River hints at the falling water levels of the now fresh water Glacial Lake Vermont, but it also holds evidence of settlement, of a culture that depending on plants for sustenance.



Abenaki clay jar, made by mixing clay from the Champlain Valley, from soils like those found on the Leduc property. Style is in the St. Lawrence Iroquoian style.

Abenaki (400ya - present)

The Abenaki called this land, Wobanakik, or the Dawn Land, and it stretched from Bitawbagok, now Lake Champlain, east to the Atlantic Ocean. Betawbagok, the lake between, separated the more peaceful Abenaki from their bellicose neighbors, the Iroquois. While their neighbors might have been somewhat more warlike, they traded food, jewelry, ideas, and artistic styles with Iroquois. It was here that the Abenaki could watch dawn swim

To cook in clay pots, Abenaki would heat stones in the fire and then put them directly into the pot using tongs made of sticks or deer antlers. One rock could heat several times its own volume of water. Soapstone is the best rock type to use.

out of the ocean and spill into the sky. Corn and other domesticated plants had reached the Indians living in the valley through long and extensive chains of trade cultural exchange. Settlements became larger, such as those surrounding Shelburne Pond. Clay pottery helps these Indians cook and store food through the winter.

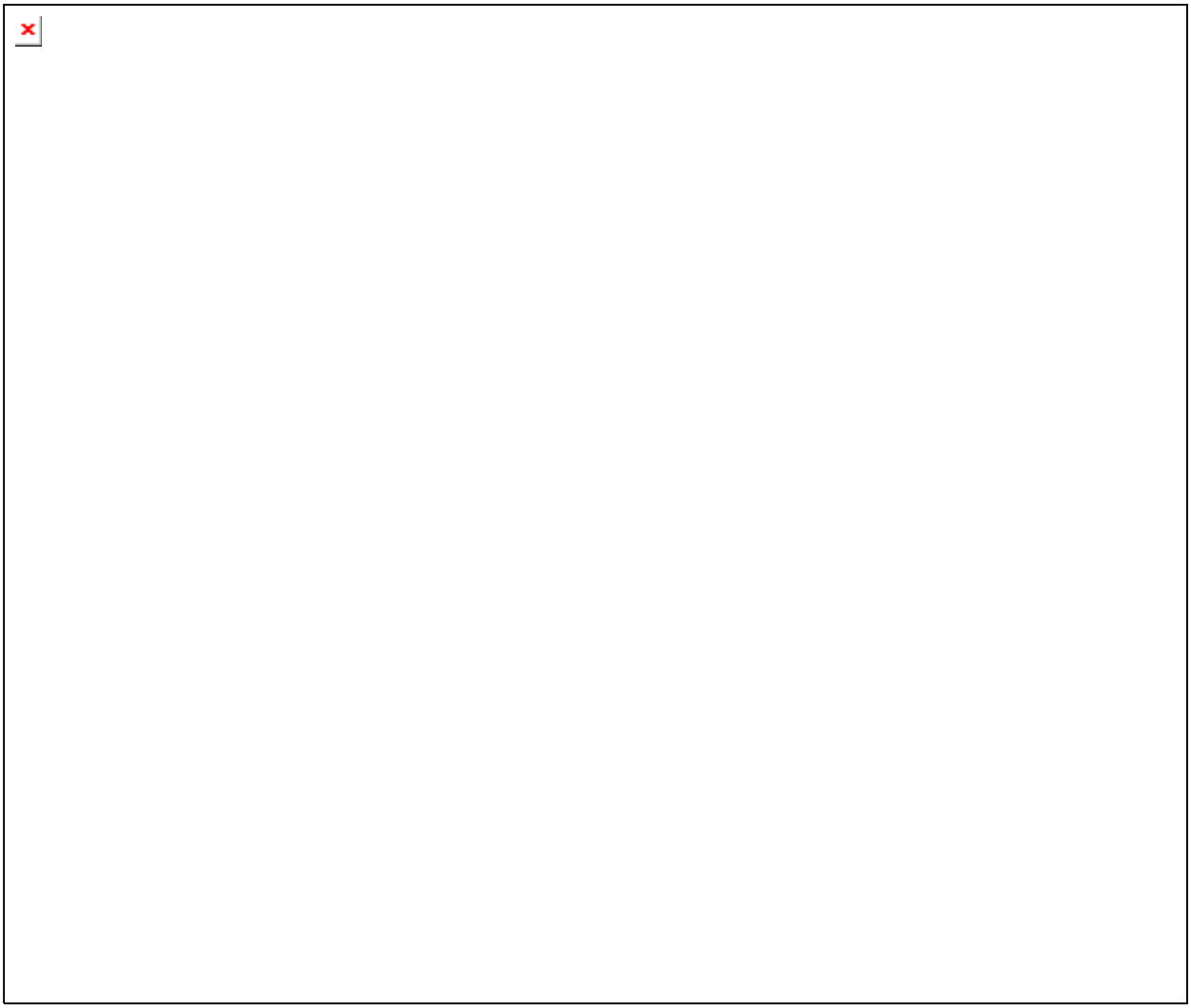
French settlement (400ya - present)

Champlain was the first of many French settlers and explorers that would dramatically alter the landscape of Champlain Valley, ultimately paving the way for what would eventually become South Burlington. Their names dot the landscape: from Montpelier to Lamoille. Former Abenaki sites, such as the Intervale and other villages along the Winooski were abandoned as Abenaki either moved north towards Swanton or faded into the mix of French settlers. In 1763, France signed the Treaty of Paris with Spain and Great Britain, ending the Seven Years War and relinquishing any and all claims France had to North America. At this time, the English had a stronghold in Connecticut and Massachusetts at the time and so after the treaty was signed, a volley of English settlers developed the land, establishing permanent residence.

However, in the late 18th century Vermont was still considered frontier land -- an almost completely forested landscape inhabited by indigenous peoples and something of a "no man's land" between the colonies of New Hampshire and New York colonies. The place names we so quickly overlook today greatly reflected that sense of settlers attempting to re-create (old) England in this new landscape. In looking at early maps of the state, it is clear that townships were carefully cut into perfectly square chunks spanning six miles on a side (whenever possible), as was the tradition of the agricultural landscape in England at the time. In Vermont, groups of surveyors started at the southern boundary and worked their way northwards creating the geopolitical borders we continue to recognize today. These orderly squares morphed as needed in areas alongside rivers and streams, one of the reasons for the shape and size assigned to the township of Burlington (Jane Dorney, personal communication February 18, 2009).

Local clay was used to create bricks for buildings, chimneys and fireplaces.

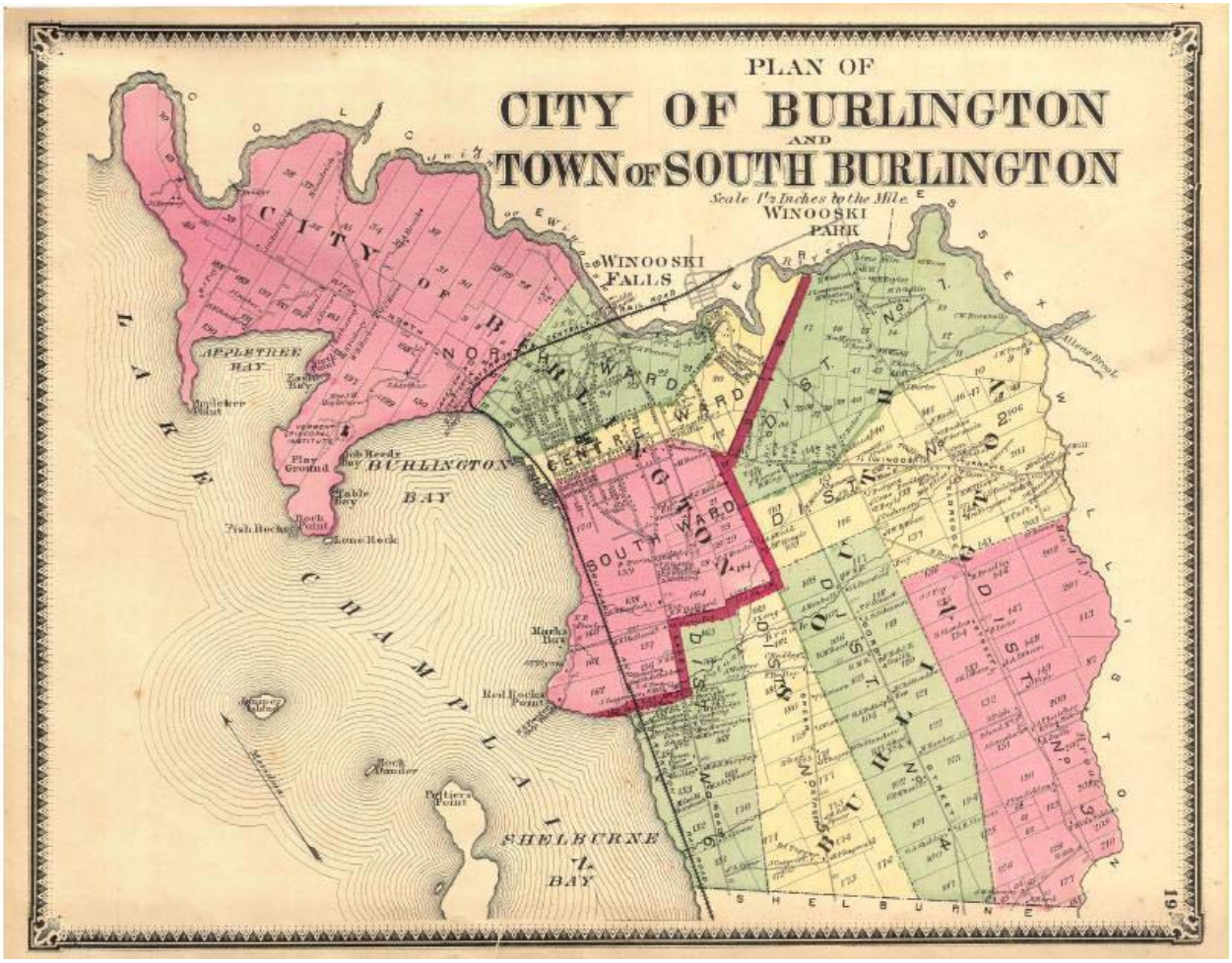
The map below is one of the earliest of the area from a surveyors mapping of Chittenden County in 1798; the original could not be located so the image below is a scan of a photographic copy of the original. It is included to provide a general overview of Burlington's beginnings. A high quality electronic image can be provided upon request.



1810 County Surveyor's Map of Burlington, VT

Historic maps give clues into the changing political views and claims to a landscape. We can track much of South Burlington's history through old maps such as the above map, Walling's map, Beer's Atlases, and even Google maps.

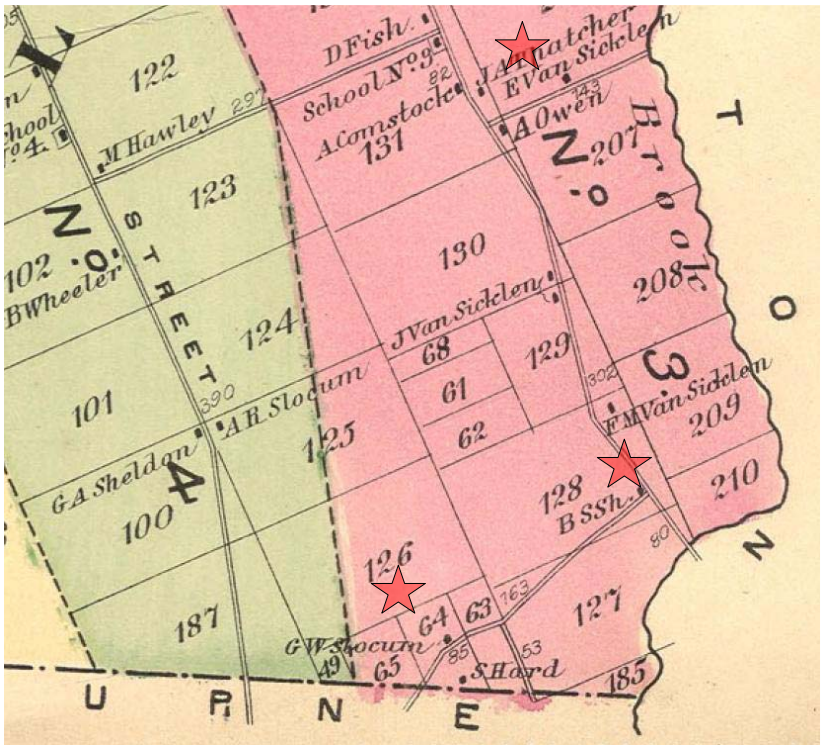
The town was quite large by English standards, which limited townships to the functional unit as determined by the travel limitations of the day (six miles squared). Burlington soon grew too big for its own good. By 1865, residents of what was then called the Town of Burlington voted to create a separate township, South Burlington, due to diverging thoughts among city dwellers and rural farming residents on how to spend public money. Residents living in the urban areas on the edge of Lake Champlain were experiencing an outbreak of typhoid fever and attributed this directly to the proximity of the sewer discharge point in Burlington Bay to their source of potable water, and intake point also in Burlington Bay. According the Jane Dorney, a Vermont historical geographer, this split separated Burlington's urban residents from the farming communities living outside of the growing city due to insurmountable differences in opinions regarding the use of public money for the installation of sewers in the city center (pers. comm., February 18, 2009). Rural residents were far removed from this problem and did not want to vote for the expensive project of extending the sewer effluent pipe farther into the lake (Simmon n.d.).



F.W. Beers 1869 Historic Map of City of Burlington and Town of South Burlington. Demarcation added by www.old-maps.com. Please note: the boundary indicated by southern end of red line is incorrect and should extend about a mile further south.

Insights on South Burlington from Historic Maps

In the following images, the authors have magnified the area of the historic map showing where the Leduc, Scott, and Bandel/Dopp parcels are located today. The first image shows these areas, which surround the black dot labeled "S Hard" on both maps, located at the border between South Burlington and Shelburne – use this as a reference point to connect the two maps appropriately.

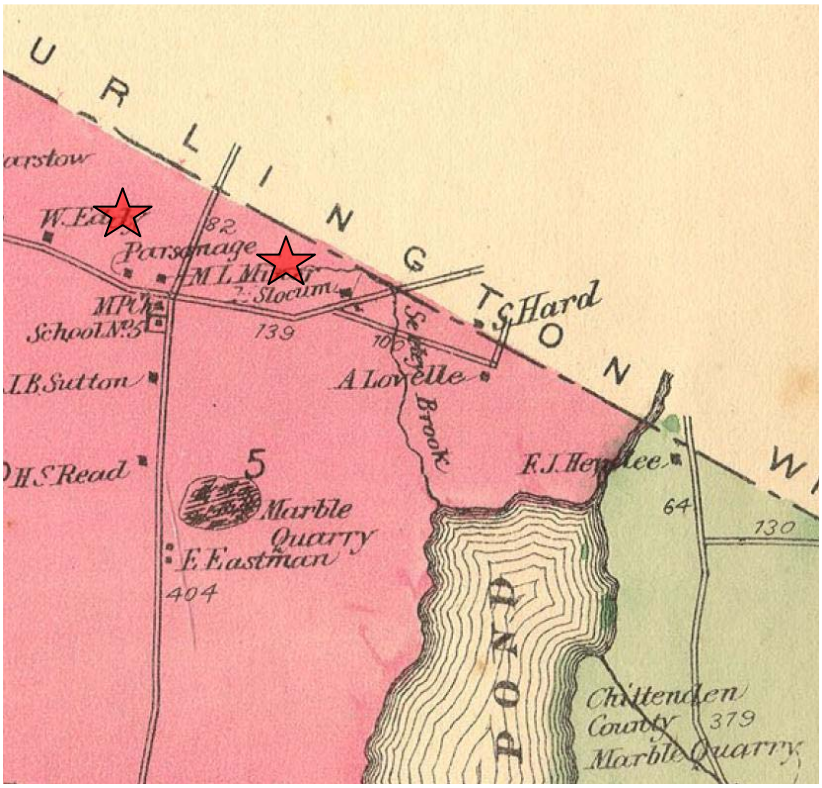


F.W. Beers 1869 Historic Map zoomed-in to show southeast corner of South Burlington, VT.

Beers used black dots to indicate the location of buildings and structures present in the time of the survey, 1869, and wrote in lot numbers (large numbers at the center of each block of land) which were used by the government to organize information in town records and tax data. The authors have added red starts to highlight a few places in this general area that may be of interest to the reader and can serve as historical reference for teachers using the southeast quadrant to teach about cultural geography. In the appendix, we are fortunate to have found and included a list of all the Homesteads listed in the Beers Atlas along with notes as to what stood in that same location at the time of the publication by Ms. Betty Bandel. Please refer to this for more information about areas from throughout South Burlington.

Route 116 was called Eldredge Street before it was named Hinesburg Road and served as a stage and mail delivery route for many years.

The northernmost star in the South Burlington mini-map shows the location of the oldest house in South Burlington, the Van Sicklen House, a stone house (see image below) built by Abel Owen, owner of lot # 207 in 1815 out of stones quarried on that very property. Likewise, "the large central chimney contains 21,000 bricks made from a bed of clay found on the home place" (Carlisle, 1975). This house still stands today, and can be seen on 1550 Hinesburg Road.



F.W. Beers 1869 Historic Map zoomed-in to show northeast corner of Shelburne, VT.

The Stone House, 1550 Hinesburg Road.

Following south from the Stone House, a red star highlights a couples structures on the corner of what is today known as Hinesburg Rd and Cheesefactory Road. The first interesting history is regarding the name of these streets: Hinesburg was previously known as Eldredge Street, according to the Beers map of 1869 and later Fourth Street as indicated in an

South Burlington became its own town in 1865 by a people's vote to separate from the City of Burlington.

excerpt by Charlotte Marsh from an early draft of the *Look Around South Burlington* (n.d.). The former name of Cheesefactory Road was likely Barstow Road, although that is unclear from historic maps and Emmanuel ("Min") Leduc remembers it being named Creamery Road at one point before being renamed in the 1970s. He attributes the new name to Betty Bandel (personal communication, March 2, 2009), but this information conflicts with information about the street being renamed two years after Betty moved to the area in 1955 (Sarah Dopp, personal communication, April 17th, 2009).

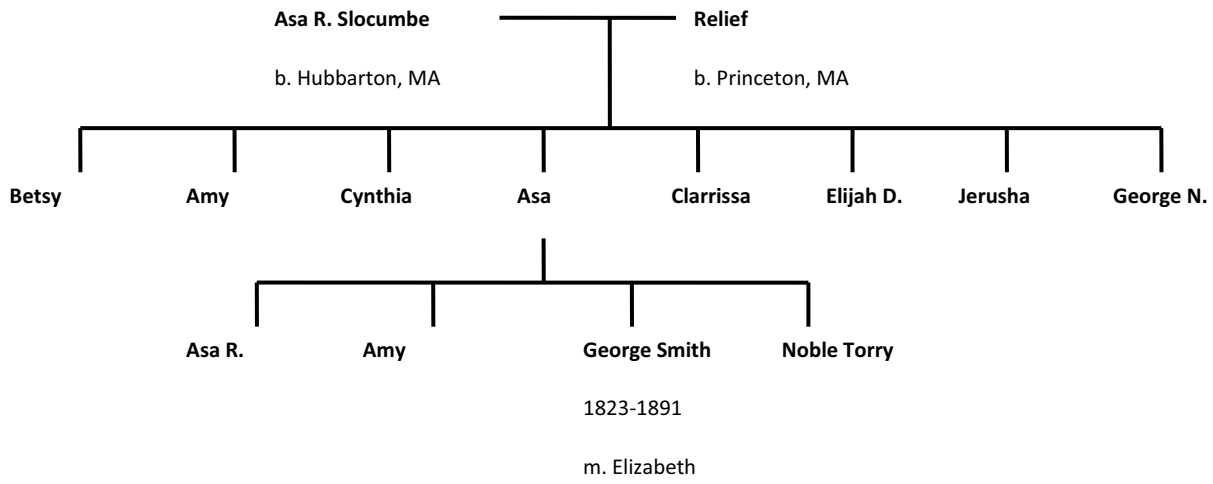
These buildings are labeled "E.W. Van Sicklen" and "B S Sh". The first of these shows the location of an inn and tavern which still stands today, although it no longer holds the kind of attraction it once held. It can be seen as it now stands in the image pictured below. Jane Dorney discussed the importance of this building as a kind of community center where men could gather after work to get the news or pick up their mail; where community dances were held on the second floor; and where even criminals were held overnight in jail cells on the ground floor. Eldredge Street at that time served as both a stage route and a mail route, so travelers were likely to take a break at this tavern on their way to or from Burlington (personal communication, February 23rd, 2009).

Old Inn and Tavern. Image taken by Nathaly Agosto Filión, 2009.

Just across the road from this building, the Beers Atlas points out the location of a "B S Sh", or Blacksmith Shop" of which there are, unfortunately, no longer any signs on the ground today. In terms of cultural geography, the location of this shop makes perfect sense across the street from a tavern where travelers could stop to mend axles, or buy spare parts before the journey ahead.

South Burlington does not have a Town Hall.

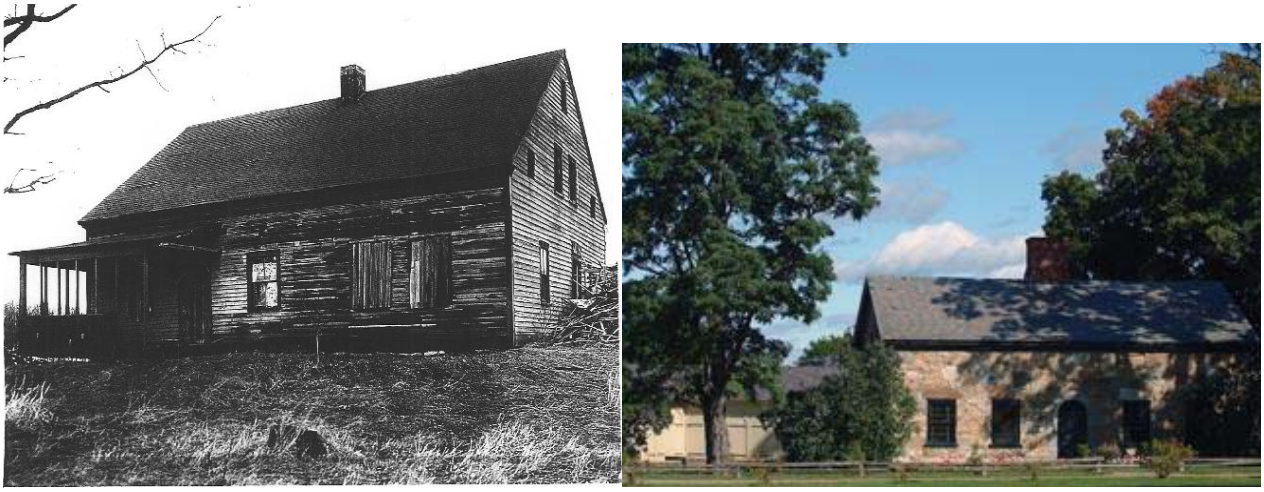
Moving further south towards the final red star in the South Burlington map, we arrive in the Slocum family farmstead, the location of today's Common Roots land. Prior to selling these properties to the Leduc family, the Slocums settled this land and distributed it among their children. The Slocum family genealogy is provided below.



Moving just across the South Burlington-Shelburne border, there is a dot labeled "A Slocum" which has an amazing story. When Asa Slocum first moved to the area to start farming his land, he was only able to afford to build small, one-room log cabin in which to live. That log cabin is what the dot on this 1869 map is showing. However, as Asa was able to adjust and grow his business, he decided to expand his home and did so by building the frame for his new home right on top of the log cabin. Even as construction progressed, he continued to live in the little log cabin, surrounding by the frame of his future home. Once the new home was ready, Asa began to slowly dismantle the log cabin, saving the logs for use as firewood (J. Dorney, personal communication, February 23, 2009). Asa moved to the area in 1790 and by the time of his death in 1830 had purchased a considerable amount of land in Shelburne and (what was then Burlington, but is today) South Burlington. The first 20 acres he bought in South Burlington cost

In 2000, the average household size in South Burlington was 2.31

him only $20! Today, the home is featured as “the Vermont House” (pictured below, next to an image from the 1950s) in the Shelburne Museum to which it was relocated piece by piece in the1950s (Carlisle, 1975).



The “Vermont House”, formerly the Slocum Family home, was renovated and relocated to the Shelburne Museum in the 1950s. Shelburne Museum Archives, Shelburne, Vermont (catalog number 4.12e317)

Do you have lilacs in your yard? How about apple trees, purslane, burdock, or garlic mustard? Those are all plants that the early settlers brought with them from Europe.

Across the street, on the very edge of Cheesefactory Road is a dot labeled “S Hard” which is known as the Slocum House and is pictured below. Much of the fame this house attracts is due to a little toolshed that sat beside the home and “might have come straight out of Grimm or Hans Christian Andersen’s fairy tales” (Carlisle, 1975), also pictured below.

Slocum Family Farm images from 1975 and from 2009. Sources: Look Around South Burlington and Emily Stone.

Historic image of the “Little Crooked House” on the Slocum Farm, Look Around South Burlington. Current image of the “Little Cooked House” by Nathaly Agosto Filión, 2009.

Stone walls pay homage to the sheep grazing history of Vermont, while barbed wire fences are relics from Vermont’s dairy era.

The Eldridge School

Once located just off Airport Drive in South Burlington was the historic Eldridge School, a one-room school house which also served as the town's first very first meeting house in 1865. It was demolished one hundred years later, in 1965, due to a lack of action on the part of South Burlington residents to respond to a call for preservation from the town's historical society. The Eldridge School served as the location of South Burlington town meetings until 1871 when a municipal building took over this purpose. The newspaper article pictured below "Town Buries Its Past" chastises South Burlington residents simply in the headline. Bricks from the little school house were saved and re-used for other construction projects throughout the city.

Because no one took initiative to save it, historic Eldridge School off Airport Drive, South Burlington, was demolished by bulldozer Friday.

South Burlington's First School, 'Town Hall'

Town Buries Its Past

Signs on the Land - Stones walls and Fencing

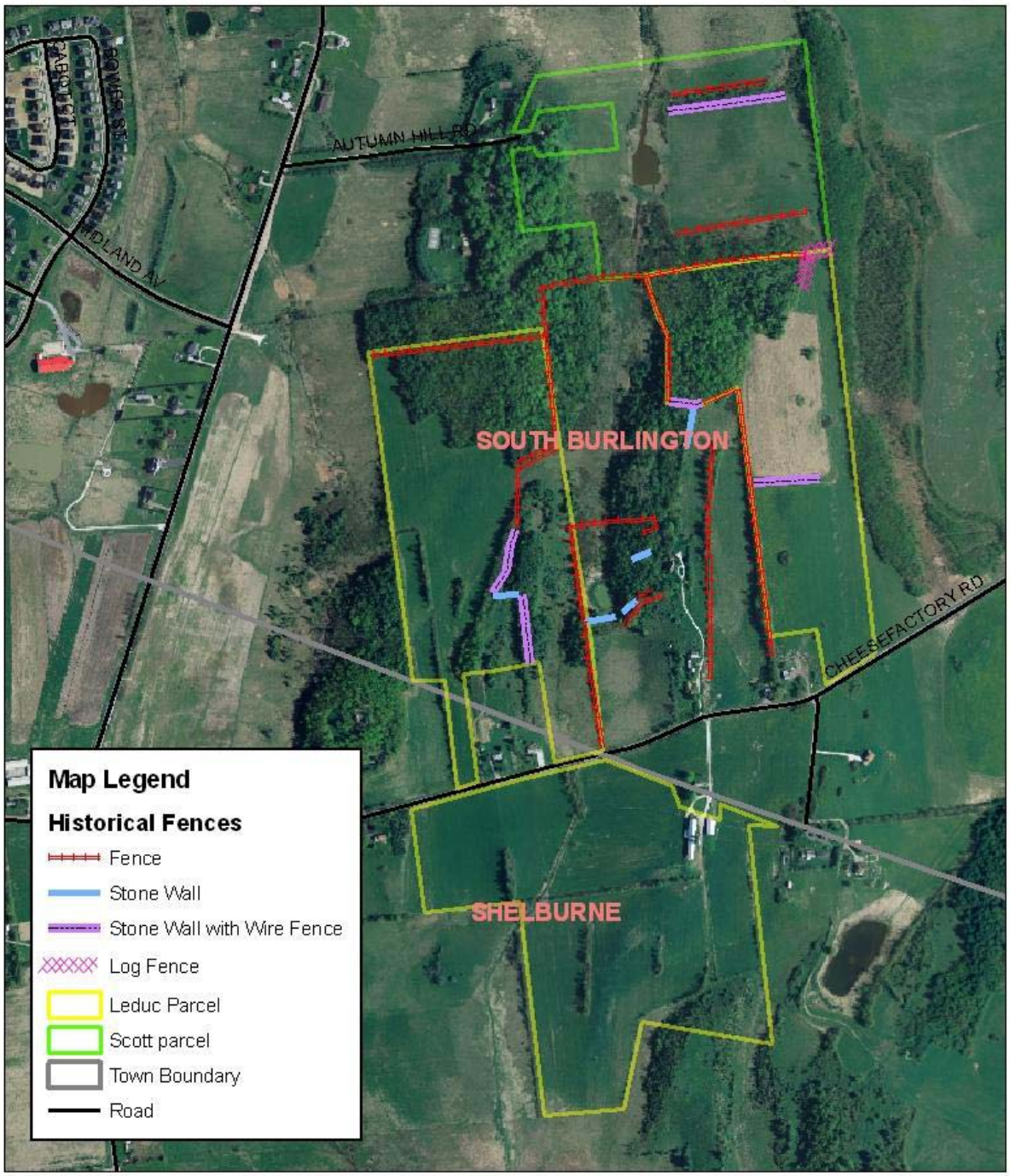
The map on the following page illustrates historical usage of the land. There are both stone walls and stone piles. The stone piles were most likely from more recent farming materials when a truck could have been loaded up with stones and then driven to the edge of the field. There is a large collection of rock dump sites along the northern edge of the old field.

Stone wall on the Leduc Parcel. Teage O'Connor. 2009.

Black locust trees aren't native this far north, but they are rot resistant, and grow really fast. They were so useful for fence posts that early settlers brought them up from the south, and now they're all over South Burlington.

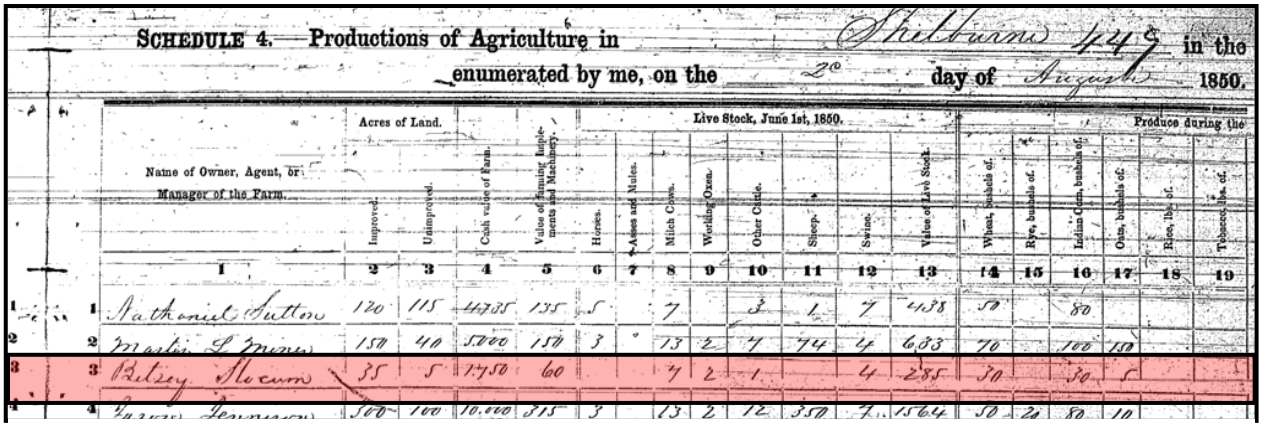
Stone Walls and Fence Rows

SB Southeast Quadrant Study Area
South Burlington & Shelburne, VT



Slocums (1790-1955)

For a very long time the area in which Common Roots will be working belonged to the Slocum Family, who carved out their little section of land on the southeast corner of South Burlington before it was even called South Burlington. Of English stock, Massachusetts-born Asa R. Slocombe, purchased his farm in 1790, and with his wife, Relief, became the first of four generations of Slocums (the spelling of the name was later changed) to farm the land before the last Slocum finally sold it off in 1955. Asa and Relief raised sheep, as evidenced by the old stone walls (see below), and in Asa's will he left his progeny 13 bee hives, a clock, and 25 geese. His children, who inherited his land, divided it in three in 1830, continued farming, though the inventory of plants and animals tended to slowly began to shift. Agricultural censuses give us snapshots in ten-year intervals into exactly how humans were utilizing their land. Through these old agricultural censuses, we can chase the mid-19th century history of the Leduc farm. Below is the entry for Betsey Slocum, which shows a shift from Asa's sheep farming to dairy cows and staple grains and corn.



SCHEDULE 4.—Productions of Agriculture in Shelburne in the enumerated by me, on the 20th day of August 1850.

	Name of Owner, Agent, or Manager of the Farm.	Acres of Land. Improved.	Acres of Land. Unimproved.	Cash value of Farm.	Value of farming implements and Machinery.	Live Stock, June 1st, 1850. Horses.	Asses and Mules.	Milch Cows.	Working Oxen.	Other Cattle.	Sheep.	Swine.	Value of Live Stock.	Produce during the year ending June 1st, 1850. Wheat, bushels of.	Rye, bushels of.	Indian Corn, bushels of.	Oats, bushels of.	Rice, lbs. of.	Tobacco, lbs. of.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Nathaniel Sutton	120	115	4475	135	5		7		3	1	7	438	50		80			
2	Martin L. Mines	150	40	5000	150	3	"	13	2	4	74	4	683	70		100	150		
3	Betsey Slocum	35	5	1750	60			4	2	1		4	285	30		30	5		
4	[illegible]	300	100	10,000	315	3		13	2	12	350	7	1564	50	20	80	10		

From Vermont Agricultural Census taken of Betsey Slocum's farm in 1850. See appendix for complete entry.

The median annual household income in South Burlington was about $50,000 in 2000.

The Slocums slowly sold off their inheritance, over 230 acres, the last of which was sold by Lewis Slocum to Betty Bandel in 1955. Somewhere between 1900 and 1910, the great-great-grandfather of the youngest Leducs still living on the land purchased the farm area surrounding what was to become Betty Bandel's property and extending across Cheesefactory Rd. This land has been farmed by four generations of Leducs, and is being purchased by the Vermont Land Trust and Common Roots to be protected as agricultural land in perpetuity.

The last star to highlight in this area, located at the intersection of Dorset Street and Cheesefactory Road is meant to highlight the area where a brick house and kiln was used to fire local clay into building materials as well as a little one room school house which, despite the changes that took place in the building was still where some members of the Leduc Family went to school in the last 50 years. The brick house was located where the map is labeled "M L Minor" but was used for only a few years before being outcompeted by the newer technologies from the factories in neighboring Winooski (J. Dorney, personal communication, February 23, 2009). School # 5, although technically in Shelburne was where current-day South Burlington resident, Emanuel "Min" Leduc remembers going to school. It was called the "Sutton School," a name which just south of the school building on the map above (E. Leduc, personal communication March 2, 2009).

The Leduc land has been a farming complex for over two hundred years. The thought of it moving forward into the future as agricultural land and with an ethic for preservation and education is truly inspiring. Even as it moves forward with a vision of preservation and, in some areas, conservation, it does so under the leadership of people from throughout the community who want to see South Burlington maximize its potential as a source of local foods, cultural and natural history education, and low-impact recreation.

Enrollment at South Burlington High School, the only high school in the city's school district, is approximately 900.

Signs of a Changing Landscape

South Burlington is one of just 11 designated cities in Vermont. It is a rapidly urbanizing area with development concentrated along in the western part of the city along Route 7/Shelburne Road and in the north eastern part outward from the intersection of Route 2/Williston Road and Dorset Street. South of I-89, the city has a far more pastoral feel.

In the following image, taken in 1937 from a different angle, use the bends in the Winooski River to orient you to the landscape, which appears drastically different from what is pictured above. Some of the forested landscape seems to have remained intact, but the encroachment of the urban and suburban landscape is unmistakable.

The Winooski One Dam pictured above was built in 1992 and listed as "World's Most Intelligent Dam" by Guinness Book of World Records due to its fiber optic sensors.

View from north (over Winooski) looking to South Burlington, Teage O'Connor, 2009.

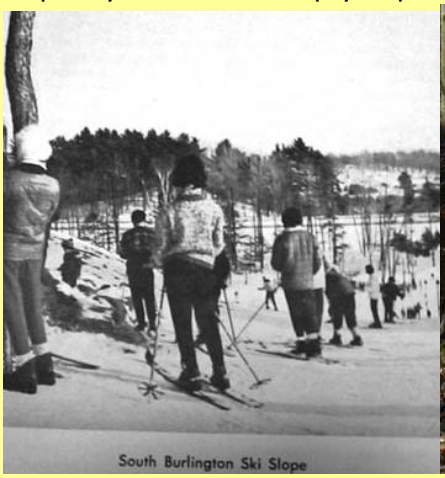
Then & Now: Main Street, South Burlington Looking East. Wilbur Collection, Bailey-Howe Special Collections Department, and Nathaly Agosto Filion, 2009.

Power lines - Not in my backyard

In the early 1970s, the Vermont Public Service Board (PSB), which regulates utilities such as electricity and gas in Vermont, proposed building the power lines that now cut through the Leduc and Bandel/Dopp properties. Betty Bandel, along with other neighbors fought against the proposed power line, concerned over ecological and aesthetic ramifications. Claiming the PSB and VELCO had overstepped their bounds and ignored due process, citizens lead by Betty filed a lawsuit, which made its way to the Vermont Supreme Court (*Vermont Electric Power Company, Inc. v. Bandel*, 135 Vt. 141 (1977)). In 1974 the state appraised the land and ultimately, through eminent domain purchased the land from Betty. She was compensated $3000 for the 3.65 acres needed for the power lines, which were built in 1977.

South Burlington's Kiwanis Ski Area

At the top of a small hill in Centennial Woods lies a decaying piece of South Burlington's changing landscape. The charred artifacts stand hidden off the trail just east of UVM's East Commuter parking lot, near an illegal encampment behind what is now the Sheraton. But long before there was a Sheraton, the South Burlington Kiwanis Ski Area gave local residents (rumored to include Billy Kidd) a ski resort closer than Stowe. The slope is evidenced today by a few burnt stumps from a shed (which would have protected the motor) and a lone rusted and broken bullwheel from the old rope-tow. Opened in the winter of 1962-3, the slope consisted of a short (500-foot) ski slope running down towards where I-89 is. Its life was cut short due to a fire in 1967. The slope's lift equipment was never rebuilt and the forest quickly filled in the empty slope with white pine and buckthorn.



Management Recommendations

Given the proximity of the farm to Shelburne Pond, which has been the source of an abundance of Abenaki artifacts uncovered under Jim Petersen's guidance, any future development of the land should necessarily be concerned with involving Abenaki and Abenaki scholars.

Characteristic Abenaki dugout canoe (c. 1450) from Shelburne Pond, made of white pine. Canoes like this were used on lakes and other large bodies of water where portaging would have been unnecessary. Abenaki store these canoes under water when not in use to preserve them.

There are over 2000 self-identified Abenaki still living in Vermont today.

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Culture overlays our perceptions but it does not erase our origins.

– David Clarke Burkes

ECOSYSTEM SERVICES

Community Capital Framework

The landscape of a particular community includes natural and built features. Both of these contribute to a sense of place and both of these can be considered important assets to that place. Identifying aspects of a place and categorizing them into different capital stocks creates a framework for an integrated and systemic approach to community planning and development. The Community Capital Framework identifies seven types of capital.

Capital	Description
Natural	Natural resources, weather, geographic features, beauty
Cultural	Traditions, language, the way in which particular groups 'know the world'
Human	Skills and abilities of people to access information to increase understanding
Social	Connections and networks between people and organizations
Political	Ability of people to engage, voice concerns and opinions, and to access power
Financial	Monetary resources for investment, capacity- building and development
Built	Infrastructure that supports the activities of the above types of capital

Each of these types of capital exist in South Burlington, however for the purposes for this report, the categories have been collapsed into two groups, natural and built. Built capital refers to the space that contains and supports the activities of human, social, political and financial capital. Natural capital refers to the natural and cultural assets present.

Ecosystem Services Map of the Leduc Parcel

The map of South Burlington has been delineated to identify areas of Built and Natural capital. The Leduc parcel in particular contains mostly natural capital. The aspects of natural capital that have been mapped here are the ecosystem services (ES) provided by this land. Natural capital can be thought of as a stock and the ecosystem services as the flows coming from that stock.

It has been reported that approximately 40-50% of Earth's ice-free land surface has been heavily transformed or degraded by anthropogenic activities.

Ecosystem services are broadly defined as the benefits that ecosystems provide to humans (Costanza et.al 1997). A properly functioning ecosystem supplies essential life-support services that directly and indirectly contribute to human well-being and survival. Dozens of services are provided by ecosystems that largely go unrecognized and are under-valued.

Ecosystem Services from the Leduc Parcel

MEA classifies ecosystem services into four categories, provisioning, regulating, cultural and supporting (*MEA*, 2005). Provisioning ES include the supplies of food, water, fiber and fuel. These are the goods and services that people are most familiar with. Regulating ES include services such as erosion control, water purification, and climate stability. Supporting ES are the functions that allow other services to continue to be produced such as nutrient cycling for biomass growth. Cultural ES provide opportunities for recreation and education. With pressure from development, natural capital becomes increasingly scarce, making it important to identify areas that supply these critical services. Mapping the current land cover of the area will provide a framework to determine what services are provided.

Ecosystem services by current land cover

Forest	**Grassland/ Pasture**	**Cropland/ Tilled**	**Wetland**	**Open Water**
Provisioning	*Regulating*	*Provisioning*	*Regulating*	*Provisioning*
timber	climate	food/ products	water quality	food
food/ products	air quality	fiber	genetic variation	water supply
fiber	erosion control	wildlife habitat	biodiversity	wildlife habitat
wildlife habitat	genetic variation			
	biodiversity	*Supporting*		*Regulating*
Regulating		nutrient cycling		genetic variation
climate	*Supporting*	soil formation		Biodiversity
air quality	nutrient cycling	primary production		
erosion control	soil formation	pollination		*Cultural*
genetic variation	primary production			education/ research
biodiversity	pollination	*Cultural*		History
		education/ research		aesthetic/ view
Supporting	*Cultural*	history		recreation
nutrient cycling	education/ research	aesthetic/ view		
soil formation	history			
primary production	aesthetic/ view			
pollination	recreation			
Cultural				
education/ research				
history				
aesthetic/ view				
recreation				

Ecosystem Services on the Leduc Parcel

Legend

- Built Capital
- Forest
- Open Space/ Grassland/ Pasture
- Cropland/ Recently Tilled
- Wetland
- Waterbody
- Recreation/ Bike Paths
- Conserved Land

Valuing Ecosystem Services

Several methods exist to determine the value of the ES that are currently, largely supplied to humanity at no cost. It is important to distinguish the difference between value and price. Value systems refer not to pecuniary value but to a set of morals and priorities that influence beliefs, attitudes and actions. Price represents the monetary worth of a good or service. Calculating the price of ES is more effective for some categories than others. Provisioning services can be priced more easily because food, fiber and other products are exchanged in a market that determines how much the product is worth. However Cultural ES may have different value to different people and cannot be exchanged in a market so price is difficult to determine. The objective of determining the value of ES can influence the decision for what methods to use.

Opportunities for Further Research

- Reasons for and objectives of stakeholders to determine the value of ES.
- Managing forests and agricultural land for maximizing the supply of ES.
- The health of various land cover and overall ecosystem to determine the quality of ES being supplied.

Recognition of how ecosystems could provide more complex services to humankind date back to at least Plato (c. 400 BC) who understood that deforestation could lead to soil erosion and the drying of springs.

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"The frog does not drink up the pond in which he lives."

--Lakota Proverb

APPENDICES

Stand-by-Stand Descriptions of Vegetation on the Leduc, Scott and Bandel-Dopp Parcels

Stand number	*Natural Community*	*Current Vegetation*	*Land Use History*	*Soil Type*	*VT NNHP Rank*	*Notes*
0	Valley Clayplain Forest	Eastern white pine	Unknown, probably light selective logging.	Covington silty clay	S2	White pine and quaking aspen are early successional members of the Valley Clayplain Forest.
1	Valley Clayplain Forest	Sugar maple - basswood -beech	Unknown, probably light selective logging.	Vergennes clay (6 to 12 % slope)	S2	
2	Mesic-Maple-Ash-Hickory-Oak Forest	Sugar maple-basswood	Unknown, probably light selective logging. An old road cuts north from the southern edge.	Farmington extremely rocky loam (5 to 20% slopes)	S3	
3	Red Maple-Black Ash Swamp	Black ash-American elm-red maple	An old road cuts through the middle.	Farmington extremely rocky loam (5 to 20% slopes)	S4	
4	Valley Clayplain Forest	Early old field succession	Originally cleared for sheep, then used for hay and/or crops.	Vergennes clay (2 to 6% slopes)		
5	Alluvial Shrub Swamp	A mix of speckled alder, and reed canary grass	Man-made pond area, recently mowed.	Limerick silt loam & Livingston Clay	S4	
6	Alluvial Shrub Swamp	Dogwood shrubs	Current footpath	Limerick silt loam		
7	Cattail Marsh	Cattails with sparse shrubs	Hydrology may have been altered by the installation of the Scott pond.	Limerick Silt loam	S4	
8	Valley Clayplain Forest	Early old field succession	Originally cleared for sheep, then used for hay and/or crops.	Vergennes clay (2 to 6% slopes)		

Stand number	*Natural Community*	*Current Vegetation*	*Land Use History*	*Soil Type*	*VT NNHP Rank*	*Notes*
9	Valley Clayplain Forest	Eastern white pine	This is an old fencerow.	Covington silty clay		
10	Red Maple-Black Ash Riparian Area	Black ash and common buckthorn	There are fencerows along both banks of the creek, and field stones have been thrown into the ravine.	Vergennes clay (2 to 6% slopes)		Buckthorn removal would be very beneficial to the native vegetation here.
11	Valley Clayplain Forest	Early old field succession	Originally cleared for sheep, then used for hay and/or crops.	Vergennes clay (2 to 6% slopes) & Covington silty clay		
12	Valley Clayplain Forest	Early successional edge, with red maple, and black ash	Originally cleared for sheep, then used for hay and/or crops.	Vergennes clay (2 to 6% slopes)		
13	Hemlock-Northern Hardwood Forest	Much younger stand of elms, ash, and buckthorn, with a hemlock understory	Unknown, likely more recent selective logging.	Farmington extremely rocky loam (5 to 20% slopes) & Vergennes clay (2 to 6% slopes)	S4	Logging road at its northern boundary.
14	Rich Northern Hardwood Forest	Sugar maple-basswood-beech	Unknown; probably light selective logging of red oak and grazing.	Farmington extremely rocky loam (5 to 20% slopes) & Vergennes clay (2 to 6% slopes)	S4	Porcupine Spring is located here. This area contains a small stream that starts in a drainage ditch in the field to its SE.
15	Valley Clayplain Forest	Eastern white pine	A fence to the east suggests it was once grazed.	Vergennes clay (2 to 6% slopes)		
Stand number	*Natural Community*	*Current Vegetation*	*Land Use History*	*Soil Type*	*VT NNHP Rank*	*Notes*

Stand-by-Stand Descriptions of Vegetation on the Leduc, Scott and Bandel-Dopp Parcels

16	Hemlock-Northern Hardwood Forest	Eastern hemlock	There is an old road, old dump, and barbed wire fences, plus the power line cuts through.	Farmington extremely rocky loam (20 to 60% slopes)	S4	There are several large bedrock outcrops.
17	Alluvial Shrub Swamp with small pockets of Alder Swamp and Sedge Meadow	Dogwood spp. and reed canary grass	Unknown; it was likely pasture and now is cut by the power line.	Limerick silt loam	S4	
18	Valley Clayplain Forest	Eastern white pine	There are two fence lines of different ages here, which suggests an interesting history.	Covington silty clay		
19	Hemlock-Northern Hardwood Forest	Hemlock-sugar maple-beech	There are several fence lines in this area.	Farmington extremely rocky loam (5 to 20% slopes)	S4	
20	Valley Clayplain Forest	Old field succession with Eastern white pine and redcedar.	Unknown; it was likely pasture, with a fence line on the east side.	Limerick silt loam & Vergennes clay (2 to 6% slopes		
21	Vernal pool	Black ash-American elm-red maple	Unknown; could it have been a man-made watering hole?	Vergennes clay (2 to 6% slopes)	S3	
22	Red Cedar Woodland	Eastern redcedar-eastern white pine	There is a small old access road from the west.	Bedrock outcrop	S2	
23	Mesic-Maple-Ash-Hickory-Oak Forest	Black cherry-maple and common buckthorn	There is an old fence line here.	Stockbridge and Nellis stony loams (8 to 15% slopes) & Vergennes clay	S3	
Stand number	*Natural Community*	*Current Vegetation*	*Land Use History*	*Soil Type*	*VT NNHP Rank*	*Notes*

24	Valley Clayplain Forest	Eastern white pine	This area contains a sizeable dump.	Vergennes clay (2 to 6% slopes) & Limerick silt loam	S2	Lots of potential, but in need of active restoration
25	Valley Clayplain Forest	Old field succession/still in residential use	There is an old road, and the grass is currently kept mowed.	Stockbridge and Nellis stony loams (8 to 15% slopes) & Vergennes clay (2 to 6% slopes)		
26	Valley Clayplain Forest	Residential	Residential	Vergennes clay (2 to 6% slopes)		
27	Valley Clayplain Forest	Eastern white pine	This may have been grazed; there is a barbed wire fence and an old road.	Vergennes clay (2 to 6% slopes), Limerick silt loam	S2	Potential special forest community
28	Mesic-Maple-Ash-Hickory-Oak Forest	Sugar maple, non-native honeysuckle and buckthorn	There is an old fence line and road.	Farmington extremely rocky loam (20 to 60% slopes)	S3	Bedrock outcrop
29	Red Maple-Black Ash Swamp	Black ash-American elm-red maple	The hydrology has likely been disturbed by the construction of the pond.	Limerick silty loam	S4	Pond
30	Mesic-Maple-Ash-Hickory-Oak Forest	Sugar maple-hophornbeam-basswood	There is an old fence line and a mowed path.	Farmington extremely rocky loam (20 to 60% slopes)	S3	
31	Mesic-Maple-Ash-Hickory-Oak Forest	Residential	Residential	Farmington extremely rocky loam (20 to 60% slopes)		
Stand number	*Natural Community*	*Current Vegetation*	*Land Use History*	*Soil Type*	*VT NNHP Rank*	*Notes*

Stand-by-Stand Descriptions of Vegetation on the Leduc, Scott and Bandel-Dopp Parcels

32	Mesic-Maple-Ash-Hickory-Oak Forest	Old field succession	Originally cleared for sheep, then used for hay and pasture.	Stockbridge and Nellis stony loams (8 to 15% slopes)		
33	Mesic-Maple-Ash-Hickory-Oak Forest	Residential	Residential	Stockbridge and Nellis stony loams (8 to 15% slopes)		
34	Valley Clayplain Forest	Old field succession	Originally cleared for sheep, then used for hay and/or crops.	Vergennes clay (2 to 6% slopes), Covington silty clay		
35	Mesic-Maple-Ash-Hickory-Oak Forest	Sugar maple	There is an old fence line with rock piles along it.	Covington silty clay, Vergennes clay (2 to 6% slopes)	S3	
36	Valley Clayplain Forest	Sugar maple	This is an old fence line, with some garbage.	Vergennes clay (2 to 6% slopes)		
37	Valley Clayplain Forest	Agriculture – current	Originally cleared for sheep, then used for hay and/or crops	Vergennes clay (2 to 6% slopes) & Covington silty clay		This is an old “Day Field”
38	Valley Clayplain Forest	Agriculture – current	Originally cleared for sheep, then used for hay and/or crops.	Vergennes clay (2 to 6% slopes) & Covington silty clay		
39	Valley Clayplain Forest	Residential	Residential	Vergennes clay (2 to 6% slopes) & Vergennes clay (6 to 12% slopes)		
40	Valley Clayplain Forest	Agriculture - current	Originally cleared for sheep, then used for hay and/or crops.	Covington silty clay & Vergennes clay (2 to 6% slopes)		
Stand number	*Natural Community*	*Current Vegetation*	*Land Use History*	*Soil Type*	*VT NNHP Rank*	*Notes*

41	Sedge Meadow	Reed canary grass, young white pin	This is possibly an old pasture; with an old drainage tile	Limerick silt loam & Vergennes clay (2 to 6% slopes)	S4	
42	Valley Clayplain Forest	Old field succession	Originally cleared for sheep, then used for hay and/or pasture.	Vergennes clay (2 to 6% slopes)		
43	Mesic-Maple-Ash-Hickory-Oak Forest	Agriculture - current	Originally cleared for sheep, then used for hay and/or crops.	Stockbridge and Nellis stony loams (3 to 8% slopes)		
44	Valley Clayplain Forest	Agriculture- current	Originally cleared for sheep, then used for hay and/or crops.	Vergennes clay (2 to 6% slopes)		
45	Sedge Meadow	Agriculture – current	Originally cleared for sheep, then used for hay and/or crops.	Limerick silt loam		
46	Valley Clayplain Forest	Agriculture - current	Originally cleared for sheep, then used for hay and/or crops.	Vergennes clay (2 to 6% slopes), Covington silty clay		
47	Mesic-Maple-Ash-Hickory-Oak Forest	Agriculture - current	Originally cleared for sheep, then used for hay and/or crops.	Stockbridge and Nellis stony loams (3 to 8% slopes)		
48	Mesic-Maple-Ash-Hickory-Oak Forest	Early successional edge, with red maple, and black ash	Originally cleared for sheep, then used for hay and/or crops.	Farmington extremely rocky loam (5 to 20% slopes)		
49	Mesic-Maple-Ash-Hickory-Oak Forest	Red maple-oak	This bedrock outcrop has had field stones added to it.	Rocky outcrop in Vergennes clay (2 to 6% slopes)		

Vegetation Species List
for the Leduc, Scott and Bandel-Dopp Parcels

Natural Community Types
Alluvial Shrub Swamp
Alder Swamp
Cattail Marsh
Hemlock-Northern Hardwood Forest
Mesic-Maple-Ash-Hickory-Oak Forest
Red Cedar Woodland
Red Maple-Black Ash Swamp
Rich Northern Hardwood Forest
Sedge Meadow
Valley Clayplain Forest
Vernal pool

**non-native*

Ferns and fern allies

Adiantum pedatum	maidenhair fern
Dryopteris intermedia	intermediate woodfern
Dryopteris marginalis	marginal woodfern
Equisetum arvense	scouring rush
Polystichum acrostichoides	Christmas fern

Herbaceous flowering plants, monocots

Carex pennsylvanica	Pennsylvania sedge
Carex plantaginea	plantain-leaved sedge
**Daucus carota*	Queen Anne's lace
Erythronium americanum	trout lily
Maianthemum canadense	Canada mayflower
**Phalaris arundinacea*	reed canary grass
Polygonatum pubescens	true Solomon's seal
Smilacina racemosa	true Solomon's seal
Trillium erectum	stinking Benjamin
Trillium grandiflorum	large-flowered trillium
Uvularia sessilifolia	sessile-leaf bellwort

Herbaceous flowering plants, dicots

Actaea pachypoda	white baneberry
Anemone quinquefolia	wood anemone
Asclepias syriaca	common milkweed
Caulophyllum thalictroides	blue cohosh
Claytonia virginica	spring beauty
Fragaria virginiana	wild strawberry
Hepatica acutiloba	sharp-lobed hepatica
Osmorhiza spp.	sweet cicely
Sanguinaria canadensis	b***loodroot***
Solidago spp.	goldenrod
Thalictrum dioicum	early meadow rue
**Veronica officinalis*	common speedwell
Viola canadensis	Canada violet
Viola pubescens	downy yellow violet
Viola rostrata	long-spurred violet
Waldsteinia fragaria	barren strawberry

Woody plants

Acer pensylvanicum	striped maple
Acer rubrum	red maple
Acer saccharum	sugar maple
Alnus incana	speckled alder
Amelanchier sp.	serviceberry
**Berberis vulgaris*	barberry
Betula allegheniensis	yellow birch
Betula lenta	black birch
Betula papyrifera	paper birch
Carpinus caroliniana	musclewood
Carya cordiformis	bitternut hickory
Carya ovata	shagbark hickory
Cornus alternifolia	alternate leaf dogwood
Cornus amomum	silky dogwood
Cornus foemina	gray dogwood
Cornus stolonifera	red osier dogwood
Dirca palustris	leatherwood
Fagus grandifolia	American beech
Fraxinus americana	white ash
Fraxinus nigra	black ash
Hamamelis virginiana	witch hazel
Juglans cinerea	butternut
Juniperus communis	juniper
Juniperus virginiana	Eastern redcedar
Lonicera canadensis	northern fly honeysuckle
**Lonicera tatarica*	Tartarian honeysuckle
Ostrya virginiana	hophornbeam
Pinus strobus	white pine
Populus tremuloides	quaking aspen
Prunus serotina	black cherry
Prunus virginiana	choke cherry
Quercus alba	white oak
Quercus rubra	red oak
**Rhamnus cathartica*	common buckthorn
Rhus typhina	staghorn sumac
**Robinia pseudoacacia*	black locust
Salix sp.	willow
Sambucus racemosa	red-berried elder
Tilia americana	basswood
Tsuga canadensis	hemlock
Ulmus americana	American elm
Ulmus rubra	slippery elm
Viburnum acerifolium	maple-leaved viburnum
Viburnum lentago	nannyberry
Xanthoxylum americanum	prickly ash

The Past, Present and Future of Valley Clayplain Forests in Vermont

By Emily Stone

The Leduc Parcel in South Burlington, as well as other areas in South Burlington, VT, contains small tracts of Valley Clayplain Forest. This rare natural community is the focus of several conservation efforts, and its presence on the Leduc Parcel may factor into future land management there. What is the Valley Clayplain Forest? How did it get there? Why does is look the way it does? What will it look like in the future? These are all questions I will explore below.

What is a Valley Clayplain Forest?

The Valley Clayplain Forest is a natural community in Vermont that occurs on clay soils in the Champlain Valley. It was the dominant forest type in the Champlain Valley prior to European settlement, but now is one of the most severely altered communities in Vermont (Thompson and Sorensen 2000). The clay soils of this forest type are deep and fertile, and lack the numerous stones that occur in glacial till-based soils that cover much of the state. Those attributes make the clay soils ideal for agriculture, especially when drained. Two variants of this natural community occur based on moisture and topography. The Mesic, or middle-moisture, Clayplain Forest, is better drained, and is preferred for agriculture. The Wet Clayplain Forest has more poorly drained soils, to the point that it is typically a wetland community, and often occurs in low pockets within the Mesic Clayplain Forest (Thompson and Sorensen 2000).

Soggy clay soils are sometimes less stable, and a high water table can discourage the deep rooting of trees because of reduced soil oxygen (Wessels 1997). As a result, wind throw is a common occurrence and the dominant disturbance type in clayplain forests (Thompson and Sorensen 2000). Tip-

up mounds are a common sight, and the forest floor of an older Valley Clayplain Forest is often described as having “pit and mound” or “pillow and cradle” topography.

The trees that characterize Valley Clayplain Forests tend to reach their northern limits in the Champlain Valley because of its relatively low elevation, and warmer and drier climate compared the rest of the state. Some of the most common trees in the Valley Clayplain Forests include oaks, (white, red, swamp white and bur), red maple, shagbark hickory, white pine, and American elm. White ash, sugar maple, Eastern hemlock, basswood, hophornbeam, musclewood, and American beech are also members of the community (Thompson and Sorensen 2000). Unfortunately, invasive species are an increasing problem in clayplain forests, and non-native honeysuckles and buckthorns, as well as barberry, are now a significant part of some patches of forest (Abbott 2005).

Today, the Valley Clayplain Forest exists in scattered patches of disturbed forest throughout the clay soils of the Champlain Valley. The history of how it came to look the way it does is long, and rich, and extends back at least as far as the last ice age. It all begins long, long ago in a land far, far away...

How did it get here?

The Pleistocene glaciation began 2-3 million years ago (mya) as the climate cooled and the mass of snow on what is now Canada didn’t melt. Over many years, large masses of permanent ice formed, and once the ice was thick enough it started to flow radialy as a glacier. At the glacial maximum, the ice may have been 2-3 miles thick at the center. At its maximum extent, 1-1.5 miles of ice covered all of New England, including most mountains. Glacial periods lasted for about 100,000-200,000 years, interspersed with warmer periods. There have been at least 4 major ice advances during the Pleistocene, with interglacial periods of 50,000 to 100,000 years. However, ice cores from Greenland provide evidence for between 15 and 30 ice advances (Stone 2008). The final maximum of the Wisconsin Glaciation occurred 18,000 years before present (BP) (Pielou 1991).

The clays that compose the soils that define the Valley Clayplain Forest were deposited during deglaciation. As the ice retreated north in the valley between the Adirondacks and the Green Mountains, it left moraines damming the southern exit of the Champlain Valley. In addition, the continental crust that had been depressed by the weight of the glaciers started to rebound. Because the southern end of the valley was unburdened first, it tipped up toward the still-depressed north end, which was blocked by the glacier. Melt water had nowhere to go, and so ponded in the valley. The resulting Glacial Lake Vermont was a large feature of the final stages of glaciation. At its maximum, 13,000 BP, Lake Vermont was 700 feet above the current sea level (Figure 1). Sediments from the Adirondacks and Green Mountains carried by glacial melt streams settled out in the lake, with the coarser sediments concentrated near shore, and the finest sediments coming to rest in the deepest areas (Stone 2008).

The Champlain Sea was another, smaller visitor to the Lake Champlain Valley. Before the crust was able to recover from isostatic depression under the weight of the glacier, and after the glacier had retreated far the north, sea water was able to inundate the Champlain Basin from the north. The Champlain Sea harbored marine life, as evidenced by the whale skeletons found near Burlington. The sediments deposited in the Champlain Sea are difficult to tell from Lake Vermont sediments. The presence of varves would indicate freshwater that would freeze seasonally, but varves are tough to see. At its maximum, 11,000 BP, the Champlain Sea was 300 feet above the current sea level (Figure 2) (Stone 2008). As the water levels in the Lake Champlain basin shifted toward current lake levels, fresh soil was

Figure 1: *Maximum extent of Lake Vermont 13,000 BP (Klyza and Trombulack 1999).*

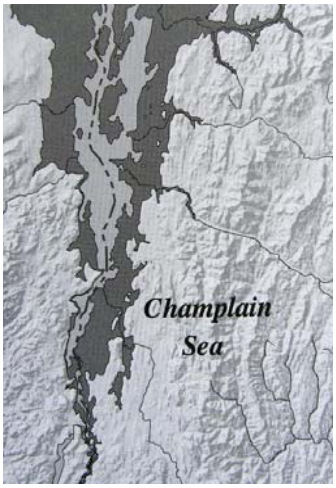

Figure 2: *Maximum extent of the Champlain Sea 11,000 BP (Klyza and Trombulack 1999).*

exposed for colonization by plants, and the development of the clayplain forest could begin.

As the glaciers advanced and retreated, plant communities also advanced and retreated with the changing climate. There is some evidence to show that the changes occurring at the end of a glaciation are much more abrupt, and therefore more disruptive than those occurring at the beginning (Davis 1981). At the maximum extent of glaciation, the plant communities were pushed far to the south, to the margins of the continents, and sometimes survived on exposed peaks sticking out of the glaciers. The plants that now make up the Valley Clayplain Forest are no exception. During glaciation, many of the trees that are considered to be part of temperate deciduous forests survived in refugia in the lower Mississippi Valley and northern Florida.

As the ice melted and the climate warmed, trees and other organisms migrated into newly hospitable habitat. The relatively warm and wet climate in the Champlain Valley would certainly have favored deciduous forests as the land was re-vegetated. However the gradual and variable pace of the re-vegetation, along with ecological inertia (what's already there tends to stick around and new arrivals have a tougher time competing for space), means that the plant communities at different times during the last 12,000 years would have looked very strange compared to what we expect now (Davis 1981). According to Davis (1981), "forest communities in temperate regions are chance combinations of species without an evolutionary history."

A grass and sedge dominated tundra typically followed the retreating glacial margin most closely, and Vermont would have been covered by tundra by around 12,000 BP, just after Lake Champlain drained about 12,500 BP (Klyza and Trombulack 1999). The smaller Champlain Sea lasted until about 11,000 BP, and would have been ringed by tundra. Two of the first trees to move north were the red spruce and balsam fir, and by 10,000 BP, white pine, gray and paper birches, and oaks dominated the landscape (Figure 3). Ash, elm and hophornbeam show early increases in pollen, and then a later, stronger increase at 9,500 BP. These typically temperate species, which are now members

of the clayplain forest, may once have grown with boreal species such as spruce, fir, and larch (Davis 1999).

Both hophornbeam (*Ostrya virginiana*) and musclewood (*Carpinus caroliniana*) now grow in clayplain forests, but hophornbeam probably arrived first, since today its range extends farther north. Their pollen is indistinguishable in the sediment record. Because of its early arrival, hophornbeam may have been much more important in the relatively low-diversity post-glacial forests than it has been since (Davis 1981).

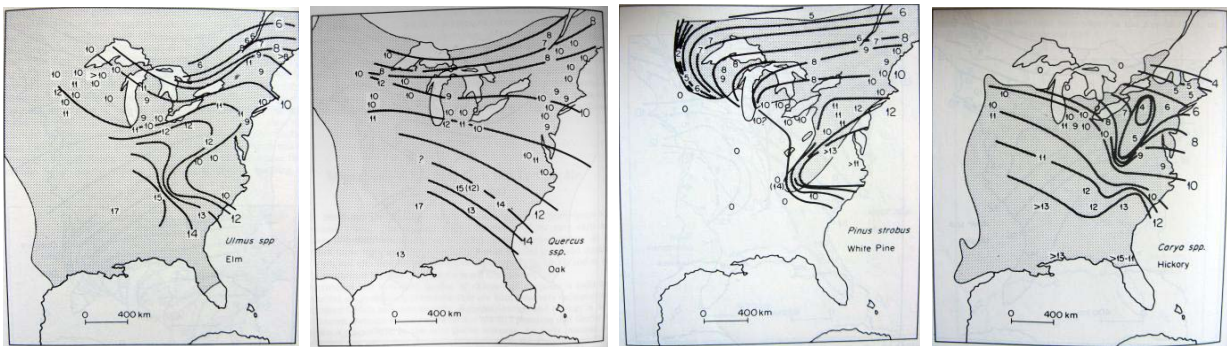

Figure 3: Migration maps for elm (*Ulmus spp.)*, oak (*Quercus spp.*), white pine (*Pinus strobus*) and hickory (*Carya spp.*). While elm and oak probably survived glaciation in the lower Mississippi Valley refugia, the migration pattern of white pine indicates that it survived on the east coast, somewhere near Virginia, along with hemlock (no map) (Davis 1991). Numbers indicate thousands of years BP.

By around 4,500 BP hemlock, beech and yellow birch moved in (Davis 1981) and the current forest type became dominant (Klyza and Trombulack 1999).

Why does is look the way it does?

Since shortly after glacial retreat, and continuing in to the present, humans have also been a part of the Champlain Valley community, and have drastically altered its appearance. The first humans on the landscape were the Paleo Indian who hunted large mammals on the tundra near the shore of the Champlain Sea. They lived in small, transient groups, and probably did little to alter the landscape (Klyza and Trombulack 1999).

After the switch from salt water to freshwater and forest in the Champlain Basin, the Archaic people moved in with a slightly different lifestyle. They tended to stay near rivers, and subsisted with a combination of hunting, fishing and gathering (Klyza and Trombulack 1999). As the forest shifted from a more coniferous, boreal composition toward the current mixed forest, the Woodland People began to engage in small-scale agriculture, have larger villages, and included beech nuts (beech trees are a member of the clayplain forest community) as an important part of their diet (Klyza and Trombulack 1999). While the Native Americans used fire to open up small patches for agriculture, or to improve hunting grounds, they didn't change the landscape (especially in the clayplain forests) as drastically as the European settlers that arrived later.

The most recent pre-European culture in the region was the Abenaki, who used many resources from the clayplain forest. See Teage's paper for more information!

Samuel de Champlain was the first European to explore the Lake Champlain region in 1609, but it wasn't until 1763 that large numbers of Europeans moved into the area. By that time, most of the Abenaki had been claimed by disease, or moved northward into Canada (Klyza and Trombulack 1999).

Hunting and trapping of many animals that are associated with the clayplain forest may have changed its appearance and composition. Beaver declined drastically during the fur-trade period and the mid 1600s, was extirpated from Vermont by 1850, and re-introduced in 1921. Deer, elk and lynx, three historical residents of the clayplain forest also declined in the area (Klyza and Trombulack 1999).

One of the first major European impacts on the forests was a logging boom focused on white pine for ship masts. While most of the white pine at that time was concentrated in stream valleys, white pine is a component of early-successional clayplain forests, and some cutting may have been done in the clayplain forest. Other early logging was done for lumber, farmland, fuel wood and potash, and in addition to resulting in more open land, logging also changed the composition of the remaining and re-growing forest. Beech and spruce declined, while birch, hemlock, maple, oak and white pine increased

(Klyza and Trombulack 1999). Today, beech is only an occasional to locally abundant species in clayplain forests (Thompson and Sorensen 2000), but according to Siccama (1971), beech composed 40% of the presettlement forests, and therefore may have been more important in clayplain forests as well.

The sheep boom from the 1820's to 1860's fueled much of the clearing to create new pastures. By 1840, 75% of the region's landscape was cleared for agriculture, but by 1900, after the sheep boom went bust, more than half of the cleared land was growing back. Land that stayed in production was converted to dairy pasture and cropland. Some land that was allowed to revert to forest, or had remained uncut was used a cow pasture, further altering it (Klyza and Trombulack 1999). A second cutting of white pine occurred in the early 1900's (Wessels 1997).

Besides changing the forest composition, logging also changed the forest structure. In comparison to uncut forests, second growth forests have fewer old trees, less downed woody debris, simpler structure, and are more even aged (Wessels 1997). Certain native plants, such as prickly ash, become more abundant in disturbed areas, while early successional clayplain forests tend to have more white pine, green ash, quaking aspen, red cedar, red maple, bur oak and white ash.

The introduction of invasive species is another powerful agent of change in our forests. Diseases like white pine blister rust, Dutch elm disease, hemlock wooly adelgid, chestnut blight, beech bark scale disease, and butternut canker change forest composition through increased mortality of certain species. The introduction of invasive shrubs to this area, like Morrow's honeysuckle in 1854, Tartarian honeysuckle in 1872, Japanese barberry, common buckthorn in the 1881 and European buckthorn can drastically change the understory composition, tree reproduction, herbaceous layer diversity, and possibly even soil nitrogen, soil moisture and leaf litter levels (Abbott 2005).

Invasive species tend to be more of a presence near the forest edges, and also in more disturbed forests. They are most heavily present in areas of recent reforestation, but are almost absent in old forests with a closed canopy (Abbott 2005). Unfortunately, the highly impacted and fragmented nature

of the remaining clayplain forests means that they have a high edge-to-center ratio, and a history of recent disturbance.

Today, what once was the matrix-forming forest covering 220,000 acres in the Champlain Valley is one of the most altered communities in Vermont (Abbott 2005). Most of the patches left are under 100 acres, and most are between 20-30 acres. Because of this, the Valley Clayplain Forest has been assigned a state rank of S2 by Nongame & Natural Heritage Program. The rank S2 indicates that it is "At high risk due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors" (Abbott 2005)

While logging and agricultural use still affects clayplain forests today, another growing threat is from housing developments, and farmland being subdivided and sold for single family homes out in the country.

What will it look like in the future?

In the face of this somewhat depressing information about the clayplain forests and the dire future predicted by climate change models, there is some hope. Several organizations are focusing on the protection and restoration of clayplain forests, and global warming may not be as detrimental in the Champlain Valley forests as in other places.

Sponsored by several local conservation organizations (South Lake Champlain Trust, The Sustainable Future Fund, and the Lake Champlain Basin Program), The Champlain Valley Clayplain Forest Project "coordinates research, conservation and restoration, and promotes stewardship of the threatened clayplain forest ecosystem. Through its work, the Project increases awareness, provides education, and encourages local pride in the unique clayplain forest natural community" (Champlain Valley Clayplain Forest Project).

In addition, the Vermont Land Trust is active in conserving farmland in the Champlain Valley (such as the Leduc Parcel). The Nature Conservancy owns and protects Williams Woods Natural Area near Charlotte, which may be the best remaining mature valley clayplain forest in the Champlain Valley (www.nature.org). In 2003, the Middlebury College Environmental Studies Senior Seminar created the *Champlain Valley Clayplain Forest Restoration: A Landowner's Guide*, which is a result of their class project to restore a field to clayplain forest.

With many ongoing conservation efforts, the clayplain forest may be on the rebound from human impact. Unfortunately, even a partial recovery will take many years, and there is much uncertainty about the future of natural communities in the face of our changing climate. Although a changing climate is precisely what brought together the assemblage we call a Valley Clayplain Forest today, the speed of the current climate change may have more detrimental effects.

The USFS's Climate Change Tree Atlas (Figure 4) provides some predictions about the future of our forests. According to the maps, the current dominant tree species in the Champlain Valley are maple, beech and birch. Models with a low prediction of climate change indicate that the community will remain in maple, beech and birch, while models with the highest predictions indicate a change toward oak and hickory. The scale on the models is pretty coarse, but one interesting note is that all the predicted dominant species are already present in clayplain forests today. In addition, while Davis et al. (2005) indicates that a novel climate reduces a species growth and reproduction, they also note that adaption to the new climate can occur, and fitness can be regained.

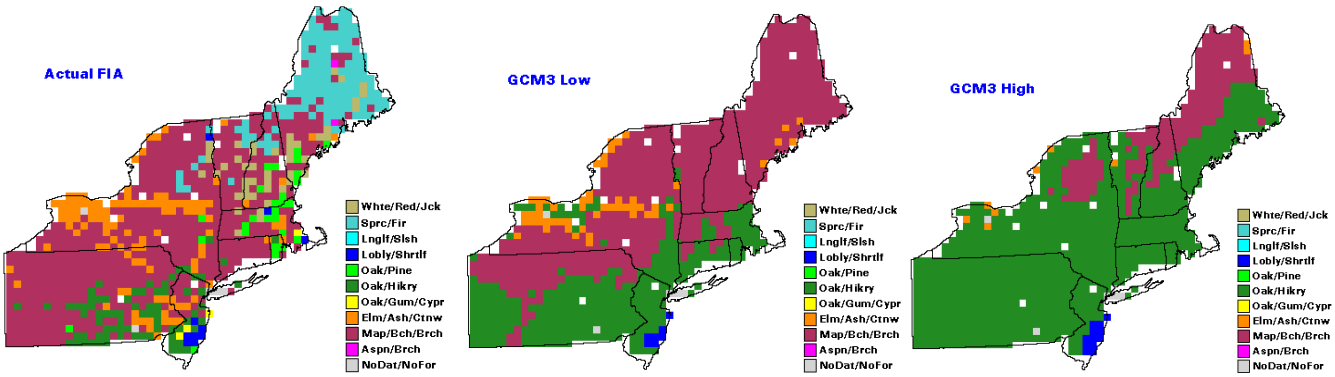

Figure 4: The USDA Forest Service Tree Atlas maps of current, low and high climate prediction in the northeast.

In conclusion, clayplain forests as we know them today are drastically different from the communities that first colonized the post-glacial landscape. The forests we have left today are only a small and impacted portion of the presettlement forests, and future forests may look just as different to our descents. Our biggest positive impact on the clayplain forest may be to help them gain back as much health as possible so that they can face the uncertain climatic future with flexibility and vigor.

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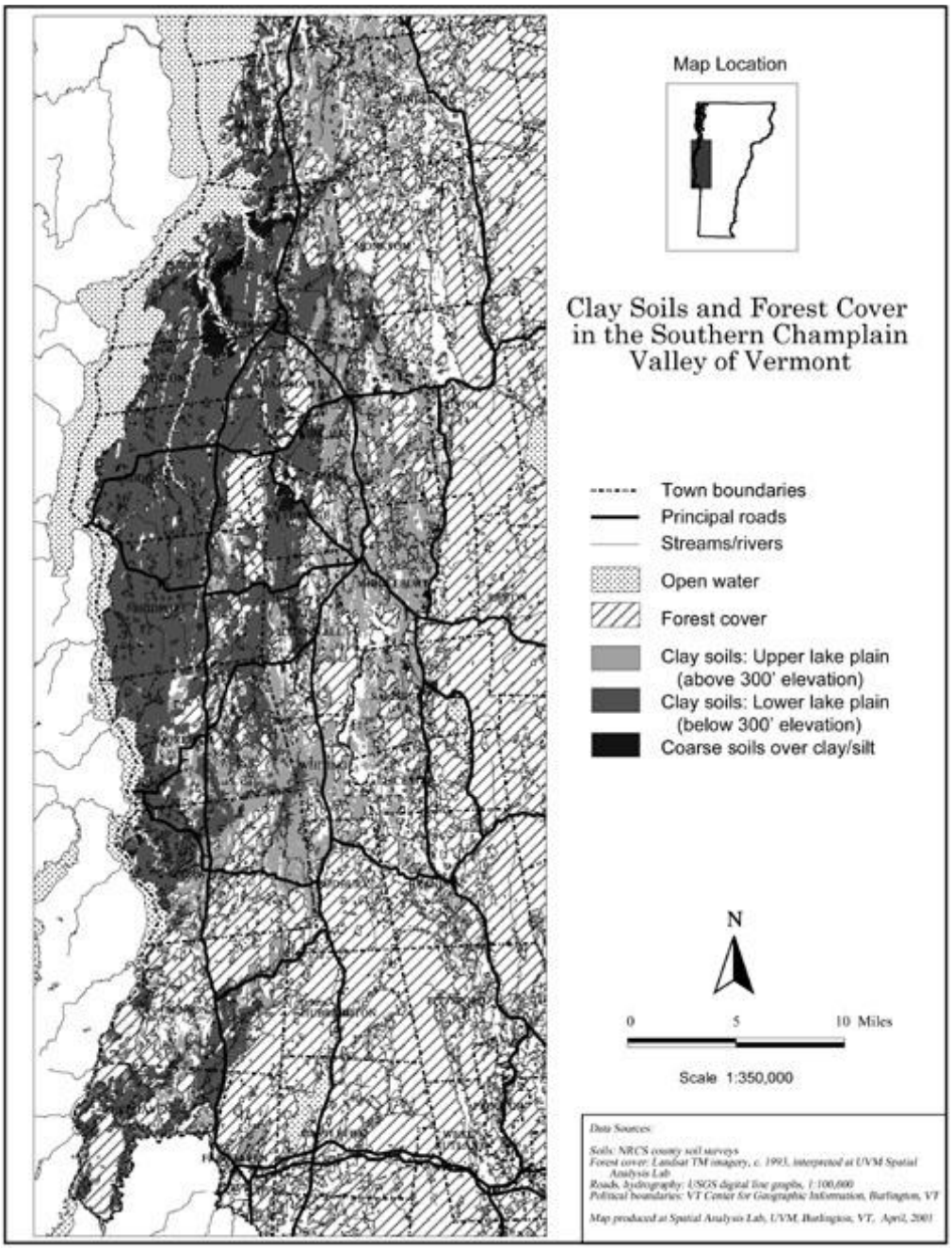


Appendix A: Map of clay soils and forest cover in the Southern Champlain Valley of Vermont. (Champlain Valley Clayplain Forest Project).

A Natural History of Beech Trees

Caitlin McDonough

Working to map natural communities in the rural-suburban habitats of South Burlington sharpens the focus on how we define "natural communities." There is history at our backs — generations of Leduc family farm operations, the barbed wire that white pines hold under their bark, and edges prickling with invasive buckthorn — and climate change looming over our future. Even with natural communities, which are more mindful of ecological factors like disturbance, soils, bedrock, and climate than the simpler vegetation cover categories, our maps are a product of the times. When D. G. Sprugel questioned the definition of "natural vegetation" eighteen years ago, he wondered, "Is the 'natural' vegetation what the first white explorers saw? the first settlers? writers? photographers? or the first plant ecologists? …Would the first European explorers have seen the same thing if they had reached the eastern US in the 1300s instead of the 1500s?" (Sprugel 1991).

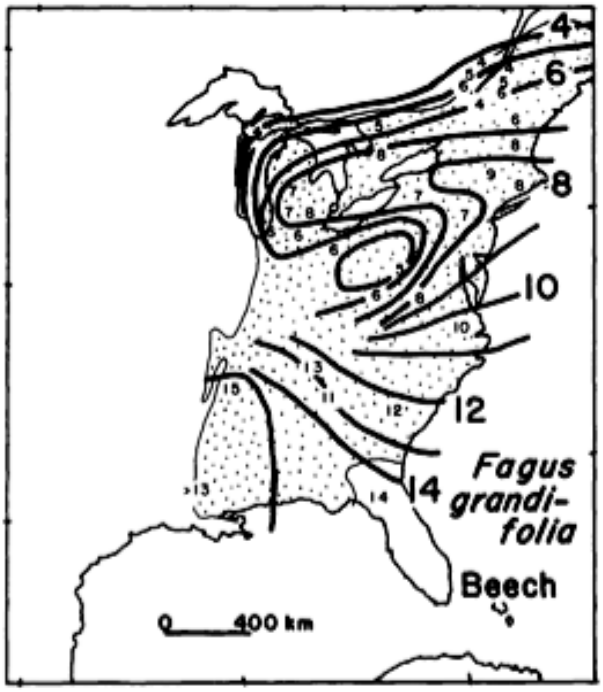
Our familiar natural communities, like the assemblage of maples, yellow birches and beeches that we recognize as the Northern Hardwood Forest, might not look so familiar to us in another time period. After all, the Northern Hardwood Forest association is only 2,000 years old in the northern New England region (Marchand 4). If we are able to wrap our minds around the lifespan of a tree that may live three or four or five times as long as us, it is a whole other thing to imagine the lifespan of a forest and not assume it to be a permanent feature of the landscape. In the Leduc parcel, we can find trees that must have overseen the rise and decline of the family farm. The giant beeches in the northwest corner may have held the ridgeline for hundreds of years while the pastures below were cleared, fields ploughed, stone walls built, barbed wire unrolled, powerlines installed, farm sold. But what about the beeches before them? In the history of one tree species (*Fagus grandifolia*) I will try to piece together the story of Leduc's natural communities, from glaciation to present. If we can understand the historical variability of beech populations, their migration after the last ice age, their place in pre-settlement forests, and the challenges they are facing today, I believe that we will gain a deeper understanding of the long-term nature of natural communities.

Ralph Waldo Emerson mused, “the creation of a thousand forests is in one acorn.” The same could be said, and perhaps more truly, for a beechnut. Beeches can reproduce vegetatively, sending up sprouts from their roots, so a single beechnut could produce a whole stand of trees, all clones of each other. Beech trees are recognizable by their smooth, light grey bark — an adaptation from their original tropical habitat where the smoothness helped deter epiphytic plants trying to grow in their canopy (Wessels 81). Beech buds are long, lance-shaped and sharp, leaves are oval with saw-toothed margins, and seeds are enclosed in a hard, spiky cupule (Castner 174). The heavy beechnuts are not as mobile as wind-dispersed maple seeds, but black bears, turkeys, blue jays, and even humans, find them to be delicious. Beeches are shade-tolerant; the root sprouts must be to grow up under their parent. They are often found in late-succession forests; with their shade-tolerance and self-cloning, beeches have the ability to wait in the understory for years and then establish long reigns of canopy dominance in old forests (Beaudet 2007). But, for a tree that is seen as a relatively stable presence, beeches have a dynamic history in Vermont.

Beeches probably over-wintered the last Ice Age in the lower Mississippi Valley (Barrington 2007). When the Wisconsin ice sheet retreated north of Vermont about 10,000 years ago, it left behind a barren tundra of till. But glaciation had displaced vegetation across North America, not just from the New England landscape, where huge ice sheets devoured the land. The cooler climate affected forests in the Southern Appalachians, where beech and other deciduous trees had been present, but then drop out of the fossil record during the Quaternary glaciations (Davis 1983). Pollen records trace the return of beeches as the ice retreated. “Deciduous tree pollen increases in abundance rapidly at many southern sites during the late-glacial period, suggesting that at least small populations of temperate trees such as *Fagus* grew nearby in very small, scattered refuges at the time of the glacial maximum” (Davis 1983). Margaret Davis has used pollen counts from sites along the Atlantic seaboard and across the Midwest to map the northward migration of tree species in the early Holocene. Obviously, the trees themselves did not migrate, but their seeds spread from the small populations of the glacial maximum, tucked away in the lower Mississippi Valley, slowly colonizing new landscapes, spreading more seeds, and expanding the population to their current distribution.

Davis’ pollen analyses reveal that natural communities did not migrate together. Different species took different routes to Vermont, and their arrivals were staggered. For example, the spruces and firs were among the earliest tree species in the pollen records after glacial retreat: their glacial

refuge was farther north than beech, and they quickly moved up the coast and established in Vermont 12,000 to 11,000 years ago (Davis 1983). In comparison, hemlocks first migrated west from the Carolinas toward the Great Lakes before reaching Vermont about 8,000 years ago (Davis 1983). Deciduous species were, in general, slower to migrate than conifers, and beech was among the slowest (Barrington 2007). After the maples, oaks and elms, beech moved northward east of the Appalachians, and expanded westward across the lower Great Lakes region, arriving in Vermont 8,000 to 6,000 years ago (Davis 1983).



Expansion of beech following the retreat of the ice: small numbers indicate arrival times in thousands of years before present at individual sites, as indicated by fossil pollen. Lines connect points of similar age, indicating the location of the expanding frontier for the species at 1,000-year intervals (Davis 1983).

By the time the first beechnut reached the rocky outcrop in the northwest corner of what would eventually become the Leduc parcel, many waves of migrating tree species may have already established "proto-northern hardwood" forests. Eight thousand years ago, the boreal species (spruce and fir) would have already been displaced by mixed-deciduous forests at low elevations (Davis 1983). Perhaps a blue jay, flying from southern New England, cached a collection of beechnuts in a forest of oaks, elms and maples. The bluejay's beechnut could germinate in the shade of these trees, and slowly emerge in the understory. Year later, an ice or windstorm might open a gap in the canopy, knocking

over a white pine or breaking the branches off of a sugar maple, and releasing the young beech. The beech would begin to establish a long-lasting population, sending up root sprouts and producing large crops of beechnuts in mast years. Perhaps in a few generations, the beeches would be presiding over hickories and chestnuts, the last migrating species to arrive in New England. The collection of species that we recognize as a northern hardwood forest is a relatively recent development Vermont. Given what we know of species migration in the early Holocene, our present day natural communities can be viewed as snapshots in a large photo album of changing assemblages and dynamic flora associations.

The generations of beeches were not a static presence — once established in the Holocene, a late-succession beech stand did not just *exist* until European settlement. Natural disturbances would have wind-thrown beech trees, flooded stands, or destroyed forests, creating a shifting mosaic steady state (Bormann 1979). Climate was not a constant either. Land in Vermont was ice-free for thousands of years, but smaller climatic fluctuations shifted the edges of species ranges. "*Fagus* also extended its range westward about 50km within the last 1,000 years, presumably in response to recent climatic changes correlative with the 'Little Ice Age'" (Davis 1983). And so, we return to Sprugel's query: Would the first European explorers have seen the same thing if they had reached the eastern US in the 1300s instead of the 1500s? For the beeches of Vermont, we might be wiser to ask, would the township surveyors have found the same witness trees had they settled in Chittenden County at a time other than 1763-1802?

In the 1960's Thomas Siccama used the records of early land surveyors to reconstruct the composition and distribution of pre-settlement forests in northern Vermont, and on a finer scale, Chittenden County. Town-line surveyors in the late 18th and early 19th centuries recorded a tree at each mile along the town lines and at each township corner. From the data surveyors recorded on these trees, Siccama estimates that "beech accounted for more than 60% of the species composition on the upland midelevation soils in Chittenden County" (Siccama 1971). Across northern Vermont, 556 beeches were counted as witness trees, 30.4% of the species composition (Siccama 1971). The abundance of presettlement beeches was a somewhat surprising result for Siccama because in 1962, the forests of Chittenden County were composed of significantly less beeches: only 3 to 5% of the trees were beech (Siccama 1971).

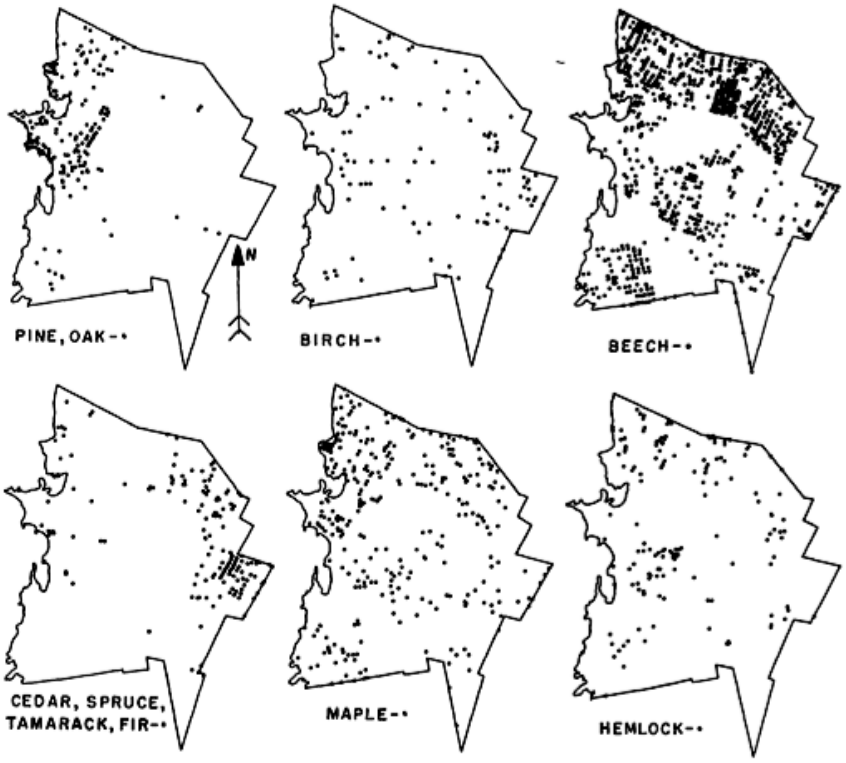


Fig. 3.—Location of individuals of major tree species used as bearing and witness trees by the surveyors of the original lot lines in Chittenden Co., Vt. (ca. 1763-1802). Large gaps in the distribution (especially recognizable in beech) are due to absence of survey records for these areas (see Fig. 1)

(Siccama 1971)

In the two hundred years between town-line surveys and Siccama's masters thesis, the landscape of Vermont had changed dramatically. White settlers had cleared land, ploughed fields, pastured sheep, raised dairy cows, abandoned farms, moved West, and logged the old field white pines for box boards[1] (Harvard Forest Dioramas). But, by 1962 Siccama reports that about half of Chittenden County was forested: "in the Champlain Valley and foothills of the Green Mountains the good-quality lands are devoted to dairying and the rest are covered with second- or third-growth forests in varying degrees of secondary succession" (Sicamma 1971). The forests seemed to recovering to a more natural state as lower-quality farmlands were abandoned. But, where were the beeches?

[1] Box board was the precursor to corrugated cardboard – it was used as a shipping container in the early 1900's. Corrugated cardboard was invented in the 1930's. Imagine the ex-Vermonters who sold the farm and moved West only to receive goods from the East, via railroad, packaged in boxboard made of the white pines that grew on their old Vermont farmlands.

During settlement, beeches were cleared along with everything else. The wood was not especially valuable, and so not selectively logged, but beech trees did compete with sugar maples in some stands (Beaudet). The second- or third-growth forests in varying degrees of secondary succession were probably dominated by less shade tolerant and faster growing species like white pines, or sugar maples. Surprisingly, a fair amount of old growth forest did survive settlement in Vermont — philanthropist and nature enthusiast Joseph Battell purchased 30,000 acres of "virgin and primeval" forest in the 19th century which he entrusted to Middlebury College in his will (Newman 1999). Despite his clearly-worded directions to keep this land wild, Middlebury, the United States Forest Service and the State of Vermont sliced up the parcels, leased mountains to ski resorts and heavily logged large portions of Battell's land (Newman 1999). By 1962, any large old growth beech groves that might have survived settlement under Battell's protection were most likely cut over and forgotten.

To add insult to injury, Vermont beeches have suffered from beech bark disease since the 20th century. Beech bark disease is a pathological condition involving two organisms: *Cryptococcus fagisuga* (an invasive insect) and *Nectria* fungus. As the insects feed on the bark, tapping the living tissue with their sucking stylets, they kill and crack the bark, leaving it susceptible to invasion by the *Nectria* fungus (Marchand 75). "Over a period of one or two decades, a predictable progression of organisms — scale insects, *Nectria* fungi, secondary wood-rot fungi, carpenter ants, pileated woodpeckers — eventually weaken the beech to the point of *beech snap* — where the tree's trunk actually snaps" (Wessels 84).

Historically, the beech scale insect was accidentally introduced into Nova Scotia from Europe in the late 1800s (Marchand 75). The first wave of beech bark disease swept through New England by 1960, leaving behind beech snaps and surviving trees with rounded knobs covering their bark where the tree encapsulated the *Nectria* fungus, restricting the invasion of secondary wood-rot fungi (Wessels 85). There are some beech trees that seem to be highly resistant to beech bark disease, and even the trees that are affected reproduce vegetatively under stress. Thus, in most models, American beech does not go to extinction over a long-term period (Le Guerrier 2003). But Tom Wessels still mourns for the beeches:

> As the remaining infected overstory beech succumb to "beech snap" and their young root sprouts grow to pole-sized trees about eight inches in diameter, the process of infection will be repeated. This time few, if any, trees will ever real the stature of the old, central beech. Although beech will continue to be common in the forests of central

> New England due to its unsurpassed ability to root sprout, the seriousness of beech bark scale disease is such that the beech's presence as a dominant canopy tree in older forests will most likely be limited to high elevation sites (Wessels 85).

The pole-sized understory beeches will still populate our forests, but beeches like those at the Leduc parcel are will be lost. One model predicts that there will be a "disappearance of *F. grandifolia* with a DBH greater than 80 cm…areas occupied by veteran trees before the introduction of the disease are replaced by a dense subcanopy layer of smaller trees" (Le Guerrier 2003). The elms and chestnuts that migrated north from glacial refuges in the lower Mississippi Valley thousands of years ago, were also affected by pathogens in the 20th century. White pine blister rust and hemlock woolly adelgid still threaten trees in Vermont today (Wessels 91). How natural are natural communities whose species compositions are subtracted and substituted by invasive forest pathogens?

Through the lens of one stately species, the American Beech, the history of natural communities on the Leduc parcel is revealed as a complicated concept. The beech, like so many European immigrants, migrated to Vermont at a time of great change and upheaval. As the climate settled, or at least calmed, from the icy Pleistocene to the warmer Holocene, forests of deciduous tree species collected in the low elevation lands of Vermont. Beeches, slow and steady growers, tended to establish stands in older, less disturbed forests where their shade tolerant root sprouts advantageously peppered the understory, ensuring future generations of canopy dominance. By the time European settlers surveyed town lines in Chittenden County, beech trees clearly outnumbered all other forest species. But with settlement and land-clearing, the beech lost their stronghold, and beech bark disease continues to ravage their population. Were we to map natural communities of the late 1700's it would a landscape of variations on a beech forest. But our future natural communities maps may not mention beech at all. In the end, though, should these complications deter us from mapping at all? Or should we soldier on, with a deep and conflicted understanding of the complex task we are attempting.

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Wildlife Species List
for the Leduc, Scott and Bandel/Dopp Parcels

Mammals

Bobcat	*Lynx rufus*
Common porcupine	*Erethizon dorsatum*
Common raccoon	*Procyon lotor*
Coyote	*Canis latrans*
Deer Mouse	*Peromyscus maniculatus or P. leucopus*
Eastern chipmunk	*Tamias striatus*
Eastern cottontail	*Sylvilagus floridanus*
Eastern grey squirrel	*Sciurus carolinensis*
Fisher	*Martes pennanti*
Groundhog	*Marmota monax*
Meadow vole	*Microtus pennsylvanicus*
Striped skunk	*Mephitis mephitis*
Northern short-tailed shrew	*Blarina brevicauda*
Red squirrel	*Tamiasciurus hudsonicus*
White-tailed deer	*Odocoileus virginianus*
Weasel	*Mustela erminea or M. frenata*

Reptiles and Amphibians

Common gartersnake	*Thamnophis sirtalis*
Painted turtle	*Chrysemys picta*
Snapping turtle	*Chelydra serpentina*
Spotted salamander	*Ambystoma maculatum*
Spring peeper	*Hyla crucifer*
Wood frog	*Rana sylvatica*

Birds

American crow	*Corvus brachyrhynchos*
American goldfinch	*Carduelis tristis*
American robin	*Turdus migratorius*
American woodcock	*Scolopax minor*
Barn swallow	*Hirundo rustica*
Black-capped chickadee	*Parus atricapillus*
Blue jay	*Cyanocitta cristata*
Brown thrasher	*Taxostoma rufum*
Cooper's hawk	*Accipiter cooperii*
Dark-eyed junco	*Junco hyemalis*
Downy woodpecker	*Picoides pubescens*
Eastern bluebird	*Sialia sialis*
Eastern phoebe	*Sayornis phoebe*
European starling	*Sturnus vulgaris*
Golden-crowned kinglet	*Regulus satrapa*
Great blue heron	*Ardea herodias*
Great horned owl	*Bubo virginianus*
Mallard	*Anas platyrhynchos*
Mourning dove	*Zenaida macroura*
Northern cardinal	*Cardinalis cardinalis*
Pileated woodpecker	*Dryocopus pileatus*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Ruffed grouse	*Bonasa umbellus*
Scarlet tanager	*Piranga olivacea*
Song sparrow	*Melospiza melodia*
Tufted titmouse	*Baelophus bicolor*
Turkey vulture	*Cathartes aura*
White throated sparrow	*Zonotrichia albicollis*
White-breasted nuthatch	*Sitta carolinensis*
Wild turkey	*Meleagris gallopavo*

Scans from Records in the South Burlington Library

Please visit a Librarian to see adjoining map, referenced in the text below.

SOUTH BURLINGTON HISTORIC SITES

Houses known to be on BEERS map, 1869. Shown on accompanying map in RED ink

HINESBURG ROAD AREA

MAP KEY	LOCATION	PRESENT OWNER	ORIGINAL OWNER	DATE
1	Cheesefactory Rd.-	Betty Bandel	G. W. Slocum	1825
2	2000 Hinesburg Rd.	Ernest Auclair	J. VanSicklen, Jr.	c1815
3	1731 "	Arthur Auclair	J. VanSicklen, Sn.	c1788
4	1550 "	Paul K. French	Abel Owen	1815
5	VanSicklen Rd.	Robt. S. Babcock	E. VanSicklen	c1840
6	1500 Hinesburg Rd.	Mrs. Kit Marston	J. A. Thatcher	c1825
7	1475 "	E. S. Horton	A. Comstock	c1835
8	1425 "	S. N. Bogorad	School House #3	c1835
9	1405 "	Homer DuBois	Nathan Smith	c1788
10	1100 "	L. H. Coffin	L. A. Isham	c1835
11	1075 "	Mrs. Harold Rye	S. K. Isham	c1825
12	835 "	Hill family	Landon	c1825
13	725 "	Robt. A. Schell	J. J. Faye	c1807
14	700 "	Rollin Tilley	M. Bradley	c1825
15	Old Farm Road	E. A. H. Sims	H. Bean	c1812
16	400 Hinesburg Rd.	H. M. Dean	H. W. R. Dean	c1825
17	200 "	Catholic Diocese	T. Doyle	c1869

SOUTH BURLINGTON HISTORIC SITES

DORSET STREET (north to south)

MAP KEY	LOCATION	PRESENT OWNER	ORIGINAL OWNER	DATE
18	701 Dorset St.	Gerald Marquis	A. Kimball	before 1869
19	800 "	Howard Brand	E. L. Barstow	" "
20	890 "	Lee Emmons	T. F. Stuart	" "
21	900 "	Mrs. E. A. Brand	A. Johnson	" "
22	1001 "	Isadore Myers	R. M. Barstow	" "
23	1200 "	Paul Heald	H. Chittenden	" "
24	1225 "	Chas. Isham	H. A. Buttolph	" "
25	1700 "	Jennie Blair	A. H. Slocum	" "
26	1725 "	Alex J. Blair	G. A. Sheldon	" "

SPEAR STREET (south to north)

27	200 Allen Rd.	Mrs. Don Irish	J. Cosgriff	" "
28	1815 Spear St.	Stuart Hall	D. I. Tupper	1862
29	1720 "	Littleton Long	Cassius Spear	before 1869
30	1560 "	Mrs. John Nowland	S. Thayer	" "
31	School House	Mrs. John Nowland	# 5	" "
32	1251 Spear St.	Urban Wheelock	F. Hadley	" "
33	University of Vermont Farm		S. A. Shedd	" "

South Burlington Historic Sites

SHELBURNE ROAD (south to north)

Map Key	LOCATION	PRESENT OWNER	ORIGINAL OWNER	DATE
34	1710 Shelburne Rd	Victorian Inn	L. S. Drew	before 1869
35	1342 "	Haselton-Melendy	Moses Murphey	" "
36	950 "	Art Mason	J. W. Pattridge	" "

WILLISTON ROAD AREA

37	870 Williston Rd.	Sheraton Inn	Carlos Baxter	1810
38	2025 "	Assembly of God	L. B. Baldwin	c1826
39	251 Shunpike Rd.-	Laurence Willis	E. Taft	c1810
40	101 Ethan Allen Rd.	Rene Berard	Chauncey Brownell	c1853

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Warranty Deed files from City of Burlington

Highway Dept. files from old Town of South Burlington

Special Collection, Wilbur Library, University of Vermont

A Study of South Burlington League of Women Voters 1965

A Study for the Historical Society of Vt., by C. Marsh 1966

SOUTH BURLINGTON HISTORIC SITES

Houses not shown on 1869 map but known to be about 100 years old. Shown on accompanying map in BLUE numbers

MAP KEY	LOCATION	PRESENT OWNER	ORIGINAL OWNER
41	1600 Dorset St.	R. Chittenden	Hawley
42	300 Swift St.	S. M. Whittlesey	Rufus Barstow
43	195 Dorset St.	Wilfred Delorme	
44	148 "	G. G. Devereaux	
45	1435 Spear St.	Martin Koplewitz	Drew
46	1233 Shelburne Rd.	Mrs. C. N. Stetson East O' Lake	
47	Allenwood	Farrell	George M. Allen
48	1076 Williston Rd.	Lamplough	Mary Fletcher Hosp. farm

Description of Houses shown above

41 Grey shingles. Red trim. (east side)

42 Grey frame. Large and rambling. Remodeled. (north side)

43 White frame. Two stories. (west)

44 White frame. Green trim. Porch across front. (east)

45 Red brick. Large. Remodeled. (west)

46 Beige frame. Brown stone base. Remodeled. (west) When the present owner bought the house 40 years ago, it was occupied by an 85 year old woman whose grandfather had been the builder. It was then only four rooms and moved from the Allenwood Estate.

47 H. H. Richardson designed several buildings in this estate including the original Allenwood Inn.

48 White frame. Large. Towers. Set back from road. (north)

DESCRIPTION OF HOUSES AS NUMBERED IN RED INK ON MAP

1 Small red brick house with brick ell. Restored. (north side)

2 3 storied red brick. Remodeled for Tack Shop. (east)

3 Large red brick farmhouse. (west). This house is said to be the oldest house standing in So. Burlington. It was here when Nathan Smith moved nearby in 1788.

4 Stone house. Set back from road. Red door. (east). Noted for its five fireplaces with central flue. 24"thick walls.

5 White frame. Remodeled. Set back from road. (north side)

6 White frame. Green door. Restored. (east)

7 Red brick. Restored. (west)

8 Small, red brick. Wrought iron railings. Remodeled. (west)

9 White frame farmhouse. (west side) This house had considerable damage by fire in Dec. 1973. The original structure is hidden behind the extensive remodeling.

10 Grey frame. Remodeled. (east side) There is no evidence of original fireplaces in this house suggesting it was heated by Franklin stoves.

11 White frame farmhouse. (west)

12 White frame, square farmhouse. (west) The original road called first Eldridge St., then Fourth St., came very close to this house, and was moved to the east to accommodate the patrons of the tavern across the road.

13 White frame. Rambling. Remodeled. (west) There is also evidence here of the original road coming very close to the house.

14. Beige frame. Brown trim. (east) This was the tavern which influenced the present location of the road.

15 Grey frame. Large. Remodeled. (north side at bend in road)

16 Red brick. Rambling. Remodeled. (north-east at bend in road)

17 Yellow shingles. Cottage. Remodeled. (east) This house was moved from its location by the Catholic Church pond 30 years ago.

DESCRIPTION OF HOUSES AS NUMBERED IN RED INK ON MAP

DORSET STREET

18 White shingled, rambling. Back from road. (west side)

19 Grey shingled. Two storied farmhouse. On hill. (east)

20 Small, white frame. Red door. (east)

21 Grey shingled, green trim. (east)

22 Red brick. Cottage type. 3 gables. Restored. (west)

23 Large yellow frame. Black trim. Restored. (east)

24 White frame. Green trim. (west)

25 Beige with green trim, farmhouse. (east) The back part of this house is very old and appears much as it did originally.

26 White frame farmhouse. (west) Four corner posts, referred to as gun stock posts, are exposed in the inside of the house. This suggests, but does not necessarily determine an old house.

SPEAR STREET AREA

27 White frame farmhouse. (north side of Allen)

28 White frame with grey trim. Remodeled. (west)

29 Brown. Large front porch. Remodeled. (east)

30 White frame. Maroon trim farmhouse. (east)

31 Light green frame. Vacant. (west)

32 White frame. Rambling farmhouse. (west)

33 White frame, large farmhouse. (east)

DESCRIPTION OF HOUSES AS NUMBERED IN RED INK ON MAP

SHELBURNE ROAD

34 Red brick and red frame. White victorian trim. (east side)

35 Red brick. Remodeled. (east). Originally a black smith shop.

36 Red brick. Close to the road. Remodeled. (east)

WILLISTON ROAD AREA

37 White frame. Remodeled. (north side) The original house can still be seen above the glass walls of the restaurant.

38 White frame. Near road. Remodeled. (south side) Formerly the toll house for collecting fees on the Winooski Turnpike. Shunpike road was made a town road in 1826 so the toll house would predate that time.

39 White frame farmhouse. Remodeled. (west)

40 Permastone. Remodeled. (south side)