

**An Ecological Perspective of the Middlebury College Mountain Lands:
Natural Communities and Vascular Flora of Lands of the Bread Loaf Region
and the Green Mountains Western Escarpment**

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September 2013

Executive Summary

The purpose of this study was to provide ecological information to decision-makers, researchers, teachers, students and general users of the 1,256 ha (3,105 ac) of Middlebury College-owned forests, fields and wetlands in the Green Mountains. Fieldwork was conducted over the course of two summers, 2011 and 2012, by walking routes across the lands to make systematic observations of natural communities and vascular plants and occasional observations of wildlife sign and wildlife habitat features such as mast stands, cavity trees and Vernal Pools with amphibian activity. A map of upland and wetland natural communities was completed during the summer of 2013 using ArcGIS 10.1. The map should be seen as our best representation of the lands' ecosystems, and as being open to future revisions and updates. Lists and maps of rare and uncommon vascular plant species were also produced. Natural communities and plant species were classified, described and ranked according to standard methodology used by natural heritage programs in the United States and numerous other countries.

To more fully understand the ecological values of a place it is important to assess characteristics of the surrounding landscape. Our landscape context analysis reveals that the Middlebury College mountain lands occupy a key position in a landscape that has high conservation values and is largely conserved as national forest. The landscape contains large blocks of unfragmented forest, parts of which are nationally designated wilderness areas. The broader landscape, including the Green Mountain western escarpment, the Ripton-Lincoln plateau and the high slopes and ridgeline of the central Green Mountains, features a wide diversity of geologic features and landforms and a wide range of elevation zones and moisture conditions. Based on factors used by two recent landscape modeling efforts we found that from a statewide and regional perspective, the central Green Mountains landscape in which the college mountain lands are located ranks high in characteristics that help us evaluate the diversity of a landscape, its hypothesized resilience in the face of climate and other environmental changes, and its importance for biodiversity conservation. Most of the landscape is rated by the Vermont Agency of Natural Resources as having high, very high or greatest contributions to biodiversity. Battell Research Forest is recognized as a National Natural Landmark by the National Park Service; it is one of 12 sites in Vermont designated as having this national-level significance.

Through our intensive field work, we mapped 37 natural community types. Of the 21 upland types, all are forested communities except for one cliff and two woodland types. The 15 wetland types consist of eight non-forest (shrub and herbaceous) and seven forest types. The general landscape pattern shows a forest matrix of different sorts of Northern Hardwood Forest with hemlock or hemlock-spruce-Northern Hardwood Forest types prominent in lower parts of the landscape. Montane conifer or conifer-hardwood forest types cap the Green Mountain summits and ridgeline. The upland forest ecosystem diversity features seven Northern Hardwood Forest types, eight hemlock or mixed conifer-hardwood types, and two spruce-fir types. Within this upland

forest matrix are many small- and medium-size wetlands, including scattered small seepage swamps and several rather extensive seepage forests. On the Green Mountain escarpment (parts of Middlebury Gorge and all of Battell Research Forest and Clapp Lot), Hemlock, Temperate Hemlock, and Mesic Red Oak-Northern Hardwood Forests are common, included are less extensive patches of Dry Oak and Red Pine Forests and small woodlands and temperate acidic cliffs and outcrops.

Two natural community types considered rare from a statewide perspective occur on the college mountain lands in the Bread Loaf vicinity; both are part of riverine systems—Sugar Maple-Ostrich Fern Riverine Floodplain Forest and River Cobble Shore. No types ranked very rare were observed on college lands. Additional rare types, Red Pine Forest and Dry Oak Woodland, occur on the escarpment at Battell Research Forest and the Clapp Lot, respectively. Thirteen uncommon types occur on the lands and comprise substantial acreage. They include upland and wetland forest types, as well as one woodland and two non-forested wetland types. Within the study area, only Northern Hardwood Forest and Alder Swamp are ranked in the most common category.

From a river perspective, the many miles of headwater streams on the college lands is certainly one of the high ecological values. In few cases are the sources of the streams on college parcels, except at the Snow Bowl, the only high mountain lot in college ownership. The sources are mostly on national forest lands, which in many cases are part of National Wilderness areas. Hence, the college lands are frequently the first private lands the streams flow through. Although little studied, many of these waters are likely in very good condition. One stream section that has been specifically identified as having altered conditions is the South Branch for approximately 3 km (2 mi) from the Snow Bowl snow-making pond nearly to the confluence with Goshen Brook. Water withdrawals lead to insufficient flow in the river section. The extensive streams network corresponds to many kilometers and hectares of riparian area. In addition to serving important functions for water quality and supply protection, riparian areas are known to be among the most important travel corridors for medium and large mammals and to be particularly rich bird habitat.

The density and ecological diversity of wetlands, is an important value of the lands and confers substantial habitat diversity and water protection functions. Wetlands cover 11% of the college-owned mountain lands. This is a surprisingly high proportion for a 1,200 ha (3,000 ac) central Green Mountain landscape; we attribute the large wetland area to the landscape characteristics particular to the Ripton-Lincoln plateau. Characteristics of high importance are likely topography—relatively level to only moderately sloping terrain—and surficial deposits—a complex pattern of compacted and non-compacted ice and water-laid materials. These factors appear to strongly influence hydrology, and thus wetland presence. Interestingly, seepage forest, as opposed to basin swamps and marshes, is the most extensive wetland type.

Plants that are ranked as rare or uncommon within the state are few on the college mountain lands. No species observed are protected (as endangered or threatened)

under the Vermont Endangered Species Law. Two rare species were observed during our field work. Shore sedge (*Carex lenticularis*) occurs peaty pond shores of Lake Pleiad and hay sedge (*Carex argyrantha*) grows on a rocky ledge beside the pond in Clapp Lot. Four uncommon species were observed. Both yellow lady's-slipper (*Cypripedium parviflorum*) and swamp thistle (*Cirsium muticum*) occur in the Edwards Lot; the lady's-slipper was seen in three locations there. Wiegand's wild-rye (*Elymus wiegandii*) is located in one portion of floodplain forest along the Middlebury River South Branch in Coal Kiln Lot 1. A single Spruce-Fir-Tamarack Swamp exists in the study area, in the Bread Loaf 11 parcel; it features the uncommon species long sedge (*Carex folliculata*). All populations of rare and uncommon plants appeared vigorous and occurred as moderately sized populations. "Unusual" plant species are those that either we consider not typical of or not common in the study area landscape (most of these species are generally near their elevation limits) or that formerly were considered rare or uncommon in Vermont but have been found to be somewhat more common than those that qualify for uncommon status statewide. We have included location information on approximately 30 such species. The most unusual one is skunk-cabbage; it was very surprising to find a thriving population at 488 m (1,600 ft) in the Green Mountains.

In general, invasive species occurrences were few and far between on the college mountain lands, and most that were sighted were on forest edges or in areas of frequent natural disturbance along the Middlebury River South Branch. The two most abundant invasive exotic shrubs of our general area, common buckthorn and the Eurasian shrub honeysuckles, were observed in several field-margin and forest-edge locations. Also present were Japanese barberry and wild chervil. Of most concern among the invasive plants is the vine Oriental bittersweet, which can overtop and "strangle" trees. One individual seen in the Edwards Lot was pulled by hand, but a population of a few individuals along the road near the Robert Frost homestead is of concern. To maintain the integrity of natural communities, we recommend invasive species control for a number, if not all, the populations on the college lands.

Inventory of wildlife or habitats was not part of this study. We did however make some general and specific observations. Since the forests of the study area are moderately young and in recovery from the heavy agricultural use and forest harvesting of the 19th century, several habitat elements of importance to many species—cavity and snag trees, dead-downed trees (coarse woody debris), and deep litter layers—are scarce on the lands. As the forests continue to mature, we expect an increase in these and, we hope, subsequent increases in populations of the many forest species that depend on such habitats. We did find several areas of bear-scarred beech, which indicate bear feeding in mast stands, a habitat type recognized as essential to the well-being of the black bear population. None of those stands was extensive or showed signs of scarring in the last five years. The mast stands straddle the college-national forest boundary, and they may be more extensive on the public lands. Additionally, recent bear feeding in the open wetland at the northeastern edge of Homer Noble Farm showed the importance of

that large wetland complex to bear in the spring and early summer. Moose and deer presence in the study area was clear from the abundance of tracks and scat. Signs of intensive use were infrequent, but both species clearly inhabit the entirety of the study area, with some pockets showing more activity than others. Vernal Pools were few on the college lands; we observed amphibian activity in Vernal Pools and the old farm ponds on Homer Noble Farm. Finally, woodcock appear to breed in many shrub wetlands and wet forests on the college lands, with the greatest concentration in the riparian areas of the South Branch and its tributaries.

We provide some specific management recommendations for each parcel, but it was not the intent of this study to carefully compile comprehensive list of management actions. Although the woods roads and trails have few water control and erosion problems, we note some areas that deserve attention. Management or and future planning for the many hectares of conifer plantation is one of our most frequent recommendations. Invasive species control is also mentioned for a number of parcels. Another common management recommendation is to update existing plans for those parcels certified for sustainable forest management.

Purpose and Study Area

The study of Middlebury College-owned lands in the Green Mountains was undertaken to provide information on the ecological values of the lands in order to 1) aid in decision-making about their stewardship and management, and 2) help guide student and faculty researchers and others interested in learning about the lands.

A general analysis of the lands “role” in the local and regional environment, that is, their contributions to the broader landscape ecological diversity, and to some extent functions, is a brief portion of the study. Greater attention has been given to documenting, through mapping, description and ranking, the natural communities of the lands, and to compiling species lists of the vascular plants. We provide data on non-native invasive plant species in the hope that control measures will be taken to avoid or minimize the spread of those forest pests. We also documented rarity status of the native plants and provide location and population information for species considered rare or uncommon in the state. Additionally, we have pointed out a number of species that are “unusual” in the local landscape; these plants are typically rare or uncommon in the broader central Vermont mountain landscape or were formerly considered rare or uncommon in the state.

We also, in a non-systematic way, evaluated trails for erosion and hydrologic disruptions that degrade the quality of soils and surface waters. Although not an initial purpose of the study, we have provided some anecdotal information on wildlife use and habitat based on our casual observations. These two efforts should be seen as preliminary and would benefit from more systematic exploration.

The lands that comprise the study area are those college-owned parcels in Ripton, Hancock and the portion of Middlebury that is within the Green Mountains. Most of the lands are adjacent to or within 3 km (roughly 2 mi) of Vermont Route 125, and we think of these as lands in the Bread Loaf or Middlebury River Gorge areas. They cover an area totaling 1,194 ha (2,952 ac), with just 19 ha (48 ac) as developed land or lawn. Two additional mountain parcels add 62 ha (153 ac) to the study area—Battell Research Forest farther north in Middlebury near the Bristol town line, and the Clapp Lot, in Bristol east of Bristol Pond. College-owned lands in the Champlain Valley were the focus of a separate study conducted in 2009 (Lapin et al. 2010).

Organization of the Report

This report is organized to be of use to a variety of users and thus is organized somewhat unconventionally. We begin with an overview of the geophysical characteristics of the land and then present a brief methodology section. The most important findings of the assessment are then presented in an “Ecological Values ‘Highlights’” section, which includes an analysis of the lands within a broader landscape setting as well as specific results of our field work. The highlights are followed by a more detailed presentation of findings arranged by parcel. Each parcel description is accompanied by a table that summarizes important results and management

recommendations. After the parcel-by-parcel review of ecological values we provide more technical descriptions arranged by natural community type. Included in the technical descriptions is discussion of ranking of natural community element occurrences; the section is preceded by several paragraphs detailing the classification and ranking methods. Because we have attempted to present information in formats most useful to different readers, there is some degree of redundancy in the by-parcel and by-natural community sections. These latter, more technical sections are likely to be of use to student and faculty who want to know more about the lands for research and teaching, as well as to land managers and the science community. The findings by parcel are likely to be of more use to higher-level decision-makers and general audiences. Species lists of vascular plants are included as an appendix. All spatial data are stored in the Middlebury College GIS database in the directory \\splinter\gg_projects\mc_lands_ecol_eval\final_shps_MtnLands.

Landscape Overview

Landscape Position, Topography, Surface Waters and Wetlands

The college lands in the vicinity of the Bread Loaf Mountain campus, in the towns of Ripton, Middlebury and Hancock, include approximately 1,200 ha (3,000 acres) of forest, open wetland and field at the southern end of the Northern Green Mountain Biophysical Region of Vermont (Thompson and Sorenson 2000) in the towns of Ripton, Middlebury and Hancock (Figure 1). The majority of the parcels lie between 425 and 550 m (1,400 and 1,800 ft) on an undulating mid-elevation plateau situated between the Green Mountains escarpment to the west and the steep slopes rising to the Green Mountains ridgeline to the east. The towns of Ripton and Lincoln both sit within this plateau-and-slope landscape, with parts of Bristol and Goshen included at the north and south ends. The highest elevation on the college's mountain parcels is 870 m (2,860 ft) on the ridgeline at the Snow Bowl, while the lowest, 165 m (540 ft), is the downstream end of the Middlebury River Gorge. Since most of the lands are on the undulating plateau landform, they tend to be gently to moderately sloping. Steep and very steep slopes are typically restricted to deeply incised stream valleys (including the Middlebury Gorge area, the Middlebury River Middle Branch, and parts of the Brandy and Goshen brooks stream systems) as well as on the higher mountain slopes that comprise the Snow Bowl. The classic, more familiar, steep mountain slopes that many of us hike and ski on are mostly not on the college territory but rather are on adjacent lands of the Green Mountain National Forest, much of which in this area was formerly owned by the college as part of the Joseph Battell legacy.

Two additional college mountain parcels lie to the north of the Bread Loaf region; both are on the Green Mountains Western Escarpment, a salient landscape feature that defines the western edge of the central and southern Green Mountains. In the northeast corner of Middlebury, near the Bristol town line, the Battell Research Forest (aka Abbey Lot) sits midslope on the escarpment from 182 m (600 ft) to 420 m (1,380 ft). Farther

north, on the Hogback Mountain portion of the escarpment at the Bristol-Monkton town line the Clapp Lot rises from midslope at 274 m (900 ft) to the ridgeline at 366 m (1,200 ft).

A purposefully coarse ecological model of the Vermont landscape divides the state into land type associations (LTAs). The LTA units are based on combinations of elevation, underlying geology, shape of the land (landform), landscape position and surficial deposit type (Ferree and Thompson 2008). The bulk of the college's mountain lands are on the plateau and are thus largely within the Precambrian plateau landtype association (Figure 2). Other LTAs represented are hills/footslopes and valley bottom. In contrast, the Snow Bowl is on the mountain slopes and upper mountain slopes/mountaintops LTAs, whereas the Middlebury Gorge (Battell Park-Middlebury River and Spear lots), Battell Research Forest (Abbey Lot) and the Clapp Lot are within the Vermont escarpment LTA, with the Gorge including bits of the low rolling upland and marine/lacustrine/glaciofluvial coarse sediments LTAs. This level of ecological classification provides a nice picture of the range of geophysiographic diversity of these lands.

The college lands are almost entirely within the Middlebury River watershed, which drains into Otter Creek and then Lake Champlain (Figure 3). The only parts of the college's Bread Loaf region lands that are not part of the Lake Champlain Basin are the eastern areas of the Snow Bowl, which drain into the White River, and are thus part of the Connecticut River watershed. Most of the Bread Loaf area lands are in the Middlebury River South Branch watershed; Brandy Brook and Goshen Brook are main tributaries of the South Branch. The Edwards Lot, approximately 700 m (0.5 mi) north of the lands contiguous to Bread Loaf Campus, is in the Middlebury River Middle Branch watershed. Named tributaries and unnamed intermittent and perennial small streams are common on the lands. These brooks range from well-developed, sometimes well-incised waterways to very small rivulets. Groundwater seepage zones, what we commonly refer to as springs, are frequent also. Many seepage zones occur as small pockets in the upland forest; these are the Seep natural community, and we have attempted to map all of them we encountered in our investigation. Surely there are many more that we did not walk near and since they are very difficult to find on aerial photographs or other remotely sensed imagery they remain unmapped. Other seepage zones are associated with forested or non-forested swamp or marsh natural communities.

Clapp Lot straddles the Lewis Creek and New Haven River watersheds, both within the Champlain Basin. Battell Research Forest is within the Otter Creek watershed, of which the Middlebury River is also a part.

Very few ponds, including natural "permanent" ponds, beaver ponds and human-made ponds, occur within the college lands. The only sizable natural pond is 2-ha (5.5-ac) Lake Pleiad, reached from a short spur off of the Long Trail in the Snow Bowl parcel.

Clapp Lot features three-quarters of a hectare (1.7 ac) of a 5-ha (12-ac) natural pond that has apparently been expanded but not created by beaver.

Artificial ponds exist at the Snow Bowl (for snowmaking) and adjacent to Steam Mill Road (old drinking water supply for Bread Loaf Campus). Two small farm ponds built at the Homer Noble Farm are still dammed and continue to hold water; beaver have used those ponds periodically. All other standing water bodies are small beaver ponds in pond/meadow/shrub swamp complexes, although interestingly we learned that those in the Edwards Lot were not naturally created by beaver but were originated by people and their digging machines. The beaver and farm ponds cover a combined area of roughly 1 ha (2.5 ac).

Wetland natural communities include both forested and non-forested types, as well as riverine and basin wetlands. Based on natural community mapping, 11% of the lands are wetland, yielding total wetland area of 136 ha (337 ac) (Figure 3). Vermont Significant Wetlands Inventory mapping, which is based on aerial photograph interpretation with very, very few updates from on-the-ground work, shows a smaller amount of wetland. We mapped 23 ha (57 ac) of non-forested, wetlands. The shrub swamps, Alder Swamp and Alluvial Shrub Swamp, accounted for nearly one-half of non-forested wetland area; marsh types comprised about one-third, and the larger Seeps (those mapped as polygons) totaled nearly one-tenth of the open wetland area. Forested wetland on the college lands far exceeded the area of non-forested wetland. A total of 113 ha (280 ac) were mapped, with only 4 ha (10 ac) riverine floodplain forest and the rest basin swamps or seepage forest. The 81 ha (201 ac) of Northern Hardwood Seepage Forest and Hemlock-Red Spruce-Northern Hardwood Seepage Forest comprised the large majority of forested wetland, with true basin swamps totaling only 25 ha (63 ac).

For those familiar with the Green Mountains, to write that this is a densely forested landscape is stating the obvious, yet it is important to mention. The college lands feature the characteristic cloak of forest, with the natural perforations of open wetland and standing and flowing waters, and the artificial perforations of old field, field, and lawns and buildings. Although we have not mapped any “open” upland natural communities (i.e., not forest or woodland types), it would be misleading to say there are none. At the base of Middlebury Gorge are cliff and outcrop natural communities. These areas would be very difficult to include as polygons that would be noticeable on the natural community map, so we have chosen to only mention that they are part of the gorge ecosystem rather than attempt to estimate their actual locations and extent via mapped data.

Bedrock Geology

Bedrock types exert the strongest influence on the chemistry of the soil parent material and bedrock is thus a primary feature, in fact the most enduring feature, of natural communities. Even in soils that are deep to bedrock, the composition of the deposits left by the glaciers, be they till, glaciofluvial or lacustrine deposits, is most

strongly influenced by the local bedrock, for most materials do not travel very far in ice or water. The college lands feature a full elevation gradient from the edge of the Champlain Valley at the base of the Green Mountain western escarpment eastward to the main ridgeline on Worth Mountain. Furthermore, the lands are perpendicular to the grain of the Green Mountain bedrock geology and therefore incorporate a number of bedrock types nicely representative of the geologic diversity of the central Green Mountains.

According to Ratcliffe et al. (2011) the bulk of the college mountain lands—the lands that are firmly on the Ripton-Lincoln plateau including the contiguous Bread Loaf lands, Edwards, Goshen Brook and Coal kiln lots—lie primarily on the Lincoln massif granitic gneiss formation Laurentian basement rocks of the Mount Holly complex. Smaller portions of those lands are on Pinnacle formation metawackes, schists and conglomerates. The parcels of the steeper, higher mountain slopes—the Snow Bowl and Crystal Brook lots—are predominantly on Tyson Formation metawackes, phyllites and quartz phyllites. Additional portions of the mountain slope parcels feature Mount Holly Complex biotite-quartz-plagioclase gneisses, amphibolites, and quartzites.

The Middlebury Gorge is cut through a number of bedrock formations. The gorge parcels' bedrocks are principally Mount Holly Complex biotite-quartz-plagioclase gneisses at the upper (eastern) end and Cheshire quartzite at the lower (western) end. In addition to Pinnacle Formation metawacke and conglomerate and Moosalamoo Formation phyllite and metawacke, within the complicated geology of the gorge are calcareous rocks including Forestdale Formation dolostone and other marble and calc-silicate gneiss rocks.

Another important structural aspect of the land's geology is that six thrust faults cut through the college parcels. It would make a very fine geo-ecological study to investigate the influence of bedrock formation contacts and thrust faults on the hydrology and natural community patterns of the college lands. The significant amount of groundwater seepage and its large influence on natural communities may be strongly related to the structural geology of the terrain.

The college lands wonderful geologic diversity contributes to a landscape full of ecological complexity and conservation values. Of ecological importance, we see that the study area's plateau is the northernmost reach of the Mount Holly complex, which is the dominant bedrock of the southern Green Mountains and is near the southernmost reaches of the Pinnacle Formation, one of the prominent bedrocks of the northern Green Mountains. The area thus shares geological and ecological characteristics with both the northern and southern Green Mountains. Combined with the many bedrock contacts, the thrust faults, and the array of surficial deposits discussed below, we describe a landscape with a rich geological-ecological fabric.

Glacial Deposits

The biological diversity of the region is largely dependent upon the glacial deposits which formed the parent materials of the current soils; the deposits, along with the inter-related hydrology, are principal factors in the composition of the vegetation and natural communities. Predominant parent materials of the plateau-and-mountain slope landscape are rocky till deposits laid down by late-Pleistocene glacial ice (Figure 4). Interspersed among the rocky till mantle are small- and medium-sized patches of water-laid (glaciofluvial) deposits, as well as a few small patches of organic and recent alluvial deposits. The lands along the South Branch of the Middlebury River (across Route 125 from the main Bread Loaf campus) are one of the areas with substantial glaciofluvial deposits, and those features are significant for the natural community diversity of the lands. The Edwards lands and the Middlebury Gorge also feature glaciofluvial deposits.

Coarse-loamy tills, the predominant deposits in the landscape, can be divided into ablation and basal tills. Ablation tills were somewhat washed as they came out of the receding glacial ice and were not pressed down by the weight of the glacier; thus, they are characterized by a higher proportion of sand and more rapid drainage. The basal tills were deposited beneath the ice, and due to the glacier's weight pressing on them basal tills are dense and compacted, thus water moves through them quite slowly. Soil drainage in these till deposits ranges from well drained to somewhat poorly drained. The degree of compaction and drainage capacity of the different soils is a fundamental characteristic that shapes the ecosystems and their vegetation. Additional complexity is added by the occurrence of hard layers (densipans) at varying depths from the soil surface; in most cases the densipans in these soils are compacted basal till that underlies the covering of ablation till. The interspersed ablation and basal tills appears to strongly influence hydrology and manifests in drainage differences that result in groundwater seepage and perched water tables. For natural communities, the hydrologic differences are a very important aspect of the ablation till/basal till/densipan pattern. On the college lands we observed many areas of groundwater seepage that occur as both large and small patches; it seems that the spatial patterns of the two types of till and especially the edge areas where different deposits come together account for many of the locations of seepage. Figure 4 provides a coarse perspective of these closely intertwined deposits; we acknowledge that there is a much finer pattern of the mosaic that the map does not capture.

In the study landscape, glaciofluvial deposits occur as elongated polygons in the environs of the Middlebury River and its branches, with patches along Brandy Brook and its tributaries and Goshen Brook. In the Middle Branch area (Edwards Lots) there appear to be broader flats of glaciofluvial deposits that are somewhat complexly interdigitating with tills. Glaciofluvial deposits are in most situations comprised of sand and gravel, but some glaciofluvial silts occur, such as the fields at Bread Loaf campus. Textural characteristics of any specific deposit depend on water flow rates and general depositional environments when and where the materials were deposited. Soils that

developed in glaciofluvial deposits usually drain very rapidly, but where silt proportions water tables are high they may have slower drainage. Thus, such soils range from excessively drained to poorly drained; although soils descriptions show the predominant glaciofluvial soils, Colton series, to be excessively drained, we found that where they are not steeply sloping they are more towards somewhat excessively drained. Such nuances in the soils have substantial impact on natural communities. For example, the glaciofluvial deposits along the South Branch are one of the most complex parts of the landscape. Depth to water table, particle size of a deposit, and perhaps microclimate in cold-air traps combine to create a fine-grained natural community mosaic.

Small patches of alluvial deposits in the plateau landscape develop in areas influenced by flowing water in modern times; thus they are closely associated with the Middlebury River and its tributaries. Only small amounts of alluvial deposits occur on college lands, most of which is found in the Alluvial Shrub Swamps alongside the South Branch. Similarly, organic deposits (muck, peat) are rare in this landscape. The deepest organic deposits encountered were in the red spruce and Spruce-Fir-Tamarack Swamps, located in the Edwards, Bread Loaf 11 and Snow Bowl parcels. Much of the wetland acreage investigated during this project was found to have upper horizons of mineral soil, mucky mineral soil, or shallow organic deposits.

Figure 4 is a useful graphic for gaining an understanding of and appreciation for an extremely important physical factor that shapes the natural community pattern of the region. The lands show an intricate mosaic of soils, hydrology, and natural communities that is very closely related to and dependent upon those deposits. Although the underlying shape of the bedrock is an additional important factor, it appears that the surficial deposits left by the glacier exert a stronger influence on the local landscape.

Soils

Description of the soils is based on the county soil survey and our field observations. It is first necessary to note that initial soils information was derived from the Addison County Soil Survey (Griggs et al. 1971), which was the first soil survey completed in Vermont, and thus lacks a lot of detail, particularly in the non-agricultural parts of the landscape (of which our heavily forested study area is part). The more recently completed Rutland County survey (Ferguson et al. 1998) depicts finer resolution of soils mapping in the mountain landscape, but we do not have the fortune of benefiting from the greater understanding and the technological advances developed in the four decades since the local soils maps were developed. It is noteworthy, however, that the Rutland County survey maps our study site's most common soils in groups, as is done in the Addison County soil survey. We mention this simply to illustrate that the mosaic of soils on the landscape is very detailed and complex and much more field work would be needed to accurately map out all of the different soils.

Well and moderately well drained spodosols are the most common soils throughout the plateau and mountain slopes, with frequent patches of somewhat poorly and poorly drained inceptisols (Figure 5). One of the two most extensively mapped soil types on the study lands is Berkshire and Marlow extremely stony loams. These are very deep to bedrock, well drained, fine sandy loams; the major difference between these two soils is that Marlow has a dense layer at 76 to 152 cm (30 to 60 in) and Berkshire does not. Our field observations did not note dense layers in most of the soils in the 30-inch range, but we rarely sampled below 90 cm (35 in), and thus dense layers may have gone undetected. Hence, we are unsure if the dense layer in the Marlow soils affects natural community composition; surely one of the important aspects is the hydrologic influence which may be most expressed as greater moisture from flow downslope to adjacent areas. The Berkshire and Marlow soils characteristically support typical northern hardwood (beech-sugar maple-yellow birch) and Hemlock-Red Spruce-Northern Hardwood natural communities.

The other soil type that is extensively mapped on the lands is Peru extremely stony loam. The Peru soils formed in dense, compacted till and are moderately well drained fine sandy loams; they also are very deep to bedrock. We found that the Peru soils featured numerous groundwater seepage areas and thus were often associated with sloping seepage forests; non-seepy areas tend to support the moderately enriched Sugar Maple—White Ash—Jack-in-the-Pulpit Northern Hardwood Forest type.

The third most common soil series in the area is Cabot extremely stony loam. Cabot, like Peru soils, formed in dense, compacted till. Cabot is a somewhat poorly to poorly drained silt loam or fine sandy loam; it occurs lower in the landscape downslope from Peru and Berkshire-Marlow soils and, in many cases, supports forested wetland natural communities. Coniferous trees predominate on the Cabot soils; among the hardwoods, beech and especially sugar maple are absent or much less common on the soils, while yellow birch and red maple are very much at home.

One glaring error in the soils mapping is the polygon mapped as Livingston clay located due north of Bread Loaf campus. Livingston is a very poorly drained, stone-free soil that formed in lake-plain clay deposits. The area mapped as Livingston is part of a large nutrient-rich seepage forest whose soils developed in dense, compacted tills; this complicated area includes moderately well drained and somewhat poorly drained very stony fine sandy loams, as well as poorly drained very stony loams and clay loams with mucky surface layers. This is one of the more unusual and unexpected parts of the landscape. The soils in the area erroneously mapped as Livingston appear to include two soils that developed in dense basal till—somewhat poorly drained to poorly drained Cabot, and very poorly drained Peacham, a very poorly drained gravelly loam with a muck layer up to 41 cm (16 in) deep.

As discussed above in greater detail in the glacial deposits section, soils derived from water-laid deposits occur in the vicinities of the Middlebury River (South Branch, Middle Branch and main stem), upper stretches of Brandy Brook and tributaries, and

Goshen Brook. Most of these are mapped as excessively drained, gravelly sandy loam Colton soils, although we believe that these are a mix of excessively and somewhat excessively drained soils. Lower in the landscape, in the more level lands near and adjacent to the South Branch are wetter glaciofluvial soils—moderately well drained Duane fine sandy loam and poorly drained Walpole silt loam. These soils are characterized by layers of sands, loamy sands and gravelly sands, with the topmost deposit typically with a sandy or silt loam texture. The height of the water table is a primary factor in the drainage capacity of these soils.

Methodology

Natural Community Classification

Classification of the natural communities of the study area follows Thompson and Sorenson (2000), with the most recent updates published by Vermont Fish and Wildlife Department (2012). Where no suitable type was described in the Vermont classification, we consulted the New Hampshire natural community classification (Sperduto and Nichols 2004). In several cases, we found no suitable type in either state classification and created our own name and description.

Fieldwork

Fieldwork was conducted from June through August in 2011 and 2012 by Marc Lapin, Max Odland (2011) and Ford Van Fossen (2012). Field observation of Clapp Lot was conducted in 2009 by Marc Lapin, Clare Crosby and Jordan Valen, during a previous phase of the college lands ecological inventory. Battell Research Forest observations are based on various visits of Lapin.

We planned routes based on topographic maps and orthophotographs so that we would observe a great deal of the heterogeneity of the each parcel. Routes generally cut across the “grain” of the landscape, that is, went up and down slopes rather than along contours and crossed over streams rather than following them for long stretches. When we encountered small, geographically well-defined natural communities, such as small wetlands, we explored the boundaries and the central zones; for natural communities that cover large expanses, we gathered data during the course of our heterogeneous routes.

Field data collected included observations of plant composition (including extensive vascular plant species lists) and community structure (including sporadic 10-basal area actor (BAF) prism plots and measurement of diameter-at-breast-height (dbh) using a diameter-tape), and observations of soil profiles (using a soil bucket auger or shovel) and hydrology. We used Garmin GPSmap76CSx gps receivers to mark waypoints of interest including species locations and natural community observation and boundary points (Figure 6).

Overview of Ranking and State Significance

Ranking and state significance are described in a more detail in the section below entitled “Natural Communities: General descriptions, Ranking and Significance” which follows the parcel descriptions. Briefly, state ranks (s-rank) of natural communities are based on rarity and threat; each state publishes state ranks that range from S1 (very rare in the state) to S5 (common and widespread in the state). Each occurrence of a natural community can be assigned an “element occurrence rank” (EO rank), which is based on condition and size of the community, as well as condition of the surrounding landscape (“landscape context”). Methodology for assigning EO ranks has been standardized and documented in great detail by NatureServe (2002).

State significance is based on a combination of rarity and quality of a natural community occurrence; rare and uncommon species presence is also given consideration (Appendix 1). State significance is a term used in Vermont to denote whether a site will be entered in the state biodiversity database; characterization as state-significant carries no legal or regulatory meaning.

Mapping Methodology

We digitized natural community polygons on ArcGIS 10.1 based on gps waypoints and interpretation of remotely sensed digital imagery and topographic maps. We utilized the following imagery:

- Vermont digital orthophotography, GEN 2, leaf-off black-and-white photography, 2011, leaf-off black-and-white and false-color infra-red photography (<http://vcgi.vermont.gov>)
- National Agricultural Imagery Program, 2011 leaf-on true-color photography (<http://vcgi.vermont.gov>)
- ArcGIS online high-resolution 2010 satellite imagery (http://goto.arcgisonline.com/maps/World_Imagery)

The base layer we started with for digitizing natural communities was the `Midd_College_Parcels.shp` 10/15/2010 version. Natural community polygons were digitized using the cut polygons tool. We created the natural communities shapefile `MC_Natural_Communities_August2013.shp`. Natural community polygons of the same type were not merged across parcel boundaries, so as to maintain the ability to make calculations on the parcel level. We did not adhere to any minimum size for natural community delineation, but rather attempted to be as true to the heterogeneity of the lands as our observations and interpretations allowed.

In the course of our fieldwork we noted where the existing hydrologic data layer, the Vermont Hydrographic Dataset which is prepared by the USGS from orthophoto interpretation and other sources, deviated greatly from actual watercourses and developed a revised streams layer for the college lands, `streams_corrected_college_clip.shp`.

Other shapefiles were created for observations of the following:

- plant rare or uncommon at the state level (plants_rare_uncommon.shp)
- plants uncommon in the study area landscape (species_of_interest.shp)
- Invasive plant species (invasive_species.shp)
- Seeps too small to map as polygons (seeps.shp)
- Wildlife sign, casual observations (wildlife_sign.shp)
- Cultural features (cultural_features.shp) which includes a partial sampling of human-made features on the land
- Stone walls (stone_walls_preliminary.shp) which is a very partial line shapefile which others may want to work from to recreate historic land-use patterns

Ecological Values “Highlights”

The Importance of Landscape Context

Before assessing ecological values at the site scale—the level at which we ask what is at a particular place—it is important to assess the context, which we can think of as the landscape scale. For instance, we ask “Where in the broader region are the Bread Loaf lands with respect to large features of the land and conservation of biodiversity?” We have discussed above the watersheds, topography and elevation of the lands, as well as the geology and soils. Landscape context is putting such factors into one or more meaningful frameworks.

From a number of landscape-context frameworks the college mountain lands have significant values. The Bread Loaf contiguous and nearby college lands occupy a key position in a landscape that has high conservation values and is largely conserved as national forest. The lands and the landscape they are situated in also, as will be explained below, possess a number of factors that are seen as critical for ecological resilience.

Unfragmented forest is a commonly used landscape-scale factor. Vermont Fish and Wildlife Department analyzed the entire state and developed a map layer of all “habitat blocks” of forest (or other natural vegetation) greater than 8 ha (20 ac) that are unfragmented by any forms of development, such as roads, agriculture and buildings (Sorenson and Osborn 2011). The habitat blocks were ranked for biological and conservation values and for the potential threat of fragmentation. Aside from the Bread Loaf Campus and smaller developments such as the Snow Bowl base lodge, almost all the college mountain lands are within very large habitat blocks with sizes of thousands to tens of thousands of hectares, and except for the Middlebury Gorge area, the habitat blocks received ranks of 9 or 10, with ten being the highest valued. Bread Loaf north of Route 125 is part of a 22,000+ ha (54,000+ acre) forest block, south of Route 125 the block is nearly 14,000 ha (34,600 ac), and the Coal Kiln Lots west of Goshen Road are part of a nearly 6,000 ha (14,800 ac) block. The Middlebury Gorge lands, with North

Branch Road to the north and Route 125 to the south, are within a 256-ha (632-ac) habitat block (Figure 7). One can also see from another Vermont Fish and Wildlife Department landscape-scale analysis, that much of the college land adjacent to Route 125, with the exception of Bread Loaf campus itself, has potentially high significance for wildlife highway crossings (Austin et al. 2006), and we do know that moose frequently cross between the Brooks Lot and the Middlebury Gap.

Evaluating the conserved lands status of the surrounding landscape is another part of landscape context. Not only are the college lands part of large contiguous forest blocks, but substantial area of the blocks is conserved land of the Green Mountain National Forest, including Breadloaf and Joseph Battell national wilderness areas north and south of Route 125, respectively (Figure 8). Other special designations for national forest lands adjacent to college lands are Elephant Mountain Ecological Special Area, which nearly surrounds Battell Research Forest, and Moosalamoo Recreation and Education Area, which is south of Bread Loaf/Upson/Brown parcels, the Coal Kiln lots and Middlebury Gorge. The Bread Loaf contiguous, Edwards, Goshen Brook, Crystal Brook, and Snow Bowl lands have a key ecological role as in-holdings within the landscape of highly protected public conservation lands.

A recent modeling effort to evaluate site resilience sites for species conservation provides a useful framework for discussing the ecological context of the study area landscape. The models authors hypothesize that landscape complexity (geophysical and hydrological diversity) and landscape connectedness (permeability to allow movement of organisms) are factors of primary importance for analyzing site resilience (Anderson et al. 2011). Connectedness of the college lands landscape is high to very high, as discussed above in the habitat block analysis conducted by the state Fish and Wildlife Department. Landscape complexity is defined by Anderson et al. as the number of microhabitats and climatic gradients available within an area and they assessed it using elevation range, landform variety and moisture gradients (as measured by wetland density). These factors have been discussed above; looking at them together provides an interesting context for the broader landscape ranging from the base of Middlebury Gorge to the spine of the Green Mountains at the Snow Bowl. The landscape captures a very good range of Vermont's elevational diversity; according to the Anderson et al. scheme it includes low, moderate, and high elevation zones, which are three of the five zones that occur in Vermont (the coastal zone is absent from the state, and the very high zone occurs in few places on the highest Green Mountain summits and ridgelines). As pertains to landform variety, our study landscape includes several physiographic features, such as escarpment, plateau and high mountain slopes and ridgeline, upon which are many different landforms. The complex topography of areas such as Middlebury Gorge and the glaciofluvial landscape on the plateau correlates to a complex mosaic including landforms such as steep slopes with cooler and with warmer aspects, sideslopes, coves, wet flats and ridgetops. The variety and fine-grained intermixture of landforms and the larger geologic formations/physiographic features on which they

occur represents a high amount of landscape diversity. Wetland density on the college lands has been discussed above and, through natural community mapping, we calculated 11% wetland area. We believe that this wetland density is very high for a mountain landscape, that it is a landscape-scale feature of the Ripton-Lincoln plateau, and that it exemplifies the concept of complexity of moisture gradients in a landscape. In summary, from a statewide and regional perspective, the central Green Mountains landscape that is the location of the college mountain lands ranks high in the characteristics that help us evaluate the diversity of a landscape, its hypothesized resilience in the face of climate and other environmental changes, and its importance for biodiversity conservation.

BioFinder, a model that the Vermont Agency of Natural Resources developed to identify “high priority ecosystems, natural communities, habitats and species,” utilizes 21 data sets to determine priority rankings at the statewide scale (Vermont Agency of Natural Resources 2013). Biofinder shows the Bread Loaf area to be within a landscape that is rated as having high, very high, and greatest contributions to biodiversity, with much smaller areas of moderate contribution (Figure 9). The Middlebury Gorge is located in a landscape of high and very high contributions to biodiversity in the lower half and moderate contributions in the upstream portion.

Combining the evaluations of the study landscape through the lenses of conserved lands, BioFinder, and the Anderson et al. (2011) resilience factors supports the conclusion that the Middlebury College lands perform an important, “high-level” role in the ecological function and biodiversity conservation of a landscape replete with numerous ecological values. The following sections present details of ecological highlights of the lands.

Natural Community Diversity

Thirty-eight natural community types (or variants per the state system of classification) were mapped on the college mountain lands, including the Battell Research Forest and the Clapp Lot, which area approximately 6.5 and 30 km (4 and 18 mi) north of the Bread Loaf area, respectively. There were 22 upland types and 15 wetland types, a diversity that includes nearly all of the natural community types found in the central Green Mountain and western escarpment regions (Table 1, Figure 10). Nearly all of the types occurred in more than one location, but several of them did have one to few occurrences. The upland types were forest natural communities with the exception of one cliff and two woodland types. Wetland natural communities included eight non-forest (shrub and herbaceous) communities and seven forest types. The general landscape pattern shows a forest matrix of different sorts of Northern Hardwood Forest with hemlock or hemlock-spruce-hardwood forest types prominent in lower parts of the landscape. Montane conifer or conifer-hardwood forest types cap the Green Mountain summits and ridgeline. Among the upland forest types, seven are Northern Hardwood Forest, eight are hemlock or mixed conifer-hardwood types, and

two are spruce-fir types. These numbers illustrate the variety of tree compositions and forest structures that occur in the study area and are representative of the Ripton-Lincoln plateau, an unusual feature of the Green Mountains.

Within this upland forest matrix are many small- and medium-size wetlands, including scattered small seepage swamps and several rather extensive seepage forests.

On the escarpment (parts of Middlebury Gorge and all of Battell Research Forest and Clapp Lot), hemlock and red oak-Northern Hardwood Forests are common, with less extensive patches of oak and red pine forests, punctuated by small woodlands and temperate acidic cliffs and outcrops. The natural community map nicely portrays this complex landscape and its high amount of natural community diversity.

Table 1. Natural community types and rarity rankings of the Middlebury College mountain lands, including the Bread Loaf region, Battell Research Forest, and Clapp Lot.

Natural Community Type	State Rank*
Wetland	
Shrub and Herbaceous	
Alder Swamp	S5
Alluvial Shrub Swamp	S3
Herbaceous Seepage Marsh	S3?
Mixed shrub Seepage swamp	S3?
River Cobble Shore	S2
Seep	S4
Subacid Forest Seep	S4
Shallow emergent marsh/beaver complex	S4
Forest	
Hemlock-Balsam Fir-Black Ash Seepage Swamp	S3
Hemlock-Red Spruce-Northern Hardwood Seepage Forest	S3?
Northern Hardwood Seepage Forest	S3?
Red Maple-Black Ash Seepage Swamp: sloping variant	S4
Red Spruce-Cinnamon Fern Swamp	S3
Spruce-Fir-Tamarack Swamp	S3
Sugar Maple-Ostrich Fern Floodplain Forest	S2
Upland	
Forest	
Northern Hardwood Forest, beech dominated	S4?
Beech-Red Maple-Hemlock Northern Hardwood Forest	S5
Dry Oak Forest and woodland (mapped as a complex)	S3 and S2
Hemlock Forest	S4
Hemlock-Northern Hardwood Forest	S4
Hemlock-Northern White Cedar Forest	S4
Hemlock-Red Spruce Forest	S4
Hemlock-Red Spruce-Northern Hardwood Forest	S4
Lowland Spruce-Fir Forest	S3
Mesic Red Oak-Northern Hardwood Forest	S4
Montane Spruce-Fir Forest	S3
Montane yellow birch-red spruce forest	S3
Northern Hardwood Forest (typic)	S5
Red pine forest	S2
Rich Hemlock-Red Spruce-Northern Hardwood Forest	S4
Rich Northern Hardwood Forest	S4
Sugar maple-white ash-jack in the pulpit Northern Hardwood Forest	S4
Temperate Hemlock Forest	S4
Yellow birch-Northern Hardwood Forest	S5
Woodland	
Northern Hardwood Talus Woodland	S3
Open	
Temperate acidic cliff	S4

*State ranks are assigned by Vermont Natural Heritage Inventory. ? Indicates a type that is not recognized in the state natural community classification; tentative ranking based on ranks of type or similar type in adjacent states.

Rare, Uncommon and State-Significant Natural Communities

Two natural communities considered rare from a statewide perspective occur on the college mountain lands in the Bread Loaf vicinity ((Figure 11); both are part of riverine systems—Sugar Maple-Ostrich Fern Riverine Floodplain Forest and River Cobble Shore—and both are ranked S2 (Table 2) in the Vermont natural community rankings. Additional rare types, Red Pine Forest and Dry Oak Woodland, occur on the escarpment at Battell Research Forest and the Clapp Lot, respectively.

Thirteen uncommon types, those with S3 ranks, occur on the lands and comprise substantial acreage (Table 1). They include upland and wetland forest types, as well as one woodland and two non-forested wetland types. On these lands, only Northern Hardwood Forest and Alder Swamp are within the most common category, S5. Hence, many of the upland forest types, as well as Shallow Emergent Marsh and Seep are ranked S4, since they are widespread in the state but either do not comprise large acreages or occur frequently as high-quality examples.

State-significant natural communities are those that are recorded in the Natural Heritage Inventory Project database and are tracked as significant elements of the state’s biodiversity. A surprisingly large area of state-significant natural communities occurs on the college lands (Figure 12); such significance is due to a combination of numerous uncommon community types and overall rather good condition of the ecosystems (recovery from former pasture use and 19th century logging has occurred with little or not very intensive logging through much of the area). State-significance is based on a combination of rarity rank and element occurrence rank (Figure 13). Although it is likely that the Northern Hardwood Forest natural community is state significant, we have not shown being so, because that assessment must include extensive acreage of which the college lands are a small portion. The Natural Heritage Inventory Project is currently conducting that assessment statewide.

Table 2. State rarity ranks and descriptions, as defined and assigned by Vermont Fish and Wildlife Department Wildlife Diversity Program.

State Rank (S-rank)	Description of the relative rarity of natural community types
S1	very rare in the state, generally with fewer than five high quality occurrences
S2	rare in the state, occurring at a small number of sites or occupying a small total area in the state
S3	high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered
S4	widespread in the state, but the number of high quality examples is low or the total acreage occupied by the community type is relatively small
S5	common and widespread in the state, with high quality examples easily found

Surface Waters and Riparian Areas

From a river perspective, the many miles of headwater streams on the college lands is certainly one of the high ecological values. In few cases are the sources of the

streams on college lands, except at the Snow Bowl, the only high mountain parcel in college ownership (Figure 3). The sources are mostly on national forest lands, which in many cases are part of National Wilderness areas. Hence, the college lands are frequently the first private lands the streams flow through. Although little studied, many of these waters are likely in very good condition. One stream section that has been specifically identified as having altered conditions is the South Branch for approximately 3 km (2 mi) from the Snow Bowl snow-making pond nearly to the confluence with Goshen Brook. Water withdrawals lead to insufficient flow in the river section.

The extensive streams network corresponds to many kilometers and hectares of riparian area. In addition to serving important functions for water quality and supply protection, riparian areas are known to be among the most important travel corridors for medium and large mammals and to be particularly rich bird habitat. The rare riverine natural communities mentioned above are mapped parts of the riparian network. Most riparian areas in the mountain landscape, however, are not classified as separate natural community types, and the present work has not included a riparian area analysis. We thus are able to make the broad statement that the college lands feature high quality headwater stream and associated riparian ecosystems, but unfortunately aside from the few natural communities mapped along the South Branch we provide no other details.

Wetlands

The density and ecological diversity of wetlands in the landscape, including seepage and swamp forests, shrub swamps, marshes and riverine floodplain types, is an important ecological value and confers substantial habitat diversity and water protection functions. Wetlands cover 11% of the college-owned lands in the study area, and the diversity of wetland natural community type (15 natural community types or variants) is high (Figure 3). Eleven percent is a surprisingly large wetland proportion for a 1,200 ha (3,000 ac) central Green Mountain landscape; we attribute the large wetland area to the landscape characteristics particular to the Ripton-Lincoln plateau. Characteristics of primary importance are likely topography—relatively level to only moderately sloping terrain—and surficial deposits— a complex pattern of basal (dense, compacted) and ablation tills and glaciofluvial sands and gravels. These factors appear to strongly influence hydrology, and thus wetland presence.

Interestingly, seepage forest, as opposed to basin swamps and marshes, is the most extensive wetland type. Such a pattern very likely does not occur on the large Southern Green Mountains plateau, and seepage forests although present are very likely less common on most slopes in the Green Mountains than they are on the study area plateau. The state Natural Heritage Inventory is planning to add seepage forest types to the natural community classification; information from the college's seepage forests will be very helpful in understanding this less-known natural community type.

Plant Species: Rare, Uncommon and “Unusual”

Plants that are ranked as rare or uncommon within the state are few on the college mountain lands (Table 3, Figure 14). No species observed are protected (as endangered or threatened) under the Vermont Endangered Species Law (10 V.S.A. Chap. 123). Two rare species were observed during our field work. Shore sedge (*Carex lenticularis*) occurs peaty pond shores of Lake Pleiad, and hay sedge (*Carex argyrantha*) grows on a rocky ledge beside the pond in Clapp Lot.

Four uncommon species were observed. Both yellow lady’s-slipper (*Cypripedium parviflorum*) (S3, G5) and swamp thistle (*Cirsium muticum*) (S3, G5) were growing in the Edwards Lot Hemlock-Balsam Fir-Black Ash Seepage Swamp near the eastern end of the chain of manmade “beaver” ponds/meadows. Another population of yellow lady’s-slipper was seen in the same type of swamp 800 m (0.5 mi) north of the chain of ponds, and a third population grows in a seepage wetland in the west-central portion of Edwards. Wiegand’s wild-rye (*Elymus wiegandii*) (S3, G4G5) was located in one portion of floodplain forest along the Middlebury River South Branch in Coal Kiln Lot 1. A single Spruce-Fir-Tamarack Swamp exists on the college lands, in Bread Loaf 11 parcel; it included long sedge (*Carex folliculata*) (S3, G4G5). All populations of rare and uncommon plants appeared vigorous and occurred as moderately sized populations.

“Unusual” plant species are those that either we consider not typical of or not common in the study area landscape (most of these species are generally near their elevation limits) or that formerly were considered rare or uncommon in Vermont but have been re-ranked as S4 species. Among the latter category are Goldie’s fern (*Dryopteris goldiana*), Braun’s holly-fern (*Polystichum braunii*) and wild-millet (*Milium effusum*) (Figure 15). A number of the other species are those that we might think of as at the upper elevational limits of their range in Vermont, such as skunk-cabbage (*Symplocarpus foetidus*), witch-hazel (*Hamamelis virginiana*) and barren-strawberry (*Waldsteina fragarioides*). Skunk-cabbage has only one known occurrence on the plateau landscape, a seepage swamp in the Edwards Lot; we were very surprised to find a vigorous population in the Green Mountains at 488 m (1,600 ft). Another group of species is related to nutrient enrichment and those plants simply do not occur much in this landscape; examples are spikenard (*Aralia racemosa*) Virginia waterleaf (*Hydrophyllum virginianum*), two-leaved miterwort (*Mitella diphylla*) and leatherwood (*Dirca palustris*). And then there are a number of species that do not find much suitable habitat in the local landscape, such as northern wild-raisin (*Viburnum cassinoides*), creeping snowberry (*Gaultheria hispidula*) and fragile fern (*Cystopteris fragilis*). The occurrences of these species may be of interest to future botanists and ecologists, and we thought it worthwhile to mention and map them in recognition of the contribution of numerous infrequent species to the area’s biological diversity.

Table 3a. Rare and Uncommon Plants of the Middlebury College Mountain Lands.

Scientific Name	Common Name	Status	S-rank	Location	Notes
<i>Carex argyrantha</i>	Hay sedge	Rare	S2	Clapp Lot	2 plants (genets), about 12 culms, east-facing ledge at edge of pond
<i>Carex lenticularis</i>	Shore sedge	Rare	S2	Snow Bowl	On south shore of Lake Pleiad, no population data collected
<i>Carex folliculata</i>	Northern long sedge	Uncommon	S3	Bread Loaf Farm and Lands 11	Localized at south end of Spruce-Fir-Tamarack swamp
<i>Cypripedium parviflorum</i>	Yellow lady's-slipper	Uncommon	S3	Edwards Lot (three locations)	3 small- to medium-sized populations in seepage wetlands
<i>Cirsium muticum</i>	Swamp thistle	Uncommon	S3	Edwards Lot	Approximately 15 plants in a swamp with <i>C. parviflorum</i>
<i>Elymus wiegandii</i>	Wiegand's wild-rye	Uncommon	S3	Coal Kiln Lot 1	Approximately 5 plants with 35 stems (ramets) in floodplain forest

Table 3b. “Unusual” Plants of the Middlebury College Mountain Lands.

Scientific Name	Common Name	Reason Considered “Unusual”
<i>Aralia racemosa</i>	Spikenard	very rare in landscape, extreme richness indicator
<i>Aronia melanocarpa</i>	Black chokeberry	rare in landscape
<i>Caltha palustris</i>	Marsh-marigold	rare in landscape
<i>Cardamine diphylla</i>	Two-leaved toothwort	very rare in landscape, associated with W. Va. White Butterfly, a GMNF species of concern
<i>Carex plantaginea</i>	Plantain-leaved sedge	very rare in landscape, extreme richness indicator
<i>Carya cordiformis</i>	Bitternut hickory	rare in landscape, a warmer-site species
<i>Corallorhiza maculata</i>	Spotted coral-root	very rare in landscape, widely scattered in state
<i>Cystopteris fragilis</i>	Fragile fern	very rare in landscape, restricted to calcareous ledges
<i>Dryopteris goldiana</i>	Goldie’s fern	uncommon in landscape, formerly S3
<i>Dulichium arundinaceum</i>	Three-way sedge	rare in landscape, peatland species
<i>Elymus riparius</i>	Riverbank wild-rye	rare in landscape, river terrace species
<i>Gaultheria hispida</i>	Creeping spicy-wintergreen	rare in landscape, spruce-fir forest species
<i>Geum cf. laciniatum</i>	Rough avens	uncommon in state, potentially occurs Brown Lot 1
<i>Geum macrophyllum</i>	Large-leaved avens	rare in landscape, formerly S3
<i>Hamamelis virginiana</i>	Witch-hazel	uncommon in landscape, warm-site species
<i>Hydrocotyle americana</i>	American marsh-pennywort	rare in landscape
<i>Hydrophyllum virginiana</i>	Eastern waterleaf	very rare in landscape, extreme richness indicator
<i>Milium effusum</i>	Wild-millet	uncommon in landscape, formerly S3
<i>Oryzopsis asperifolia</i>	Rough-leaved rice grass	rare in landscape
<i>Packera schweinitziana</i>	New England groundsel	very rare in landscape, most often in calcareous wetlands
<i>Phryma leptostachya</i>	American lop-seed	rare in landscape, warm nutrient-rich sites
<i>Platanthera clavellata</i>	Little club-spur bog-orchid	very rare in landscape
<i>Polystichum braunii</i>	Braun's holly fern	rare in landscape, formerly S3
<i>Pyrola cf. minor</i>	Lesser pyrola	potentially in wetland in Edwards Lot; state-endangered, very rare in VT
<i>Quercus alba</i>	White oak	very rare in landscape, warm-site species
<i>Quercus prinus</i>	Chestnut oak	very rare in landscape, warm-site species
<i>Rhododendron prinophyllum</i>	Early azalea	very rare in landscape, warm acidic sites
<i>Sambucus nigra var. canadensis</i>	Black elderberry	rare in landscape, nutrient-rich wetlands
<i>Solidago flexicaulis</i>	Zig-zag goldenrod	uncommon to occasional in landscape, rich woods
<i>Symplocarpus foetidus</i>	Skunk-cabbage	very rare in landscape, warm nutrient-rich wet sites
<i>Viburnum nudum var. cassinoides</i>	Withe-rod	rare on college lands, northern species
<i>Viburnum recognitum var. lucidum</i>	Smooth arrowwood	very rare in landscape, warmish wetlands
<i>Waldsteinia/Geum fragarioides</i>	Appalachian barren-strawberry	occasional in landscape, warm rich woods

Plant Species: Invasive

In general, invasive species occurrences are few and far between on the college mountain lands (Table 4, Figure 16). The intactness of the forest and wetland ecosystems and the mid- to high-elevation of the lands help contribute to the small invasives populations. Many of the occurrences are close to roads or on naturally disturbed substrates along the South Branch (which is largely paralleled by Route 125). Some of the most pernicious invasive species in our region are absent from these lands; we found no garlic-mustard or multiflora rose, for example. The two most abundant invasive exotic shrubs of our general area, common buckthorn and the Eurasian shrub honeysuckles, are scattered about on field margins and in the less intact forest edges. Japanese barberry is another invasive shrub that has found its way into a few of the forest areas. Of most concern among the woody invaders is the vine Oriental bittersweet, which can overtop and “strangle” trees. One individual seen in the Edwards Lot was pulled by hand, but a population of a few individuals along the road near the Robert Frost homestead is of concern.

Wild chervil is an herbaceous plant that has been spreading in the Ripton area for a decade or so. A number of small populations were seen, mostly along roadsides but also on gravel bars in the South Branch. The population that appears to have the greatest ability to do real ecological damage to a natural community is in a small Herbaceous Seepage Marsh that lies adjacent to Route 125 in the Snow Bowl parcel.

Other non-native plants are present that are not considered to be particularly damaging or serious pests that have the ability to substantially alter ecological systems. Examples are forget-me-not, self-heal and coltsfoot. These plants are scattered about in low densities, as they are throughout much of the Vermont landscape.

Table 4. Invasive Plants of the Middlebury College Mountain Lands.

Scientific Name	Common Name	Location(s)
<i>Berberis thunbergii</i>	Japanese barberry	Bread Loaf Farm and Lands 4
<i>Rhamnus cathartica</i>	Common buckthorn	Homer Noble Farm
<i>Lonicera tatarica</i> , <i>L. morrowii</i> , <i>L. X bella</i>	Eurasian bush honeysuckles	Homer Noble Farm, USFS Exchange Lot
<i>Valeriana uliginosa</i>	Garden valerian	Bread Loaf Farm and Lands 14
<i>Celastrus orbiculatus</i>	Oriental bittersweet	Homer Noble Farm
<i>Phalaris arundinacea</i>	Reed canary grass	Coal Kiln Lot 1, Edwards Lot, Snow Bowl
<i>Anthriscus sylvestris</i>	Wild chervil	Bread Loaf Farm and Lands 14, Coal Kiln Lot 1, Snow Bowl
<i>Wild parsnip</i>	Eastern waterleaf	Bread Loaf Farm and Lands 14

Wildlife Notes

Casual observation of wildlife and wildlife sign were recorded through the course of our field work, although no systematic sampling effort was made for wildlife use or presence. Deer scat and tracks were surely the most frequent sign we encountered and we made no effort to record these. Next most frequent were moose sign and flushing of woodcock (Figure 16). Woodcock were flushed from numerous places with wet woods; they appear to find suitable habitat in seepage forests, shrub swamps, and woods near streams and rivers in quite a few parcels from the Snow Bowl down to Coal Kiln. Sign of intensive moose use, such as concentrations of scat, tracks or barked trees, was rather infrequent, actually, although moose certainly inhabit the landscape. Bark feeding was noted in Edwards, Coal Kiln and Upson Lots, and the conifer-dense area around the Brooks and Goshen Brook lots appears to be crossed through somewhat regularly.

Bear scat was noticed on occasion and bite-marked trees were recorded at the Middlebury Gorge. Bear-scarred beech were observed in the Crystal Brook, Snow Bowl, Bread Loaf 4 and Homer Noble Farm lots. Bear-scarred beech indicate a mast-stand habitat type, which is recognized by the state Fish and Wildlife Department as essential to the well-being of the black bear population. None of these beech groves showed recent scarring, certainly none more recent than 5 to 10 years old. Signs of very recent bear activity were seen in the seepage forest in the northeast corner of Homer Noble Farm; fresh, sedge-filled scat indicated feeding in the open wetland complex which is almost entirely on GMNF lands; the conifer-hardwood seepage forest appears to be important cover habitat.

We noted amphibian breeding in artificial ponds at Homer Noble Farm and USFS Exchange Lot and in Vernal Pools in the Homer Noble Farm and Bread Loaf 5 parcels. Vernal Pools are rare on the lands and the amphibian breeding that does occur is likely more prevalent in beaver and old farm ponds. One wood duck brood was seen at the Edwards Lot chain of ponds.

Vermont Fish and Wildlife Department has mapped large portions of the Edwards parcels as deer wintering area ("deer yard") (Figure 7). These areas generally coincide with the forest types that are dominated by hemlock or hemlock and red spruce. Similarly the conifer forests of the Goshen Brook and Brooks lots and those along the South Branch in the Bread Loaf 14 parcel are considered to be deer wintering areas. Only a small portion of the Middlebury Gorge parcels is included as deer wintering area, as most of the Gorge forest, although dominated by hemlock, is a narrow coniferous area embedded within a deciduous forest matrix. The entirety of Battell Research Forest is mapped as deer yard. The Fish and Wildlife Department is undertaking re-inventory of deer wintering areas to better ascertain that the mapped areas meet deer habitat and use requirements.

The Fish and Wildlife Department has also developed a model that assigns wildlife crossing values to the state highways. All sections of Route 125 that the college lands abut are ranked as having high crossing value except for the non-forested Bread

Loaf campus and adjacent field area and a section of the Middlebury Gorge (Figure 7). These wildlife crossing values are based on GIS analysis, not on field data.

Much work remains to be done to document wildlife use of the many habitats on the college lands. We provide these anecdotal observations and models developed by the state with the caveat that they present a very incomplete picture. Of specific field survey efforts, we know that small mammal data have been collected by Steve Trombulak and his students over a number of years, but little has been done to systematically observe and record presence and use patterns of the many taxa of vertebrates and invertebrates that are part of the terrestrial, wetland and aquatic ecosystems of this landscape.

Parcel Descriptions

Battell Park-Middlebury River and Spear Lot ("Middlebury Gorge")

Dramatic and rare Vermont scenery of boulders, small cliffs, steep slopes and thundering mountain waters are principal features of the Gorge, a geologic feature of regional significance. State-significant Hemlock Forests of a warmer and a cooler type strongly dominates vegetation. Old and large trees, signs of fire history, and bear-marked pine are all easily observed. Although bordered closely by roads on each side, the steepness of the Gorge lends remoteness to the site. Natural community diversity is augmented by a talus woodland and seepage areas; floristic diversity is increased by warm air influence from the Champlain Valley. Dry chestnut oak-red oak forest just barely spills over the GMNF boundary.

Exemplary Natural Communities	Temperate Hemlock Forest	Northern Hardwood Talus Woodland	Hemlock Forest	Northern Hardwood Seepage Forest
Natural Community Explanation	B-ranked S3 type	B-ranked S3 type	B-ranked S4 type	C-ranked S3 type
Species of Special Interest	Species uncommon in the landscape: Chestnut oak, Bitternut hickory, Lopseed, Pinkster azalea, Fragile fern, Hillside blueberry			
Recreation features	Informal trails provide access from both Route 125 and North Branch Road; area receives much use from kayakers, swimmers and anglers			
Specific Management Items	No management plan exists despite substantial recreational use and recurring road/flood issues that have impact on the Gorge lands		East Middlebury water supply infrastructure appears to be on college lands and the college does not seem to have records of this	

Middlebury River Gorge Parcels **Battell Park-Middlebury River 1-7, 10-13**

A short distance downstream from the confluence of the Middle Branch and the main stem, the Middlebury River flows through the extremely steep-walled three-mile-long Middlebury Gorge which extends from the west edge of Ripton Village, at roughly 335 m (1,100 ft), to the eastern bounds of East Middlebury Village, where the river opens out to a broader floodplain at approximately 150 m (500 ft). Small portions of the Gorge walls are vertical Temperate Acidic Cliffs with much exposed rock and only scattered plant cover, but for the most part the slopes are soil-covered and support two hemlock-dominated types, a warmer variety, Temperate Hemlock Forest, and the natural community more typical of most of central and northern Vermont's climate, Hemlock Forest. During glacial retreat, rushing waters laid down boulder, cobble, gravel and sand deposits within the Gorge; the resulting soils that developed in these rapidly drained parent materials are Colton gravelly sandy loams. Although this soil type is classified as excessively drained, Gorge areas with only moderately steep slopes should be considered somewhat excessively to well drained, and areas with groundwater seepage are even moderately well drained. Hemlock-Northern Hardwood Forest and Northern Hardwood Seepage Forest occupy those moister areas on the Gorge slopes.

Even the steep slopes of the Gorge have been historically logged, but since hemlock was not sought after in the 20th century, the only logging after the earliest decades of that century appears to have taken place either in the hemlock-northern hardwood areas or as part of post-hurricane salvage logging. Twentieth century hurricanes that appear to have impacted small portions of the Gorge forests blew through in 1938 and 1950. The forests are therefore generally more mature than those in the surrounding landscape. In the Hemlock and Temperate Hemlock Forest natural communities, hemlock sizes of 40-50 cm (16-20 in) dbh are typical of dominant trees, while in many areas patches or scattered individuals showcase diameters up to 75 cm (30 in). Associate tree species include white pine, red and sugar maples and yellow birch, with the addition of red oak, red pine and black birch in the temperate forest type. The groundcover vegetation is sparse throughout, although there are showy displays of pink lady's-slipper. In very exposed, warm, shallow-soil parts of the south-facing Temperate Hemlock Forest, dense tree cover is punctuated with sunny, mossy or barren rock outcrops, and dense patches of blueberries and huckleberries. In this area black bear have marked a number of the 30-40 cm (12-16 in) dbh red pine with bites and hair/scent rubbed off their backs; also the forest history of fire is prominently displayed on hemlock and white pine trunks on the upslope sides, where dry needle litter accumulates and the fires that move downslope from the adjacent oak forest tend to get hotter and even smolder for days. Hearing and seeing the plunging, plummeting river thundering through the Gorge below, all visitors surely appreciate that this is one of the most unique spots in Vermont and one of the more grandiose forest areas in the Gorge. The section of Temperate Hemlock Forest on the south side of the river is not quite as

dramatic, but it has the same general character. Red pine is rare there, but for one or two promontories that jut out over the river.

Another noteworthy natural community in the Gorge is a very nice example of Northern Hardwood Talus Woodland, where huge boulders are clothed in a lush and diverse plant cover including mosses, liverworts, mountain maple, Canada yew, various ferns and numerous flowering herbs. Additionally, a small section of Hemlock Forest at the mouth of the North Branch has been mapped as a Hemlock-Northern White Cedar type. The unusual site has a forest with similarities to the Vermont type called Limestone Bluff Cedar-Pine Forest, but this location really appears more as a Hemlock Forest variant. How geologic, soils, and hydrologic conditions, as opposed to or perhaps in conjunction with human use history, have contributed to the current vegetation of the hemlock-cedar forest have not been investigated but would make for an interesting study. More ecological diversity is seen at the Gorge's downstream end, where Northern Hardwood Seepage Forest contrasts sharply with the dry, rocky Temperate Hemlock Forest on the south side.

The Gorge, a feature that contributes substantially to the ecological-geological diversity of the mountain landscape, is undoubtedly one of the "special" places, not only locally, but also from a regional perspective. From a human perspective, it is a favored recreation area for anglers, kayakers, swimmers and river-walkers. Botanically the steep south-facing slopes allow an up-valley extension for some species that require warmer conditions. These include chestnut oak, black birch, lopseed, marginal wood fern, early azalea and hillside blueberry. The average tree size is greater than the general Vermont condition, but among the many large-diameter trees, one huge "legacy tree" white pine stands out on the south side of the river; the 113.5 cm (44.7 in) dbh monarch towers above the 45-50 cm (18-20 in) hemlocks nearby. The pine's crown has a 10-11 m (32-35 ft) radius, so this single tree has immediate influence over nearly 400 m² (0.1 ac) of forest.

At the upper end of the Gorge are some eroded banks that have received very high-energy waters during several severe storms in the early 21st century. The main portion of the Gorge, however, is naturally armored with rock and is not as subject to extreme bank erosion. Runoff and efforts to manage runoff from Route 125 and from North Branch Road are two of the few direct human intrusions into the Gorge. Another is the structures and an access road related to water supply that have been built and maintained in Battell Park-Middlebury River Parcel 5, at the lower end of the Gorge on the south side.

Spear Lot

The Spear Lot is a small parcel that geographically is part of the Middlebury Gorge forests on the south side of the river. The southern part of the lot is level to gently sloping Mesic Red Oak-Northern Hardwood Forest, whereas the northern third is steeply sloping Gorge land that is Temperate Hemlock Forest. Both of these natural

communities exhibit the warm influence seen in the lower elevations of the Gorge. Temperate Hemlock Forest on this north-facing side of the Gorge is more similar to the non-temperate type than what is seen on the south facing side, but it does include black birch, a tree more indicative of warm sites. Mesic Red Oak-Northern Hardwood Forest in the Spear Lot is former agricultural field. The soil is quite sandy (very stony fine sandy loam), and hence the site is a dry-mesic flat. Trees that have recolonized to establish the old-field forest are yellow and black birches, red oak, white pine, red maple and northern white cedar. A bitternut hickory sapling was seen—a true indication of the lower-elevation, warm-site conditions. Similarly, an abundance of early low blueberry attests to the dry conditions. The other common woody plants are beaked hazel and striped maple. Herbaceous dominants are wild sarsaparilla and Canada mayflower, with lesser amounts of painted trillium, starflower, Indian cucumber-root, sessile-leaved bellwort and goldthread. A tributary stream flows across the southwestern corner of the lot, and Northern Hardwood Seepage Forest occurs in the narrow incised valley of the small stream.

Bread Loaf Farm and Lands Parcels

These lands were acquired by the College in 1916 and are the site of Bread Loaf campus. Numerous other college-owned lots are contiguous with the Bread Loaf Farm and Lands parcels; together we refer to them as the Bread Loaf contiguous lands. Most of these lands were, as the name implies, previously used for agriculture. Although there is no active farming, some lands are maintained as fields, most of which are mowed infrequently (once or twice per year). In the area developed as the campus, lawns are maintained. Aside from these mowed areas and the sites that were planted to conifers in the early decades of the 20th century, the lands have reverted back to native forest species and have, for the most part, regained rather natural composition and mid-successional structure. Due to both the age of the recovering forest and the history of logging, snags, cavity trees and coarse woody debris are generally uncommon; there are exceptions in older stands. Few areas show signs of severely eroded soils; in only a few spots did we notice missing or extremely shallow topsoil horizons. Soils on the Bread Loaf Farm and Lands are best characterized as a mosaic of well drained Berkshire (and some Marlow) extremely stony loam, which is dominant in the northern, mid- and upper-hillslope region, and moderately well drained Peru extremely stony loam and poorly drained Cabot silt loam in the southern, lower-slope terrain. The land levels in the Homer Noble Farm, adjacent to the north of the Bread Loaf Farm and Lands parcels.

One persistent human feature in the Bread Loaf forests is the Rikert Ski Center trails. Annual mowing creates narrow breaks in the natural vegetation, and some of the wetter areas have mildly disturbed hydrology. Neither of these disturbance factors likely alters ecosystem function except very locally at the sites of disturbance. Only the smallest, least mobile species would find the ski trails to be movement barriers. There is,

however, a small amount of habitat loss, which includes both the trails themselves and a narrow band adjacent. Wildlife presence was evident throughout the Bread Loaf lands; in few locations was wildlife sign abundant, however. Deer and moose sign were frequent across the landscape; bear-scarred beech were observed in scattered locations but nowhere in enough concentration to indicate an important feeding area.

Bread Loaf 4, 5, 11 and 14 are those Bread Loaf parcels with natural vegetation. Other parcels are developed with buildings and lawns.

Bread Loaf Farms and Lands 4

Bread Loaf 4 is a diverse parcel that includes the principal Brandy Brook headwaters. An array of state-significant natural communities fills most of the parcel. Old-growth Hemlock Forest is a highlight; contiguous with it are an extent of Hemlock-Red Spruce-Northern Hardwood, hemlock-Northern Hardwood, and Hemlock-Red Spruce Forest. Farther from the streams Northern Hardwood Forest is predominant. The northeast corner contains one of the few bits of Rich Northern Hardwood Forest on college lands, as well as two sizeable Seeps. Many small Seeps are scattered in the woods. Unmanaged conifer plantation occupies the south-central area, north of Gilmore Cabin. The northeast corner has water system infrastructure for Bread Loaf campus.

Exemplary Natural Communities	Hemlock-Red Spruce-Northern Hardwood Forest	Hemlock Forest	Hemlock-Red Spruce Forest	Hemlock-Northern Hardwood Forest	Hemlock-Red Spruce-Northern Hardwood Seepage Forest
Natural Community Explanation	part of the large B-ranked occurrence Bread Loaf north of Route 125, S4 type	B-ranked S4 type, old-growth patch	B-ranked S4 type	B-ranked S4 type	BC-ranked S3 type
Species/Habitat of Special Interest	Species uncommon in the landscape: Barren-strawberry	Bear-scarred beech in northeast area	Woodcock		
Species/Habitat notes		Most of mature trees in grove were harvested	Observed in southwest corner during breeding season		
Recreation features	Rikert Center ski trails				
Specific Management Items	Management planning is needed for the future of the conifer plantation				

Bread Loaf 4

Located north of Steam Mill Road on the east side of the Bread Loaf lands, the lot includes numerous Rikert Center ski trails and the Gilmore cabin. Another built feature is the Bread Loaf Campus water source in the northeastern corner of the lot. Stone walls and barbed wire are apparent in all but the far northern areas and bear testament to the land's history of pasture use. A prominent feature of the forested lands is a Brandy Brook headwater tributary network that flows southward to meet the main waterway near Steam Mill Road. The land ascends from this confluence area northward with heavily dissected terrain in the incised brook valley. Predominant forest cover is a mix of Northern Hardwood, Hemlock-Red Spruce-Northern Hardwood and Hemlock Forest. Bread Loaf 4 is the site of the oldest forest on the college's Bread Loaf-region lands; a 5.6-ha (14-acre) patch of old-growth Hemlock Forest occupies a very steep slope in the parcel's north-central area. Adjacent on a knoll to the east is a Hemlock-Red Spruce Forest that has been relatively recently logged, but retains some very large hemlock and an incredibly deep organic soil horizon with layer upon layer of decomposed, fallen trees. At the northern boundary of the parcel are two small, level forest patches that are rare features in the landscape—Rich Northern Hardwood Forest and an unusual Beech Forest. At the south boundary is a sloping, rocky wet area representative of the seepy nature of the Bread Loaf lands; in this area seepiness is expressed as Hemlock-Red Spruce-Northern Hardwood Seepage Forest. One individual of Japanese barberry, an invasive non-native species, was observed not far from Steam Mill Road in the seepage forest.

East of the Gilmore cabin is a red pine-white spruce-Norway spruce plantation. The plantation, in which not much forest management has been undertaken, shows little advance regeneration of native species beneath the planted canopy.

The exceptional forest ecosystems are described below. More information on other forest and wetland types mapped in the parcel is located in the "Natural Communities of the College Lands" section.

The old-growth Hemlock Forest remnant does show evidence of some logging, primarily for spruce, yet there are many larger hemlock (50-65cm (20-25 in) dbh) that are quite old. A cored 57cm (22 in) individual was found to be slightly over 190 years old. Old growth characteristics, in addition to the tree ages, include a very uneven-age/size structure and more dead wood than probably any other area in the Bread Loaf region. Large snags and coarse woody debris resulting from low snaps are common, and the soil features a deep layer of organic matter, in places as deep as 60 cm (24 in), over the stony sandy loam mineral soil. The many decaying logs in the organic layer are a clear indication of intense treefall events in the forest's past. This forest is on a very steep slope that is not really amenable to human uses, but it is worth mentioning that because of the rarity of forests with such age and structure it should not be disturbed by harvest or by constructing trails within it. Also of interest is the Hemlock-Red Spruce Forest knoll to the east across the brook. Remnant red spruce that remain after a harvest

several decades ago measure 30-40 cm (12-16 in) dbh and are approximately 100 years old. Large hemlock do persist there, for that species was not sought in the harvest; largest trees are 70 to 80 cm dbh (28-32 in) and were too rotted in the center to get accurate age estimates. A small hemlock, 43.5 cm (17 in), was found to be approximately 110 years old. The most interesting discovery in this natural community was the depth of the organic soil layer, which was greater than 70 cm (28 in). Much of the organic material that we penetrated through was well-decayed logs, a reinforcement of evidence of numerous severe wind events through this area which took down what appears to be generations of hemlock and spruce trees.

A not particularly old but unusual piece of forest occurs adjacent to the northwest of the old-growth hemlock where a nearly pure stand of beech occupies a silt loam soil flat. The soil type, the levelness of the land, and the extreme dominance of beech are all anomalies on these lands. Other areas of Northern Hardwood Forest are more characteristic of the soils (mostly well drained Berkshire stony sandy loam) and tree composition found throughout Northern Hardwood Forests in the larger landscape. Although these too are largely post-agricultural forests, the Northern Hardwood and Hemlock-Northern Hardwood natural communities located in this northern/northeastern area are among the more intact Northern Hardwood Forests on the contiguous Bread Loaf lands,. Dominant trees in these more intact places are in the 100-year old range, and the herb composition is slightly more diverse than in areas that were not abandoned from agriculture as long ago.

Bread Loaf Farms and Lands 5

The dominant forest types of northern hardwood and state-significant Hemlock-Red Spruce-Northern Hardwood cover most of Bread Loaf 5. Natural community diversity includes Sugar Maple—White Ash—Jack-in-the-Pulpit Forest that lies adjacent to Homer Noble Farm's large Seepage Forest, Alder Swamp in the Brandy Brook riparian zone, and several Seeps scattered among the upland forest.

Exemplary Natural Communities	Hemlock-Red Spruce-Northern Hardwood Forest	Sugar Maple—White Ash—Jack-in-the-Pulpit Forest
Natural Community Explanation	part of the large B-ranked occurrence Bread Loaf north of Route 125, S4 type	B-ranked S4 type
Species of Special Interest	Species uncommon in the landscape: Goldie's fern, Wild-millet, Witch-hazel, Plantain-leaved sedge	
Species rarity rank	Goldie's fern, Wild-millet formerly S3, now S4	
Recreation features	Rikert Center ski trails	
Specific Management Items	Wetness considerations require attention on skid/ski trails at northern end of parcel	

Bread Loaf 5

Parcel 5 is west of parcel 4, with the Myrhe Lot lying between the two. An unnamed Brandy Brook tributary flows south from the Homer Noble Farm through the center of the parcel. Brandy Brook itself runs roughly along the lot's southern border. From the brook's banks at 420 m (1,380 ft) the property's south-facing slopes rise gradually toward a highpoint of 488 m (1,600 ft) on a hillside in the northeast corner of the lot. The parcel is a central piece of the Rikert Ski Touring Center and features a high density of ski trails. Stone walls indicate the history of pasture use, but forests have readily regenerated throughout to a quite natural composition and still-improving structure. As with the rest of the lands, historic wood harvests have been conducted; a more recent operation selectively removed hardwoods at the far northern end of Bread Loaf 5.

Most of the southern half of the property is dominated by Hemlock-Red Spruce-Northern Hardwood Forest, though a small finger of Northern Hardwood Forest pokes in near the southwest corner. Notably, the southern area of Bread Loaf 5 boasts some large diameter hemlock. Northern Hardwood Forest, which appears to have been high-graded of sugar maple, covers most of the northern half of the parcel. The southernmost portion, along Brandy Brook is Alder Swamp, low and wet, and in the extreme southeast corner is a small portion of younger successional Red Maple-Black Ash Seepage Swamp, the majority of which is on the adjacent Myrhe Lot.

Along the northern border the landscape is quite interesting; a patch of Sugar Maple—White Ash—Jack-in-the-Pulpit Forest occupies a concavity and flat along the brook; north of this, on the Homer Noble Farm, moisture and richness increase in a large seepage forest, the largest on the college lands and likely one of the largest in the much broader landscape. Although seepage does occur in places within the Sugar Maple—White Ash—Jack-in-the-Pulpit Forest, it is overall not predominantly characterized by seepage as is a true seepage forest. Nevertheless, recent blowdown was seen in a couple of seepy strips, the largest of which we mapped as a Seep.

Small sections of ski trails are low and wet. One trail in the northern part of the property seems to interrupt the hydrology slightly. Consequently, summer logging activity seems inappropriate, and allowing drainage beneath the trail would help repair the altered hydrology.

Bread Loaf Farms and Lands 11

This large parcel which includes Bread Loaf campus has a high level of diversity. Brandy Brook and one direct South Branch tributary flow through state-significant hemlock and Hemlock-Red Spruce-Northern Hardwood Forest. Wetlands include the only Spruce-Fir-Tamarack Swamp in the landscape, as well as two areas of Hemlock-Balsam Fir-Black Ash Swamp forest and an Alder Swamp. West of the campus is more forest, both northern hardwood and mixed wood, and seepage wetlands. With so much stream length and wetland acreage, the lands serve numerous watershed and water quality protection functions. The largest area of conifer plantation, some of which is very wet and seepy, fills a third of the eastern portion.

Exemplary Natural Communities	Hemlock-Red Spruce-Northern Hardwood Forest	Hemlock Forest	Northern Hardwood Seepage Forest	Sugar Maple—White Ash—Jack-in-the-Pulpit Forest	Spruce-Fir-Tamarack Swamp
Natural Community Explanation	part of the large B-ranked occurrence north of Route 125, S4 type	B-ranked S4 type, part of the occurrence north of Steam Mill Road	C-ranked S3 type	part of the large B ranked occurrence north of Route 125, S4 type	C-ranked S3 type, only one of this community known in the entire landscape
Species of Special Interest	Carex folliculata	Species uncommon in the landscape: Pinkster azalea			
Species rarity rank	S3				
Species notes	Occurs in Spruce-Fir-Tamarack Swamp				
Recreation features	Rikert Center ski trails				
Specific Management Items	Management planning is needed for the future of the conifer plantation				

Bread Loaf 11

Bread Loaf 11, located east of the junction of VT Route 125 and Steam Mill Road, encompasses the majority of Bread Load Campus. The western half of the property is relatively level at an approximate elevation of 433 m (1,420 ft). To the west, the lot climbs gentle west-facing slopes to an elevation of roughly 40 m (130 ft) higher. Brandy Brook and its tributaries flow through much of the northern portion of the property. Additionally, an unnamed tributary of the South Branch of the Middlebury River runs through conifer plantations in the southeast section before crossing the highway to its mouth. The yellow and green buildings of the College's mountain campus dominate the eastern portion of the property. Surrounding the campus are large frequently mowed fields which are used for skiing in the winter and gathering places during summer programs. Additional cultural features in the western portion of the property include an annually mowed field in the southwest corner, Kirby Cemetery in the northeast corner, and a large plantation (almost 20 ha (50 ac)) in the southeast. A barbed wire fence suggests that this area was pastured before being planted with Norway spruce in the early 1930s. Red pine was subsequently planted around 1970. The spruce plantation is on wet soils, with many small seepage areas and is, overall, a land of impeded drainage. Retired College forester, Steve Weber, related that the plantations were cut at various times, with the most recent logging completed in 1978-1979. The Bread Loaf 11 Norway spruce plantation has been one of the most intensively harvested parts of the college forestlands; until the 1990s harvest of the forests that are enrolled in Vermont Family Forests, the only place that saw greater amounts of harvest was the Upson Lot plantation.

The natural communities of the parcel show considerable variation. The most extensive community of the eastern portion is Hemlock-Red Spruce-Northern Hardwood Forest; there is much variability in this forest, with some of it level and very coniferous and other areas, notably the central section, a mixed woods on rolling, dissected terrain. This central part (to the west of the large plantation) features quite a lot of larger white pine, a cohort that would have established after pasture abandonment. The northeastern area has the most hardwoods in the parcel, but it does not seem to be a Typical Northern Hardwood Forest. Being close to the main farmstead, these former pastures were likely quite heavily used and were in use longer than outlying lands. Large white pine continue to stand as sentinels to the regenerating forest. It is curious that sugar maple is not more abundant given the well drained fine sandy loam soils on some of the hills in this area. One does see some large sugar maple on and atop the slopes of the deeply incised brook, but sugar maple regeneration and under- and over-story trees are virtually non-existent elsewhere. Beech and red maple comprise the majority of hardwood trees coexisting with the hemlock, spruce and pine; thus the area was mapped as Hemlock-Red Spruce-Northern Hardwood Forest. With regard to deadwood, the northeast corner, up towards the Kirby Cemetery, has more cavity trees and snags than in many other areas.

The larger patches of upland forest east of the campus fields are punctuated by a variety of wetland natural communities. The only Spruce-Fir-Tamarack Swamp on college lands lies in a narrow basin extending from Route 125 northwesterly to an adjacent Alder Swamp and stream that are crossed by the Battell Loop ski trail. Spruce-Fir-Tamarack Swamp is uncommon in Vermont and rare in this part of the state, and thus although small and nearly touching Route 125 this swamp is of high local biological-diversity value. Uncommon long sedge (*Carex folliculata*) occurs in the swamp, and this wetland is one of the few locations of tamarack in the broader landscape. Another small wetland forest, Hemlock-Balsam Fir-Black Ash Seepage Swamp, fills a small concavity a bit to the east of the Alder Swamp. Along the lot's northern border, on the Brandy Brook flats, a quite beautiful, level Hemlock Forest includes a number of larger diameter trees; interwoven with the upland Hemlock Forest are a sinuous Hemlock-Balsam Fir-Black Ash Seepage Swamp and a small Seep, which drain into a tributary of Brandy Brook. The complex mix of upland and wetland natural communities in the Brandy Brook-South Branch landscape is extremely well developed here. Undoubtedly, many skiers and woods-walkers enjoy this highly aesthetic display of ecological diversity.

Northwest of the developed campus is an undulating swath of young mid-successional Northern Hardwood Forest. In the northern part of the stand, a linear complex of northern hardwoods, stream, old field and seep connects to a larger Alder Swamp that drains to Brandy Brook. The upland-wetland mosaic is present here, as it is in the eastern part of the parcel, but being dissected by Route 125 and Steam Mill Road it is not as intact a piece of landscape, with greater impacts from the campus and the roads.

Bread Loaf Farms and Lands 14

The large fields south of Route 125 are a prominent feature of Bread Loaf 14, but ecologically of most importance is the assortment of forest and wetland types, many of which are associated with the South Branch. Hemlock Forest, state-significant, dominates the slopes and terraces by the river and one small part is in old-growth condition. Shrub swamps, Seeps and a marsh/beaver pond complex comprise the wetlands which are largely concentrated at the eastern and western ends of the parcel. The eastern side contains sandy flats that host Lowland Spruce-Fir Forest, a rare part of this landscape. The spruce-fir continues to the east on college and other lands; a small portion in Bread Loaf 14 has been converted to pine plantation.

Exemplary Natural Communities	River Cobble Shore	Alluvial Shrub Swamp	Herbaceous Seepage Marsh	Hemlock Forest	Alder Swamp	Lowland Spruce-Fir Forest
Natural Community Explanation	B-ranked S2 type, part of large South Branch occurrence	C-ranked S3 type, part of large extent along South Branch but separated from the large occurrence by >1 mile, therefore not the same occurrence	B-ranked S3 type	B-ranked S4 type, includes a small old-growth remnant next to river	B-ranked S5 type, part of large South Branch occurrence	C-ranked S3 occurrence, locally important although degraded by heavy logging (as is true for most of this type in New England)
Species of Special Interest	Species uncommon in the landscape: New England groundsel, Smooth arrowwood, Highbush-cranberry, Velvet-leaved blueberry, Withe-rod					
Recreation features	Rikert Center ski trails	Informal walking/snowshoeing trail along section of South Branch		Snowmobile trail in eastern fields		
Specific Management Items	Management planning is needed for the future of conifer plantation		Control of Wild chervil along South Branch small population of Eurasian honeysuckle in wetlands recommended			

Bread Loaf 14

Bread Loaf 14 is located south of VT Route 125, across from the main part of Bread Loaf Campus. The South Branch of the Middlebury River flows through the southern portion of the property and in some places forms its border. Similar, Brandy Brook forms much of the property's western boundary. The lot gradually slopes down from the campus proper to the flats that surround the river at approximately 408 m (1,340 ft). Soils on these lands are a different mix from what is found north and south on the more sloping terrain. These soils were derived from both water-laid (glaciofluvial) and ice-laid (till) parent materials; soils series include level, well drained, stone-free Salmon very fine sandy loam (which is dominant on the Bread Loaf field areas), well drained Berkshire-Marlow and poorly drained Cabot extremely stony loams on the undulating and gently sloping lands, and patches of poorly drained Limerick silt loam on the floodplains.

Adjacent to Route 125 are numerous, small campus buildings and three large, mowed fields around and through which course ski trails. Other cultural features include hiking paths, old logging roads and a small fire ring near the lot's southwestern corner. Additionally, a small Norway spruce-red pine plantation was established adjacent to Brooks Road, which forms the eastern lot boundary near the Chatfield parking area.

Bread Loaf 14 provides another fine example of the complex upland-wetland mosaic typical of the lower Brandy Brook-South Branch landscape. Natural community diversity is high and some of the land's rarer natural communities are found here, including Lowland Spruce-Fir Forest and floodplain-associated wetland forest and shrub types. Hemlock Forest and Lowland Spruce-Fir Forest are the most extensive natural communities on the lands adjacent to the river. Hemlock Forest occurs on the steep slopes and terrace flats adjacent to the South Branch in the western two-thirds of Bread Loaf 14. It has been lightly managed over the 20th century and is an exceptionally beautiful part of the land, with large-diameter hemlock forming a shady forest beside the clear-flowing cobble-speckled brook. One small area of old-growth Hemlock Forest still persists on a flat next to the South Branch. In the eastern third, Lowland Spruce-Fir Forest occupies level areas, some of which are elevated like plateaus. The spruce-fir has been heavily harvested, and much of it is the thickety regeneration of small clearcuts. Open wetland of a variety of beaver-impacted shrub and marsh types fills in the low-lying areas within and adjacent to the spruce-fir flats. Additional non-forested wetland occurs in the far western area with a sizable Seep complex close to the river and a shrub-graminoid complex on the edge of the fields. In summary, this is a very nice piece of the diverse "South Branch" landscape.

Moose browsing was noted in the southern part of the parcel; the wetland complex, which extends eastward into the Brooks parcel and adjacent lands appears to provide favored moose habitat. Additionally, the large, infrequently mowed fields may provide habitat for grassland birds such as bobolink, eastern meadowlark and savannah

sparrow, although since the fields are isolated patches within a forested landscape they are not optimal habitat. Management decisions regarding timing of mowing the large open areas could, however, consider impacts on nesting species.

Other Parcels of the Bread Loaf Contiguous Lands

Bridgman and Wimett Lot

Bridgman and Wimett Lot is a highly dissected piece of sandy-gravelly terrain with Beech-Red Maple-Hemlock Northern Hardwood Forest and Hemlock-Red Spruce-Northern Hardwood Forest. Both are parts of larger, state-significant examples. A moderate-sized Seep lies near the parcel center.

Exemplary Natural Communities	Sugar Maple—White Ash—Jack-in-the-Pulpit Forest	Hemlock-Red Spruce-Northern Hardwood Forest
Natural Community Explanation	B-ranked S4 type, part of the large occurrence north of Route 125	B-ranked S4 type, part of the large occurrence north of Route 125
Habitat of Special Interest	Moose bark-stripping Common on red and striped maples	
Recreation features		
Specific Management Items		

Bridgman and Wimett Lot

Located on the eastern side of the Bread Loaf contiguous lands, at the foot of Kirby Peak, the Bridgman and Wimett Lot is accessed roughly two kilometers up Steam Mill Road. The College acquired the parcel in 1977. Located between 518 and 582 m (1,700 and 1,910 ft), its topography is largely defined by a concavity in which Brandy Brook flows. The glacial deposits on this part of the landscape were laid by flowing water, and the soils are Colton gravelly loamy sands. Convex hill spurs and smaller concavities complicate the moderate, generally west-facing slopes of the property. A smaller brook runs through the northwestern corner of the lot.

The excessively to somewhat excessively drained soils support Beech-Red Maple-Hemlock Northern Hardwood Forests. Where the banks of the brook slope steeply and the soils moisture from downslope flow, the beech-dominated forests give way to Hemlock-Red Spruce-Northern Hardwood stands. These forests have been fairly recently logged, and dense beech sapling thickets have developed, as is common in logged beech woods.

A well-developed linear Seep and a moist Sugar Maple—White Ash—Jack-in-the-Pulpit Forest add natural community and plant species diversity to these drier lands.

Moose find good winter feed in these areas with striped maple and young red maple; a moderate amount of bark stripping was observed on the maples.

Brooks Lot

The small Brooks Lot includes open wetland and spruce-fir forest that appear to be important moose habitat.

Exemplary Natural Communities	Herbaceous Seepage Marsh	Lowland Spruce-Fir Forest
Natural Community Explanation	B-ranked S3 type	C-ranked S3 type, part of a larger occurrence most of which is on Bread Loaf lands
Habitat of Special Interest	Moose frequently utilize the wetlands and coniferous forests and appear to use this area for crossing Route 125	
Recreation features		
Specific Management Items	Route 125 has some degrading impact on the Herbaceous Seepage Marsh. Can any different management ameliorate impacts or contain them from expanding?	Control of invasive Eurasian honeysuckle would help keep the shrub from spreading in the local area

Brooks Lot

The tiny Brooks Lot is located on the intersection of VT Route 125 and Brooks Road. The College acquired the property in 1979. A house sits in the north corner of the largely flat lot. An unnamed brook flows from the Burdick Lot under the highway and through the Brooks Lot on its way to the confluence with the South Branch near the Chatfield parking area.

Much of the Brooks Lot is covered in Lowland Spruce-Fir Forest on moderately well drained Duane fine sandy loam, a soil with water-laid (glaciofluvial) parent material, although the soils mapping incorrectly shows the land to have Cabot soil. Forest structure varies widely in response to previous logging disturbance. The western half of this site is characterized by canopy trees up to 40 cm (16 in) dbh and spruce and fir regeneration so dense that it excludes most other woody and herbaceous species. Woody debris from natural thinning of the saplings was common in this area. The eastern section has much less dense regeneration and greater diversity of herbs and mosses.

Along Route 125, a willowy example of an Herbaceous Seepage Marsh fills a narrow depression between the blocks of Lowland Spruce-Fir Forest. Moose tracks and browsing were seen near the wetland, and bear clawing was noticed on a single fir tree. This wetland area is apparently a highway crossing zone for moose, with signage noting such on the highway.

A narrow Hemlock-Red Spruce-Northern Hardwood Forest on poorly drained Cabot extremely stony loam is located on the northern side of the lot, slightly elevated from the nearby wetland and Lowland Spruce-Fir Forest. Pit-and-mound microtopography was evident but not drastic. The area displays successional vegetation

and a transition from Lowland Spruce-Fir Forest to the Hemlock-Red Spruce-Northern Hardwood Forests that commonly grow along the mountain streams in the study area. It is unfortunate that the highway both interrupts the transition from mixed forest to spruce-fir and divides the wetland. The brook and wetland provide a valuable connection between the South Branch lowlands and the higher mountain slopes of the Bread Loaf Wilderness Area.

The southern corner of the lot contains a small portion of a red pine plantation that extends to the south of Brooks Lot. Eurasian honeysuckle was noticed near the brook.

Brown Lots 1 and 2

Brown Lot 1, south of the South Branch, is a slice of hillslope with level land in a wide band adjacent to the river. Part of the level land is red pine plantation, while less manipulated areas are portions of the state-significant South Branch riverine-riparian complex Alluvial Shrub Swamp that continues up- and downstream. Bands of seepage and upland Northern Hardwood Forest types rise up the slope, and near the southern boundary lies a small, state-significant, perched Hemlock-Balsam Fir-Black Ash Swamp. Small Brown Lot 2, between the South Branch and Route 125, is a mix of annually mowed field and riparian wetland, including parts of the extensive, state-significant Alluvial Shrub Swamp.

Exemplary Natural Communities	Alluvial Shrub Swamp	Alder Swamp	River Cobble Shore	Northern Hardwood Seepage Forest	Hemlock-Balsam Fir-Black Ash Seepage Swamp
Natural Community Explanation	B-ranked S3 type, part of South Branch riverine/riparian complex	B-ranked S5 type, part of South Branch riverine/riparian complex	B-ranked S2 type, part of South Branch riverine/riparian complex	B-ranked S4 type, reforested from historic pasture use	B-ranked S3 type, small and remote
Habitat of Special Interest	These shrub wetlands provide good habitat for woodcock, which were observed during nesting season				
Recreation features					
Specific Management Items	Management planning is needed for the future of conifer plantation	Enrolled with Vermont Family Forests and thus requires periodic management plan updates			

Brown Lot 3

Groundwater seepage is prominent on this piece of land. The large area of Hemlock-Red Spruce-Northern Hardwood Seepage Forest is young and in recovery from pasture use. The upland forests to the northeast and southwest have recovered somewhat more quickly but are also young. The lot includes an unmanaged red pine plantation and a mowed field.

Exemplary Natural Communities	Hemlock-Red Spruce-Northern Hardwood Forest, includes enriched variant	Hemlock-Red Spruce-Northern Hardwood Seepage Forest	
Natural Community Explanation	B ranked S4 type, part of larger occurrence on adjacent parcels	BC-ranked S3 type, most of occurrence on Brown Lot 3	
Species/Habitat of Special Interest	1 unusual species noted: Barren-strawberry	American toad observed; likely breeds in Homer Noble Farm ponds	
Recreation features			
Specific Management Items	Check Homer Noble Farm access road for invasive species and control if detected	Enrolled in VFF thus required periodic management plan updates	Management planning is needed for the future of conifer plantation

Brown Lots 1, 2 and 3

The Brown Lots, acquired by the College in 1972 from Polly Upson Brown, daughter of author William Hazlitt Upson, are located north and south of Route 125 just east of the Robert Frost interpretive trail. Riparian wetland communities along the South Branch are a highlight of these parcels. Lot 1 is the southernmost parcel, south of the South Branch; Lot 2 between the South Branch and the highway includes a house and lawn in addition to the riparian wetlands. Lot 3, north of the highway, is largely successional forest with a history of pasture use; near the road are a red pine plantation and annually mowed field.

Elevation at the South Branch of the Middlebury River is roughly 395 m (1,300 ft) and the terrain is rather level with shrub swamp and red pine plantation. The soils on the riparian flats include poorly drained Cabot extremely stony loam, moderately well drained Duane fine sandy loam, and Walpole silt loam. The areas support a mix of wetland communities, including state-significant Alluvial Shrub Swamp, part of the large South Branch occurrence that extends both up- and down-stream. Along the stream itself are cobble shores that line the river channel. On the flat south of the Alluvial Shrub Swamp is 3.5 ha (8.7 ac) white spruce-red pine plantation. South of the riparian flat the forest is mid-successional old-pasture woods of three types—Northern Hardwood Seepage Forest, Typic Northern Hardwood Forest and Sugar Maple—White Ash—Jack-in-the-Pulpit Forest; the latter two on a steep north-facing slope. Near the 493-meter (1,620-foot) height of the parcel is a small, high-quality Hemlock-Balsam Fir-Black Ash Swamp. Barbed wire fencing indicates that these woods were pasture in former times, and skid trails suggest past logging, but there is no evidence of recent harvest and the forests are recovering nicely. Upslope soils are the typical Berkshire and Marlow extremely stony loams that cover most of the hill terrain. In addition to groundwater seepage on the toeslope, surface water is common upslope, with several unmapped permanent and intermittent streams.

North of Route 125, Brown Lot 3 features a south-facing moderate slope that rises to the Homer Noble farm boundary at an elevation of 440 m (1,440 ft). Groundwater seepage is the dominant feature of this land, and Hemlock-Red Spruce-Northern Hardwood Seepage Forest is the largest community on the narrow parcel. The seepage forest is mostly in young successional status, but is contiguous with more mature seepage forest to the east on the Upson Lot. Soils are primarily Cabot extremely stony loam, with areas of Peru extremely stony loam to the north and Berkshire extremely stony loam to the south. A mapped stream originating at an old farm pond on Homer Noble Farm flows south next to the western boundary, and several smaller, unmapped streams flow south through the interior of the lot. The seepage forest is bordered by upland conifer-hardwood forests. To the south is a red pine plantation that dates to the 1960s and has received little management; the result being a dense stand of low value trees. A small meadow is maintained in the southeast corner of the lot. Despite its

mostly early successional condition, Brown Lot 3 is one of the parcels enrolled with Vermont Family Forests for sustainable forest management.

From a wildlife perspective, the Brown Lots include the valuable South Branch riparian zone with a diversity of habitat types. Woodcock were observed in the shrub swamps.

Burdick Lot

An interesting feature of Burdick Lot is the numerous, parallel tributary streams with broad riparian/alluvial flats and intervening terrain undulations. Also present are a sizable Seep and Northern Hardwood Seepage Forest, within a Northern Hardwood Forest matrix. The stream and riparian zones show signs of having performed important downstream flood mitigation functions during Tropical Storm Irene, and likely other heavy storms also.

Exemplary Natural Communities	Northern Hardwood Seepage Forest	Seep
Natural Community Explanation	BC-ranked S3 type	S4 type, relatively large example
Species of Special Interest	Species uncommon in the landscape: Witch-hazel, Virginia waterleaf	
Recreation features		
Specific Management Items	Maintain intact riparian areas to allow for maximum hydrologic functions	

Burdick Lot

Burdick Lot, acquired by Middlebury College in 1966, is separated from Bread Loaf parcel 11 by Deacon Hill Road. The undulating terrain ranges from 463 m (1520 ft) to 488 m (1600 ft) and features numerous parallel streams that cross Route 125 and flow into the South Branch. The predominant natural community is Typic Northern Hardwood Forest, but this water-rich small lot also includes both Northern Hardwood Seepage Forest and a sizeable open Seep community. Part of the seepage forest is young and has been degraded by activities related to construction of a large pond on the parcel adjacent to the east. Other parts, however, are in better condition. Soils include well drained Berkshire extremely stony loam on the drier parts of the site, with wetland areas on poorly drained Cabot extremely stony loam, some of which had 10-20 cm of mucky silt and standing water. The Burdick house and a small lawn area are in the northwest corner and several power line corridors cut through the property.

It is important to note the watershed protection functions of the Burdick Lot. The main stream, the southernmost, arises high in the mountains between Kirby Peak and Burnt Hill. We observed that a large volume of sand, gravel and cobbles was moved in this stream bed during Tropical Storm Irene. Since the parcel features so much groundwater seepage and is the source area of numerous streams, maintaining forest cover and strict protection of seepage and riparian zones will aid in abating storm damage.

Homer Noble Farm

Homer Noble Farm includes one of the most interesting natural communities on college lands, a large and diverse seepage forest that occupies much of the mid-section of the parcel. In addition to being a state-significant natural community, this area surely serves important watershed protection functions. Substantial portions of upland forest were logged in early 2000s, with poor regeneration in some areas. Two old farm ponds are among the few bodies of standing water on college mountain lands; they appear to support amphibian breeding and beaver.

Exemplary Natural Communities	Northern Hardwood Seepage Forest	Sugar Maple—White Ash—Jack-in-the-Pulpit Forest	Vernal Pool	
Natural Community Explanation	A ranked S3 type, includes Hemlock-Red Spruce-Northern Hardwood Seepage Forest variant	B-ranked S4 type, recovering from historic pasture use	S3 type, few small pools, not ranked	
Species of Special Interest	Species uncommon in the landscape: Goldie's fern, Wild-millet, Spikenard, Witch-hazel, Canada violet	American toad observed; likely breeds in old farm ponds	Adult frogs observed in pools	
Species rarity rank	Goldie's fern, Wild-millet formerly S3, now S4			
Wildlife/Habitat notes		Surprisingly very few toads observed during study		
Recreation features	Rikert Center ski trails			
Specific Management Items	Enrolled with Vermont Family Forests and thus requires periodic management plan updates	Trails/woods roads cross through some very wet areas and require management attention	Dense hay-scented fern establishment has impeded tree regeneration post the recent logging	Invasive exotics around the homestead (Oriental bittersweet, common buckthorn, purple nightshade, Eurasian honeysuckle) should be controlled as this is one of the very few areas locally where these pests have established

Homer Noble Farm

Homer Noble Farm, a mostly forested lot contiguous with the Bread Loaf Farm and Lands parcels, was acquired by Middlebury College in 1966. It contains the homestead and writing cabin of Robert Frost. Frost spent each summer and fall from 1939 to 1963 at the farm while writing and teaching at the nearby Bread Loaf School of English. The homestead is currently managed by the college as an historical site and is also used as housing.

A prominent topographic feature of these lands is a large southwest-facing concavity; a large, high-quality seepage forest fills much of the concavity, with a permanent stream flowing north-south through the middle. The elevated sections, rising to 543 m (1,780 ft), are moderate slopes with south to southwest aspects, although the northern part has some steeper slopes. The easternmost section of the Noble Farm is relatively level and a small portion of a larger beaver wetland complex occupies the northwest corner, which abuts national forest land. Other water features include two overgrown farm ponds in the southwestern part of the property near the Frost homestead; both show present or former occupation by beaver.

Cabot and Peru soils, which are moderately well to poorly drained, predominate throughout the parcel. The large central concavity, mapped in the county soil survey as Livingston clay, is actually a complex mosaic of those two predominant types. Only the northern portion, which has steeper slopes, is well drained ablation till Berkshire and Marlow soils.

The natural communities on the property are upland or seepage Northern Hardwood Forest types with varying degrees of moisture and nutrient enrichment. Typic Northern Hardwood Forest fills much of the eastern and northwestern areas, while Sugar Maple—White Ash—Jack-in-the-Pulpit Forest predominates in the east; seepage forest, both hardwood and conifer hardwood types, fills the central zone. These seepage forests are an exceptional feature of Homer Noble Farm. A great diversity of forest structure and composition and herbaceous species was observed in the seepage forests. They are an uncommon natural community type in Vermont and have not yet been formally included in the state's natural community classification.

The entirety of the lot was used as farmland in the past; if not all of it was cleared, all experienced livestock grazing, even if an open canopy of trees was maintained (such as in the wet areas). Areas closer to the homestead were small, intensively used fields, and field area remains; west of the access road is annually mowed field whereas to the east is old field that is quite wet and has been "let go." Old stone walls attest to the field divisions throughout the farm. The large area of Sugar Maple—White Ash—Jack-in-the-Pulpit Forest that covers the western part of the farm is in mid-successional condition and continues to regain structural diversity and an herbaceous flora more characteristic of older forests.

The Homer Noble Farm is enrolled with Vermont Family Forests and certified as sustainably managed forest. The most recent logging operation on college lands, 2000-

2002, was largely in the Northern Hardwood and Northern Hardwood Seepage Forest of the parcel. Unfortunately, the plan allowed for some degradation in the northeast of the seepage forest (as it was not identified as wetland in the management plan). Additionally, hay-scented fern has grown densely in the eastern part of the northern hardwoods and has suppressed tree regeneration there.

Oddly, a small Norway spruce plantation sits on a bench perched to the northwest of the seepage concavity. The old field site has the appearance of a leveled terrace, but we did not find a clear plow horizon in the fine sandy loam soil; a stone wall on the east edge was not investigated to see if small stones indicative of plowed land were included in the wall. Based on tree core data, the spruce were planted in the mid-1960s and tree growth has been very unequal.

A variety of wildlife use was evident throughout the property. Recent bear scat was found in the northeast corner of the property and bear scarring was seen on beech trees in the northwest corner of the property's western portion. The more extensive beech grove appeared to be across the boundary on national forest land. It is unknown if this area meets the state's criteria for important feeding area. Also of special importance to much smaller wildlife are the few Vernal Pools seen within northern parts of the seepage forest complex; Vernal Pools were generally rare on the college lands. In addition, moose barking, tracks and scat were observed in several locations.

Homer Noble Farm is one of the few places where invasive exotics were observed on the college lands, and the only place where we found Oriental bittersweet, a vine of particular concern because of its ability to "strangle" trees. Eradication of these populations while they are still small and localized is recommended. Additional non-native plants noted were common buckthorn, Eurasian honeysuckles and purple nightshade, all observed in the southwestern corner of the lot along and near the homestead access road. Other management recommendations include improving ski and skid trails in wet areas to restore natural hydrology and diminish negative impacts on water and soil quality.

Myrhe Lot

The Myrhe Lot forests are generally in younger successional stages than the surrounding woods of the Bread Loaf lands. The lot's Hemlock-Red Spruce-Northern Hardwood and Typic Northern Hardwood Forests are integral to the continuity of the Bread Loaf forests. The old sugarbush features a glade-like structure with fern-covered ground. The southern part of Myrhe Lot is sloping wetland--young successional swamp forest, some of which currently hosts tall alder vegetation.

Exemplary Natural Communities	Hemlock-Red Spruce-Northern Hardwood Forest
Natural Community Explanation	part of the large B-ranked occurrence Bread Loaf north of Route 125
Recreation features	Rikert Center ski trails
Specific Management Items	Enrolled with Vermont Family Forests and thus requires periodic management plan updates

Myhre Lot

The Myhre Lot, acquired by the College in 1974, is located north of Steam Mill Road and is sandwiched between Bread Loaf Farm and Lands parcels 4 and 5. It is an integral part of the Rikert ski trail system. The property's south-facing slope climbs gently from just north of the Bread Loaf campus fields to a hilltop at approximately 515 m (1,690 ft). Soils are a mosaic of Berkshire, Marlow, Peru, and Cabot extremely stony loams, which varies from well drained to poorly drained types.

The far south end of the lot, nearest to the road, is a sloping Red Maple-Black Ash Seepage Swamp with forest young enough to still support early successional species and areas of tall alder thickets. In contrast, the well-drained slopes of the northern portion of the property support Northern Hardwood Forest. In between these two communities and along the eastern section is Hemlock-Red Spruce-Northern Hardwood Forest, which is part of a large occurrence on the Myrhe and Bread Loaf parcels.

Forest in the Myrhe Lot generally shows more recent human disturbance than on the adjacent parcels. Paper birch is quite common in the southern half, along with other signs of more intensive logging than in the adjacent Bread Loaf parcels. A northern, spruce-y area is another piece of successional forest showing altered composition. An area in the central part was previously managed as a sugarbush and is now a stand of large maples with a glade-like forest floor. The Myhre Lot is part of the lands enrolled and certified with Vermont Family Forests.

Norton Lot

Norton Lot, part of the Bridgman & Wimett and Norton lots group, contains parts of the Seepage Forest and the Beech-Red Maple-Hemlock Northern Hardwood Forest.

Exemplary Natural Communities	Hemlock-Red Spruce-Northern Hardwood Seepage Forest
Natural Community Explanation	part of A-ranked occurrence with USFS Exchange Lot, S3 type
Recreation features	Burnt Hill trail crosses lot
Specific Management Items	If not in existence, develop formal agreements with GMNF with regard to Burnt Hill Trail

Norton Lot

Located to the east of the Bread Loaf lands, the small Norton Lot abuts the USFS Exchange and Bridgman and Wimett lots two kilometers north up Steam Mill Road. The parcel was acquired by the College in 1937 and is part of a glaciofluvial, gravelly-sand landscape positioned at roughly 550 m (1,800 ft) near the base of the steep mountain slopes.

Excessively to somewhat excessively drained Colton gravelly loamy sand slopes comprise the majority of this section of landscape. Beech-Red Maple-Hemlock Northern Hardwood Forest is the characteristic forest type of these droughty soils. In contrast, the southeastern quadrant of the property features groundwater seepage and is one corner of a moderately large, state-significant Hemlock-Red Spruce-Northern Hardwood Seepage Forest.

The Green Mountain National Forest Burnt Hill Trail passes through the Norton Lot, as do other old logging roads.

Upson Lot 1

Upson Lot 1, on the north side of Route 125, is predominantly a combination of state-significant Hemlock-Red Spruce-Northern Hardwood Forest and an uncommon, enriched variant of that type which appears to receive nutrient enrichment via subsurface flow from the adjacent upslope Homer Noble Farm. The parcel also contains a large conifer plantation that has been the most actively logged area over the past three decades. Wetland—seepage forest, swamp forest and Alder Swamp—is common in the southwest of the parcel and the lands are important in hydrologic functions.

Exemplary Natural Communities	Hemlock-Red Spruce-Northern Hardwood Forest, includes enriched variant	Hemlock-Red Spruce-Northern Hardwood Seepage Forest
Natural Community Explanation	B-ranked S4 type, part of larger occurrence on adjacent parcels	
Habitat of Special Interest	Moose bark-stripping on maple poles	
Recreation features		
Specific Management Items	Management planning is needed for the future of the conifer plantation	Enrolled with Vermont Family Forests and thus requires periodic management plan updates

Upson Lot 2

Middlebury River South Branch flows through Upson Lot 2, with several state-significant natural communities associated with the riverine-riparian wetlands. Along the river are a narrow piece of rare Sugar Maple-Ostrich Fern Floodplain Forest, as well as Alluvial Shrub Swamp and River Cobble Shore, with Alder Swamp set farther back. North of the river are three annually mowed fields and patches of northern hardwood and conifer-hardwood forests.

Exemplary Natural Communities	River Cobble Shore	Sugar Maple-Ostrich Fern Floodplain Forest	Alluvial Shrub Swamp	Alder Swamp	Hemlock Forest
Natural Community Explanation	B-ranked S2 type, part of South Branch riverine/riparian complex	B-ranked S2 type, part of South Branch riverine/riparian complex	B-ranked S3 type, part of South Branch riverine/riparian complex	B-ranked S5 type, part of South Branch riverine/riparian complex	B-ranked S4 type, small portion extends from occurrence on Bread Loaf 14
Species/Habitat of Special Interest	Species uncommon in the landscape: Black chokeberry, Wild-millet		Woodcock were observed during nesting season; the shrub wetlands provide good habitat		
Species rarity rank	Wild-millet formerly S3, now S4				
Recreation features					
Specific Management Items	Invasive species control of wild chervil along the South Branch and Japanese barberry in woods behind Brandy Brook House is recommended; control of Eurasian honeysuckle along river is also suggested		Consider allowing lower (southern) field to naturally reforest		

Upson Lot 1

Acquired by the College in 1969, Upson Lot 1, an important part of the Rikert Center ski trail network, is located north of VT Route 125 adjacent to the west of the Bread Loaf Farm and Lands. From the highway at 396 m (1,300 ft) the property rises to a highpoint of approximately 470 m (1,540 ft) at its relatively level northeast corner. The topography is dominated by a southwest-facing concave to flat slope. Bedrock outcrops are uncommon on the Bread Loaf contiguous lands, but the Upson Lot does include a ledge on its eastern boundary. Soils are predominantly Peru moderately well drained and Cabot somewhat poorly drained extremely stony loams, with smaller patches of well drained Berkshire and Marlow stony loams. An area of Lyman extremely rocky loam occurs in the area of the bedrock ledge. Several small brooks flow through the lot although only one is mapped.

The property contains Earthworm Manor, a former home of the Upson family, now used as housing during the summer Bread Loaf programs. The house is surrounded by a regularly mowed narrow field. Just north of Manor and field, on the steepest slopes of the parcel, is a large Norway spruce-red pine-European larch plantation planted in the early 1930s. The Upson plantation is the most intensively managed of the college's forestlands, with thinnings conducted around 1970 and group, patch and selective harvests in 1980, 2008 and 2009. Despite the steep terrain, the network of permanent logging roads is generally in good shape, although periodic assessment and maintenance for water and erosion control are necessary.

Much of the land has a history of pasture use, and it is likely that the plantation was the last zone of agricultural abandonment. Hemlock is a dominant to co-dominant tree in the most extensive natural communities. The northern portion shows some enrichment and is mapped as the enriched variant of Hemlock-Red Spruce-Northern Hardwood Forest; the Vermont classification does not recognize an enriched variant of this type, but we have classified and mapped it as such since the herb layer clearly indicates an elevated level of nutrients. The enrichment appears to be, at least in part, related to downslope flow of moisture and nutrients on the gentle to moderate southerly slopes. Adjacent to the east is the more usual Hemlock-Red Spruce-Northern Hardwood Forest. Straddling the Upson-Brown lot line is an area with very active groundwater seepage. On Upson, Hemlock-Red Spruce Northern Hardwood Seepage Forest narrows into a more saturated area, Hemlock-Balsam Fir-Black Ash Seepage Swamp; some of the wetland area is now spruce plantation. Near the south end a strip of Alder Swamp lies in a narrow depression between elevated spruce areas.

Upson Lot 2

Upson Lot 2 lies south of Route 125 and was acquired by the college in 1969 along with lot 1. The small lot is a combination of nearly level and broad flat along the South Branch of the Middlebury River. The confluence of the South Branch and Brandy Brook is located in the southeast corner of the parcel. Soils are a mosaic of till and water-laid

deposits—well drained Berkshire extremely stony loam, well drained Duane gravelly sandy loam, and poorly drained Walpole silt loam.

Upson Lot 2 includes three large annually mowed fields and a small red pine plantation. Surrounding the northern half of the more northern field is a fringe of early successional Hemlock-Red Spruce Northern Hardwood Forest, while the easternmost field is lined by small stands of typical northern hardwoods. South of the plantation is a band of Alder Swamp, part of the large South Branch riverine-riparian shrub swamp-floodplain forest complex. Additional patches of non-forested wetland lie to the south, closer to the river. The lot also includes the western tip of the Hemlock Forest that lines the South Branch upstream in Bread Loaf parcel 14.

Along the river itself are River Cobble Shore and Sugar Maple-Ostrich Fern Floodplain Forest, part of a string of patches of these state-significant natural communities along the South Branch from the confluence of Brandy Brook to Goshen Road. Wild chervil, an invasive exotic herb, was observed on cobble bars on the south side of the South Branch.

At least half of Upson Lot 2 is maintained as field. The need for and desirability of continuing mowing on the southernmost of the fields, that closest to the river, should be examined. It is not within the viewshed of frequently traveled spots like the highway or the main Bread Loaf campus and thus seems to serve no aesthetic purpose. Allowing the field to revert to forest now, while invasive species are infrequent in the landscape is ecologically sensible.

USFS Exchange Lot

USFS Exchange Lot is primarily wetland which includes state-significant seepage forest, mostly of the Hemlock-Red Spruce-Northern Hardwood Seepage Forest type, and Herbaceous Seepage Marsh, part of which has been converted by beaver to shallow emergent marsh and pond. A strip of Hemlock-Red Spruce-Northern Hardwood Forest, part of a larger state-significant example, and the small reservoir of the former Bread Loaf water system occupy the northern part.

Exemplary Natural Communities	Hemlock-Red Spruce-Northern Hardwood Seepage Forest	Hemlock-Red Spruce-Northern Hardwood Forest	Hemlock-Red Spruce Forest	Herbaceous Seepage Marsh
Natural Community Explanation	part of A-ranked occurrence with Norton Lot, S3 type	part of the large B-ranked occurrence north of Route 125	part of the large B-ranked Hemlock Forest occurrence north of Route 125	B-ranked S3 type
Habitat of Special Interest	Amphibian breeding observed in beaver ponds			
Recreation features	Burnt Hill trail and trailhead/parking area			
Specific Management Items	If not in existence, develop formal agreements with GMNF with regard to Burnt Hill Trail		Control of Eurasian honeysuckle in marsh is recommended	Chain-link fence around old reservoir will require periodic maintenance (or removal?)

USFS Exchange Lot

The USFS Exchange Lot is one of the most easterly properties in the landholdings contiguous with Bread Loaf. Acquired by the College in 1980, it is located east of where steep-sided Brandy Brook crosses Steam Mill Road. The predominantly west-facing lot rises gently from the stream bank at 500 m (1,640 ft) to a hillside at 560 m (1,840 ft). The Burnt Hill Trail crosses east-west through the center of the property. A more prominent human feature is the old Bread Loaf water system reservoir created by a dam across Brandy Brook in the northwest corner of the lot.

The Walpole silt loam soil that covers much of the parcel supports a relatively large Hemlock-Red Spruce-Northern Hardwood Seepage Forest and a non-forested marsh and pond beaver wetland. Near the pond is a band of better drained soil with Hemlock-Red Spruce-Northern Hardwood Forest and Hemlock-Red Spruce Forest surrounding the reservoir itself. Corners of the parcel include bits of the glaciofluvial Beech-Red Maple Hemlock Forest that mostly occurs on the adjacent Norton and Bridgman and Wimett lots.

Wildlife sign was evident in the property, particularly in the wetlands. Moose and deer track were seen in willow portions, and bear scat was observed in the seepage forest. Eurasian honeysuckle was noted in the area of the beaver meadow. Minor to moderate soil erosion was noted on parts of the old logging roads.

Parcels not Contiguous with Bread Loaf lands

Coal Kiln Lots

The Coal Kiln parcels' most important ecological features are the riverine-riparian wetland natural communities associated with the South Branch and the tributary on the west side of Goshen Road. In addition to their natural community significance, these are very important for natural river function, flood control and water quality maintenance. The South Branch riparian complex extends upstream through national forest lands to the college's Bread Loaf lands.

Exemplary Natural Communities	Alluvial Shrub Swamp	Alder Swamp	Sugar Maple-Ostrich Fern Floodplain Forest
Natural Community Explanation	B-ranked S3 type	B-ranked S5 type	B-ranked S2 type
Species of Special Interest	Plant species that are uncommon in the landscape: Barren-strawberry, New England groundsel, Three-way sedge, Rough-leaved ricegrass, White oak		
Recreation features	Spirit-in-Nature Trails		
Specific Management Items	Management planning needed for future of conifer plantations		

Coal Kiln Lots (1-4)

Acquired by the College in 1916, the Coal Kiln lots lie at the confluence of the Middlebury River South Branch and the western of two local streams named Goshen Brook. The location is south of VT Route 125 and southeast of the village of Ripton; Goshen Road bisects the lot. The eastern portion of the property is level to gently rolling, punctuated by a series of floodplain terraces along the river. A prominent feature of the landscape is the series of steep, high banks of the South Branch which are actively eroding. West of Goshen Road, the lot is flat between the road and brook, and to the west rises to only 396 m (1,300 ft) on the lower slopes of a low mountain along the ridge of Mount Moosalamoo. Soils on the Coal Kiln lots are quite varied, as is common along the South Branch; both till and water-laid soils occur. Drainage ranges from well drained to poorly drained among the series Berkshire and Marlow extremely stony loams, Peru extremely stony loam, Duane fine sandy loam and Walpole silt loam.

The history of the Coal Kiln from which the property surely takes its name was not known to the college staff who work with the lands. Stone walls and old-field pine growth suggests this lot was pastured in the not-so-distant past. Several conifer plantations were established in the mid 20th century to restore the old farmland. The Spirit in Nature Trails crisscross most of the upland areas. This system consists of a series of paths, each of which includes inspirational writings from different faiths. Trail use is leased to Spirit in Nature and that organization maintains the trails.

The highlight of the Coal Kiln parcels is the riverine-riparian complex of state-significant natural communities along the South Branch. Alongside the river's bends are several small patches of Sugar Maple-Ostrich Fern Floodplain Forest, a type rare in the state. These forests are fine examples of the type and are part of an occurrence that extends eastward to the Bread Loaf lands. Dynamics of flooding are very evident, as the region has experienced not only Tropical Storm Irene, but numerous severe rainfall events in the past decade. One plant in the floodplain forest, Wiegand's wild-rye, is uncommon in the state.

Upstream is an extensive network of Alder Swamp and Alluvial Shrub Swamp. Also part of the riverine-riparian complex is River Cobble Shore, which occurs as scattered point bars. The cobble shores include both native and non-native plants. The invasive species wild chervil, Eurasian honeysuckle, and reed canary grass all persist in the repeatedly disturbed river bar habitat.

A number of non-riparian wetlands are scattered throughout both north and south of the river. In the southwestern part of lot 2 lies a long wetland complex along a small unnamed creek. Near the mouth are an Alder Swamp and Hemlock-Balsam Fir-Black Ash Seepage Swamp. Upstream the wetland opens into a small, linear beaver meadow complex that includes several open beaver ponds and shrub and emergent marsh wetlands in various stages of beaver-pond succession.

The uplands south of the river are Hemlock-Red Spruce-Northern Hardwood Forest, some of which is an old-field white pine forest with large diameter trees on level

and rolling terrain. North of the river the uplands feature both Hemlock-Red Spruce Northern Hardwood Forest and Typic Northern Hardwood Forest. The latter type is on land that looks as if it could have been plowed. Soil observations made by augering showed jumbled horizons and some charcoal. This appears to be one clue to the history of a kiln on these lands.

The western lots, separated by Goshen Road, contain both Norway spruce and red pine plantations, along with seepage forests and scattered wetlands associated with the brook. One red pine plantation, unlike most such areas, has a well established undergrowth of saplings and some herbs.

Wildlife sign was commonly observed on the Coal Kiln lots, particularly in the between the river and Route 125 where bear scat, moose barking, scat and fresh tracks, and many fresh deer track and scat were observed. Additionally, the alders provide habitat for woodcock, which were flushed as we passed through.

Crystal Brook Lots

For a relatively small piece of land, the Crystal Brook lots have a relatively high level of natural community diversity. Ecological features of greatest interest are a sizable glaciofluvial terrace/slope with beech-red maple northern hardwood and Hemlock Forests and a moderately large patch of rich Northern Hardwood Forest. Interesting ice-block depressions occur midslope.

Exemplary Natural Communities	Hemlock-Red Spruce Forest	Hemlock Forest	Rich Northern Hardwood Forest	Northern Hardwood Forest
Natural Community Explanation	B-ranked S4 type (bulk is on adjacent GMNF lands)	B-ranked S4 type (bulk is on adjacent lands)	B-ranked S4 type	Part of large, protected (GMNF) occurrence
Habitat of Special Interest	Bear-scarred beech numerous			
Habitat notes	No sign of very recent feeding, scarring likely not recent enough to qualify as necessary feeding habitat per state's criteria			
Recreation features	GMNF Norske Trail crosses parcel			
Specific Management Items	Enrolled with Vermont Family Forests and thus requires periodic management plan updates	If not in existence, develop formal agreements with GMNF with regard to Norske Trail	Wetness on sections of Norske Trail could use attention; low priority since trail receives light use	

Crystal Brook Lots (1-3)

The Crystal Brook lots are located west of Crystal Brook along Route 125 approximately 1.2 km from west of Middlebury Gap. Vehicle access for logging was from a woods road that enters at a gravel pit on another ownership west of the parcel; foot access is available from a pull-off on the northern side of the highway at the east corner by Crystal Brook. From its base at 488 m (1,600 ft) the property rises to an elevation of 640 m (2,100 ft) in its northeast corner. The topography includes several benches, a flat alongside the highway and moderate to steep slopes with generally south to west aspects. Above 518 m (1,700 ft), the eastern half of the property is an uneven slope dissected by small spurs and hollows. A notable feature of this area is a group of several small ice-block depressions, deep circular hollows with steep walls. Crystal Brook, a tributary of the Middlebury River South Branch, flows through the southeast corner of the property and is its only significant water feature. The Green Mountain National Forest Norse Trail crosses diagonally through the northeast quadrant of the site.

Because of its varying glacial deposits and topography the property features several forest natural communities, and due to land-use history small areas feature young forest stands. The upslope, northern portion, of the property is Northern Hardwood Forest with a band of Rich Northern Hardwood Forest occupying the terrain between the 579 m (1,900 ft) and 610 m (2,000 ft) contours, on a bench at the base of steep, rocky slopes. The Norse Trail is routed along the bench. The Northern Hardwood and Rich Northern Hardwood Forests were selectively logged from 2003 to 2005 as part of a Vermont Family Forests and FSC-certified management plan. Hay-scented fern has densely colonized some of the more heavily harvested spots and appears to be suppressing tree regeneration.

At the south end of the lots, adjacent to the wet flat along the highway, an extremely steep hillside runs the length of the property. The soils of these southern hills and associated benches are somewhat excessively to excessively drained sandy, glaciofluvial soils (Colton series) where a Beech-Red Maple-Hemlock Northern Hardwood Forest natural community occurs. Sugar maple, which requires higher levels of moisture and nutrients, is absent from this area.

In the southwest corner is a very small (0.2 ha (0.6ac)) Hemlock Forest with uneven-age forest structure; tree sizes range up to 75 cm (30 in) dbh; the remainder of the Hemlock Forest polygon falls onto the adjacent parcel and is a very young stand recovering from clearcutting. To the south, adjacent to the highway, a seepy linear basin includes Hemlock-Balsam Fir-Black Ash Seepage Swamp, Hemlock-Northern Hardwood Forest, and a small open Seep.

Evidence of wildlife was observed throughout the property. Moose and deer tracks were present. Perhaps most notably is a location of beech with a moderate amount of older bear scarring. The site may, based upon the density of scarred trees, qualify as Vermont Fish and Wildlife Department necessary black bear habitat, although

we do not know if the scarring occurred within the last 10 years, which is part of the state's definition of necessary black bear habitat.

Goshen Brook Lots

Ecological highlights of the Goshen Brook lots are the two mountain brooks that flow through the parcels, a very fine piece of Hemlock-Northern Hardwood Forest, and the downstream tip of a seepage wetland which is mostly on national forest land. Lot is nearly fully surrounded by GMNF land.

Exemplary Natural Communities	Hemlock-Northern Hardwood Forest	Lowland Spruce-Fir Forest
Natural Community Explanation	B-ranked S4 type	C-ranked S3 type, part of a larger occurrence most of which is on Bread Loaf lands
Species of Special Interest	Plant species uncommon in the landscape, Goldie's fern	
Species rarity rank	Formerly S3, now S4	
Species notes	In Seep, upslope portion of population is on GMNF lands	
Recreation features		
Parcel-specific Management Items	Presence of a well-tended campsite and fire-ring on flat adjacent western brook; develop agreement with user(s)?	Plan needed for the mowing regime of field in Lot 1

Goshen Brook Lots 1 and 2

The Goshen Brook Lots are located south of the Chatfield parking area along the eastern of two local streams named Goshen Brook. From the creek bank at 463 m (1,520 ft) the property rises gently to a low knoll of 512 m (1,680 ft) in the center of its southern half. The sloping lands generally face the north. A confluence of two smaller brooks is located at the center of the northern lot.

The lower-lying areas feature a lot of hemlock, while on the sandy glaciofluvial features—a knoll in the center of the southern lot and a low ridge alongside the road in the northern lot—beech is prominent in Beech-Red Maple-Hemlock Northern Hardwood Forest. In the lower sandy flats of the property's northeast corner Lowland Spruce-Fir Forest straddles the line of the college and national forest lands. Hemlock-Northern Hardwood Forest lines both of the brooks and forms a state-significant occurrence; the polygon in the southeast corner showcases the most mature forest structure of these two lots. The abundance of coarse woody debris and the larger diameter hemlock and sugar maple noticeably differ from other forest stands on the college and adjacent lands.

In the southeast corner of the property the forest opens into a seepy wetland that is connected to a larger Seep/beaver wetland on national forest land. A sizable population of the seldom-seen Goldie's fern (*Dryopteris goldiana*) occurs in the Seep.

Moose scat, tracks and barking were all frequent. Except for the more mature area of Hemlock-Northern Hardwood Forest, snags and cavity trees were sparse.

Goshen Brook Lot 2 contains an open field which appeared to be mowed annually. A fire pit was found at the center of the lot and a well-tended campsite with woods-road access sits on a lovely flat next to Goshen Brook. Logging was apparent in most sections of these parcels, with heaviest activity seen in the area of dense spruce regeneration in the northeast quadrant. An open area with apple trees appears to mark the location of an old homestead near the boundary between the two lots. South of the small opening, in the Sugar Maple—White Ash—Jack-in-the-Pulpit Forest, a nearly level area has the appearance of a formerly plowed field. Most other parts of the parcels were pastured in the past.

Snow Bowl

The Snow Bowl is the only college land that is truly high mountain slopes, which is the landform that to most people is classic Green Mountain terrain. Natural community diversity is rather high, with a mix of northern hardwood and montane forest types, varying levels of nutrient enrichment and scattered wetlands. A large portion of the terrain is within state-significant natural communities. Presence of steep terrain and mountain headwater streams of both the Middlebury River and White River watersheds; these lands thus serve important watershed functions.

Exemplary Natural Communities (continued next pg.)	Montane Yellow Birch-Red Spruce Forest	Seep	Montane Spruce-Fir Forest	Hemlock-Red Spruce-Northern Hardwood Seepage Forest	Hemlock-Red Spruce-Northern Hardwood Forest
Natural Community Explanation (continued next pg.)	A-ranked S3 type, large extensive occurrence on adjacent lands also	A-ranked S4 type, numerous Seeps, one of which is remote and high-quality, others medium quality	B-ranked S3 type, most of occurrence not on college parcel	B-ranked S3 type	B-ranked S4 type, small but very high quality example at Bailey Falls
Species of Special Interest	1 rare species, Shore sedge	Species that are uncommon in the landscape: Fragile fern, Goldie's fern, Braun's holly-fern, Wild-millet;			
Species rarity rank	S2	latter three species formerly S3, now S4			
Species notes	Shores of Lake Pleiad				
Recreation features	Alpine ski trails and lifts, Long Trail				
Specific Management Items (cont. next pg.)	Invasive species control could be considered for the several populations on parcel		Include consideration of state-significant natural communities and the forest's important watershed functions in ski area management decisions.		

Snow Bowl (cont.)

Exemplary Natural Communities (cont.)	Rich Northern Hardwood Forest	Sugar Maple—White Ash—Jack-in-the-Pulpit Forest	Northern Hardwood Seepage Forest	Northern Hardwood Talus Woodland	Red Spruce-Cinnamon Fern Swamp	Lake Pleiad
Natural Community Explanation (cont.)	B-ranked S4 type, some very fine patches, rather rare in this high-elevation landscape	B-ranked S4 type	B-ranked S3 type, unusual high elevation example	B-ranked S3 type, perhaps rare in local landscape	C-ranked S3 type, locally significant	Montane pond with diversity of aquatic plants; rare feature in landscape
Specific Management Items (cont.)	The snow-making pond has been identified as creating artificial flow conditions in the South Branch nearly to the confluence with Goshen Brook, due to insufficient flow below the pond					

Snow Bowl

The Snow Bowl parcel is the largest of the college mountain lands parcels and is the only one that extends to the spine of the Green Mountains. The elevation range extends from 503 m (1,650 ft) along the South Branch in the northwestern corner to 884 m (2,900 ft) along the Long Trail on the mountain spine in the southwestern corner, upslope of the ski area development. Aside from level areas along the northern shoulder of Worth Mountain and scattered mid-slope benches and concavities, the lands are moderately to very steeply sloping. Slope aspects include western, northern and eastern faces, with the latter two very much predominating. The Snow Bowl includes headwaters streams of both the Middlebury River, which is part of the Lake Champlain watershed, and the White River, which is part of the Connecticut River watershed. Lake Pleiad is a natural 2.2-ha (5.5-acre) high-elevation pond. A smaller, man-made snow-making pond sits lower on the slope close to the Neil Starr Shelter (ski lodge). The Snow Bowl is the only portion of the college lands with upper mountain slopes and, therefore, typical mountain-slope till soils. The most extensive soils are shallow-to-bedrock, somewhat excessively drained Lyman very rocky loam and well drained Berkshire and Marlow extremely stony fine sandy loams. Smaller areas of moderately well drained Peru extremely stony loam and somewhat poorly to poorly drained Cabot extremely stony loam occupy some mid- and lower-slope positions.

The predominant natural community at the Snow Bowl is Typic Northern Hardwood Forest, the classic matrix forest of the Green Mountains below approximately 610 m (2,000 ft) elevations. These Northern Hardwood Forests are uneven-aged stands, and some areas have numerous large diameter trees in the 50-60 cm (20-24 in) dbh range; the general forest structure shows dominant trees in the 30-40 cm (12-16 in) range. Upper portions of the Snow Bowl, above 760 m (2,500 ft), are montane forest types, predominantly Montane Yellow Birch-Red Spruce Forest with only small patches of Montane Spruce-Fir Forest. Both of these montane forest types are part of extensive state-significant examples, the bulk of which are to the south in the national forest Joseph Battell Wilderness Area. Also of statewide significance at the Snow Bowl are the several patches of Rich Northern Hardwood Forest which mostly lies in a band between 610 and 700 m (2,000 and 2,300 ft). The rich forests contribute greatly to the herbaceous species diversity of the Bowl and also feature some of the best developed forest structure. Sugar maple with diameters 60 cm (24 in) to even 75 cm (30 in) dbh were not uncommon through much of the rich forest area. Of local significance is a trio of small Red Spruce-Cinnamon Fern Swamps, positioned mid-slope in nearly circular depressions. Additional natural communities contribute to the diversity of this mountain landscape. These include state-significant Northern Hardwood Talus Woodland and Hemlock-Red Spruce-Northern Hardwood Seepage Forest. Also state-significant is a very nice, mature but small piece of Hemlock-Red Spruce-Northern Hardwood Forest in the lot's corner at Bailey Falls.

Among the more surprising finds is the high-elevation Subacid Forest Seep near the southwest corner. That deep-peat (<130 cm (51 in)) wetland has characteristics of both red spruce swamp and forest Seep. The plants are an unusual mix of “typical” swamp trees—red spruce, fir, yellow and paper birches—and Seep/seepage swamp herbs—northeastern manna grass, turtleheads, bristly aster, scabrous and gynandrous sedges. Small, more typical forest Seeps on the mid- and lower-slopes are another natural community notable in the landscape; several have been mapped at the Snow Bowl, mostly on the east-facing terrain; there are certainly more that were not encountered during this work.

A small Herbaceous Seepage Marsh adjacent to Route 125 on the eastern side of Middlebury Gap is the only open wetland on the parcel. It contains two invasive exotic plant species, wild chervil and reed canary grass. The invasive grass also occurs in a Subacid Forest Seep adjacent to a ski trail in a mid-slope location. Such populations of troublesome non-native species are rare locally, and these are the only known occurrences of invasives within the natural communities of the Snow Bowl parcel.

Edwards Parcels (grouped Edwards Lot, Edwards Second Gift, Gibeault Lot)

The Edwards lands comprise a very interesting part of the landscape featuring a complex pattern of glaciofluvial- and till-based soils, groundwater seepage zones and headwater streams, as well as a high level of natural community diversity. The area also has a large amount of wetlands, is nearly fully surrounded by national forest and is remote from roads.

Exemplary Natural Communities (continued next pg.)	Hemlock-Balsam Fir-Black Ash Seepage Swamp	Hemlock-Red Spruce-Northern Hardwood Seepage Forest	Hemlock-Red Spruce-Northern Hardwood Forest	Hemlock-Red Spruce Forest	Hemlock Forest, plus an enriched variant
Natural Community Explanation (continued next pg.)	A-ranked S3 type	A-ranked S3 type	B-ranked S4 type	B-ranked S4 type	B-ranked S4 type
Species of Special Interest	Uncommon species: Yellow lady's-slipper, Swamp thistle	Plant species that are uncommon in the study area landscape 15 additional—see list below			
Species rarity rank	S3 species				
Species notes	Two populations and one population, respectively	Several are S4 species, formerly S3			
Recreation features	Catamount Trail				
Specific Management Items (continued next pg.)	Formal access agreement needed with in-holding owner/resident (Gover)	Access road management currently contributes to water quality degradation	Consider acquiring right of first refusal on in-holding		

Edwards Parcels (cont.)

Exemplary Natural Communities (cont.)	Rich Northern Hardwood Forest	Sugar Maple—White Ash—Jack-in-the-Pulpit Forest	Northern Hardwood Forest
Natural Community Explanation (cont.)	B-ranked S4 type	B-ranked S4 type	Part of large, protected (GMNF) occurrence
Specific Management Items (cont.)	Management planning needed for future of plantations	Noted trespass of small pole cutting (shooting lane) in Hemlock-Balsam Fir-Black Ash Seepage Swamp	Attention needed in several places on main road east of in-holding to manage water runoff/erosion

Edwards Parcels

The Edwards lands consist of over 526 ha (1,300 ac) of land approximately 800 m (0.5 mi) north of the Bread Loaf contiguous lands. A 0.8 ha (2-ac) in-holding, including an off-grid year-round residence, sits near the center of this large block of basically uninterrupted forestland. The college mows a 1.4 ha (3.5 ac) field in the south-central area, and the Catamount Trail runs east-west across the parcels, partially on a “permanent” woods road that extends north and east from the gate at the end of Wagon Wheel Road, and in small part recently re-routed through the woods to avoid the plowed road that provides access to the in-holder’s house.

These lands occupy very interesting terrain at 427 to 549 m (1,400 to 1,800 ft) in the headwaters of the Middlebury River Middle Branch. Glacial deposits from which the soils formed are a mix of glaciofluvial sands (deposited by water during glacial retreat) and basal till (deposited under ice and densely compacted); the complex pattern of deposits has led to fabulous juxtaposition of dry sites and wet sites, the latter characterized by high amounts of groundwater seepage. Additionally, headwater streams were able to incise deeply through the glaciofluvial sands and gravels, so we now see very steep slopes bordering the larger streams. One look at the shape of the contours on a topographic map indicates that this landscape is not typical evenly sloping or regularly undulating mountain terrain. The landform complexity is mirrored in the diverse mosaic of natural community types. Also noteworthy is the density of the stream network; more than ten streams coalesce near the center of the lands to form the Middle Branch.

Natural forest cover dominates the landscape, most of which was not historically farmed. Norway spruce plantation occupies much of the former field acreage; the larger of these have seen harvest throughout the latter third of the 20th century. Other lands have been logged repeatedly, although none of the operations were in recent decades. A cultural feature well-known to Rikert Center skiers who adventure to the farther reaches of the trail system is the “blue bed house.” The former hill-farm homestead is now collapsed and losing its prominence as a landmark. Old foundations, fence remnants and successional fields are the legacy of the former hill-farm homestead.

The lowest portions of the landscape are a mosaic of Hemlock-Red Spruce-Northern Hardwood Forest, Hemlock-Red Spruce-Northern Hardwood Seepage Forest and Hemlock-Balsam Fir-Black Ash Seepage Swamp. A “hemlock theme” on large portions of these lands comes through pretty clearly. The seepage forest and swamps are particularly interesting; both are A-ranked, state-significant examples of uncommon natural community types. In general, these wetland ecosystems are in better condition than the upland forests, simply because they do not support the valuable hardwood trees that loggers sought. Intermixed with the lower-terrain natural communities, or in some cases adjacent to them upslope, are sizable patches of Sugar Maple—White Ash—Jack-in-the-Pulpit Forest, which is the name used in Vermont for moderately enriched Northern Hardwood Forest. One very fine example of Rich Northern Hardwood Forest

occurs on a flat adjacent to a small headwater brook in the northwest of the lands. Forest with such richness is uncommon in the local landscape. These lands even feature a moderately enriched variant of Hemlock-Red Spruce-Northern Hardwood Forest; nutrient enrichment of these places surely comes from subsurface flow of water boosting the mineral levels available to plants. These rich and moderately enriched natural communities are also state-significant (B-ranked S4 communities). With the large area of seepage forest, seepage swamp, moderately enriched and rich forest, plant species diversity is very high in the Edwards parcels. Two uncommon species were observed (yellow lady's-slipper and swamp thistle), as well as a number of species that are uncommon in this central Green Mountains landscape, such as plantain-like sedge, Goldie's fern, barren-strawberry, leatherwood, New England groundsel, American spikenard, and skunk-cabbage). Adding to the diversity of these lands is a small patch of recently clearcut Lowland Spruce-Fir Forest. Although too small and too young to be state-significant, the community, another rare element in the regional landscape, is locally significant.

The higher parts of Edwards lands feature two Northern Hardwood Forest types—the typic (sugar maple-beech-yellow birch) forest, which occupies the well-drained till-based soils, and the Beech-Hemlock-Red Maple Northern Hardwood Forest variant, which is the primary type on the well to somewhat excessively drained glaciofluvial deposits. Beech-Hemlock-Red Maple Northern Hardwood Forest occurs in several patches on college lands and extends onto national forest lands; 28 ha (70 ac) are within the college lands and a quick interpretation of topographic contours and black-and-white orthophotography indicates a likely total of 40 to 60 ha (100 to 150 ac), a rather large area of this variant. Typic Northern Hardwood Forest is more extensive; nearly 80 ha (200 ac) are mapped on the Edwards lands and this type covers the bulk of the landscape on the adjacent national forest lands.

Non-forested wetland communities occur in a complex of ponds and marshes along one tributary in the east-central portion of Edwards lands. This is the largest area of open wetland on the college lands, but a conversation with Gover, the owner and occupant of the in-holding, revealed that these are not entirely natural wetlands. Gover reported that he and his son constructed the “beaver” dams between 1950 and 1955. Their objective was to create waterfowl, marsh and pond habitat. Beaver have inhabited the ponds and worked the dams periodically, and the wetlands have changed as the beavers have come and gone through the decades.

Other information gleaned from Gover was that the last logging (aside from the plantation harvests managed by Steve Weber) was in the 1970s and 80s; logging was conducted by Masterson, a relative of his (or perhaps his wife's family). He knew little more about the logging history. He has resided permanently on his parcel since 1990 when he moved down from Williston. He reports that both porcupine and fisher have increased in recent years, he hears geese frequently on the ponds but not ducks, and hunting has tapered off since he moved there and requested that the college install a

gate on the road. He also told us that the concrete slab at the end of the public road was a dance hall known as the Wagon Wheel Dance Hall. Other longer-term residents of Ripton surely know more of that history.

To summarize, the natural community and floristic diversity on the Edwards lands are likely greater than what occurs on the broader landscape. Elevated diversity is due to the interacting combination of landscape position, glacial deposits and surface and groundwater hydrology. These factors also lead to higher than typical diversity on the Bread Loaf contiguous lands, but the extensive groundwater seepage on the Edwards lands and the extensive acreage of rapidly drained glaciofluvial sands and gravelly sands make for a very different landscape occupied by the Edwards lands.

List of “Unusual” Plant Species Observed in Edwards lots

Battell Research Forest (Abbey Lots)

Battell Research Forest contains old-growth Hemlock Forest that is of significance within the province of northeastern forests. The steep to extremely steep slopes are classic escarpment terrain with a mix of Hemlock Forest, red and white pine forest, temperate acidic cliff and Northern Hardwood Forest. The research forest parcel also includes a swamp in a saddle between a pine ridge and steep hemlock slope. Research on fire history and gap regeneration has contributed to knowledge of Hemlock-Northern Hardwood Forest dynamics.

Exemplary Natural Communities	Hemlock Forest
Natural Community Explanation	A-ranked S4 type
Recreation features	GMNF Abbey Pond Trail crosses through both lots
Specific Management Items	Legal conservation protection and a conservation management plan, including research and recreation considerations, are needed for this forest of statewide and regional significance If not in existence, agreements with GMNF with regard to trail maintenance should be established

Battell Research Forest (Abbey Lots 1 and 2)

Battell Research Forest is part of the Green Mountain western escarpment, a steep rocky slope that defines the western extent of the Green Mountains in southern and central Vermont. Soils of the forest are a mosaic of excessively and somewhat excessively drained Lyman extremely rocky loam and well drained Berkshire extremely stony loam. The research forest parcel is bordered by Abbey Brook and a branch of Dow Brook on the north and south, respectively. The land is at a middle elevation on the escarpment, ranging from 210 m (690 feet) to 418 m (1,370 feet).

The old-growth forest is a landscape of dense Hemlock Forest intermixed with Hemlock-White and Red Pine Forest (Red Pine Forest seems the best fit for this ridge, per the Vermont natural community classification) and Northern Hardwood Forest. The National Park Service has designated Battell Research Forest as a National Natural Landmark in recognition of its national-level significance as one of the very few remaining old-growth forests in the eastern United States (<http://www.nature.nps.gov/nnl/site.cfm?Site=BATT-VT>). The forest history and its vegetation dynamics are subjects of much research. Extensive descriptions can be found in the papers listed and others:

- Mann, D. H., F. B. Engstrom, and J. L. Bubier. 1994. Fire history and tree recruitment in an uncut New England forest. *Quaternary Research* **42**:206-215.

- Gilbert, A. 2000. The composition of woody plant seedlings in forest gaps created by the 1998 ice storm in an uncut hemlock forest in Vermont. Undergraduate thesis, Middlebury College.
- Jewell, K. 2002. Forest regeneration in 1998 ice storm gaps in an old-growth hemlock forest in Vermont. Undergraduate thesis, Middlebury College.
- Hewitt, R. 2005. Spatial regeneration patterns of old-growth hemlock forest gaps in the Battell Research Forest, VT. Undergraduate thesis, Middlebury College.
- Tuttle, E. 2009. Roost tree usage by southern flying squirrels (*Glaucomys volans*) in an old-growth forest. Undergraduate thesis, Middlebury College.
- Weverka, A. 2009. Two roads diverge: how shifting disturbance regimes change forest composition. Undergraduate thesis, Middlebury College.

In addition to the significant forest, Temperate Acidic Cliff may be part of a more extensive and thus state-significant example; it is certainly a locally significant natural community. Most of the non-forested areas on the escarpment south of Bristol Cliffs are not as steep as the feature in the Research Forest and thus are Temperate Acidic Outcrops rather than cliffs. The seepage swamp at the site drains to the south into Dow Brook.

A small section of the GMNF Abbey Pond Trail crosses through Abbey Lots 1 and 2, and the bridge over Abbey Brook is in Lot 2. Recreation- and research-use guidelines should be determined to help protect the ecological values of the Research Forest.

Clapp Lot

On Hogback Mountain, part of the Green Mountain western escarpment, Clapp Lot is the only college parcel that includes Dry Oak Forest and woodland. These ridgetop community types are patches within a matrix of Temperate Hemlock Forest. A secluded natural pond and two Vernal Pools add species and habitat diversity to the otherwise dry landscape. The Clapp Lot forests are in better condition than those on parcels north and south of the college land, as a result of much more judicious logging on the part of the college. Most recent harvest occurred in the late 1980s; mostly red oak were removed.

Exemplary Natural Communities	Dry Oak Forest	Temperate Hemlock Forest	Dry Oak Woodland	
Natural Community Explanation	A- or B-ranked S3 type, part of a larger occurrence extent of which was not determined in this study	A-ranked S4 type, of a much larger occurrence extent of which was not determined in this study	unranked S2 community, patches on lot too small to map and extent on other parts of Hogback Mountain unknown	
Species/Habitat of Special Interest	Hay sedge	Vernal Pools, appeared small and may not stay wet long enough to support amphibian breeding	Bear sign: marked red pine in Dry Oak Forest and fresh scat	Small great blue heron rookery at north end of pond; it did not appear to be active during 2009 site visit
Species rarity rank	S2			
Species/Habitat notes	Population on rocky outcrop adjacent to pond		Acorns, beechnuts and blueberries equal abundant bear food	
Recreation features				
Specific Management Items	Refreshing boundary markings recommended since lot is surrounded by private land in an area with frequent timber harvest		Adjacent landowner's logging access passes through Clapp Lot; agreement and monitoring for this are needed if it is to continue	

Clapp Lot

The Clapp Lot is an extremely rocky and in many places very steep piece of ridgeline forest on Hogback Mountain, situated on the town line due east of the north end of the Bristol Pond. Elevation of the lot is from 275 to 366 m (900 to 1,200 feet) above sea level. The highest ridge along all of Hogback's length is 507 m (1,663 feet) and is approximately two kilometers (1.2 mi) north of the Clapp Lot. Bedrock of the mountain is Cheshire Quartzite, the same formation as that at Bristol Cliffs and along the whole of the steep Green Mountain western escarpment. The topography varies from nearly level, narrow ridgeline to extremely steep and very rugged slopes and ledges. The Clapp Lot, which is only 0.6 km (1,970 feet) wide, includes four different north-south ridges with hollows between them. Several of the ridges are bordered by both west and east facing nearly vertical ledges. Soils are mapped as rock land for the entire parcel, but that is inaccurate and surely some of the soils are better characterized as Lyman and Tunbridge extremely stony fine sandy loams. The southern third of a large beaver pond extends onto the tract. The pond flows into the principal headwater stream of Beaver Brook, a tributary of the New Haven River. The only other surface waters on the site consist of several Vernal Pools. A one-tenth hectare swamp forest in the hollow south of the pond and the small Vernal Pools within the eastern strip of Typic Northern Hardwood Forest are the only wetlands on the site, but are too small to map.

Clapp Lot is comprised of numerous forest types, most of which are dry to extremely dry. The land shows a very clear pattern of hemlock-oak forests on the ridges and deciduous forest of slightly varying composition in the hollows. The highest ridgetop features Temperate Hemlock Forest on the level ridge, with Dry Oak Forest, an uncommon natural community type, on the south-facing noses of the ridge. Among the Dry Oak Forest are just a few small patches of Dry Oak Woodland, a rare natural community type. These natural communities are part of a documented natural heritage element occurrence that consists of many patches of Dry Oak Forest and Dry Oak Woodland on Hogback Mountain. Woodland differs from forest in that it has an open canopy (<60% tree cover). At this site, the composition of the dry forest and the woodland do not differ much, but the forest structure does differ. Red oak is the dominant tree, with red pine and white pine as associates or co-dominants. Along the highest ridgeline, white oak is present in the forest but is very scarce, while in the lower forests, white oak is much more prominent. Trees are very stunted due to the extreme dry, hot, and windy conditions. There is no tall shrub layer, but the low shrub layer is a dense growth of black huckleberry, early and late lowbush blueberries, and, in the woodland areas, black chokeberry and juneberry. Tree diameters are in the 20 to 30 cm-dbh range. A 32 cm (13 in) dbh red oak was approximately 85 years old, and a 23 cm (9 in) dbh red pine was approximately 65 years old. Fire scars and charcoal (on both stumps and the bases of red pine and hemlock), along with the multi-trunked structure of red oak, indicate a history of fire. It is very likely that the 63-year old red pine established after a fire in which only the most fire-resistant trees survived. Such a

disturbance dynamic is very typical of the heights on the steep mountain slopes that border the Champlain Valley.

The lower ridges host Temperate Hemlock Forest, with the south-facing noses supporting Dry Oak Forest. White pine is a common associate tree; red pine is scarce. Red maple, beech, and sweet birch are present. The forest on the east side of Hogback Mountain was not logged in 1988 and has a more natural structure. The 1988 timber harvest removed most of the large oak on the western side of the ridgeline; stumps indicate many cut trees were approximately 50 to 65 cm (20-26 in) dbh. On the west side of the main ridge, the standing forest now has dominant oak trees in the 35 to 40 cm (14 to 16 in) diameter range and dominant hemlock to 50 cm (20 in); the scattered white pine are generally 40 cm (16 in) or slightly larger. Cored trees (waypoint 001) revealed ages of 169 years for a 43-cm (17-in) white oak and 146 years for a 45-cm (18-in) hemlock. On the east side of the ridge, oak between 40 and 60 cm (16 and 24 in) dbh are common, and hemlock seems to be a little smaller, with few trees over 40 cm (16 in) dbh observed. The ground cover throughout this forest type is very sparse and species-poor, as is typical under dense hemlock. The understory has many subcanopy, pole and sapling hemlock. Coarse woody debris in the forest is beginning to develop, with numerous, fallen smaller-diameter trees that died in the understory and subcanopy, and, on the east side, numerous downed large trees.

The steepest slopes, such as the one south of the beaver pond (east of waypoint 004 to the ridgeline) are Hemlock Forest, with few other species. The lower slopes and the narrow ravine at the base of the steep slope have large trees, up to 60 cm (24 in) dbh; a large hemlock (52 cm (20 in) dbh) was found to be about 155 years old. Higher on the slope, the drier, shallower soils support much shorter and smaller hemlock. No open talus appears at the site, but large, blocky, Cheshire-quartzite talus has fallen to the forested ravines. On the east side of the height of land is scenic a “giant’s staircase” formation of enormous, staggered slabs of the quartzite bedrock. The age structure and lack of human disturbance indicate that this area is state-significant Hemlock Forest. It is likely that there are additional undisturbed patches of Hemlock Forest on extremely steep slopes of Hogback Mountain, and the college-owned piece may be part of a larger state-significant occurrence of this natural community type.

Dry Oak Forest, which is only on the south-facing slopes, has red and white oaks co-dominant, with white and red pines, hemlock, and red maple as associates. All trees have stunted, contorted stature. The huckleberry-blueberry low shrub layer is dense, and bracken fern is scattered throughout.

Diversity of plant species and forest types is enhanced by the complex topography. In the hollows one finds a number of wet and mesic ecosystems that host a greater assortment of trees and herbs. Mesic forest in the hollows features beech-red maple forest. The influence of the warm, Champlain Valley climate is seen in the occurrence of witch-hazel, maple-leaved viburnum, and sweet birch. At least one hollow is moist and rich enough to support maidenhair and lady ferns and downy yellow violet. Another

cooler hollow has a more northern feel, with an abundance of hobblebush and yellow birch, and a bit of bluebead lily. That cooler, moister hollow is the only area on the lot that includes sugar maple. The hollow at the base of the “giant’s staircase” is a rocky, treeless fern glade with a mixture of intermediate wood fern, and New York, interrupted, Christmas and hay-scented ferns. South of the fern glade the hollow features a series of Vernal Pools. The northern one probably does not hold enough water most years to function for amphibian breeding, but the southern one appears to be deep and wet enough to do so.

The mapped, small wetland south of the beaver pond is an acidic basin swamp of approximately one-tenth hectare. A very open canopy of stunted hemlock, yellow birch and red maple tops an herb layer of cinnamon fern, wild iris, wool-grass, Canada manna grass, three-seeded sedge, and northern water-horehound. Mounds of floating sphagnum and pools of water are intermixed in the swamp. The north end of the beaver pond, on an adjacent ownership, is the site of a great blue heron rookery that was known to be active as recently as 2007.

In addition to the diversity of forest and wetland types on the small parcel, we noted one rare plant and several signs of active bear use. The rare hay sedge (*Carex argyrantha*) grows on a small ledge on the west side slightly above the beaver pond. This sedge has been documented at one other location on Hogback Mountain, and given that rock ledge is one of its preferred habitats, it is likely that there is a population of hay sedge scattered on the Hogback. Bear sign observed during our visit included a fresh scat with acorn shells and a 32 cm (13 in) dbh red pine that has been repeatedly marked with bear bites; one bite was fresh from this summer.

The management of Clapp Lot is in striking contrast to the adjacent parcels, which have seen more intensive tree harvest. The adjacent lands, as looked at from the property boundaries, are hardwood forest, with overstory dominated by paper birch and smallish diameter beech. The lack of overstory hemlock and oak dominance appears to be a clear artifact of forest management. Hence, the Clapp Lot, with its light and very infrequent harvests, is a very good example of the more natural forest condition.

Natural Communities: General descriptions, Ranking and Significance

Methods of Natural Community Classification and Ranking

Protocol for classifying and ranking natural communities has been developed by ecologists working with state natural heritage programs The Nature Conservancy's science division, and NatureServe. The State of Vermont utilizes a natural community classification published as *Wetland, Woodland, Wildland* (Thompson and Sorenson 2000), which has been revised and updated with input from a number of natural community inventory projects completed since the publication of that published version. Current classification of natural community types can be accessed at http://www.vtfishandwildlife.com/library/reports_and_documents/nongame_and_Natural_Heritage/Natural_Communities/_List_of_Natural_Community_Types_and_Other_Classification_Systems.pdf where a January 2009 update is posted.

In addition to utilizing the existing Vermont classification, our work has been informed by the New Hampshire classification (Sperduto and Nichols 2004), which has taken the approach of more refinement in the classification and thus has more types and subtypes (variants). In cases where no good fit has been described in the Vermont classification, we turn to the New Hampshire classification. If no good fit was located in the latter, we provide our own description of the natural community that occurs on the land.

Documentation for ranking methodology has been published by NatureServe (2002). In short, ranking is based on three factors: community condition, occurrence size, and landscape context (condition of the broader surrounding landscape in which the natural community is located). Ranking individual natural communities of different types is done by assigning different weightings to these three factors. The apportionment of importance (weighting) of the three factors is determined by state ecologists working for natural heritage programs, based on guidelines published by NatureServe. In Vermont this work has been led by Eric Sorenson, ecologist with Vermont Fish and Wildlife Department Natural Heritage Information Project.

Ranking is based on a scale of A to D, in which A=4, B=3, C=2 and D=1. The three factors are ranked and then combined into an "element occurrence" ranking based on the assigned weightings for a natural community type. Where no weightings have been assigned, equal weightings of the three factors are used. Letter ranks are then assigned to each natural community occurrence according to the following:

EO Rank	Numeric Values
A	>3.25 and ≤4.00
B	>2.50 and ≤3.25
C	>1.75 and ≤2.50
D	>1.00 and ≤1.75

In addition to ranking of the different natural communities, each type of natural community has been assigned a “state rank,” or “S-rank,” which denotes its rarity or commonness in the state. This same rarity scale is also used at global (G-rank) and national (N-rank) scales, and some ecologists have developed congruent local scales also. The state rank descriptions are as follows:

- **S1:** very rare in the state, generally with fewer than five high quality occurrences
- **S2:** rare in the state, occurring at a small number of sites or occupying a small total area in the state
- **S3:** high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered
- **S4:** widespread in the state, but the number of high quality examples is low or the total acreage occupied by the community type is relatively small
- **S5:** common and widespread in the state, with high quality examples easily found

State Significance

Determination of state significance is based on guidelines developed by the Vermont Natural Heritage Inventory Program. The guidelines have no legal or regulatory significance, but rather are used to determine whether a particular site will be included in the state database and included in inventory reports (if inventories have been undertaken for the natural community type or region involved). The guidelines are included as Appendix 1.

Northern Hardwood and Hardwood-Conifer Forest and Woodland Types **NORTHERN HARDWOOD FOREST—TYPIC VARIANT**

State-significant occurrence—Likely. The Northern Hardwood Forest on college lands cannot be evaluated for ranking and significance on its own, since this type is the matrix forest—the predominant fabric of the landscape within which all other types occur as smaller patches. From a statewide perspective Northern Hardwood Forest on college lands in the Bread Loaf region will likely be seen to be parts of two, large A-ranked occurrences, one north and one south of Route 125. National Wilderness Areas lie both north and south of the highway and can be seen to form cores of the two occurrences. The college lands, which largely abut Route 125, are on the periphery of the two large occurrences. The Vermont Fish and Wildlife Department has been systematically evaluating large forest blocks and will likely in the future issue a determination of the rank and significance of these northern hardwood matrix forests within which the college lands lie. It is expected that the college lands Northern Hardwood Forest will be considered state significant.

Extent and patch pattern—The typic variant of Northern Hardwood Forest is a matrix-forming natural community in northern New England. Northern Hardwood Forest is not only one of the most extensive types on the college lands, it is also the

“matrix” of the natural community mosaic on the entire landscape in which the college parcels sit. The college lands, however, are not actually a representative piece of the overall landscape since they 1) center on the plateau landforms described above, and 2) cover a relatively small area of hill tops and upper slopes (Figure 2). Thus, Typical Northern Hardwood Forest is not as prominent a part of the college forest lands as one might think given the general “mountain” location. The largest blocks of Northern Hardwood Forest on the college lands are in the Snow Bowl parcel on the northern and eastern slopes of Worth Mountain.

General description—Northern Hardwood Forest is the most common forest type in Vermont. Since it is so widespread and occurs on so many different landforms and soil types, its ecosystem characteristics of composition, structure and productivity are very variable. Even what is considered as “typical” shows quite a lot of variation. Typical Northern Hardwood Forest is co-dominated by at least two of the three primary northern hardwood species—sugar maple, beech, and yellow birch. In the college’s mountain lands, much of the northern hardwood terrain was cleared for pasture; the slopes of the Snow Bowl, Battell Research Forest and Clapp parcels are exceptions to this generality. The current forest composition on the former pasture lands reflects a mid-successional forest stage with differences in composition and structure in different places related to time of pasture abandonment, intensity of livestock use (grazing pressure and length of use), available seed source (distance to seed trees during earlier successional stages from which the current forest has developed), and soils and hydrology. Sugar maple is scarce or absent on some of the lands mapped as Typical Northern Hardwood Forest; this is thought to be related to interactions of the above-mentioned factors, and perhaps especially to lack of seed source during re-establishment of forest. The lack of sugar maple in these mid-successional forests regrown on long-abandoned pastures is one of the unanswered ecological curiosities that the lands present to us. Furthermore, distinguishing between Typical Northern Hardwood Forest and Hemlock-Red Spruce-Northern Hardwood Forest (the latter type generally occurs on sites that are not amenable to an even moderate presence of sugar maple) is not a fully clear matter given the history of disturbance and questions of sugar maple seed source and re-establishment. Determination in our mapping has been made largely based on soils; we interpreted light, ashy gray E horizons and prominent mottling in upper B horizons (generally basal till parent material) as indicators of “non-sugar maple” sites, and thus mapped those as Hemlock-Red Spruce-Northern Hardwood Forest.

The mid-successional stage in which we now see the Northern Hardwood Forests is characterized by sugar and red maples, beech, yellow birch, and scattered hemlock. In places more heavily “worked” we find less sugar maple and more red maple, and varying but noteworthy amounts of paper birch and red spruce. The forests on the undulating plateau (where most of the lands lie, as opposed to the mountain slopes such as the Snow Bowl parcel) is the approximate elevation at which red spruce becomes a

characteristic member of the Northern Hardwood Forest. Although red spruce is currently present in many of these forests, there are a number “red spruce questions” to ask about these lands, such as: How much red spruce was present in the pre-settlement forest of any given area? Is red spruce likely to persist or is it likely to be present only for one generation? Hemlock presence and abundance raises similar questions. Hemlock is near the higher elevation limit at which the species characteristically occurs as a “more-than-rare” component of the Northern Hardwood Forest. One of the first things we noticed on the college lands is that hemlock is very common in a multitude of conditions (i.e., soils, hydrology and landscape position factors). Although it has regenerated or persisted well in many ecological settings, historical ecology research shows hemlock to have been more common region-wide in the Typic Northern Hardwood Forests than it now is (Cogbill et al. 2002). In line with these findings, we see hemlock in low abundance in the post-agricultural forests that contain a plethora of red maple and red spruce.

The Typic Northern Hardwood Forest stands in the study area share a common history of either former pasture land or numerous episodes of logging. As a result there is similar forest structure in most places. The overstory trees are in the 25-40 cm (10 to 16 in) dbh range, downed dead wood is uncommon, and cavity trees and snags are scarce. In some areas snags are more abundant, for they have developed from old pasture trees or dead/declining paper birch.

Common ground-cover species of the Typic Northern Hardwood Forest are intermediate wood fern, northern wood sorrel, Canada mayflower, and shining clubmoss. The lands show a great deal of patchiness in herb cover, and the species diversity may be lower or higher than “average” in any given place. Additional frequent species include sedges (e.g., roseate, common and feeble woodland, arching, few-nerved), hay-scented fern, sessile-leaved bellwort, and occasional painted trillium and Indian cucumber-root. In areas recently logged, particularly in Homer Noble Farm and the northernmost reaches of Bread Loaf 4, hay-scented fern has come to strongly dominate the groundcover vegetation. This species is known to detrimentally impact tree regeneration (Royo and Carson 2008, George and Bazzaz 1999), and the forest now features a very open canopy and with a fern-glade undergrowth.

Soils of the Typic Northern Hardwood Forest can best be characterized by the Berkshire and Marlow extremely stony loam soil series. These have an ablation till parent material, and the sand component is predominantly fine sand. Berkshire soils are spodosols, and in most places were seen to have thin E horizons with strong, bright B horizons. Since these soils developed under influence of deciduous trees, the E horizons are medium to even purplish gray rather than the light, ashy gray color found when conifers have exerted a stronger influence. Typic Northern Hardwood Forests tend to be on side slopes and low hilltops; the soils are well drained and densipans are either absent or quite deep in the profile.

*Community condition, size and landscape context*¹— Since Route 125 is a fragmenting feature, there are two separate element occurrences of this matrix community. Also, heritage program protocol ranks all Northern Hardwood Forest variants together, so this ranking discussion refers to Typic Northern Hardwood Forest, Sugar Maple—White Ash—Jack-in-the-Pulpit Northern Hardwood Forest, Beech-Red Maple-Hemlock Northern Hardwood Forest, Yellow Birch-Northern Hardwood Forest and Northern Hardwood Forest, beech dominated.

Condition of the natural community on the college lands can generally be characterized as two different types: 1) former pasture that has been re-growing as forest for 80 to 100 years and has undergone logging per methods other than clear-cutting, and 2) never-cleared lands that have been heavily logged by a variety of silvicultural methods. The largest and best condition patch on college lands is on the Snow Bowl parcel, which hosts the only truly high-mountain slope landform on the landholdings. Additionally, it is noteworthy that invasive species are very rarely encountered in these forests. According to Vermont ranking specifications for Northern Hardwood Forest the condition rank of Northern Hardwood Forests on college lands ranges from B (forest dominated by characteristic species and with many structural characteristics of a mature forest...but with selection harvesting resulting in stand age of 60 to 150 years old; forest is generally uneven aged, but may also be even aged, full recovery to mature forest conditions is expected for the majority of the EO, and other criteria) to C (alterations to composition and structure due to intensive logging or alterations such as grazing, stand age 15-60 years, full recovery or restoration of mature forest conditions is expected but may take many years or significant effort, and other criteria). The particular stands that were either formerly pastured or have undergone more intensive recent timber extraction better fit the C condition but the entire occurrences are ranked according to the overall condition of the whole.

Final landscape context and size rankings of the Northern Hardwood Forest element occurrences of which the college lands are small sections will be undertaken by state ecologist Eric Sorenson who is in the process of mapping large contiguous forest blocks and reports that the block north of Route 125 contains 55,600 acres of Northern Hardwood Forest and the block south of the highway has 34,500 acres. Thus, the size rank for each of these is certainly A, greater than 1,500 acres. Landscape context of each occurrence is likely to be considered A, highly connected landscape.

Element occurrence rank—(Size rank x 0.4) + (Landscape Context rank x 0.4) + (Condition rank x 0.2) = A (3.8). This should be considered to be the rank of a very large contiguous area of the northern hardwood matrix forest, most of which is in the Green

¹ These three factors are utilized by state natural heritage programs to calculate an “element occurrence” rank, which can be thought of as an indication of the ecological integrity, probable viability, and statewide significance of that natural community occurrence in its particular site. Refer to <http://www.natureserve.org/prodServices/eodata.jsp> for full methodology.

Mountain National Forest; the college lands are on the periphery of these intact forest block.

State natural community rank—S5, common and widespread in the state, with high-quality examples easily found. To be a state significant example, an S5 community type must have an element occurrence rank of A.

SUGAR MAPLE—WHITE ASH—JACK-IN-THE-PULPIT NORTHERN HARDWOOD FOREST (MODERATELY ENRICHED)

State-significant occurrence— Yes. This natural community type is considered a “variant” of Northern Hardwood Forest, but the state has given it an S4 rarity rank and we therefore have ranked it separately from the two large Northern Hardwood Forest occurrences north and south of Route 125, even though it ultimately will be considered part of the two large occurrences. Without on-the-ground ecological work, it is impossible (i.e., via interpreting aerial photography and other remotely sensed imagery) to differentiate this type from typical northern hardwood. The forest of this type on college lands is mostly mid-successional from old pasture, but there is a large amount of it in a highly connected landscape. Forest on the Snow Bowl parcel has been historically logged but is not regrown from pasture. Natural communities of this type north of Route 125 and in the Snow Bowl parcel are estimated to be state-significant occurrences.

Extent and patch pattern— Sugar Maple—White Ash—Jack-in-the-Pulpit Northern Hardwood Forest is listed as a small-to-large patch natural community type in Vermont. This forest type covers a substantial portion of the Homer Noble Farm’s western half and adjacent areas on the Upson and Bread Loaf parcels, as well as one large and several small parts of the Edwards parcels and Snow Bowl. Therefore, the natural community occurs as a large patch in part of our study area and as small, scattered patches in other parts.

General description—A large acreage of the college forestlands features a moderate boost of nutrients and moisture (above the levels of Typical Northern Hardwood Forest). This moderately enriched Northern Hardwood Forest type appears to be associated with Peru soils, but it is certainly not a perfect correlation. The elevated nutrient (and in some places moisture) status in this natural community allows for greater species richness than in sites with even slightly less moisture and nutrients. White ash, a common tree in the moderately enriched forests, is uncommon to absent in Typical Northern Hardwood Forests. Sugar maple is either dominant or co-dominant in this type and is more abundant than beech. Common herbs in the moderately enriched forests are lady fern and jack-in-the-pulpit. Other species include Christmas fern, Solomon’s-seal, false Solomon’s-seal, graceful sedge, early yellow and other violets, and red trillium. In moister successional woods interrupted fern may be abundant, whereas New York fern is often seen in abundance in less moist successional areas. Alternate-leaved dogwood is a shrub that indicates the greater enrichment of the Sugar Maple—White Ash—Jack-in-the-Pulpit type. Additionally, black cherry seems to occur in greater

numbers in this type than in Typic Northern Hardwood Forest. This natural community tends to occur on gentle to moderate, flat to concave slopes, and it is usual to see an increasing gradient of enrichment toward lower parts of a slope.

Productivity is greater compared with Typic Northern Hardwood Forest and most other northern hardwood types. Ash is a fast-growing tree and is frequently larger than other species at a given age, which can make these forests look older than they are. Additionally, sugar maple grows more rapidly in this type than in most other types except the Rich Northern Hardwood Forest natural community. Structure is similar to that of Typic Northern Hardwood Forest in this landscape. It is generally mid-successional, with canopy trees ranging from 25 to 40 cm (10 to 16 in) dbh and dead wood mostly related to decline of remnant open grown trees from clearcut or pasture succession.

Community condition, size and landscape context—Condition of all occurrences is B-ranked. Landscape context of Bread Loaf contiguous lands north of Route 125, Edwards lots, Snow Bowl and Goshen Brook parcels is A/B; south of Route 125 Bread Loaf contiguous lands and Coal Kiln lots rank as B for landscape context. Size rank categories have not been established by the state, and we have not ranked this factor. Were this variant ranked separately from Typic Northern Hardwood Forest we estimate EO ranks of B for the best quality occurrences, north of Route 125 and Snow Bowl.

State natural community rank—S4, widespread in the state, but the number of high quality examples is low or the total acreage occupied by the community type is relatively small. To be state-significant, an example must have an element occurrence rank of A or B.

NORTHERN HARDWOOD FOREST, BEECH DOMINATED (BEECH FOREST)

State-significant occurrence— Yes. This natural community type is considered a “variant” of Northern Hardwood Forest and is ranked as part of the Northern Hardwood Forest occurrences.

Extent and patch pattern—One small area of this unusual Northern Hardwood Forest variant occurs in the Bread Loaf 4 parcel. It is a small patch that occurs on a discrete landform and soil deposit.

General description—One area of the college lands appears to truly be a Beech Forest; the “reason” why beech occurs in a monotypic stand at the site is unclear, however. Neither the Vermont natural community classification type “Beech-Red Maple-Hemlock Northern Hardwood Forest” nor the New Hampshire type “Beech Forest” perfectly describes this forest ecosystem on the college lands. Both of those types describe beech as achieving dominance on coarser soils (washed till or sandy sediments) or convex knobs where soils are extremely well to well drained. The Beech Forest at Bread Loaf occurs on a level area with a stone-free, very fine sandy loam spodosol topped by a silt loam A horizon. The deposit is certainly water-laid, for the texture is very regular and the site is a level micro-feature. Aside from a smattering of old, open-

grown red maple that apparently remain from pasture succession, beech is the only overstory or understory tree. Hobblebush forms a dense shrub layer, and the herbaceous flora is species poor, with only intermediate wood fern, shining clubmoss, sessile-leaved bellwort and hay-scented fern present. The small polygon of Beech Forest is a unique little area and one of the most unusual Northern Hardwood Forest types found on the lands. Hemlock, although plentiful in the adjacent Hemlock Forest to the east, does not occur at the beech site, nor does sugar maple which is common to the west. It is clear neither if those two species would establish on such a site, nor why they have not heretofore.

Community condition, size and landscape context—Ranking of these factors is not done separately from the Typic Northern Hardwood Forest, of which this type is a variant. The Beech Forest patch is in rather good condition. Overstory beech and yellow birch are 30 to 50 cm (12 to 20 in) dbh; there are some larger red maple that have stout low branches indicating that they were open-grown; some of these large maple are good cavity trees and there are dead standing ones also. The single Beech Forest community covers 1.1 ha (2.7 ac).

State natural community rank—This type is not recognized as a separate natural community or variant in Vermont and is therefore not ranked. If one considers it to be within the definition of Beech-Red Maple-Hemlock Northern Hardwood Forest it would receive an S5 state rank. If one considers it to be a unique expression of Northern Hardwood Forest, it would likely receive a state rank of S3, since the land type on which the Beech Forest occurs is not something commonly found in the mountains of northern New England.

YELLOW BIRCH-NORTHERN HARDWOOD FOREST

State-significant occurrence— Yes. This natural community type is considered a variant of Northern Hardwood Forest and is ranked as part of the Northern Hardwood Forest occurrence.

Extent and patch pattern—A single small patch of this type was encountered on the Snow Bowl.

General description—As is typical of Yellow Birch-Northern Hardwood Forests, this occurrence lies on a cool, steep, rocky slope. Yellow birch dominates with associates of paper birch, red and sugar maples, red spruce and beech. The largest yellow birch are around 40 cm (16 in) dbh, whereas the general tree size is in the 20-30 cm (8 to 12 in) dbh range. Shrub species typical of this type of site are present, including mountain maple, mountain-ash, hobblebush, and red-berried elder. Intermediate wood fern is common in a mixed herb layer with painted trillium, bluebead lily, whorled mountain aster, sessile-leaved bellwort, and other typical northern hardwood herbs.

Community condition, size and landscape context—The Yellow Birch-Northern Hardwood Forest has not seen a lot of disturbance on the western side, but an eastern

band of it includes the land that was the site of the former ski jump, which was decommissioned in 1983. The patch is slightly over four acres.

State natural community rank—S5.

BEECH-RED MAPLE-HEMLOCK NORTHERN HARDWOOD FOREST

State-significant occurrence— Yes. This natural community type is considered a variant of Northern Hardwood Forest and is ranked as part of the Northern Hardwood Forest occurrences north and south of Route 125.

Extent and patch pattern—On the college lands this type is located on water-laid deposits of Colton soils in the upper Brandy Brook and upper Middle Branch watersheds, as well as on an esker (or esker-like feature) in the Goshen Brook Lot. A band of glaciofluvial Colton soils also occurs along the lower slopes in the Crystal Brook Lot. These features are distinct from the surrounding landscape and cover tens of acres.

General description—Beech-Red Maple-Hemlock Northern Hardwood Forests occur on sites with less available moisture and lower nutrient levels than those where typical forest grows. This type occurs on ridges and convex knobs, which often feature shallow soils from which moisture rapidly drains, and on sandy deposits that have low moisture holding capacity. Soil on these features is strikingly different from the till-based soils that dominate the landscape. These soils are loamy sand to sandy loam spodosols that typically feature very well developed E horizons. One auger hole on a ridge in the Bridgman and Wimett Lot had a remarkable 40 cm (16 in) deep E horizon; they are more typically one-quarter to one-half that depth. On the Goshen Brook esker the top 15 cm (6 in) (A horizon) is fine sandy loam, beneath which are layers of medium sand to medium fine sand, some of which are slightly loamy. The Edwards and Bridgman and Wimett areas tend to have some gravelly layers. The B horizons in all of these rapidly drained sandy soils are usually very brightly reddish colored.

Sandy, glaciofluvial landforms cover large expanses in the eastern half of the Edwards lots. Whether on well-defined ridges or on gravelly-sandy flats, the preponderance of beech cannot go unnoticed. A nearly constant companion to the beech abundance is the high density of hobblebush. Red maple is a common associate, whereas hemlock occurs in some areas and not others, and red spruce is occasional. Herb diversity is low in these forests; intermediate wood fern, starflower, Canada mayflower, painted trillium and shining and bristly clubmosses are the most common species. A portion of the Beech-Red Maple-Hemlock Northern Hardwood Forest north of the chain of beaver ponds on the Edwards lands occurs on a wet (somewhat poorly to moderately well drained) fine sand soil. Except for the pockets of wetland herbs in the scattered five-meter-radius depressions, the general composition is not very different from that on the dry sandy features. Logging is evident throughout these forests; it is not unusual to see strongly two-aged structure with an overstory of 35-50 cm (14 to 20 in) dbh trees and a regeneration stratum of 2 to 10 cm (1 to 4 in) dbh saplings/small poles. In some spots, remnant red maple “wildlife trees” are as large as 65 cm (25 in) dbh. In

all places, beech bark disease has severely infected the beech trees; dead wood is scarce, with beech snags or snaps contributing the only coarse woody debris.

Glaciofluvial ridges dominate the eastern parts of the Bridgman and Wimett, Norton, and USFS Exchange Lots. Forests show very strong dominance by beech. Red maple is common; red spruce and hemlock are less frequent. The understory supports many beech saplings within a dense growth of hobblebush. In addition to the above-mentioned herbs, bluebead lily, common wood-sorrel and goldthread are present there.

The Goshen Brook Lot occurrence has succeeded from old pasture. Beech dominates the understory, but the overstory is a mix of red spruce, red maple, hemlock and balsam fir. Striped maple is also a common understory species. Herb composition is similar to that described previously. The steep slopes of these glaciofluvial features are not so strongly dominated by beech; they tend to support a forest with a high percentage of hemlock and a mix of beech, red maple and yellow birch.

Community condition, size and landscape context—Condition varies throughout these patches. As mentioned, the Goshen Brook Lot woods of this type is re-growth on pasture and is in mid-successional status but has not regained the beech overstory typical of the natural community. The northern patch on the Bridgman and Wimett group parcels alongside Steam Mill Road has experienced fairly recent logging, but composition is characteristic of the forest type; dense beech sapling thickets have established post logging. The Edwards examples have also been logged in the latter half of the 20th century, but retain a closed to moderately closed canopy.

The Goshen Brook Lot Beech-Red Maple-Hemlock Northern Hardwood Forest area covers nearly 25 acres on college lands, with an additional acreage on adjacent GMNF lands. The northern patch adjacent to Steam Mill Road covers nearly 50 acres on college land, with again more land of this type on the national forest. In both cases, it appears that the college parcels contain the larger portion of these glaciofluvial features that support the beech-dominated forest. Topography east and north of the Edwards parcels (and the presence of a gravel pit on the topographic map) suggest that the glaciofluvial landscape is quite extensive adjacent to the college lands.

This natural community type is a variant of Northern Hardwood Forest and the occurrences are ranked along with Typic Northern Hardwood Forest. Were there especially mature or otherwise exemplary conditions or a different state rank, it would make sense to rank an occurrence of the variant separately, but that is not the case here.

State natural community rank—S5.

MESIC RED OAK-NORTHERN HARDWOOD FOREST

State-significant occurrence—No.

Extent and patch pattern—Only one small area of Mesic Red Oak-Northern Hardwood Forest occurs on college lands in the Bread Loaf region, with another occurrence on the Clapp Lot on Hogback Mountain. The former bit is in the Spear Lot, which is a parcel in the Middlebury Gorge landholdings (Battell Park-Middlebury River),

and likely is a downslope extension of an occurrence south of Route 125 in the vicinity of the GMNF Oak Ridge Trail.

General description—The landform of the Spear Lot occurrence is a small flat adjacent to the steep slopes of the gorge and the soil, a stony fine loamy sand, contributes to more of a dry-mesic forest than is typical for flats in the area. The lot is old farm field and the tree composition includes a mix of mid-successional species along with a bit of bigtooth aspen. In addition to red oak, black birch and bitternut hickory indicate that this woods is not a typical northern hardwood type. Other trees in the mix include white pine, red maple and white ash. The seedling and sapling strata are comprised of hemlock, sugar maple, beech and bitternut hickory. The Clapp Lot features only a small finger of this type, which is presumed to be very extensive on Hogback Mountain and may be a state-significant occurrence.

Community condition, size and landscape context— Condition of the Spear Lot occurrence, with its younger forest age and longer historic period of farming is ranked B/C. Size of 5 ½ acres on the college lands is D-ranked. The community is considered a large patch type in Vermont. Landscape context rank is B/C given the proximity of roads. EO rank = C (2.145)

No factors were ranked for the small piece on the Clapp Lot, since the larger occurrence is unknown.

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33).

State natural community rank—S4.

RICH NORTHERN HARDWOOD FOREST

State-significant occurrences—Yes; several locations host Rich Northern Hardwood Forest; the Snow Bowl is the area of greatest concentration. In the Bread Loaf contiguous lands a small segment occurs on college lands and an apparently larger portion extends east on national forest lands. A very fine, albeit small, example is on a western edge of the Edwards lots. The rich forest type is uncommon in the broader local landscape and was seen to occur only in small patches, thus the significance gains importance locally.

Extent and patch pattern—Small, scattered patches were found in several college parcels. One patch, located in the northeast corner of Bread Loaf 4 was seen to extend to the east onto national forest land but its full extent on the neighboring lands was not explored. The Edwards Lot occurrence appears to extend west onto neighboring lands, and likely remains as a band adjacent to the brook. The Crystal Brook and Snow Bowl occurrences are in discrete patches, typically occupying concavities or benches below steeper slopes.

General description—Rich Northern Hardwood Forest occurs on sites where nutrient availability is great enough to allow for a suite of species not found elsewhere in the Northern Hardwood Forest. Sugar maple is the rich forest canopy dominant; white

ash and basswood are typically present, and beech and yellow birch are less abundant than in Typical Northern Hardwood Forest. The “rich-woods” herbs include wild leek, blue cohosh, silvery glade fern, two-leaved bishop’s-cap, and foam-flower; in seepy locations one encounters northeastern manna grass, false hellebore, and spotted and yellow touch-me-nots.

Community condition, size and landscape context—Bread Loaf 4: Condition of the natural community is characteristic of this landscape’s general condition on lands that were not cleared for pasture. Dominant trees are in the 30-50 cm (12 to 20 in) dbh range and there are signs of historical logging but no recently cut trees in this community. The area is tending to uneven-aged structure. The condition rank is thus B. Size of the Rich Northern Hardwood Forest occurrence is not accurately known, since the greater extent of it on public lands was not explored; given what we have observed in this landscape, extent is unlikely to exceed 12 ha (30 ac). Size rank is therefore estimated to be C (3-29 acres); the bit on college land is only three-quarters of an acre. Landscape context rank of this site is A/B, as it is close to a forest service road yet very close to national wilderness. EO rank = provisionally B (3.0), pending any further information about the bulk of the occurrence on adjacent lands.

Edwards Lot: This wonderfully interesting patch of Rich Northern Hardwood Forest straddles the description of rich forest and seepage forest. The northeastern end is Seepier and features a sugar maple-black ash-yellow birch canopy with an herb layer dominated by brome-like sedge and northeastern manna grass. The less seepy parts are strongly dominated by sugar maple, with herbaceous dominants of lady fern, slender wood-reed, intermediate wood fern, large-flowered and sessile-leaved bellworts, silvery glade fern and Canada wood-nettle. The shrub layer is relatively open and includes a large population of the seldom-seen rich-woods obligate, leatherwood. The site has neither been recently disturbed, nor features any exceptionally large trees. The condition rank equals B. Size of the occurrence is 2.2 ha (5.5 ac) on college land with more to the west, for a size rank of C. The landscape context is A/B, as the occurrence is on the western edge of a large intact landscape with only a forest service road separating it from wilderness area. EO rank = B (3.0).

Crystal Brook Lot: The Crystal Brook Rich Northern Hardwood Forest occurrence occupies a flat-and-lower-slope landform that was logged in the early/mid 2000s in accord with an FSC-certified management plan. Overstory trees, primarily sugar maple and beech, have diameters of 35 to 45 cm (14 to 18 in) dbh, and some smallish (0.1 h (<0.25 ac)) openings were created by the tree harvesting. The rich-woods herbs occur in scattered patches, with other patches looking more like a moderately enriched forest. Blue cohosh, jack-in-the-pulpit, Canada wood-nettle, round-leaved and Canada violets, zig-zag goldenrod and silvery glade fern are present. Despite the recent harvest the stand composition and age fit within a condition rank of B. The patch is 5.2 ha (13 ac) and it does not extend much onto the adjacent national forest lands; thus the size rank

equals C. The landscape context rank is A, as the occurrence abuts national wilderness. EO rank = B (3.2).

Snow Bowl: Four rich patches occur in the same general area within an elevation band of 670 to 730 m (2,200 to 2,400 ft). The locations include seepy rock ledge and ledge base, concavity, and seepy flat; thus the rich forest is a combination of both seepy-rich and just plain rich. The westernmost polygon has the largest trees—sugar maple and some yellow birch to 75 cm (30 in) dbh with many diameters larger than 50 cm (20 in). Large populations of rich-woods herbs characterize all the patches; wild-millet, Braun's holly-fern, and Goldie's fern were observed in a number of spots. The polygon closer to the southeast of Lake Pleiad has several open Seeps and at least one Vernal Pool within the rich forest. Area of the four patches is approximately 10 ha (25 ac), which qualifies as C size rank. Landscape context rank is A/B, based on the large contiguous surrounding forest but presence of continual disturbance of ski trail maintenance. EO rank = B (3.0).

Element occurrence rank weightings—(Condition rank x 0.4) + (Landscape Context rank x 0.4) + (Size rank x 0.2) = Edwards Lot: B (3.0). Snow Bowl: B (3.0).

State natural community rank—S4.

HEMLOCK—NORTHERN HARDWOOD FOREST

State-significant occurrence—Yes; a state-significant, B-ranked, occurrence is in the Goshen Brook Lots.

Extent and patch pattern—The study area's Hemlock-Northern Hardwood Forest occurrences are in Bread Loaf 4, Goshen Brook Lot, and Battell Park-Middlebury River. None of these are very large, although the Battell Park occurrence is part of an extensive complex of hemlock-dominated natural community types in the Middlebury Gorge. Most of the hemlock-y forests in the area are either Hemlock Forest or Hemlock-Red Spruce-Northern Hardwood Forest.

General description—Hemlock-Northern Hardwood Forest is similar to Typic Northern Hardwood Forest, but hemlock is co-dominant or a strong associate species. In New Hampshire the corollary of this type is called hemlock-beech-Northern Hardwood Forest, an indication that hemlock, like beech, tends to gain greater abundance on sites with somewhat lower nutrient status compared with places where sugar maple is more abundant. In Northern Hardwood Forests located in our part of the state, hemlock tends to be more abundant in cool sites (often north-facing slopes or steep-banked stream ravines), although it also gains prominence on exposed, fire-prone sites (e.g. the Green Mountain escarpment). Hemlock-Northern Hardwood Forest includes beech, sugar and red maples, and yellow birch as canopy associates. Red spruce may occur, but in relatively low numbers. The forest understory generally features at least a moderately dense hobblebush shrub layer. Painted trillium and Indian cucumber-root are characteristic herbs of this type, along with the more typical species

of Northern Hardwood Forests, such as intermediate wood fern, Canada mayflower, and shining clubmoss.

Community condition, size and landscape context—The areas of Hemlock-Northern Hardwood Forest in the Bread Loaf and Goshen Brook parcels are in better than “typical” condition in comparison to the study area’s other forests; this is largely due to little hemlock harvesting in 20th century logging operations and thus these sites possessing some more mature structural components, large hemlock. Forest structure is uneven-age or close to it, with numerous dominant trees ranging from 40 to 60 cm (26 to 24 in) dbh and no recent logging. Goshen Brook Lot occurrence: The Goshen Brook Lot example has a particularly nice dead-wood component. Two patches of Hemlock-Northern Hardwood Forest occur in the parcel, both areas are associated with brooks; these two comprise one element occurrence. Community condition rank is A/B. Surrounding landscape is a large expanse of forest including Joseph Battell Wilderness Area, but the lot is adjacent to a forest road and not far from Route 125; thus the rank is A/B. Size of the occurrence is C-ranked, 9 ha (22 ac) on college lands, with perhaps another two hectares on national forest. EO rank = B (3.0).

Bread Loaf 4 occurrence: Community condition, with fewer mature forest characteristics than the Goshen Brook Lot example and signs of light selective harvest is B. Landscape context is A/B. The size needs more investigation of the part of the natural community on national forest lands; orthophoto interpretation reveals that it might be as large as 32 to 40 ha (80 to 100 ac) and thus qualify for a B rank. To be conservative, we score it as a B/C rank. This occurrence is also noteworthy as part of the complex of hemlock-dominated forests surrounding Brandy Brook through the entirety of the Bread Loaf 4 parcel; the complex includes the patch of old-growth Hemlock Forest. EO rank = B (3.0).

Battell Park-Middlebury River occurrence: Condition receives a B rank, as the forest has uneven-age structure and numerous trees with diameters from 40 to 60 cm (26 to 24 in) dbh. Landscape context of the gorge is B/C, due to the proximity of roads and scattered residences. Size of the occurrence includes 8 ha (20 ac) of college lands and perhaps up to an equal amount on adjacent parcels, which qualifies as C rank for size. EO rank = C (2.5).

Element occurrence rank calculation—(Condition rank x 0.33) + (Size rank x 0.33) + (Landscape Context rank x 0.33).

State natural community rank—S4.

HEMLOCK—RED SPRUCE—NORTHERN HARDWOOD FOREST
(VERMONT NAME = RED SPRUCE-NORTHERN HARDWOOD FOREST)

State-significant occurrence—Yes. The college lands include several B-ranked example of this S4 natural community type—the Bread Loaf lands occurrence north of Route 125, the Edwards parcels occurrence, and perhaps the small but stunning Snow Bowl (Bailey Falls) occurrence.

Extent and patch pattern—Hemlock-Red Spruce-Northern Hardwood Forest is one of the most extensive natural community types on the Bread Loaf contiguous lands north of Route 125, on the Edwards parcels and on the Coal Kiln lots; in all three locations, part of the lands that would support this natural community have been converted to conifer plantations. Smaller patches occur in Goshen Brook, Crystal Brook and, most notably, an excellent small example around Bailey Falls in the Snow Bowl parcel.

General description—In Vermont this type is called red spruce-Northern Hardwood Forest, and hemlock is listed as an occasional to locally abundant species. In our study area, hemlock is such a consistent part of the composition that we have used the New Hampshire name. Compared with Typic Northern Hardwood Forest, this type occurs in areas where soils are less well drained, which in this landscape is most often due to a combination of three factors—lower slope positions, compact till parent material, and densipans relatively close to the surface. The soils are almost always derived from basal tills rather than ablation tills; they also are generally thought to have lower nutrient availability than soils in Northern Hardwood Forest (although we did not analyze that in this study). Better drained portions of Cabot are the most common soils associated with the Hemlock-Red Spruce-Northern Hardwood Forest in our study area, although it seems that the type occurs on some Peru soils also.

These are truly “mixed” forests where evergreen conifers and deciduous hardwoods co-occur in response to geophysical conditions rather than from successional status. The tree composition of Northern Hardwood Forests can appear nearly identical to this type where red spruce and red maple are prominent colonizers in old-field succession, but careful observation of soils can clarify confusion in most cases. The patterning of natural communities on the college lands clearly shows Hemlock-Red Spruce-Northern Hardwood Forest associated with streams on moderately level lower-slope lands.

Hemlock, red spruce, red maple and yellow birch are co-dominant canopy species, with beech an associate that is patchily common to abundant. Sugar maple is usually not a component of this forest type. Common herbaceous species include Canada mayflower, sessile-leaved bellwort, common wood-sorrel, intermediate wood fern, partridgeberry, starflower, goldthread, painted trillium, bluebead lily and a variety of clubmosses (*Lycopodium*, *Diphasiastrum* and *Huperzia*). Bunchberry dogwood and New York and hay-scented ferns may be common as well. In depressions within the woods and other

moister microsites, one finds ferns such as interrupted, cinnamon and sensitive ferns and mossy mounds, often featuring the liverwort *Bazzania*.

Community condition, size and landscape context—Hemlock-Red Spruce-Northern Hardwood Forest on the Edwards lots and the Bread Loaf contiguous lands may comprise one occurrence, but since the lands between these two blocks have not been mapped they are herein considered as two separate occurrences. If they are a single one, the size would still be B-ranked, for it would need to exceed 1,000 acres for an A rank.

Bread Loaf contiguous lands occurrences: Much of the Hemlock-Red Spruce-Northern Hardwood Forest in the Bread Loaf area has succeeded from abandoned pasture and then subsequently was selectively logged, but most of it has not been logged in the past several decades. The condition is characteristic of mid-successional woods in which red maple likely has a higher basal area than would be the case in a more natural situation. Hemlock was not sought after in the logging operations; therefore, they comprise many of the larger and older trees; the larger ones exceed 60 cm (24 in) dbh. A number were aged and most fall between 85 and 120 years. The area between Route 125 and Steam Mill Road was some of the last pasture abandoned, and the forest there still features a lot of post-agricultural white pine and some paper birch in the canopy, whereas north of Steam Mill Road white pine were largely harvested and paper birch is gone or in decline due to its advanced age. Two different occurrences of this natural community must be considered, since Route 125 is a fragmenting feature. The condition rank is B for both of these. The size of the occurrence north of the highway receives B rank (80-404 ha (200-999 acres)), whereas south of the highway the type is less extensive and rank size rank is C. Landscape context of the Hemlock-Red Spruce-Northern Hardwood Forest is B north of Route 125 and B/C on the south side, where much of the community is adjacent to mowed fields. EO rank north of Route 125 = B (3.0). EO rank south of Route 125 = C (2.4).

Edwards lots occurrence: Condition in the Edwards lots is B. Although the forest has been logged more heavily than on the Bread Loaf contiguous lands, hemlock was not sought and some very old hemlock and red spruce were encountered. Not exceptionally large, a 54 cm (21 in) dbh hemlock has found to be 253 years old and a 49 cm (19 in) dbh red spruce was 209 years old. Trees of this age are definitely not common in these woods; other cored trees were from 80 to 110 years old. Size rank is B, and landscape context is B, with only a forest road separating this area from extensive uninterrupted forest and national wilderness, but quite a bit of this type adjacent to gravel road or plantation. EO rank = B (3.0).

Snow Bowl occurrence: The small patch of Hemlock-Red Spruce-Northern Hardwood Forest right around Bailey Falls is a magical place. The rock slabs pummeled by falling water are what bring visitors to the spot, but it is hard not to notice the beautiful surrounding forest. Dominant trees measure 60 to 65 cm (24 to 26 in) dbh, with the heft of the largest yellow birch at 80 cm (31 in) dbh. This little patch has old-

growth structural characteristics of tree size—large ones and others of all sizes—and moderate to large amounts of snags and dead-down trees. The soil displays a 30 cm (12 in) deep organic horizon, another forest legacy not found in more disturbed forests. Unfortunately the adjacent national forest lands are young forest re-growing from intensive logging. This patch is a special place for a number of reasons. It may be a B-ranked occurrence if the size of the type on national forest lands going up the brook valley brings it above four hectares (ten acres). Regardless, this is one of the highlights of the Snow Bowl parcel and is a fine example of what the other forests of this type can grow to be.

Coal Kiln occurrence: Most of the Coal Kiln lands are Hemlock-Red Spruce-Northern Hardwood Forest on well drained to moderately well drained sandy loam soils; hemlock is uncommon to rare in these sandy-soil examples, despite the presence of a very nice hemlock swamp on adjacent national forest lands. The forests are mostly post-agricultural; some areas are predominantly old-field white pine forest, while other abandoned fields were planted to conifers. Condition of these forests is B/C; landscape context, adjacent to Goshen Road is B/C and size, less than 81 ha (200 ac), is C. EO rank = C (2.3).

Element occurrence rank weightings—(Size rank x 0.4) + (Landscape Context rank x 0.4) + (Condition rank x 0.2).

State natural community rank—S4.

RICH HEMLOCK-RED SPRUCE-NORTHERN HARDWOOD FOREST (NOT INCLUDED IN VERMONT CLASSIFICATION)

State-significant occurrence—The state classification does not recognize an enriched type of red spruce-Northern Hardwood Forest, but would likely consider this a variant of the non-enriched forest of this general type. Thus, these patches would be considered part of the state-significant Hemlock-Red Spruce-Northern Hardwood Forest occurrences in the Bread Loaf contiguous lands and the Edwards parcel.

Extent and patch pattern—Enriched examples occur in two distinct patches; one in Brown and Upson lots and another in Edwards Lot.

General description—Richness is sporadic, but clearly present in both of these examples, although the Brown-Upson example seems to have a bit more enrichment. Rather than the more typical acidic-soil herb flora that accompanies this conifer-hardwood forest type, these areas include a notable component of jack-in-the-pulpit, lady fern, round-leaved violet and, in Brown-Upson, blue cohosh. White ash and sugar maple are canopy associates; tree diameters as with much of the landscape fall within the 20-35 cm (8-14 in) dbh range, with sporadic larger hemlock. Seepy patches and signs of surface flow indicate that the likely source of the nutrient boost is subsurface flow down the gentle slopes.

Community condition, size and landscape context—Condition ranks in both patches are B; size and landscape context are as above for the Hemlock-Red Spruce-Northern Hardwood Forest.

Element occurrence rank—Ranked with the above type, Hemlock-Red Spruce-Northern Hardwood Forest.

State natural community rank—Recommended S3 rank. Similar forests have been seen in Lincoln, VT, but we do not think this type is more than uncommon in the Vermont landscape.

NORTHERN HARDWOOD TALUS WOODLAND

State-significant occurrence—Yes; both occurrences of this uncommon community type are significant.

Extent and patch pattern—Two occurrences were observed on college lands. One is located in Middlebury Gorge, on a steep slope adjacent to the Middlebury River; another is at the Snow Bowl, approximately 0.2 km (0.1 mi) south of the Starr Shelter.

General description—Middlebury Gorge occurrence: Large blocks of talus covered in lush greenery and backed by a seepy ledge best describe this talus woodland. The boulders are covered with rock polypody overtopped with an open canopy of mountain maple and yellow birch, plus a bit of hemlock and white ash. The herbaceous flora is diverse, particularly on the weeping ledge but also spilling onto the talus blocks; species include whorled, flat-topped and bristly asters, intermediate and marginal wood ferns, lady and fragile ferns, tall meadow-rue, spotted joe-pye-weed, white boneset, jack-in-the-pulpit, tall rattlesnake-root, small enchanter's-nightshade and scabrous sedge. Among the shrubs are Canada yew, bush-honeysuckle, purple-flowered and red raspberry, and vines Virginia creeper and riverbank grape. Snow Bowl occurrence: This is an east-facing steep slope of blocky talus with a small cliff rising above on the west and a small brook flowing on the east. Mountain maple is the dominant woody vegetation. Intermediate wood fern, lady fern, tall meadow-rue, dwarf red blackberry, scabrous sedge and touch-me-not are prominent herbs. Both Braun's holly-fern and wild millet are in the mix also.

Community condition, size and landscape context— Middlebury Gorge occurrence: Condition of this remote natural community with very difficult access is A-ranked. The two-acre size of this small-patch community type would be at least a B rank. Landscape context is also B, since the location is surrounded by little disturbance but up out of the Gorge are roads and scattered homes. EO rank = B (3.3).

Snow Bowl occurrence: Condition is B, as there has been some tree harvest on the edges and directly adjacent. Size, as with the other occurrence, is at least B-ranked. Landscape context of this lower part of the Snow Bowl is B. EO rank = B (3.0).

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33)

State natural community rank—S3, occurrences with EO ranks of A or B are state significant.

Seepage Forest Types

NORTHERN HARDWOOD SEEPAGE FOREST AND

HEMLOCK-RED SPRUCE-NORTHERN HARDWOOD SEEPAGE FOREST

State-significant occurrence—Yes. Although not yet formally recognized by the Vermont Fish and Wildlife Department, discussions about occurrences of this natural community type in the state have been active for more than a few years and it is a recognized type in New Hampshire. College lands include several state-significant examples: Homer Noble Farm/Brown Lot 3/Upson Lot 1, USFS Exchange Lot/Norton Lot, and Snow Bowl.

Extent and patch pattern—Seepage forest of both types is well distributed throughout the college lands. A very large area (for this type) is the most extensive forest community in the central portion of the Homer Noble Farm. On the Bread Loaf contiguous lands other much smaller patches occur in Brown 1 Lot south of Route 125, and Burdick Lot. Four moderate-size patches which total to a large area occur in the Edwards Lot. Two patches occur in Coal Kiln Lot 4, two in the Snow Bowl parcel one of which is at high elevation, and two additional small seepage forests lie within Middlebury Gorge parcels.

General description—Seepage forests are unusual parts of the landscape where groundwater seepage is very active, but soil saturation is not great enough for the formation of swamp forest or non-forested wetland. They are thus characterized by a combination of upland and wetland species and are largely shaped by the hydrological dynamics specific to the site. The New Hampshire natural community classification calls these a “swampy, semi-rich Northern Hardwood Forest” (Sperduto and Nichols 2004). They usually occur on gently to moderately sloping lands, a topography that lends itself to water flow rather than accumulation. Sperduto and Nichols (2004) note that the community type occurs on Cabot and Peacham soils in northern New Hampshire. This appears to hold for our study area, but we include Peru as a common soil type of seepage forests also.

Two different forest compositions were observed in the seepage forests and we have mapped them separately as “Northern Hardwood Seepage Forest” and “Hemlock-Red Spruce-Northern Hardwood Seepage Forest.” Although they are ranked together (the Vermont Fish and Wildlife Department will likely consider these as one type, with perhaps the conifer-dominated forest a variant), to provide the most information we describe them as separate types.

The Northern Hardwood Seepage Forests likely display the greatest plant species diversity encountered on the landscape. Sugar maple dominates the canopy, and the most plentiful associates are red maple, hemlock, and yellow birch. Fewer in numbers are basswood, white ash, beech, and red spruce. Among the many herbaceous species

are northeastern manna grass, scabrous sedge, false hellebore, Canada wood-nettle, silvery glade and sensitive ferns and spotted touch-me-not.

Hemlock-Red Spruce-Northern Hardwood Seepage Forest differs in having hemlock and red spruce dominant in the canopy and northern hardwood species as associates. It seems that wildlife would perceive the conifer-dense seepage forest as a different habitat resource than the more common northern hardwood type and that soil chemistry and nutrient cycling would differ from the hardwood-dominated seepage forests. Trees in addition to the dominant conifers include red and sugar maples, yellow birch and white ash. The herbaceous flora is quite diverse for a conifer/mixed forest, and in some areas strong differences were noted between mounds and the general, non-elevated regions. Mounds included goldthread, bunchberry dogwood, bluebead lily, common wood-sorrel, Canada mayflower and Indian cucumber-root, with creeping snowberry and three-seeded sedge seen on mounds in the wettest area. Among the species growing in lower-lying ground were cinnamon, lady and sensitive ferns, false hellebore, touch-me-not, dwarf red blackberry, foam-flower, northeastern manna grass, scabrous sedge, and Maryland sanicle, a species very uncommon to rare in the overall landscape. Soil in the Hemlock-Red Spruce-Northern Hardwood Seepage Forest in some places showed a more decomposed organic horizon and, in some places, a deeper organic horizon compared with the places featuring the more typical deciduous composition. These types approach swamp forest, and the “line” between what one calls a swamp versus a seepage forest is nebulous.

Community condition, size and landscape context— Homer Noble Farm/Brown Lot 3/Upson Lot 1 occurrence: The seepage forest on the Noble Farm is one of the most noteworthy natural communities on the college lands. It is a large area with a lot of diversity and good forest structure. The diverse flora includes several seldom-seen species (witch-hazel, Goldie’s fern, wild-millet). Sugar maple is the dominant tree, with red maple, yellow birch, hemlock and basswood also common; white ash and beech are uncommon. Overstory trees measure 25-40 cm (10-16 in) dbh. Two understory woody species found in few other natural communities in the study area—hophornbeam and witch-hazel—are common here; both are more-or-less at their regional elevation limits. Over 50 herbaceous species were observed in the large Homer Noble Farm seepage forest. Intermediate wood fern, false hellebore, wild leek, Canada wood-nettle and silvery glade fern were abundant. Among the seepage and richness indicators were swamp saxifrage, northeastern manna grass, downy yellow violet, white baneberry, scabrous sedge, ostrich, maidenhair and Goldie’s ferns, plantain-like sedge, golden-saxifrage, wild millet and large-flowered bellwort. The Addison County soil survey (Griggs 1971) has the Noble Farm area incorrectly mapped as Livingston clay. Instead, shallow (up to 20 cm (8 in)) muck or mucky loam was found to overlie extremely stony very fine to fine sandy loam; rounded small cobbles and gravel contributed to the extreme stoniness; Cabot soil would appear to be the correct series for the Livingston polygon.

One portion near the northern end of the Homer Noble Farm seepage forest is a more level and wetter area. Recent logging (within ten years) occurred in that area, which also features a fairly large open Seep (or lightly wooded swamp) dominated by northeastern manna grass with lady fern, spotted joe-pye-weed and spotted touch-me-not common also. The open area is less than a quarter hectare (0.6 ac), but it is unclear due to the logging disturbance how large the open-canopy portion was prior to that. Within this opening were several tip-up depressions that were water-filled and functioned as amphibian breeding pools. Sperduto and Nichols (2004) also mention that seepage forests include frequent Seep openings and seepage runs, so it is not unexpected to find this degree of variability within a large seepage forest. A northern part of the seepage forest was involved in the 2000-2002 logging operation. Aside from that portion the dominant trees are 30-45 cm (12-18 in) dbh and woody debris is at moderate to moderately high levels as a result of frequent single and few-tree blowdowns. This occurrence also includes the conifer-hardwood variant in the northwestern part and a non-contiguous patch about 100 m (300 ft) to the northeast.

Because the Brown Lot 3/Upson Lot 1 seepage forest patch is roughly a kilometer (0.6 mi) to the west, these are considered part of the same occurrence. Old barbed wire surrounds the Brown Lot and the seepage forest natural community there is currently mostly a successional wet field. The northern one-quarter or so has succeeded to forest, and the Upson Lot portion is also intact forest. These areas contain a heavy conifer component and are mapped as the conifer-hardwood seepage forest type.

Condition receives a B rank since most of the area is intact forest that has neither been recently logged nor is young successional. The total size is approximately 36 ha (90 ac), which is large to very large for seepage forests; provisional rank is thus A/B. Landscape context is A/B. EO rank = A (3.3).

Edwards parcels occurrence: Edwards lands support five patches of seepage forest—three are Northern Hardwood Seepage Forests and two are Hemlock-Red Spruce-Northern Hardwood Seepage Forests. The largest covers nearly 12 ha (30 ac) in the central area of these parcels. This species-rich wetland has a canopy of hemlock, red spruce, balsam fir, sugar maple, white ash, American elm, beech, and even some black ash. Some parts appear more like Hemlock-Balsam Fir-Black Ash Seepage Swamp, but overall the sloping terrain and forest composition suggest that seepage forest is a more appropriate mapping unit. Approximately 60 herbaceous species were noted, including abundance of seepage indicators such as silvery glade fern, scabrous sedge, northeastern manna grass, Canada wood-nettle, spotted touch-me-not and drooping sedge. Species seen in few places in the landscape include Goldie's fern, creeping snowberry (on mossy mounds), and hairy wood brome. The forest has an uneven-age tree structure with the largest conifers 60-cm (24-in) dbh hemlock and the largest hardwoods 50-cm (20-in) dbh sugar maple. The seepage wetland complex is quite variable; small areas are more densely coniferous and feature moss carpets and more acid-site herbs. The soil in the seepage forest has a shallow mucky A or muck O horizon over stony fine sandy to silt

loam. A similar sloping seepage forest of approximately ten acres occurs one-half mile north of the larger patch. The area also has a high herb diversity and good forest structure, including a nicely developed dead wood component. Another patch, slightly over four hectares (ten acres), is in the southwest corner of the Edwards lands and extends a bit onto adjacent national forest land. Some of that community's terrain has been planted to conifer plantation, but that is only a small part. The existing, intact natural community is another fine example of the type. It also contains a large population of Goldie's fern. Condition of the seepage forest occurrence is B; landscape context is B, and the 24-ha (60-ac) size likely qualifies as an A rank. EO rank = A (3.3).

Brown Lot 1 occurrence: This two-hectare (five-acre) area is successional old-field forest and displays open-grown sugar and red maples, black cherry and white ash in the canopy. Northeastern manna grass, lady fern, slender sedge, northern long-awned wood grass and dwarf red blackberry are common groundcover species. The seepage forest does not appear to extend very far east or west onto the adjacent national forest lands. Condition rank C due to recovery from land-clearing; size rank C; landscape context rank A/B. EO rank = C (2.5).

USFS Exchange and Norton lots occurrence: Seepage forest on the USFS Exchange and Norton lots is a mix of hardwood dominated and conifer-hardwood forest. Red spruce and yellow birch tend to be the largest trees and reach 55 cm (22 in) dbh. Generally the dominant trees are 30 to 45 cm (12 to 18 in) dbh. Red and sugar maples, hemlock, beech and white ash are all present, as are large, mostly dead/dying trembling aspen. Over 50 herbaceous species were observed, with many areas mossy and/or fern-covered. Ferns include lady, New York, cinnamon, interrupted, royal, sensitive and bracken ferns; other herbaceous species round out a typical moist- and seepage-forest flora. Forest condition is B-ranked, and the community covers 6.5 ha (16 ac) which yields a provisional B rank. Landscape context is A/B, on the edge of national wilderness but also not far from a forest road and on the edge of mountain home development. EO rank = B (3.1).

Coal Kiln Lot 4 occurrence: Two very small areas of seepage forest are growing on the east-facing slope. The smaller, southern patch is a bit unusual; dominated by the small tree musclewood, the relatively open tall canopy is formed by American elm, red maple and white ash. Characteristic seepage indicators such as swamp saxifrage, dwarf red blackberry, scabrous sedge and sensitive fern are common, but an unusual component was an abundance of barren-strawberry. That species is more common in the lower elevation ecosystems in the state, but was seen sporadically in the seepage communities on the college's mountain lands. The northern patch was a more typical seepage forest. Condition rank is B. Size is C. Landscape context is B/C, as the areas are adjacent to plantations or road to the east. EO rank = C (2.5).

Battell Park-Middlebury River occurrence: Two small Northern Hardwood Seepage Forest patches were found among the hemlock-landscape of the Gorge. The forests were predominantly deciduous, with a canopy of white ash, yellow and paper

birches, sugar maple and also hemlock. These areas provide natural community and floristic diversity in the overwhelmingly coniferous, species-poor Gorge forests. The very small areas comprise a C-ranked occurrence.

Burdick Lot occurrence: Burdick Lot features quite a bit of seepage in its northern half. Seepage forest there has been more disturbed, by logging as well as by apparent access for bulldozer work associated with the adjacent pond. Due to such disturbances, trembling aspen and tamarack are present in the northern patch with the red maple, yellow birch and white ash. There is also a population of witch-hazel, with some individuals reaching three meters tall. The linear seepage forest patch is more mature with characteristic canopy species to 35 cm (14 in) dbh. Typical seepage herbs dominate both patches, but the northern tip of the parcel is dominated by cinnamon fern and star sedge.

Snow Bowl occurrence: One of the two seepage forest communities on the Snow Bowl parcel is a Hemlock-Red Spruce-Northern Hardwood Seepage Forest adjacent to Route 125 east of the base lodge. There, a high amount of seepage flows down the slope from the north as well as from a small open Seep, which is the source of a headwaters stream. Despite being pinched between the road and a ski trail, the area displays the characteristic features for the type; the disturbances have not seemed to impact hydrology or species composition to a great extent. The other seepage forest is high up in the parcel. It is surprising to find a patch of Northern Hardwood Seepage Forest so near the Green Mountains' ridgeline, as one might expect spruce and fir to mix in at those elevations. The otherwise perfectly characteristic sugar maple-dominated seepage forest sits in a small concavity amidst a matrix of yellow birch-red spruce forest. Both patches are state-significant with B-ranked condition and C-ranked size. The lower one, adjacent to the highway, receives an A/B landscape context, while the high-elevation patch is in an A-ranked landscape; these are both B-ranked (EO rank = 2.64 and 2.97, respectively).

Element occurrence rank weightings— (Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33).

State natural community rank—Northern Hardwood Seepage Forest is not recognized as a separate natural community or variant in Vermont (although there are ongoing discussions about the type and its features) and is therefore not ranked in the state. New Hampshire considers the type to be S3. The type will likely eventually be S3 in Vermont, thus we consider occurrences with EO ranks of A or B as state significant.

Conifer Forest Types ***HEMLOCK FOREST***

State-significant occurrence—Yes. Two B-ranked examples of Hemlock Forest occur on the Bread Loaf contiguous lands and extensive Hemlock Forest in the Middlebury Gorge is also state-significant. The most noteworthy piece is a 5.6-ha (14-ac) example of old-growth Hemlock Forest in the Bread Loaf 4 parcel; additionally, a 0.8-ha

(2-ac) old-growth patch lies approximately 1.3 km (0.8 mi) to the south in the Bread Loaf 14 parcel on a South Branch terrace. The latter patch lies within a very nice 16-ha (40-ac) Hemlock Forest that fills the flats alongside the South Branch. The larger old-growth patch, one of the gems of the college landholdings, is on an extremely steep slope alongside an unnamed tributary of Brandy Brook.

Extent and patch pattern—This small-to-large patch natural community type is predominant in the Middlebury River Gorge (Battell Park-Middlebury River parcels) and also occurs in three sizable patches on the contiguous Bread Loaf lands. Small patches are found in the Crystal Brook and Edwards parcels.

General description—Hemlock Forest is one of the most recognizable natural community types to all who frequent the northern woods. The dense conifer overstory lets in little sunlight, and, in combination with the deep, acidic layer of needle litter, makes for a species depauperate groundcover. When canopy disturbances are infrequent, hemlock can gain dominance on upland sites and persist for 400+ years. Thus, although some of the Hemlock Forests on college lands are older than the general stand age, they still have centuries to go with the same trees that now occupy the terrain.

Community condition, size and landscape context—The three separate patches in the contiguous Bread Loaf lands are considered as two element occurrences; Route 125 separates the South Branch patch, but the two north of Route 125 (herein called the Brandy Brook occurrence) are within 0.8 km (0.5 mi) of each other.

Brandy Brook occurrence: A 5.6-ha (14-ac) patch of old-growth Hemlock Forest occurs along an undulating, steep slope (30-50% gradients) alongside a tributary to Brandy Brook. This small natural community is one of the gems of the college lands. Hemlock measuring 50 to 80 cm (20 to 32 in) dbh strongly dominate the tree stratum. An additional canopy tree species is red spruce, while red maple, yellow birch and beech occur as understory individuals. One prism sample recorded a very high basal area of 57 m³/ha (250 ft²/ac). Dead wood in many different stages of decay is abundant. Most of the dead trees are low snaps and have fallen in different directions. Striped maple and hobblebush grow in the shrub layers and common wood-sorrel, intermediate weed fern, painted trillium goldthread and Indian cucumber-root are among the most common herbaceous species. Few other ground cover species fill out the composition; these are pink lady's-slipper, creeping snowberry, Canada mayflower, wild sarsaparilla, bluebead lily, shining clubmoss and cinnamon fern. The liverwort *Bazzania trilobata* forms a carpet on the ground. Soil observations indicate that the current trees established on an old blowdown. Fifty to 70 cm (20 to 28 in) of organic matter overlies the stony fine sandy loam spodosol soil. In several auger holes a 20-cm (8-in) layer of decomposed wood was part of the O horizon. The upper reaches of the slope have decomposing spruce stumps that indicate past harvest of that species. One hemlock was cored; the 57 cm (22 in) dbh tree showed a minimum age of 191 years.

A second patch of Hemlock Forest is east of the Bread Loaf campus in the area of the Battell ski trail. It sits on a level area through which Brandy Brook winds. Some

parts have been logged heavily enough that the area has regenerated to a stand of red spruce with some yellow birch among the well decayed hemlock stumps. In the more intact portions, the structure is similar to that in the patch alongside the South Branch, which is described in the following paragraph. Small patches of seepage wetlands are dispersed within the Brandy Brook Hemlock Forests.

Condition of the Hemlock Forest receives an A rank based on the excellent condition of the old-growth patch. The size of the two patches together totals 9.7 ha (24 ac), plus the 1.2-ha (3-ac) patch of the hemlock-red spruce variant (discussed below) yields a total of 11 ha (27 ac) and a C rank. Landscape context is B, since Steam Mill Road and Bread Loaf campus are proximal to part of the occurrence. EO Rank = B (3.05).

South Branch occurrence: A 16-ha (40-ac) patch of Hemlock Forest occurs along a 0.8-km (0.5 mi) stretch of the South Branch. This forest is in quite good condition also and does contain a very small area of old-growth forest on a streamside flat. The patch is uneven-age hemlock with dominant trees in the 40 to 70 cm (16 to 28 in) dbh range. Canopy red spruce, red maple, yellow birch and the rare sugar maple are associates. Cored trees in the stand were a 109-year old 55-cm (22-in) dbh red spruce and a 164-year old 50-cm (20-in) dbh hemlock. Larger hemlock were too rotted to be cored successfully. The sparse understory consists of the canopy species and striped maple. Low shrubs are hobblebush and Canada fly honeysuckle, along with small red spruce. The most common herbs are oak fern, intermediate wood fern and wild sarsaparilla. Among the others are some indicators of moderately elevated nutrient richness—pedunculate sedge and barren-strawberry. Surely the streamside position influences the natural community. The soil is comprised of riverine sand deposits. Approximately 30 cm (12 in) of recent medium sand deposits overlie a complicated profile that shows numerous deposition events (none as large as the event that deposited 30 cm) atop buried horizons of a loamy sand to fine sandy loam spodosol. A few snags and several down-dead trees contribute to the coarse woody debris component. The bulk of this 16.5-ha (41-ac) patch of Hemlock Forest along the South Branch features a canopy of 35 to 50 cm (14 to 20 in) dbh hemlock and red spruce, with some hemlock as large at 65 cm (26 in) dbh. It is a scenic woods that has been selectively logged in the past (no harvests in recent decades). Common wood-sorrel and intermediate wood fern are dominant herbs, and the ground is covered in patches of *Bazzania* interspersed with a conifer needle forest floor. A small stone fire-circle by the river shows that people have enjoyed the cool shaded woods. Small patches of seepage wetlands are dispersed within the South Branch hemlock flats.

Condition of the forest is AB; the bulk of it is in B condition, but one small patch is A condition structure and composition. The 16.5-ha (41-ac) community receives a B rank. Landscape context B, with highly connected natural communities extending to the south, but the Bread Loaf campus adjacent to the north. EO Rank= B (3.2).

Battell Park-Middlebury River occurrence: Hemlock Forest dominates the steep terrain of the Middlebury River Gorge; also mapped in the Gorge are Hemlock-Northern Hardwood Forest and Temperate Hemlock Forest. Hemlock sizes of 40-50 cm (16-20 in) dbh are typical of dominant trees, while in many areas patches or scattered individuals showcase diameters up to 75 cm (30 in). Groundcover is typically sparse. Associate tree species include white pine, red and sugar maples and yellow birch. A huge “legacy tree” white pine occurs in Hemlock Forest on the south side of the river; the 113.5 cm (44.7-in) dbh monarch towers above the large hemlock nearby. The pine’s crown has a 10-11 m (32-35 ft) radius, so this single tree has immediate influence over nearly 400 m² (0.1 ac) of forest.

Condition rank is B, based on the generally good to very good forest structure, with some selective logging in more accessible locations and small areas apparently having been salvage-logged post the 1951 hurricane. The size of the occurrence is approximately 26 ha (65 ac) (20 ha (50 ac) on college lands) which qualifies as B. Landscape context of the gorge is B/C, an adjacent landscape with roads and widely scattered houses but also national forest lands. EO Rank= B (2.8).

Crystal Brook Lot occurrence: One small Hemlock Forest occurs on a small rise in the glaciofluvial soil part of this landscape. Hemlock up to 75 cm (30 in) dbh dominate an uneven-age structure stand. The sparse groundcover includes scattered intermediate wood fern and pink lady’s-slippers. The soil displays excellent characteristics of a spodosol in an excessively (or somewhat excessively) well drained conifer forest—30 cm (12 in) of E horizon in medium sand over another 30 cm (12 in) of B_{hs} and upper B_s horizons in sandy loam. At 80 cm (31 in) the texture changes to loamy sand, still in a B_s horizon. Unfortunately, the community has been truncated by a parcel boundary and the rest of it to the west is young forest recovering from heavy logging.

Edwards parcels occurrence: Somewhat surprisingly, only one Hemlock Forest natural community was mapped on the Edwards lands. Although much of the terrain on the exceptionally steep slopes of the Middle Branch headwaters streams is hemlock dominated, we found that most of it has enough of a component of red spruce and/or deciduous trees to be mapped as hemlock-red spruce or Hemlock-Red Spruce-Northern Hardwood Forest. The one Hemlock Forest observed occupies a small, elevated knoll above the Middle Branch.

Element occurrence rank weightings—(Calculation for EO Rank = (Condition rank x 0.35) + (Landscape Context rank x 0.35) + (Size rank x 0.3).

State natural community rank—S4.

HEMLOCK-NORTHERN WHITE CEDAR FOREST

State-significant occurrence—Yes; this small area is a variant of Hemlock Forest and is thus ranked with the occurrence of that natural community in the Middlebury River Gorge.

Extent and patch pattern—One small slope contains this unusual forest type.

General description—The very steep, rocky-ledge slope is anomalous within the mix of Hemlock Forest types in the Middlebury River Gorge. It occurs on the southeast-facing slope at the confluence of the North Branch and the main stem. Hemlock, northern white cedar, and red spruce are dominant, with yellow and paper birches and red maple as associate species. Stairstep moss and the liverwort *Bazzania trilobata* cover the forest floor which displays scattered intermediate wood fern, rock polypody, wild sarsaparilla, bluebead lily and whorled aster. Trees are in the 35-40 cm (14-16 in) dbh range. Limited parts of the slope have groundwater seepage, but it did not overall appear to be a seepy or seepage-controlled place. Northern white cedar are present within the seepy spots in Hemlock Forest on the south side of the river; their prominence here seems to be in response to seepage, bedrock outcrop and perhaps microclimate of the confluence microsite.

Community condition, size and landscape context—Not ranked separately from Hemlock Forest at the Gorge site.

HEMLOCK—RED SPRUCE FOREST

State-significant occurrence—Yes, as part of the state-significant Brandy Brook Hemlock Forest, because Hemlock-Red Spruce Forest is considered a variant of that type and is ranked along with it. The Edwards Lot and Crystal Brook occurrences also qualify as state-significant.

Extent and patch pattern—One 1.2-ha (3-ac) patch of this forest type was mapped on the Bread Loaf contiguous lands, with an additional acre surrounding the old water supply pond. A separate occurrence on the Edwards Lot consists of approximately 5 ha (12 ac) in two patches; about one-quarter of the patch is on national forest land. An occurrence in the Crystal Brook Lot is a similar size, with only 1 ha (2.5 ac) on the college parcel and the remaining 4 ha (10 ac) on national forest.

General description—This variant is very similar to Hemlock Forest, but red spruce comprises a substantial portion of the canopy.

Community condition, size and landscape context—Brandy Brook occurrence: The Hemlock-Red Spruce Forest beside Brandy Brook occupies a knoll atop the slope opposite from the old-growth Hemlock Forest. A spruce harvest took place and the stand has regenerated to spruce and gone through a period of natural thinning. Remnant spruce measure 30 to 40 cm (12 to 16 in) dbh, whereas the regeneration is young and in the 10 to 15 cm (4 to 6 in) dbh size class. A 39-cm (15-in) dbh cored spruce was approximately 95 years old and a nearby 43-cm (17-in) dbh hemlock was slightly older at 105 years. On the slopes of the knoll are the largest trees, hemlock with diameters of 70 to 80 cm (28 to 31 in). The Hemlock-Red Spruce Forest soil is remarkable; an organic layer of well decayed wood and a more typical O_a horizon extends deeper than 70 cm (28 in). No charcoal was found in or on the soil, despite a bit of searching. The forest is part of the state-significant Hemlock Forest to which it is adjacent.

Edwards Lot occurrence: Hemlock-Red Spruce Forest in the Edwards Lot occurs in an area of ridges and steep slopes alongside a Middlebury River Middle Branch headwater stream. The fine sandy soils are well drained. Large hemlock, up to nearly 70 cm (28 in) dbh are scattered throughout, but most trees are less than 50 cm (20 in). Condition of the forest ranks B based on little disturbance to these steep slopes. The 4-ha (10-ac) size qualifies as C rank. Landscape context is A/B in this remote part of the Edwards lands. EO rank = B (2.9).

Crystal Brook Lot occurrence: Occupying a steep slope that rises from Crystal Brook to the knoll on the college parcel, the forest is dominated by 30-55 cm (12-22 in) dbh hemlock, with red spruce saplings and poles to about 25 cm (10 cm) dbh. Intermediate wood fern is the most common herbaceous species; starflower and pink lady's-slipper are well distributed on the slope. The occurrence, most of which is on GMNF land is B-ranked. The very small patch on the west boundary of the Crystal Brook lot, is partially a sapling stand recovering from clearcutting on the adjacent parcel; that patch is part of the same element occurrence since it is so close and no major road intervenes.

Element occurrence rank weightings—(Condition rank x 0.35) + (Landscape Context rank x 0.35) + (Size rank x 0.3).

State natural community rank—S4.

TEMPERATE HEMLOCK FOREST

State-significant occurrence—Yes; two occurrences. One in the Middlebury Gorge has very fine compositional and structural features, and although pinched between roads, the Gorge itself is “remote” from human developments. The Clapp Lot Temperate Hemlock Forest is part of a much larger occurrence on Hogback Mountain.

Extent and patch pattern—A single patch of this warm-site type of Hemlock Forest occurs on the college lands of the Battell Park-Middlebury River parcels.

General description—This forest type occurs in the warmer locations of the Middlebury River Gorge and on slopes of Hogback Mountain where the Clapp Lot is located. These are both warm-exposures (west or south-facing), dry, fire-prone locations. The Gorge occurrence also occupies the lower elevations on the north-facing slope. Trees such as white and chestnut oaks and black birch indicate the warm conditions; witch-hazel is a shrub that is often common in the warmer Hemlock Forests.

Community condition, size and landscape context—Battell Park-Middlebury River occurrence: The south-facing slope of Temperate Hemlock Forest in the Gorge is spectacular! Many white pine, hemlock and red oak from 50 to 80 cm (20 to 31 in) dbh, sunny outcrops with blueberries, huckleberries, and pink lady's-slipper, and the plunging, plummeting river thundering through the gorge below, make this one of the most unique spots in Vermont and one of the more grandiose forest areas in the gorge. Additionally, black bear have marked several of the 30-40 cm (12-16 in) dbh red pine with bites and hair/scent rubbed off their backs. Plus, the forest history is prominently

displayed in prominent fire scars on the upslope sides of hemlock and white pine, where dry needle litter accumulates and the fires that move downslope from the adjacent oak forest tend to get hot and can smolder for days. The red pine surely established after such fires provided the open conditions needed for natural establishment of those sun-lovers. The section of Temperate Hemlock Forest on the south side of the river is not quite as dramatic, but it has the same general character. Red pine is rare but for one or two promontories that jut out over the river.

Condition of the forest ranks as B, with past selective harvest evident in the more accessible upper slopes. Landscape context of the gorge is B/C due to the proximity of roads and scattered rural residences. Size of the occurrence is 12 ha (30 ac), which qualifies as B rank. EO rank = B (3.0).

Clapp Lot occurrence: The steepest slopes, such as the one south of the pond are Hemlock Forest, with few other species. The lower slopes and the narrow ravine at the base of the steep slope have large trees, up to 60 cm (24 in) dbh; a large hemlock (52 cm (20 in) dbh) was found to be about 155 years old. Higher on the slope, the drier, shallower soils support much shorter and smaller hemlock. Much of the broader occurrence is on steep slopes and it is assumed that there has been little recent timber harvest, due to the slopes and the fact that hemlock is not a particularly desired timber tree. It is likely that this is an A-ranked occurrence.

Element occurrence rank weightings—(Condition rank x 0.35) + (Landscape Context rank x 0.35) + (Size rank x 0.3)

State natural community rank—S4.

MONTANE SPRUCE-FIR FOREST

State-significant occurrence—Yes, but these patches are small pieces separated from the main 40-ha (100-ac) element occurrence to the south.

Extent and patch pattern—Only two small patches occur on college lands on sub-summits of Worth Mountain, above the Snow Bowl. While these are only ½ km (0.3 mi) north of a 40+ ha (100+-ac) patch, Sorenson (2010) notes that small patches are usually poorly developed and intergrade with the surrounding community. That is the case on the college parcel, where Montane Yellow Birch-Red Spruce Forest is the predominant natural community at the highest elevations.

General description—Montane Spruce-Fir Forest occurs on the two highest sub-summits of Worth Mountain on the college parcel. In both of these areas, paper birch co-dominates with balsam fir and red spruce. Tree diameters are generally small, <20 cm (8 in) dbh, and small diameter dead wood is common. The common, montane-forest herbaceous species, such as bluebead lily and bunchberry dogwood, are present, but not abundant.

Community condition, size and landscape context—Condition rank should not be based on these small separate patches but on the bulk of the occurrence south of the college parcel. Landscape context is A, although the Long Trail is a “permanent,” very

minor disturbance to the forest. Size of the whole, multi-part occurrence is between 40 and 200 ha (100 and 500 ac) and is thus B-ranked. EO rank is likely B.

Element occurrence rank weightings—(Condition rank x 0.3) + (Landscape Context rank x 0.35) + (Size rank x 0.35)

State natural community rank—S3.

MONTANE YELLOW BIRCH- RED SPRUCE FOREST

State-significant occurrence—Yes, the Montane Yellow Birch- Red Spruce Forest on the Snow Bowl parcel is part of a much larger occurrence that extends south in the Green Mountain National Forest Joseph Battell Wilderness Area.

Extent and patch pattern—Six polygons of the natural community occur at the Snow Bowl; the largest is contiguous with the very large patch in the wilderness area; the smallest is a 1-ha (2.5-ac) narrow ridge spur.

General description—The forest is dominated by yellow birch and red spruce, with sugar maple and beech as sporadic associates. As is typical, the well developed shrub layer of hobblebush (along with large-shrub to small-tree striped and mountain maples) makes walking a tangled challenge. Dominant herbs are intermediate wood fern, bluebead lily, Canada mayflower, whorled aster, wild sarsaparilla, slender wood-reed and sedges (*Carex debilis*, *C. intumescens*). The largest trees are yellow birch measuring 40-55 cm (16-22 in) dbh; other species are typically no larger than 30 cm (12 in) dbh. As sugar maple is a canopy component in most of the patches, this community on the Snow Bowl should likely be considered the Montane Yellow Birch-Sugar Maple-Red Spruce Forest variant.

Community condition, size and landscape context—Condition of the natural community ranks B, due to former selection harvest, stand age estimated at around 100 years, and a small amount of permanent ski-trail clearings (most of this forest type is above the elevations of the ski trails). Landscape context of the entire occurrence is A/B, reduced from the highest rank due to the Snow Bowl development. The extent of the natural community to the south of college lands is estimated at greater than 200 ha (500 ac) (based on orthophoto interpretation), and thus the size rank is A. EO rank = A (3.5).

Element occurrence rank weightings—(Condition rank x 0.3) + (Landscape Context rank x 0.35) + (Size rank x 0.35); weightings used are those published for Montane Spruce-Fir Forest, another S3 matrix forming community type.

State natural community rank—S3.

LOWLAND SPRUCE-FIR FOREST

State-significant occurrence—No, since this uncommon (S3) natural community type is a C-ranked occurrence it does not qualify as state-significant. However, since Lowland Spruce-Fir Forest is rare to very rare in the central and northern Green Mountains and does not occur in the Champlain or White River valleys, Lowland

Spruce-Fir Forest in the South Branch-Goshen Brook vicinity and the very small patch in the center of the Edwards Lot should be considered of local significance.

Extent and patch pattern—Lowland Spruce-Fir Forest is a large patch natural community type in the study area; farther north in New England it is a matrix forming type. In the Bread Loaf area, a very few, very small lowland spruce-fir patches occur alongside the South Branch and tributaries (Bread Loaf 14, Brooks Lot, Goshen Brook Lot 2); two even smaller patches occur in the Edwards parcel (Lots 1 and 2) in seepy, swampy parts of the landscape.

General description—Lowland Spruce-Fir Forest occurs to a limited extent on glaciofluvial flats near the South Branch; some of the land that would naturally support this forest type now features conifer plantations. Along with the dominant red spruce and balsam fir, low to moderate amounts of red maple and yellow birch are present. All of the patches of this natural community have been logged such that pole and sapling stands predominate; most of the spruce-fir woods have trees from only two- to three-meter (6-10 ft) tall saplings to canopy trees with diameters rarely achieving 30 cm (12 in) dbh. Only one small area, at the northeast corner of Goshen Brook Lot has trees as large as 45 cm (18 in) dbh. As is characteristic of the forest type, the ground is partially to mostly carpeted with Schreber's moss, the liverwort three-lobed *Bazzania*, and Knight's plume moss (*Ptilium crista-castrensis*). Common herbs are Canada mayflower, bunchberry dogwood, common wood-sorrel, goldthread, and starflower. Among the patchily distributed shrubs and small trees are American mountain-ash, low early and velvetleaf blueberries, and northern wild-raisin. The Lowland Spruce-Fir Forests occur in a landscape with complex hydrology and a variety of different soil types. As such, there are varying hydrologic and soils conditions in the different patches. Some areas have high water tables (within 40 cm (16 in) or so in August), black, organic-rich Oa/A horizons, and heavily mottled B horizons, whereas other locations are deep, well drained spodosols. In general, the soils are fine sandy loams with some deeper gravelly horizons.

Community condition, size and landscape context—South Branch occurrence: Bread Loaf, Brooks and Goshen lots patches are within an 800-m (0.5-mi) stretch near the South Branch and thus are considered one natural community occurrence, despite the interceding of a forest road. Community condition receives a C rank due to the recent logging and subsequent young forests. A continuation of the Goshen Brook patch onto the national forest was found to be a very young sapling thicket, so it is expected that all patches in this landscape have similarly been logged in the past three or four decades. Twenty-four acres were mapped on the college lands and aerial photos and maps suggest there are an additional 30 h (75 ac) maximum on other parcels between and adjacent to the Brooks and Goshen lots. Size rank is thus C. Landscape context is B-ranked, due to the proximity of Route 125, plantations, and small meadows. EO Rank = C (2.4).

Edwards Lot occurrences: In the Edwards 1 and 2 lots are two very small patches. The patch in Edwards 1, in the south-central part of the Edwards lots, is a typical wet

Lowland Spruce-Fir Forest, with a *Sphagnum* carpet and herbs and shrubs such as the sedges *Carex trisperma* and *C. echinata*, bunchberry dogwood, whorled aster, creeping snowberry, early low blueberry and mountain holly. The forest had been clearcut and is now a small pole stand with a few remnant 35-40 cm (14-16 in) dbh red spruce; sporadic red maple and yellow birch are present also. This discrete patch of lowland spruce-fir is on the edge of a very large hardwood-conifer seepage forest but with the *Sphagnum* carpet and very strong conifer dominance it is quite distinct from that more variable and diverse minerotrophic type. The second small patch is in the northwest corner of the Edwards lands and is less typical. The moss layer is a mix of *Sphagnum*, Schreber's moss, *Fissidens* and haircap moss. The trees are red spruce, balsam fir and red maple. The land has hummocks and hollows, with Canada mayflower, goldthread and bluebead lily on the hummocks, and royal and interrupted ferns in the sphagnous hollows. New York fern is widespread. The area is an old field, with numerous stone walls defining different fields in this part of the Edwards lands. It is possible that field management and repeated burning (charcoal was observed in nearby areas and the B horizon of soil has odd black layers that could be charcoal that has migrated downward) have altered this to a more coniferous forest with a moss floor. No other natural community type seemed appropriate, so it has been mapped as Lowland Spruce-Fir Forest which is the best fit.

Both occurrences are very small, D size rank, and therefore do not qualify for state significance.

Element occurrence rank weightings— (Size rank x 0.4) + (Landscape Context rank x 0.4) + (Condition rank x 0.2)

State natural community rank— S3.

Wetland Forest Types

SUGAR MAPLE-OSTRICH FERN FLOODPLAIN FOREST

State-significant occurrence—Yes. This natural community is in reasonably good condition and is a type that rare statewide and very rare in the mountain landscape.

Extent and patch pattern— Floodplain forest of this type occurs along the South Branch on college lands in the Upson 2 and Coal Kiln 1 and 2 lots. The largest contiguous floodplain forest is in the Coal Kiln lots, where this community type occurs on frequently flooded low terraces and point bars.

General description—Sugar Maple-Ostrich Fern Riverine Floodplain Forest occurs on terraces where inundation either is not an annual event or if there is annual flooding the duration of inundation is short. In the examples along the South Branch, intense flooding has been experienced numerous times in the past decade, during severe summer and autumn storms, including Tropical Storm Irene. The diverse forest canopy is comprised of sugar maple, white ash, yellow and paper birches, black cherry, red maple, hemlock, American elm and beech. The similarly diverse shrub layer includes beaked hazel, speckled alder, alternate-leaved dogwood, choke cherry, highbush-

cranberry, and mountain holly. High fertility and favorable moisture status of the soil is reflected in the herbaceous flora, which includes ostrich, lady, sensitive, bracken and intermediate wood ferns, zigzag goldenrod, jack-in-the-pulpit, white avens, foamflower, tall meadow-rue, northern long-awned wood grass, false hellebore and large-leaved aster. A population of the uncommon species, Wiegand's wild-rye, occurs in the Coal Kiln forests. Overstory trees generally range from 20 to 50 cm (8 to 14 in) dbh, with the largest trees, which tend to be black cherry, up to 70 cm (28 in). The dynamic flood regime is evident from observations of soil and woody debris. The soil in the Upson Lot was observed prior to the floods of Tropical Storm Irene and showed a recent deposit, up to several tens of centimeters deep, of medium sand, presumably washed in by storms in late winter and spring. Observation in the Coal Kiln Lots was the summer following Irene and showed numerous signs of sand and woody debris deposition. The soil is a light sandy loam whose water-deposited layers (including the recent deposit of sand) and whose profile development vary quite a bit from place to place. Drainage ranges from well drained in the most elevated positions to moderately well drained in lower parts of the forest. The frequent stresses that the plants experience in this natural community are displayed not only in the small plants being flattened after floods but also in the numerous snags and snapped trees throughout the woods. Frequent disturbance is often a factor that promotes invasion of non-native species, and the floodplain forest appears to have more invasive exotic species than elsewhere on the college lands. Species on the rivershore gravel and sand and in the floodplain forest include wild chervil, Japanese barberry, Tatarian and Morrow's honeysuckles and reed canary grass.

Community condition, size and landscape context—Possessing natural composition and structural characteristic of mid-age forests, the occurrence receives a B condition rank. The 4 ha (10 ac) size yields B/C rank, and the landscape context, with the proximity of Route 125 and the associated fields and development, is also B/C. EO Rank = B (2.7).

Element occurrence rank weightings—(Condition rank x 0.35) + (Landscape Context rank x 0.35) + (Size rank x 0.3)

State natural community rank—S2, rare in the state, occurring at a small number of sites or occupying a small total area in the state. Occurrences with ranks of A, B or C are considered state-significant.

RED MAPLE—BLACK ASH SEEPAGE SWAMP: SLOPING VARIANT

State-significant occurrence—No; the example on college lands is small and recovering from historic use as pasture.

Extent and patch pattern—One small-patch example of the natural community type was found close to Steam Mill Road on the Myrhe Lot and adjacent Bread Loaf lands.

General description—The sloping wetland forest is somewhat unusual and does not fit well with descriptions of either swamp forest types or Northern Hardwood Seepage Forest, so they have thus been herein named as a sloping variant of Red Maple-Black Ash Seepage Swamp. New Hampshire's classification describes a sloped black ash variant of Northern Hardwood-Black Ash-Conifer Swamp and our examples are similar, despite the absence of black ash. Additionally, at our site there is the confounding factor that the area had been cleared for pasture and now supports successional vegetation. Thus, current conditions certainly reflect alterations from the agricultural use and we have no clear picture of a less-altered community. These forests do not contain sugar maple, nor do they have either the characteristic composition of Northern Hardwood Seepage Forest or the composition or structure of level swamps (typically with hummocks and well developed O horizons).

The Myrhe Lot/Bread Loaf swamp is dominated by red maple, with black cherry, red spruce and trembling aspen associates, as well as remnant old-field white pine. The once-abundant gray birch have mostly died out due to that species' short lifespan. Aside from the larger pine (60-65 cm (24-26 in) dbh), canopy trees are 15 to 30 cm (6 to 12 in) dbh. The understory is composed of shadbush, musclewood, and speckled alder which on this 20% slope can grow to heights of six to eight meters (20 to 26 ft). The forest is young, and as is often the case in young old-field woods, the groundcover has a strong fern component; in this case New York, sensitive, lady and interrupted ferns are well represented. Nevertheless, the herb flora is quite diverse for a small and recently disturbed area. Among the species are brome-like, gynandrous, bladder, common and graceful sedges, woodland horsetail, northern long-awned wood grass, jack-in-the-pulpit, wood anemone, hispid buttercup and dwarf red blackberry. Soil on the slope is a silt loam, showing 10 to 15 cm (4 to 6 in) of A horizon over a heavily mottled gravelly loam B horizon. Based on soil series descriptions, this seems to be most similar to the soils series Nicholville (which is moderately well drained whereas this soil appears to be somewhat poorly drained) or Roundabout (which is described as glaciolacustrine or glaciomarine in origin, and this soil is most likely glaciofluvial).

Community condition, size and landscape context—Community condition has been altered by previous pasturing and the entirety of the community is transitioning from early- to mid-successional. Exotic species are absent or very rare. Condition thus qualifies for a C rank. The 3 ha (8 ac) is within in the 2 to 8 ha (6 to 20 ac) B-rank category. Landscape context is B/C, since the area is adjacent to Steam Mill Road right across from the Bread Loaf campus, yet in the opposite direction there is a large expanse of uninterrupted forest. EO Rank = C (2.2).

Element occurrence rank weightings—(Condition rank x 0.35) + (Landscape Context rank x 0.35) + (Size rank x 0.3)

State natural community rank—S4.

SPRUCE—FIR—TAMARACK SWAMP

State-significant occurrence—No; the single occurrence is too small to be state-significant. It is of local significance, since this type of swamp natural community is very rare in the broader landscape, and in this part of the state generally. To qualify as state-significant the swamp would need to be more remote from development or encompass at least 4 ha (10 ac).

Extent and patch pattern—A single example of Spruce-Fir-Tamarack Swamp was discovered in the Bread Loaf vicinity. The small swamp is in a narrow depression of 1.6 ha (4 ac) that continues to the north as a small Alder Swamp.

General description—This surprising little pocket of Spruce-Fir-Tamarack Swamp appears to be a one-of-a-kind in this landscape; the mapped occurrence is the only non-minerotrophic swamp encountered in investigations of the college lands (wet portions of Lowland Spruce-Fir Forest are another non-minerotrophic wetland type). The vegetation is characteristic of the natural community type, but the soil is somewhat atypical with the peat layers shallower (20 cm (8 in)) than is usually seen. Layers of fibric peat 15 cm (6 in) thick and sapric peat 5 cm (2 in) thick overlie mucky silt loam and fine sandy loam. The water table in early July was at 20 cm (8 in); the mineral soil horizons were gleyed nearly to their top. Tamarack and red spruce are the most common trees. One of the largest tamarack, 30.5 cm (12 in) dbh, was cored and showed an age of 95 years; most measure 20 to 25 cm (8 to 10 in) dbh. Other trees present are red maple and white pine. The shrub flora is diverse, with mountain-holly, black chokeberry, low early blueberry, meadowsweet, and shadbush prominent. Dwarf red blackberry, bristly dewberry and snowberry creep along the sphagnum carpet. A relatively large number of herb species occur, with a few indicating areas of slightly elevated nutrients and more flowing water than generally found in the swamp. Among the over thirty herbaceous species are three-seeded, poor and gynandrous sedges; cinnamon, marsh, sensitive and crested wood ferns; starflower, dewdrop, bunchberry dogwood, woodland horsetail, and small enchanter's-nightshade. A small population of folliculate sedge, which is uncommon in the state, was seen near the south end of the swamp. Species indicative of the slight nutrient boost are rare but present; these include swamp saxifrage, lady fern, turtleheads and slender wood-reed.

Community condition, size and landscape context—The composition of the swamp is very characteristic of this type; many species of boreal, acidic wetland forests are present. Structural features of live and dead vegetation and hydrology are in good condition, with a substantial amount of dead wood throughout the swamp and no disturbances to hydrology apparent, despite that Route 125 is only 20 m (66 ft) from the swamp's southern margin. Based on one tree core and general diameters seen, the trees are less than 150 years old and the condition rank is thus B. Landscape context of the natural community receives B/C rank, for it is close to the Bread Loaf campus and Route 125. Size of the narrow swamp is four acres, qualifying as D rank. EO Rank = C (2.2).

Element occurrence rank weightings—(Condition rank x 0.35) + (Landscape

Context rank x 0.35) + (Size rank x 0.3)

State natural community rank—S3, high quality examples are uncommon in the state, but not rare; the community is restricted in distribution for reasons of climate, geology, soils, or other physical factors, or many examples have been severely altered. To be state-significant, an example must have an element occurrence rank of A or B.

HEMLOCK—BALSAM FIR—BLACK ASH SEEPAGE SWAMP

State-significant occurrence—Yes. Occurrences in Edwards Lot and Brown Lot 1 are state-significant.

Extent and patch pattern—The Edwards parcels' six patches comprise the most acreage of this minerotrophic swamp forest type on the college lands. Additionally, two small patches occur in Bread Loaf 11 (in the Battell Loop area), with a third patch in Upson Lot 1 adjacent to the westernmost plantation. Small examples occur in Brown Lot 1, Crystal Brook and Coal Kiln parcels.

General description— Hemlock-Balsam Fir-Black Ash Swamps are level areas with generally shallow organic horizons that in some places were found to be as much as 60 cm (24 in) deep. For example, soil in the larger of the two Bread Loaf swamps has a 10-cm (4-in) organic horizon over 10 cm (4 in) of mucky loam to fine sandy loam A horizon with the underlying soil a prominently mottled, olive-gray silt loam with; very dense and rocky material was observed at 50 cm (20 in) deep. In most cases the swamps are mossy but do not have moss carpets, rather, the low spots have shallow water or bare muck with ferns and sedges. These are species-diverse swamp forests; canopy trees include those in the community name, but black ash is not present in all of them. Additional trees include yellow birch, red spruce, red maple, white ash and rarely, basswood and beech. As with some of the seepage forests, witch-hazel, a species uncommon at these elevations, tends to be present in these nutrient-rich seepage swamps. In two of the Edwards lands swamps, yellow lady's-slipper, uncommon in the state and very rare on college lands, is present. Another uncommon species located in the southeastern-most of the Edwards swamps is swamp thistle, a soft thistle not like the spiny field ones. Plant species diversity is similar to that in the seepage forests, but usually not quite as diverse. Shrubs and small trees include speckled alder, mountain holly, beaked hazel, and on mounds striped maple, hophornbeam and shadbush. Groundcover composition is indicative of the nutrient enrichment from active groundwater seepage. Species include swamp saxifrage, spotted touch-me-not, dwarf red blackberry, water avens, lady fern, northeastern manna grass, sensitive and interrupted ferns, and scabrous, few-nerved, and delicate-stemmed sedges. Among the additional species are small enchanter's-nightshade, violet (possibly sweet white violet), leek-colored sedge, and the alien self-heal. Mosses are common, including *Sphagnum* cf. *squarrosum*, *Thuidium delicatulum* and *Mnium* sp. The largest trees tend to be hemlock measuring 35 to 45 cm (14 to 18 in) dbh.

Community condition, size and landscape context—Upson Lot 1 occurrence: The Hemlock-Balsam Fir-Black Ash Swamp in Upson Lot 1 is part of a linear, sloping wetland that shows a history of pasturing. Early successional species—trembling aspen and balsam poplar—are present in addition to the typical canopy trees. Groundcover in the swamp consists of sensitive, lady, interrupted, cinnamon, and royal ferns, along with tall meadow-rue, flat-topped aster and fowl manna grass. Part of the area has large mounds and recent blowdown. Community condition is B/C, as rather recent selective logging has occurred and skid trails course through the community. Size of the linear swamp is 0.7 ha (1.7 ac), which correlates to D rank. Landscape context is B/C due to the proximity of conifer plantation and roads. EO Rank = C (2.1).

Brown Lot 1 occurrence: A 0.4-ha (1-ac) patch of Hemlock-Balsam Fir-Black Ash Swamp extends north of the Alder Swamp upslope of the southern lot line. This gently sloping wetland forest straddles description of nutrient-enriched mineral soil swamp and seepage forest. Red spruce, hemlock, red maple and yellow birch are the tree species and measure to 30 cm (12 in) dbh. The soil has 20 cm (8 in) of mucky silt loam over a prominently mottled extremely rocky silt loam, with a densipan at 55 cm (22 in). Cinnamon and sensitive ferns, northeastern manna grass, turtleheads, marsh violet, northern water-horehound, American marsh-pennywort, and three-seeded and gynandrous sedges are common. Condition rank is B. Landscape context rank is A/B. The small size gives a D rank. EO rank = B (2.575).

Edwards Parcels occurrence: Hemlock-Balsam Fir-Black Ash Seepage Swamps are scattered throughout the Edwards lands; these swamps are in most cases downslope from either seepage forest or Hemlock-Red Spruce-Northern Hardwood Forest. They are in very fine condition, although probably not supporting trees greater than 150 years old, some of the hemlock are 50 cm (20 in) dbh. These are probably the most species-diverse swamp forests on all the lands, and even include uncommon species yellow lady's-slipper and swamp thistle. One swamp had a wintergreen that may be the state rare little shinleaf. Condition receives B rank. Landscape context is A/B and size of the six patches totals 15 ha (38 ac) yielding an A rank. EO rank = A (3.5).

Crystal Brook Lot occurrence: The swamp on this lot is just a bit over 0.6 ha (1.5 ac) and is adjacent to Route 125. Nevertheless, it is in fine condition, with hemlock as large as 57 cm (22 in) dbh and red spruce reaching 40 cm (16 in). The canopy is less diverse than the other swamps of this type, with yellow birch and red maple as the only hardwoods. The herbaceous flora, however, clearly displays the seepage influence. Condition ranks B; Landscape context ranks B/C. Size rank is D. EO rank = C (2.2).

Coal Kiln occurrences: Coal Kiln lots 2 and 3 each support small conifer-hardwood seepage swamps that are good examples of the type. The southern one, in Lot 3, is partially on national forest land. This swamp shows more mineral enrichment than the one on Lot 2. Although adjacent to a forest road the hydrology does not appear to have been altered and it is easily accessed. Both swamps receive the same ranking; condition is B, landscape context is B/C, and size is D. EO rank = C (2.2).

Bread Loaf 11 occurrence: Community condition is B. Selective logging of spruce and/or hemlock has left old, very well decayed mossy stumps and the canopy is less than 150 years old. Size of the two patches is small, totaling 0.8 ha (1.9 ac), which correlates to D rank. Landscape context is B/C due to the proximity of roads and Bread Loaf campus. EO Rank = C (2.2).

Element occurrence rank weightings—(Condition rank x 0.35) + (Landscape Context rank x 0.35) + (Size rank x 0.3)

State natural community rank— S3.

RED SPRUCE-CINNAMON FERN SWAMP

State-significant occurrence—No, although the Edwards Lot occurrence is definitely of local significance and statewide interest due to the unusual presence of skunk cabbage in the mountain landscape at an elevation of 506 m (1,600 ft).

Extent and patch pattern—Three Red Spruce-Cinnamon Fern Swamps lie in small basins to the east of Lake Pleiad at the Snow Bowl; they are within 160 m (500 ft) of each other and comprise one element occurrence. Edwards Lot 2 contains a single Red Spruce-Cinnamon Fern Swamp.

General description—Snow Bowl occurrence: These three small swamps are quite characteristic of the variation of this type of swamp that shows a bit of nutrient enrichment. Red spruce and balsam fir are strong canopy dominants, while red maple and yellow and paper birches are also present. Mountain-ash and striped and mountain maples form a tall shrub/small tree layer, and *Sphagnum* and other mosses cover the forest floor. Cinnamon fern, three-seeded sedge, intermediate and mountain wood ferns, and another 25 or so herbaceous species grow in the swamps. Among the scattered indicators of active seepage and elevated nutrient availability are jack-in-the-pulpit, scabrous sedge, northeastern manna grass, spotted touch-me-not, and false hellebore. Soil in these three swamps is well decomposed peat, from 40 to 100 cm (16 to 39 in) deep over bedrock.

Edwards Lot 2 occurrence: This headwater seepage swamp is an unusual example of a coniferous swamp, in part because of the extreme differences between upslope and downslope portions in a short distance, and in part because of the presence of skunk cabbage, a plant that was seen nowhere else in the mountain landscape and is known from very few locations in Addison County. The upper part of the swamp is more typical of somewhat nutrient enriched Red Spruce-Cinnamon Fern Swamps. In addition to spruce the canopy includes balsam fir, red maple, yellow birch and white pine. *Sphagnum* covers the swamp floor, and some of the more typical herb species are goldthread, intermediate and crested wood ferns, bunchberry dogwood, northern water-horehound, cinnamon, interrupted and royal ferns, and a variety of sedges. Groundwater seepage and nutrient enrichment increase downslope, as one would expect, and also abundance of skunk cabbage increases along with northeastern manna grass, scabrous sedge, virgin's-bower, and rattlesnake and American manna grasses. The soil

features roughly 20 cm (8 in) of mucky loam to very fine sandy loam atop extremely stony subsoil. The lower section of the forested swamp grades into an Herbaceous Seepage Marsh with a well-formed stream flowing south.

Community condition, size and landscape context— Snow Bowl occurrence: Condition of the three little-disturbed swamps is B. Landscape context of the surrounding ski area development is B/C, and the three-swamp sum of two hectares (5 ac) is a C size rank. EO rank = C (2.5).

Edwards Lot 2 occurrence: Condition of the swamp is B, recovering from past agricultural influences (stone walls are adjacent to the north and nearly so to the west) but in quite natural condition. Landscape context is B with widely scattered rural development not far. The swamp covers approximately 0.3 ha (0.75 ac) and thus receives a D rank. EO rank = C (2.4).

Element occurrence rank weightings—(Condition rank x 0.35) + (Landscape Context rank x 0.35) + (Size rank x 0.3)

*State natural community rank—*S3.

Non-forested Wetland Types

SEEP

*State-significant occurrence—*Yes. The set of Seeps within the Bread Loaf and contiguous lands together comprise a state-significant natural community occurrence.

*Extent and patch pattern—*Nineteen Seeps were mapped as polygons on the college Bread Loaf vicinity lands in 2012, and there are certainly more small ones that we did not encounter in our routes. Those that we mapped range in size from 0.01 to 0.3 ha (0.03 to 0.8 ac); all of these mapped ones are larger than the minimum 0.008 ha (0.02 ac) size that the Vermont Fish and Wildlife Department recognizes for the Seep natural community. The Seeps are scattered throughout the lands.

*General description—*Seeps are non-forested patches where groundwater seepage is continuous throughout the year, with a great enough amount of water emerging such that tree establishment is precluded. Each Seep is slightly different in vegetation composition, but there is a suite of species that is characteristic of Seeps in general, and that is so for the Seeps in our study area also. Common species are northeastern manna grass, scabrous sedge, yellow and spotted touch-me-nots, sensitive, lady and silvery spleenwort ferns, woodland horsetail, gynandrous sedge, false hellebore, Canada wood-nettle, and dwarf red blackberry. Goldie's fern was seen in one Seep (Goshen Brook Lot); the species had been considered uncommon (S3 rank) in the state, but is now listed as s4 "may be locally uncommon or widely scattered, but not uncommon on a statewide basis."

Community condition, size and landscape context— The Seeps in the Bread Loaf contiguous lands are all within the South Branch watershed and are generally not more than 0.8 km (0.5 mi) distant from the next nearest Seep; thus they are considered as one

element occurrence. The Seep in Goshen Brook Lot 1 is a separate occurrence, since it is 1.6 km (1 mi) from the nearest neighboring Seep.

Bread Loaf Seeps: The condition of all Seeps is very good. Hydrologic disturbance was not observed, nor were invasive species. The only non-native species noted was self-heal, which was seen in a number of the documented Seeps. Condition rank for the occurrence is A. The size of the contiguous Bread Loaf lands Seep element occurrence as the sum of all those mapped is 1.6 ha (4 ac) and thus receives an A size rank. Eleven of the mapped Seeps fall within the 0.04-0.4 ha (0.1-1 ac) range and each of these would receive a C size rank and would qualify as B-ranked occurrences separately (and thus qualify individually as state significant). Landscape context rank for the Bread Loaf Seeps is A/B. The subwatersheds of which they are part are generally very intact, but hydrological disruptions do occur from ski trails and woods roads. Logging in the past several decades has occurred in some of the subwatersheds also. EO rank = A (3.795)

Goshen Brook Lot 1 Seep: Community condition of the Seep is excellent and thus receives an A rank. The Seep covers 0.2 ha (0.5 ac) on the college parcel and extends southward onto national forest land. The wetland to the south extends for approximately 320 m (0.2 mi) and includes beaver ponds and meadows; the amount of Seep within the wetland has not been documented. Given what is known, the Goshen Brook Lot 1 Seep receives a C size rank, but it may deserve a B rank depending on what is located on the national forest lands. Landscape context rank of the Goshen Brook Lot Seep is A. EO rank = A (3.3).

Edwards Lot Seeps: Community condition of the two Seeps is good, although one is beside Wagon Wheel Road and includes some reed canary grass; condition rank is thus ranked A/B. The Seeps covers 0.24 ha (0.6 ac) for a C rank. Landscape context of the larger Seep is roadside and thus is B ranked. EO rank = B (2.8)

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33)

State natural community rank—S4.

SUBACID FOREST SEEP (VERMONT NAME = SEEP)

State-significant occurrence—The larger and more remote of these two interesting moderately closed canopy large Seeps is state significant. The smaller example has been quite disturbed by ski trail development.

Extent and patch pattern—Two seepage wetlands with moderate canopy cover of conifers and hardwoods occur in the Snow Bowl parcel. The 0.4- and 1.2-ha (1- and 3-ac) communities are larger and broader than typical forest Seeps documented on the college lands.

General description—These two areas are difficult to fit into existing natural community classifications, but seem to be best described by the New Hampshire category Subacid Forest Seep. Tree cover consists of red spruce, balsam fir, and yellow and paper birches. Southwestern Snow Bowl occurrence: The high elevation example, in

the southwest corner of the parcel, features a deep peat (>130 cm (51 in)) soil and mossy mounds of *Sphagnum* and stairstep moss. The herb layer, which has nearly full cover, is dominated by northeastern manna grass, turtleheads, gynandrous sedge, and purple-stemmed American aster. Other species include spotted touch-me-not, sensitive fern, scabrous sedge, wild mint, white northern bog-orchid, interrupted fern and dwarf red blackberry. On mounds are intermediate wood fern, lady fern and tall meadow-rue. This area is a headwater basin from which arises one of the three streams that form Bailey Falls Brook and per the New Hampshire classification would be the subacid sphagnum variant. Central Snow Bowl occurrence: This community does not have a peat soil but rather a mucky mineral soil and is actually a large Seep complex with conifer-dominated tree cover all around. Among the species are golden-saxifrage, swamp saxifrage, scabrous sedge, foamflower, rough bedstraw, fowl manna grass, and marsh violet. The southwestern corner of the wetland, which abuts the junction of two ski trails, is dominated by the invasive reed canary grass. This example is better described as the foamflower graminoid variant.

Community condition, size and landscape context—Southwestern occurrence: Condition and landscape context of this remote, undisturbed example are both A-ranked. Size of slightly over 1.2 ha (3 ac) also receives an A rank. EO rank = A (4).

Central occurrence: Condition is C/D ranked due to the conversion of part of the Seep to ski trail. Landscape context is B/C since the occurrence is right within the Snow Bowl trail network; the 0.4 ha (1 ac) size ranks B. EO rank = C (2.3)

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33)

State natural community rank—S4.

Non-forested Wetlands

ALDER SWAMP

State-significant occurrence—Probably not state-significant but definitely locally significant. Investigation of the heart of the Alder Swamp on Green Mountain National Forest land in the area of the Robert Frost Trail, however, may alter the current evaluation.

Extent and patch pattern—Small, narrow patches of Alder Swamp occur in scattered areas along the South Branch and the lower reaches of tributaries, including Brandy Brook. The largest shrub swamp in the area extends for 1.6 km (1 mi) and is only partially on college lands; it borders the South Branch from the Brown Lot across national forest lands, the site of the Robert Frost Trail, onto the Coal Kiln lot. The national forest Alder Swamp not been inventoried or accurately mapped, and that is the major part of the occurrence.

General description—The various Alder Swamp patches exhibit compositional and structural differences within and among sites. What they share is dominance of speckled alder and soil that is mucky (in most places a mucky mineral soil is the top

horizon) and does not show signs of recent and periodic alluvial deposition. Shrub swamps with alluvial influence are mapped and described as the Alluvial Shrub Swamp natural community type, and along the South Branch the shrub wetlands are a mosaic of both of these alder-dominated types.

Alder Swamps typically feature alder that are one to two meters (3 to 6 ft) tall, with some of the non-alluvial areas featuring slightly taller alder. Other woody species present in any particular swamp may include northern wild-raisin, meadowsweet, and small individuals of red maple, red spruce, and choke cherry, along with occasional birches and trembling aspen. Most of the Alder Swamp in the study area likely has relatively active subsurface flow, judging from the presence of species such as northeastern manna grass and scabrous sedge. Additional common herbs in these swamps include numerous ferns (sensitive, cinnamon, interrupted, royal, and lady), purple-stemmed American aster, woodland horsetail, spotted joe-pye-weed, tall meadow-rue, swamp candles, water avens, gynandrous sedge, bluejoint grass, Canada and fowl manna grasses, spotted touch-me-not and bedstraws (marsh and rough); some of the swamps include small populations of broad-leaved cattail. Some swamp areas, such as southeast of the Brandy Brook house, have a substantial component of sedges and bulrushes. One type of Alder Swamp in Coal Kiln Lot 1 occurs at the base of the steep upland slope and features a less dense alder canopy and more dense herbaceous layer than is typical pictured for Alder Swamps.

Community condition, size and landscape context—Robert Frost Alder Swamp occurrence: This occurrence is along the South Branch south of Route 125. Community condition is overall good, with characteristic species present and no apparent disturbance to vegetation and no invasive species noted. The swamp east of the house in the Brown Lot has a large marshy opening, which may have been a farm pond; that part of the wetland was not investigated on the ground, but a field visit would be informative. Due to the previous agricultural use of the landscape and apparent slight (to moderate) hydrologic disruptions in some swamp portions, condition rank is B. Landscape context for the Alder Swamps is B/C; lands to the north are moderately fragmented (adjacent roads, fields and other anthropogenic features); those to the south are intact forest. Size of the occurrence is 20 to 30 acres, likely a B size rank. EO rank = B (2.8).

About two hectares (5 ac) of Alder Swamp occurs north of Route 125; hydrologically these patches are part of the same Alder Swamp system, despite the separation by a highway. Among these northern pieces, swamp portions near or adjacent to Steam Mill Road may have some minor alterations to the natural hydrology, but no major hydrologic disruptions were noted there.

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33)

State natural community rank—S5.

ALLUVIAL SHRUB SWAMP

State-significant occurrence—Yes assuming that the acreage of the type in the area of the Robert Frost Trail Alder Swamp complex would add another two to four hectares (5 to 10 ac) to the occurrence. If not state-significant, the occurrences in the Robert Frost Trail area and adjacent to Brooks Road are certainly locally significant.

Extent and patch pattern—Alluvial Shrub Swamp occurs as small patches in complex with Alder Swamp alongside and near the South Branch. A patch adjacent to Brooks Road is nearly 1.6 km (1 mi) from the Robert Frost Trail complex and thus may be seen as part of another wetland complex.

General description—Soils and hydrologic processes differentiate this type from Alder Swamp. Brief inundation and deposition of alluvium characterize Alluvial Shrub Swamp, and thus the community is by definition in riparian locations. Soils in this natural community formed in silt to fine sandy loam alluvium, and in the lower energy riparian locations, such as along Brandy Brook, one finds mucky versions of those textures. The alder shrubs are taller than those in Alder Swamp, for after inundation events the soil does not stay saturated as in typical shrub swamps; alder heights are four to six meters (13 to 20 ft) and in some cases as great as eight meters (26 ft). Along with the alders are one to several willow shrub species (including silky willow), red raspberry, highbush-cranberry, and meadowsweet, as well as a light cover of trees such as red maple, black cherry, red spruce, and balsam fir. In the Brown Lot 2 example, black elderberry was present, as was some exotic Tatarian honeysuckle. Herbaceous species include rough-stemmed and giant goldenrods, tall meadow-rue, spotted joe-pye-weed, spotted touch-me-not and virgin's-bower. Additional herbs are avens (water and yellow or perhaps large-leaved), manna grasses (great and fowl), sensitive, ostrich and lady ferns, rough bedstraw, common eastern and eastern riverbank wild-ryes, and sedges including brome-like, gynandrous and scabrous. Herb cover varies quite a bit from place to place and some spots can be strongly dominated by one or two species.

The patch adjacent to the south side of the South Branch in Brown Lot 2 is an excellent example of natural community pattern from river channel to Alluvial Shrub Swamp; there are bands of twisted sedge low riverbank, willow low riverbank, and Alluvial Shrub Swamp. The former two types are described for New Hampshire by Sperduto and Nichols (2004); per the Vermont classification they are combined into River Cobble Shore. The patch of Alluvial Shrub Swamp in the Brown Lot 2 mapped approximately 150 meters south of the South Branch (south of conifer plantation) is not in the active zone of inundation but appears to be an ancient terrace of the river (silt loam soil). Seepage coming off the slope to the south provides abundant moisture, and there are numerous small trees present; it is unclear why this site does not support forest cover. For lack of a “better fit” we have mapped it as Alluvial Shrub Swamp. The sinuous patch of more characteristic Alluvial Shrub Swamp nearly adjacent to the east lies in an intermittent and well-defined river channel.

Community condition, size and landscape context—Robert Frost Trail occurrence: The community condition is judged as B-ranked, for these lands were formerly pastured (time of abandonment not investigated) and there are small amounts of invasive, exotic species (Eurasian honeysuckles, purple nightshade, live-forever). Size of the few small patches totals approximately 4.5 ha (11 ac) as mapped, and it is estimated that there is nearly equal additional acreage on national forest lands, which would qualify as a B rank. Landscape context receives a rank of B/C, moderately fragmented on the north due to the adjacent conifer plantation, fields and road, but intact forest to the south. EO rank = B (2.8), provisional pending determinations on adjacent lands. *Brooks Road occurrence:* If not considered part of the more extensive South Branch complex in the Robert Frost Trail area, this patch 1.3 ha (3.3 ac) patch adjacent to Chatfield parking area has an EO rank of C.

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33)

*State natural community rank—*S3.

***MIXED SHRUB SEEPAGE SWAMP
(NOT INCLUDED IN VERMONT CLASSIFICATION)***

*State-significant occurrence—*Not likely, since the single occurrence of this somewhat unusual shrub swamp type is small and close to roads and fields.

*Extent and patch pattern—*One wetland in Bread Loaf 14 adjacent to Brooks Road has one or several patches of this type within a larger wetland complex that includes beaver ponds and meadows, Herbaceous Seepage Marsh and wet Lowland Spruce-Fir Forest.

*General description—*The Mixed Shrub Seepage Swamps occur within linear depressions that are approximately one meter (3 ft) below the terrain level of the adjacent forest. Soil is mucky silt loam (one location measured had 80 cm (31 in) of this horizon) over medium sand. The entire complex is adjacent to the South Branch and likely experiences a cold air-sink microclimate. Shrub species include silky and heart-leaved willows, meadowsweet, witherod, highbush-cranberry, silky dogwood, and sapling-sized red maple. The herb composition is similarly quite diverse, with a mix including purple-stemmed American aster; sensitive, royal and marsh ferns; gynandrous, little prickly, pointed broom, delicate-stemmed, and garish sedges; spotted joe-pye-weed; water avens; swamp saxifrage; turtleheads and dwarf red blackberry.

*Community condition, size and landscape context—*The Mixed Shrub Seepage Swamp appears quite natural and undisturbed, although it is adjacent to a forest road and the surrounding landscape is a mix of heavily-logged and plantation forests. Hydrology is natural, although there must be slight alteration due to runoff from the nearby fields and roads. Condition rank is therefore B (A/B at best). Size of mapped community is 1.2 ha (3 ac), a small to very small size for a shrub swamp, so size rank is

D (C/D at best). Landscape context rank is B/C due to presence of adjacent roads and fields within an otherwise largely intact landscape. EO rank = C (2.1 – 2.5).

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33)

State natural community rank—This type is not recognized as a natural community type in Vermont and is therefore not ranked in the state; in New Hampshire it might be recognized as mixed tall graminoid—scrub-shrub marsh, a wetland with <60% shrub cover and is considered an S4S5 type. The Vermont state rank would likely be S3 or S4. Investigation of shrub swamp types in the state is needed, but the lack of a type that really describes this sort of wetland does indicate that the community is restricted in distribution (S3).

HERBACEOUS SEEPAGE MARSH

(VERMONT NAME = SHALLOW EMERGENT MARSH)

State-significant occurrence—Yes. These small marshes appear to have natural composition and processes, despite that roads and fields are nearby.

Extent and patch pattern—Four small areas were mapped on the Bread Loaf Lands (Bread Loaf 14), Brooks, and USFS Exchange lots. This small-patch natural community type is in some cases associated with larger wetland complexes; two of our examples are pockets within upland forest, while two are part of small wetland complexes.

General description—Herbaceous Seepage Marsh is a type name in the New Hampshire classification but is not currently recognized in Vermont, where little ecological study of open wetlands (aside from bogs and fens) has been conducted. Per the Vermont classification these communities would likely need to be classified as shallow emergent marshes (which Thompson and Sorenson (2000) admit to be a broad category). Nevertheless, the vegetation is quite a mix of graminoids, forbs and ferns, and thus is not what we typically picture when thinking of emergent marshes. Sperduto and Nichols (2004) describe Herbaceous Seepage Marshes as occurring in association with discharge zones often near upland-wetland borders of larger wetlands. In the Brooks Lot example small-fruited bulrush and slender spikerush are abundant, with an admixture of river horsetail, marsh St. John's-wort, spotted touch-me-not, marsh fern, giant goldenrod, common water-horehound, swamp candles, and a bit of purple-fringed orchid. There is a 40% cover of shrub willow (species not determined) and a light covering of tamarack and red maple. Soil consists of 10-15 cm (4-6 in) fibrous muck and 15-20 cm (6-8 in) mucky loam overlying gleyed silt loam; clearly the water table sits at the surface throughout the growing season.

The western example in Bread Loaf 14 is somewhat different. It occupies a small basin at the foot of a steep slope, where it receives abundant moisture from downslope flow. Herbaceous flora consists of river horsetail, sensitive and cinnamon ferns, purple-stemmed American aster, spotted joe-pye-weed, great manna grass, swamp saxifrage,

water avens, little prickly sedge, marsh bedstraw and a small amount of broad-leaved cattail. Woody vegetation includes a 25% cover of silky willow and scattered red spruce, red maple, and yellow birch. No soil observations were made.

Between these two examples is a linear wetland complex that includes some Herbaceous Seepage Marsh. This is a beaver-influenced wetland, but the marsh occurs in a narrow portion that does not appear susceptible to inundations from beaver impoundments. Shrub species in the marsh include silky and heart-leaved willows, mountain-holly, meadowsweet and steeplebush. Herbs include woolgrass, little prickly sedge, golden saxifrage, crested wood fern, field horsetail, rough and marsh bedstraws, broad-leaved cattail, purple-stemmed American aster, bog willow-herb, rough goldenrod and dwarf red blackberry.

The example in the USFS Exchange Lot starts as several seepage heads at the northern end; these coalesce on the very gently sloping land to form the broader marsh, whose downslope portion does not include the same seepage species and is mapped as a shallow emergent marsh/beaver complex. Within the marsh are widely scattered small red maple, red spruce and paper birch overtopping a shrub mix of meadowsweet, steeplebush, willows, beaked hazelnut, common blackberry, red raspberry, and a scattered Tatarian honeysuckle. The herbaceous flora is more diverse than in the other marshes. Some of the additional species are small-flowered bulrush, Canadian, northeastern and great manna grasses, New England groundsel, white boneset, virgin's-bower, giant goldenrod, grass-leaved goldenrod, arrow-leaved tearthumb, purple-fringed orchid, and northern long-awned wood grass.

Community condition, size and landscape context— Since the two patches in the Bread Loaf 14 and the one in Brooks Lots are not separated by more than one-half mile they are listed as a single element occurrence; the USFS Exchange Lot Herbaceous Seepage Marsh is a separate occurrence.

Bread Loaf 14 and Brooks Lot occurrence: The natural communities in Bread Loaf 14 are intact with no apparent disruptions, but the Brooks Lot marsh appears to have been cut in two by Route 125 (north of the highway is not college land and was not visited). Thus the condition rank is A/B; no invasive species observed but there is likely some hydrologic disruption and some input of salt, sand and silt from road runoff in the Brooks Lot marsh. Size of the occurrence is 0.5 ha (1.3 ac), which is moderate for a small-patch marsh type and suggests a size rank of C. Landscape context is B/C as atop the slopes north of the Bread Loaf 14 wetlands are annually mowed fields, and roads are close to and dividing the wetlands. Utilizing generic ranking guidelines, the occurrence receives an EO rank of B, good estimated viability.

USFS Exchange Lot occurrence: Community condition receives a B rank due to the presence of the invasive honeysuckle. No other apparent disruptions to the natural processes, structure or composition were noted. Size of the marsh is 0.3 ha (0.7 ac), which likely translates to moderate, a rank of C. Landscape context is B since Steam Mill

Road and a couple of small house-site perforations are close by. EO rank for the marsh is B, good estimated viability.

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33)

State natural community rank—No state rank for Herbaceous Seepage Marsh in Vermont, although New Hampshire lists the type as S3. The closest type in Vermont, shallow emergent marsh, is ranked S4. In either case and EO rank of A or B is required for an example to be considered state significant.

SHALLOW EMERGENT MARSH/BEAVER COMPLEX

State-significant occurrence—The occurrence that just barely extends onto the eastern edge of Homer Noble Farm may be a state-significant occurrence; documentation of the major portion (on national forest lands) would be required to verify. Other occurrences are small and are not state-significant natural communities.

Extent and patch pattern—Beaver activity is scattered on the Bread Loaf vicinity lands. The most extensive beaver-influenced wetland complex occurs northeast of the Bread Loaf lands on the national forest, but only a very small finger of that complex extends onto the Homer Noble Farm. The largest areas of beaver-influenced wetland on the college parcels are in the Bread Loaf 14 parcel, the Coal Kiln Lots, and Edwards Lot (human-created chain that “invited” beaver). Other areas include the USFS Exchange Lot southwest corner and the Homer Noble Farm pond that is slightly east of the access road (but no beaver meadow or wetland currently exists there).

General description—The small bit of beaver meadow in the northeast corner of Homer Noble Farm is currently vegetated with gynandrous sedge, sensitive fern, spotted joe-pye-weed and a bit of broad-leaved cattail. A small pond sits to the east of the meadow.

The beaver-influenced wetland complex in Bread Loaf 14 has a variety of meadows and shrubby meadows that are successional on former ponded lands. One is dominated by little prickly sedge, with broad-leaved cattail, common rush, and goldenrods mixed in. Another features small-flowered bulrush and broad-leaved cattail; portions of the open wetland are also mapped and described as Herbaceous Seepage Marsh. The only currently ponded portion is adjacent to Route 125 has some cattail in a vegetated portion of the basin. One meadow within the complex is adjacent to open field and appears to have been formerly impounded by a human-made earthen dam (i.e. an old farm pond). That basin’s vegetation is more characteristic of unnaturally disturbed places; reed canary grass and goldenrods dominate and the noxious weed, wild parsnip is present.

Beaver are active in the USFS Exchange Lot wetland downstream from the Herbaceous Seepage Marsh. The active beaver area features pond as well as meadow with rice-cutgrass dominant, along with arrow-leaved tearthumb, great manna grass, silky willow, red raspberry and common blackberry. Tatarian honeysuckle occurs on the

wetland edge. The pond supports frog breeding (no notes were taken on species present, likely green frog).

The Edwards Lot chain of beaver ponds was created in the early 1950s by Gover, the resident of the in-holding, and his son. We did not explore the vegetation of these marshes in more than a cursory fashion. Currently the marshes are graminoid dominated, with a mix of grasses, sedges and bulrushes. A few areas are dominated by broad-leaved cattail.

Community condition, size and landscape context—Homer Noble Farm/GMNF occurrence: Condition of this large complex was not explored since it is almost entirely on the national forest. It appears quite natural and likely qualifies as A rank. The size is quite large, roughly 15 ha (37 ac), which is probably worthy of B ranking. Landscape context is A/B ranked, with Steam Mill Road the only factor reducing quality. EO rank is likely B.

Bread Loaf 14 occurrence: Varied conditions exist in the different parts of this complex. A reed canary grass-dominated meadow degrades the condition ranking to C. The small size yields C rank, and the position adjacent to fields and Route 125 leads to landscape context rank of B/C. EO rank = C (2.145).

USFS Exchange Lot occurrence: Minor degradation based on the presence of Tatarian honeysuckle provides for a B condition rank; size is small at best, for a C rank, and the landscape context, adjacent to a house lot near Steam Mill Road is B/C. EO rank = C (2.475).

The Edwards Lot occurrence, being artificially created, has not been ranked. The site may have been naturally recolonized by beaver, however, even if the ponds hadn't been built.

Element occurrence rank weightings—(Condition rank x 0.33) + (Landscape Context rank x 0.33) + (Size rank x 0.33)

*State natural community rank—*S4.

RIVER COBBLE SHORE

*State-significant occurrence—*Yes. The South Branch from Brooks Road to Goshen Road contains a B-ranked example of this rare natural community type.

Extent and patch pattern— The cobble shore natural community occurs along a low-gradient stretch of the South Branch as a series of bars along the river from Bread Loaf 14 (Brooks Road), through the Upson, Brown and Coal Kiln lots. Aerial photographs reveal additional open bars on national forest land just downstream of the Brown Lot in a very sinuous portion of the river; these were not investigated so it is not known if these are cobble, sand or gravel shore natural communities. Comparison of orthophotos from the past two decades shows that the extent of River Cobble Shore has increased in this occurrence; nearly certainly the scouring and deposition associated with severe storm events has been responsible for the increase.

General description—River Cobble Shore natural communities are within the river channel and rise gradually from the water to the banks. They are fully inundated during spring high water flows, and parts or whole bars are inundated during storm events. Vegetation is sparse and typically patchy; bare cobble is the dominant ground cover. Patches of sandbar and heart-leaved willows occur along with scattered small balsam poplar, black cherry, American elm and red maple. In places along the river's edge, twisted sedge grows in the lowest position closest to or in the water. Observations of the cobble shores were not very thorough, but the herbaceous plants recorded were a variety of native and non-native herbs, including ox-eye daisy, St. John's-wort, self-heal, red clover, yellow sweetclover, coltsfoot, water forget-me-not, timothy, ragweed, giant goldenrod, tear thumb, twisted sedge, fringed willow-herb, bladder campion, evening-primrose, field horsetail, fringed bindweed, spotted joe-pye-weed and giant goldenrod. The invasive non-native wild chervil occurs at various cobble shore locations on the South Branch. Invasive reed canary grass, a non-native species with a longer history in the Vermont landscape, occurs in patches at several of the cobble shore locations also.

Community condition, size and landscape context—As the list of herbaceous species indicates, the natural community is home to numerous non-native plants. That is not unusual in places with frequent disturbance, even when, as in this case, disturbance is natural. Condition is therefore given a B/C rank to indicate that the natural community dynamic of flooding and ice-scour are intact, as is woody plant structure and composition, but herbaceous alien species are present in substantial numbers. Size of the River Cobble Shores occurrence on the South Branch that extends from Brooks Road (Bread Loaf 14) to Goshen Road (Coal Kiln Lots) on the college and national forest lands currently totals approximately 1.5 ha (3.7 ac) over a 3.2 km (2 mi) length, with about half of the area on college parcels and the rest on GMNF lands. These shore communities occur in very small linear patches, and this is a sizeable length and acreage of this type, worthy of a B size rank (according to New Hampshire size specifications). The landscape context rank is B/C given the proximity of fields, conifer plantations and highway, but also the presence of an intact forested landscape south of the river. EO rank = B (2.6).

State natural community rank— S2.

LITERATURE CITED

- Austin, J., K. Viani, and F. Hammond. 2006. Vermont wildlife linkage habitat analysis. Vermont Fish and Wildlife Department, Waterbury, VT. http://www.vcgi.org/dataware/default.cfm?layer=EcologicHabitat_WCV. Accessed October 2011.
- Cogbill, C. V., J. Burk, and G. Motzkin. 2002. The forests of presettlement New England, USA: spatial and compositional patterns based on town proprietor surveys. *Journal of Biogeography* 29:1279-1304.
- George, L. O., and F. A. Bazzaz. 1999. The fern understory as an ecological filter: emergence and establishment of canopy-tree seedlings. *Ecology* 80:833-845.
- Griggs, J. E. 1971. Soil Survey of Addison County, Vermont. USDA Soil Conservation Service, Washington, D.C.
- Lapin, M., C. Crosby, J. Valen, and A. Oberg. 2010. Ecological and agroecological evaluation of Middlebury College lands in the Champlain Valley. Middlebury College, Middlebury, VT.
- NatureServe. 2002. NatureServe element occurrence data standard. <http://www.natureserve.org/prodServices/eodata.jsp>.
- Ratcliffe, N.M., Stanley, R.S., Gale, M.H., Thompson, P.J., and Walsh, G.J. 2011. Bedrock geologic map of Vermont: U.S. Geological Survey Scientific Investigations Map 3184, 3 sheets, scale 1:100,000. <http://pubs.usgs.gov/sim/3184/>.
- Royo, A. A., and W. P. Carson. 2008. Direct and indirect effects of a dense understory on tree seedling recruitment in temperate forests: habitat-mediated predation versus competition. *Canadian Journal of Forest Research* 38:1634-1645.
- Sorenson, E., and J. Osborn. 2011. Vermont habitat blocks and wildlife corridors: an analysis using Geographic Information Systems. Vermont Fish and Wildlife Department. http://www.vcgi.org/dataware/default.cfm?layer=EcologicHabitat_HABITATBLKS. Accessed 28 August 2013.
- Sperduto, D. D., and W. F. Nichols. 2004. Natural Communities of New Hampshire. The New Hampshire Natural Heritage Bureau and The Nature Conservancy, Concord, NH. in print and http://www.nhdf.org/library/pdf/Natural_Communities2ndweb.pdf.

Thompson, E. H., and E. R. Sorenson. 2000. Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont. Vermont Fish and Wildlife Department, Waterbury, VT and The Nature Conservancy, Montpelier, VT. in print and http://www.vtfishandwildlife.com/books.cfm?libbase_=Wetland,Woodland,Wildland.

Vermont Agency of Natural Resources. 2013. BioFinder. biofinder.vermont.gov. Accessed 29 August 2013.

Vermont Fish and Wildlife Department. 2012. Synonymy of Vermont natural community types with International Vegetation Classification associations. Nongame and Natural Heritage Program, August 14, 2012. http://www.vtfishandwildlife.com/library/reports_and_documents/nongame_and_Natural_Heritage/Natural_Communities/_List_of_Natural_Community_Types.pdf. Accessed August 2013.

Appendix 1.

**Nongame and Natural Heritage Program
Vermont Fish and Wildlife Department
March 2001
GUIDELINES FOR STATE SIGNIFICANCE**

The following guidelines are for determining whether a particular site will be included in an inventory report and entered into the NNHP database only; there is no legal or regulatory significance involved. The document is primarily intended for contractors and others performing work for NNHP.

Although these are intended as guidelines only, they are meant to represent the default position and any deviation from then would need to be justified.

Meeting any of the following criteria would constitute state significance of sites for the purposes of NNHP inventories and for mapping and entering into the NNHP database.

SPECIES

- the presence of any state listed (T & E) species, regardless of rank;
- the presence of any S1 or S2 species regardless of rank.
- the presence of an G3/S3 species with an EO rank of A or B.
- the presence of nesting/wintering habitat for S3 species of Special Concern

Note that split rank species default to the lower ranking, e.g. an S2/S3 species is treated as an S2 and mapped regardless of its EO rank. S3 and S3S4 species are recorded in log books.

COMMUNITIES

- the presence of any S1 or S2 communities with an EO rank of A, B, or C;
- the presence of an S3 or S4 community with an EO rank of A or B;
- the presence of a S5 community with an EO rank of A.

Note that C-ranked S3 communities and B-ranked S4 and S5 communities are tracked, and may be considered state-significant

HABITATS

- the presence of communal breeding/hibernating areas such as heron rookeries, or bat cave/mine, or Vernal Pool/amphibian breeding area with significant usage.
Note that there are presently no ranking specs for these habitats, and that the above criteria do not distinguish between natural and artificial examples.

SITE

- some allowances should be made for a cluster of somewhat significant natural communities occurring at a site provided there is some connection between them. Such sites would require at least 2 communities within 1 level of significance and a strong justification for a connection between them. Such a connection could be hydrologic as a small fen within a large marsh or colluvial as a rich woods below a talus slope.

Appendix 2. Vascular plant species of the Middlebury College Mountain Lands in Ripton, Middlebury and Hancock, Vermont (partial flora).

Scientific Name	Common Name	Family	Group
<i>Dendrolycopodium dendroideum</i>	Prickly Tree-Clubmoss	Lycopodiaceae	clubmoss/horsetail
<i>Dendrolycopodium obscurum</i>	Flat-Branched Tree-Clubmoss	Lycopodiaceae	clubmoss/horsetail
<i>Diphasiastrum tristachyum</i>	Blue Ground-Cedar	Lycopodiaceae	clubmoss/horsetail
<i>Equisetum arvense</i>	Field Horsetail	Equisetaceae	clubmoss/horsetail
<i>Equisetum fluviatile</i>	River Horsetail	Equisetaceae	clubmoss/horsetail
<i>Equisetum hyemale</i>	Tall Scouring-Rush	Equisetaceae	clubmoss/horsetail
<i>Equisetum scirpoides</i>	Dwarf Scouring-Rush	Equisetaceae	clubmoss/horsetail
<i>Equisetum sylvaticum</i>	Wood Horsetail	Equisetaceae	clubmoss/horsetail
<i>Huperzia lucidula</i>	Shining Firmoss	Huperziaceae	clubmoss/horsetail
<i>Spinulum annotinum</i>	Common Interrupted-Clubmoss	Lycopodiaceae	clubmoss/horsetail
<i>Adiantum pedatum</i>	Northern Maidenhair Fern	Pteridaceae	fern
<i>Athyrium filix-femina</i>	Northern Lady Fern	Woodsiaceae	fern
<i>Cystopteris fragilis</i>	Fragile Fern	Woodsiaceae	fern
<i>Dennstaedtia punctilobula</i>	Eastern Hay-Scented Fern	Dennstaedtiaceae	fern
<i>Deparia acrostichoides</i>	Silvery False Spleenwort	Woodsiaceae	fern
<i>Dryopteris campyloptera</i>	Mountain Wood Fern	Dryopteridaceae	fern
<i>Dryopteris carthusiana</i>	Spinulose Wood Fern	Dryopteridaceae	fern
<i>Dryopteris goldiana</i>	Goldie's Wood Fern	Dryopteridaceae	fern
<i>Dryopteris intermedia</i>	Intermediate Wood Fern	Dryopteridaceae	fern
<i>Dryopteris marginalis</i>	Marginal Wood Fern	Dryopteridaceae	fern
<i>Gymnocarpium dryopteris</i>	Northern Oak Fern	Woodsiaceae	fern
<i>Matteuccia struthiopteris</i>	Ostrich Fern	Onocleaceae	fern
<i>Osmunda claytoniana</i>	Interrupted Fern	Osmundaceae	fern
<i>Osmunda regalis</i>	Royal Fern	Osmundaceae	fern
<i>Osmundastrum cinnamomeum</i>	Cinnamon Fern	Osmundaceae	fern
<i>Parathelypteris noveboracensis</i>	New York Fern	Thelypteridaceae	fern
<i>Phegopteris connectilis</i>	Long Beech Fern	Thelypteridaceae	fern
<i>Polypodium virginianum</i>	Rock Polypody	Polypodiaceae	fern
<i>Polystichum acrostichoides</i>	Christmas Fern	Dryopteridaceae	fern
<i>Polystichum braunii</i>	Braun's Holly Fern	Dryopteridaceae	fern
<i>Pteridium aquilinum</i>	Bracken Fern	Dennstaedtiaceae	fern
<i>Thelypteris palustris</i>	Marsh Fern	Thelypteridaceae	fern
<i>Actaea pachypoda</i>	White Baneberry	Ranunculaceae	herb
<i>Actaea rubra</i>	Red Baneberry	Ranunculaceae	herb
<i>Agrimonia gryposepala</i>	Common Agrimony	Rosaceae	herb
<i>Agrostis</i> spp.	Bentgrass	Poaceae	herb
<i>Allium tricoccum</i>	Wild Leek	Alliaceae	herb
<i>Amphicarpaea bracteata</i>	American Hog-Peanut	Fabaceae	herb
<i>Anaphalis margaritacea</i>	Pearly Everlasting	Asteraceae	herb
<i>Anemone acutiloba</i>	Sharp-Lobed Hepatica	Ranunculaceae	herb
<i>Anemone quinquefolia</i>	Wood Windflower	Ranunculaceae	herb
<i>Angelica atropurpurea</i>	Purple-Stemmed Angelica	Apiaceae	herb
<i>Aralia nudicaulis</i>	Wild Sarsaparilla	Apiaceae	herb
<i>Aralia racemosa</i>	American Spikenard	Apiaceae	herb
<i>Arisaema triphyllum</i>	Jack-In-The-Pulpit	Araceae	herb
<i>Bidens cernua</i>	Nodding Beggar-Ticks	Asteraceae	herb
<i>Brachyelytrum aristosum</i>	Northern Long-Awned Wood Grass	Poaceae	herb
<i>Bromus ciliatus</i>	Fringed Brome	Poaceae	herb

<i>Calamagrostis canadensis</i>	Canada Reed Grass	Poaceae	herb
<i>Caltha palustris</i>	Marsh-Marigold	Ranunculaceae	herb
<i>Cardamine diphylla</i>	Two-Leaved Toothwort	Brassicaceae	herb
<i>Carex arctata</i>	Drooping Woodland Sedge	Cyperaceae	herb
<i>Carex bromoides</i>	Brome-Like Sedge	Cyperaceae	herb
<i>Carex brunnescens</i>	Brownish Sedge	Cyperaceae	herb
<i>Carex communis</i>	Fibrous-Rooted Sedge	Cyperaceae	herb
<i>Carex conoidea</i>	Open-Field Sedge	Cyperaceae	herb
<i>Carex cristatella</i>	Crested Sedge	Cyperaceae	herb
<i>Carex debilis</i>	White-Edged Sedge	Cyperaceae	herb
<i>Carex deweyana</i>	Round-Fruited Short-Scaled Sedge	Cyperaceae	herb
<i>Carex echinata</i>	Star Sedge	Cyperaceae	herb
<i>Carex folliculata</i>	Northern Long Sedge	Cyperaceae	herb
<i>Carex gracillima</i>	Graceful Sedge	Cyperaceae	herb
<i>Carex gynandra</i>	Nodding Sedge	Cyperaceae	herb
<i>Carex intumescens</i>	Greater Bladder Sedge	Cyperaceae	herb
<i>Carex leptalea</i>	Bristly-Stalk Sedge	Cyperaceae	herb
<i>Carex leptonevia</i>	Nerveless Woodland Sedge	Cyperaceae	herb
<i>Carex lurida</i>	Sallow Sedge	Cyperaceae	herb
<i>Carex magellanica</i>	Boreal Bog Sedge	Cyperaceae	herb
<i>Carex pedunculata</i>	Long-Stalked Sedge	Cyperaceae	herb
<i>Carex plantaginea</i>	Plantain-Leaved Sedge	Cyperaceae	herb
<i>Carex projecta</i>	Necklace Sedge	Cyperaceae	herb
<i>Carex retrorsa</i>	Retorse Sedge	Cyperaceae	herb
<i>Carex scabrata</i>	Eastern Rough Sedge	Cyperaceae	herb
<i>Carex scirpoidea</i>	Canadian Single-Spike Sedge	Cyperaceae	herb
<i>Carex scoparia</i>	Pointed Broom Sedge	Cyperaceae	herb
<i>Carex stipata</i>	Awl-Fruited Sedge	Cyperaceae	herb
<i>Carex tribuloides</i>	Blunt Broom Sedge	Cyperaceae	herb
<i>Carex trisperma</i>	Three-Seeded Sedge	Cyperaceae	herb
<i>Carex vulpinoidea</i>	Common Fox Sedge	Cyperaceae	herb
<i>Caulophyllum thalictroides</i>	Blue Cohosh	Berberidaceae	herb
<i>Cenchrus longispinus</i>	Long-Spined Sandbur	Poaceae	herb
<i>Chelone glabra</i>	White Turtlehead	Plantaginaceae	herb
<i>Chrysosplenium americanum</i>	Golden-Saxifrage	Saxifragaceae	herb
<i>Cinna latifolia</i>	Slender Wood-Reed	Poaceae	herb
<i>Circaea alpina</i>	Small Enchanter's-Nightshade	Onagraceae	herb
<i>Circaea canadensis</i>	Broad-Leaved Enchanter's-Nightshade	Onagraceae	herb
<i>Cirsium muticum</i>	Swamp Thistle	Asteraceae	herb
<i>Clintonia borealis</i>	Blue-Bead Lily	Liliaceae	herb
<i>Coptis trifolia</i>	Goldthread	Ranunculaceae	herb
<i>Corallorhiza maculata</i>	Spotted Coral-Root	Orchidaceae	herb
<i>Corallorhiza trifida</i>	Early Coral-Root	Orchidaceae	herb
<i>Cornus canadensis</i>	Canada Dwarf-Dogwood	Cornaceae	herb
<i>Cypripedium acaule</i>	Pink Lady's-Slipper	Orchidaceae	herb
<i>Cypripedium parviflorum</i>	Yellow Lady's-Slipper	Orchidaceae	herb
<i>Danthonia spicata</i>	Poverty Oatgrass	Poaceae	herb
<i>Dichanthelium acuminatum</i>	Hairy Rosette-Panicgrass	Poaceae	herb
<i>Dichanthelium clandestinum</i>	Deer-Tongue Rosette-Panicgrass	Poaceae	herb
<i>Doellingeria umbellata</i>	Tall White-Aster	Asteraceae	herb
<i>Dulichium arundinaceum</i>	Three-Way Sedge	Cyperaceae	herb
<i>Eleocharis tenuis</i>	Slender Spikesedge	Cyperaceae	herb
<i>Elymus riparius</i>	Eastern Riverbank Wild-Rye	Poaceae	herb
<i>Elymus virginicus</i>	Common Eastern Wild-Rye	Poaceae	herb




<i>Elymus wiegandii</i>	Wiegand's Wild-Rye	Poaceae	herb
<i>Epilobium ciliatum</i>	Fringed Willow-Herb	Onagraceae	herb
<i>Epipactis helleborine</i>	Broad-Leaved Helleborine	Orchidaceae	herb
<i>Eupatorium perfoliatum</i>	Boneset Thoroughwort	Asteraceae	herb
<i>Eurybia divaricata</i>	White Wood-Aster	Asteraceae	herb
<i>Eurybia macrophylla</i>	Large-Leaved Wood-Aster	Asteraceae	herb
<i>Euthamia graminifolia</i>	Common Grass-Leaved-Goldenrod	Asteraceae	herb
<i>Eutrochium maculatum</i>	Spotted Joe-Pye Weed	Asteraceae	herb
<i>Fallopia cilinodis</i>	Fringed Bindweed	Polygonaceae	herb
<i>Fragaria virginiana</i>	Common Strawberry	Rosaceae	herb
<i>Galeopsis tetrahit</i>	Brittle-Stemmed Hemp-Nettle	Lamiaceae	herb
<i>Galium asprellum</i>	Rough Bedstraw	Rubiaceae	herb
<i>Galium palustre</i>	Marsh Bedstraw	Rubiaceae	herb
<i>Galium triflorum</i>	Fragrant Bedstraw	Rubiaceae	herb
<i>Gaultheria hispidula</i>	Creeping Spicy-Wintergreen	Ericaceae	herb
<i>Gaultheria procumbens</i>	Eastern Spicy-Wintergreen	Ericaceae	herb
<i>Geum alepicum</i>	Yellow Avens	Rosaceae	herb
<i>Geum canadense</i>	White Avens	Rosaceae	herb
<i>Geum fragarioides</i>	Barren-Strawberry	Rosaceae	herb
<i>Geum rivale</i>	Water Avens	Rosaceae	herb
<i>Glyceria borealis</i>	Northern Manna Grass	Poaceae	herb
<i>Glyceria canadensis</i>	Rattlesnake Manna Grass	Poaceae	herb
<i>Glyceria grandis</i>	American Manna Grass	Poaceae	herb
<i>Glyceria melicaria</i>	Northeastern Manna Grass	Poaceae	herb
<i>Glyceria striata</i>	Fowl Manna Grass	Poaceae	herb
<i>Heracleum maximum</i>	American Cow-Parship	Apiaceae	herb
<i>Hydrocotyle americana</i>	American Marsh-Pennywort	Apiaceae	herb
<i>Hydrophyllum virginianum</i>	Eastern Waterleaf	Boraginaceae	herb
<i>Hypericum mutilum</i>	Dwarf St. John's-Wort	Hypericaceae	herb
<i>Impatiens capensis</i>	Spotted Touch-Me-Not	Balsaminaceae	herb
<i>Impatiens pallida</i>	Pale Touch-Me-Not	Balsaminaceae	herb
<i>Juncus brevicaudatus</i>	Short-Tailed Rush	Juncaceae	herb
<i>Juncus effusus</i>	Common Soft Rush	Juncaceae	herb
<i>Lactuca sp.</i>	Wild Lettuce	Asteraceae	herb
<i>Laportea canadensis</i>	Canada Wood-Nettle	Urticaceae	herb
<i>Leersia oryzoides</i>	Rice Cut Grass	Poaceae	herb
<i>Lemna minor</i>	Common Duckweed	Araceae	herb
<i>Linnaea borealis</i>	American Twinflower	Caprifoliaceae	herb
<i>Ludwigia palustris</i>	Common Water-Primrose	Onagraceae	herb
<i>Lycopodium clavatum</i>	Common Clubmoss	Lycopodiaceae	herb
<i>Lycopus americanus</i>	American Water-Horehound	Lamiaceae	herb
<i>Lycopus uniflorus</i>	Northern Water-Horehound	Lamiaceae	herb
<i>Lysimachia borealis</i>	Starflower	Myrsinaceae	herb
<i>Lysimachia ciliata</i>	Fringed Yellow-Loosestrife	Myrsinaceae	herb
<i>Lysimachia terrestris</i>	Swamp Yellow-Loosestrife	Myrsinaceae	herb
<i>Maianthemum canadense</i>	Canada-Mayflower	Ruscaceae	herb
<i>Maianthemum racemosum</i>	False Solomon's-Seal	Ruscaceae	herb
<i>Medeola virginiana</i>	Indian Cucumber Root	Liliaceae	herb
<i>Menispermum canadense</i>	Canada Moonseed	Menispermaceae	herb
<i>Mentha arvensis</i>	Ginger Mint	Lamiaceae	herb
<i>Mentha spicata</i>	Spearmint	Lamiaceae	herb
<i>Micranthes pensylvanica</i>	Swamp Small-Flowered-Saxifrage	Saxifragaceae	herb
<i>Milium effusum</i>	Millet Grass	Poaceae	herb
<i>Mitchella repens</i>	Partridge-Berry	Rubiaceae	herb

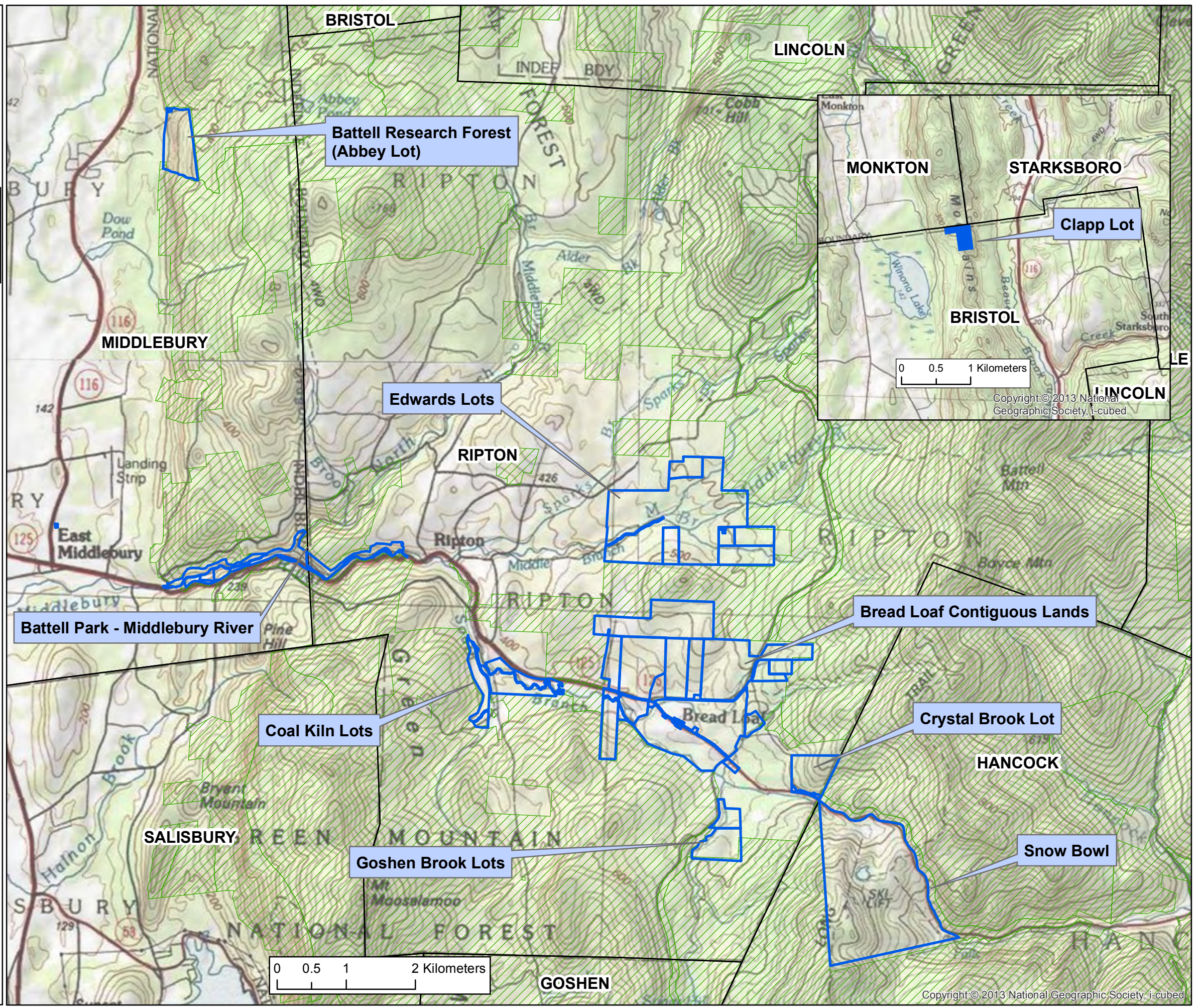
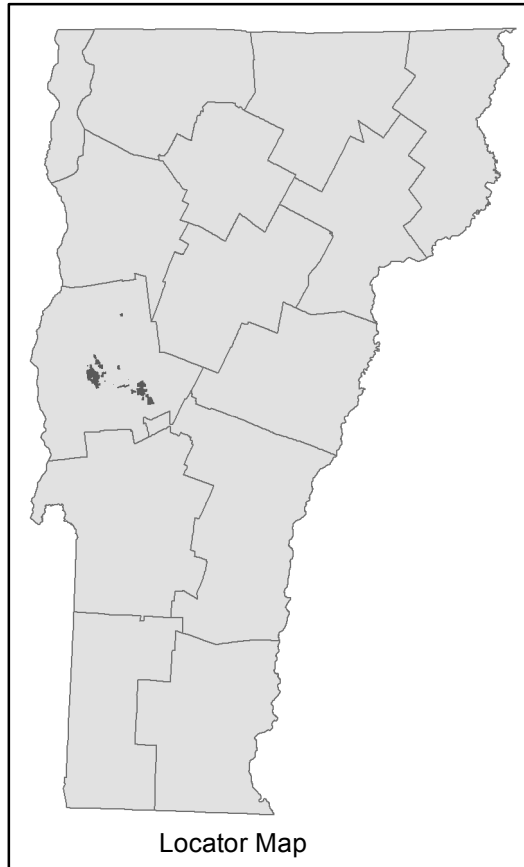
Mitella diphylla	Two-Leaved Bishop's-Cap	Saxifragaceae	herb
Moneses uniflora	One-Flowered-Shinleaf	Ericaceae	herb
Muhlenbergia frondosa	Wire-Stemmed Muhly	Poaceae	herb
Nabalus altissimus	Tall Rattlesnake-Root	Asteraceae	herb
Oclemena acuminata	Sharp-Toothed Nodding-Aster	Asteraceae	herb
Onoclea sensibilis	Sensitive Fern	Onocleaceae	herb
Osmorhiza claytonii	Bland Sweet-Cicely	Apiaceae	herb
Oxalis montana	Northern Wood Sorrel	Oxalidaceae	herb
Packera schweinitziana	New England Groundsel	Asteraceae	herb
Persicaria hydropiper	Water-Pepper Smartweed	Polygonaceae	herb
Persicaria pennsylvanica	Pennsylvania Smartweed	Polygonaceae	herb
Persicaria sagittata	Arrow-Leaved Tearthumb	Polygonaceae	herb
Phalaris arundinacea	Reed Canary Grass	Poaceae	herb
Phryma leptostachya	American Lop-Seed	Phrymaceae	herb
Pilea pumila	Canada Clearweed	Urticaceae	herb
Platanthera clavellata	Little Club-Spur Bog-Orchid	Orchidaceae	herb
Platanthera psycodes	Lesser Purple Fringed Bog-Orchid	Orchidaceae	herb
Poa palustris	Fowl Blue Grass	Poaceae	herb
Polygonatum pubescens	Hairy Solomon's-Seal	Ruscaceae	herb
Potamogeton robbinsii	Robbins' Pondweed	Potamogetonaceae	herb
Potentilla simplex	Old-Field Cinquefoil	Rosaceae	herb
Prunella vulgaris	Common Selfheal	Lamiaceae	herb
Pyrola elliptica	Elliptic-Leaved Shinleaf	Ericaceae	herb
Ranunculus abortivus	Kidney-Leaved Crowfoot	Ranunculaceae	herb
Ranunculus acris	Tall Crowfoot	Ranunculaceae	herb
Ranunculus hispidus	Hispid Crowfoot	Ranunculaceae	herb
Ranunculus recurvatus	Hooked Crowfoot	Ranunculaceae	herb
Rubus dalibarda	Dewdrop	Rosaceae	herb
Rumex crispus	Curly Dock	Polygonaceae	herb
Sanicula marilandica	Maryland Sanicle	Apiaceae	herb
Scirpus atrovirens	Dark-Green Bulrush	Cyperaceae	herb
Scirpus cyperinus	Common Woolsedge	Cyperaceae	herb
Scirpus microcarpus	Barber-Pole Bulrush	Cyperaceae	herb
Scutellaria lateriflora	Mad Dog Skullcap	Lamiaceae	herb
Sedum sp.	Stonecrop	Crassulaceae	herb
Solanum dulcamara	Climbing Nightshade	Solanaceae	herb
Solanum nigrum	European Black Nightshade	Solanaceae	herb
Solidago altissima	Tall Goldenrod	Asteraceae	herb
Solidago bicolor	White Goldenrod	Asteraceae	herb
Solidago caesia	Blue-Stem Goldenrod	Asteraceae	herb
Solidago flexicaulis	Ziz-Zag Goldenrod	Asteraceae	herb
Solidago macrophylla	Large-Leaved Goldenrod	Asteraceae	herb
Solidago rugosa	Common Wrinkle-Leaved Goldenrod	Asteraceae	herb
Sonchus arvensis	Field Sow-Thistle	Asteraceae	herb
Streptopus amplexifolius	Clasping-Leaved Twistedstalk	Liliaceae	herb
Streptopus roseus	Lance-Leaved Twistedstalk	Liliaceae	herb
Symphyotrichum lateriflorum	Calico American-Aster	Asteraceae	herb
Symphyotrichum puniceum	Purple-Stemmed American-Aster	Asteraceae	herb
Symplocarpus foetidus	Skunk-Cabbage	Araceae	herb
Thalictrum pubescens	Tall Meadow-Rue	Ranunculaceae	herb
Tiarella cordifolia	Foam-Flower	Saxifragaceae	herb
Trillium erectum	Red Wakerobin	Melanthiaceae	herb
Trillium undulatum	Painted Wakerobin	Melanthiaceae	herb
Tussilago farfara	Coltsfoot	Asteraceae	herb

<i>Typha latifolia</i>	Broad-Leaved Cat-Tail	Typhaceae	herb
<i>Uvularia grandiflora</i>	Large-Flowered Bellwort	Colchicaceae	herb
<i>Uvularia sessilifolia</i>	Sessile-Leaved Bellwort	Colchicaceae	herb
<i>Veratrum viride</i>	American False Hellebore	Melanthiaceae	herb
<i>Veronica officinalis</i>	Common Speedwell	Plantaginaceae	herb
<i>Viola canadensis</i>	Canada White Violet	Violaceae	herb
<i>Viola cucullata</i>	Blue Marsh Violet	Violaceae	herb
<i>Viola pubescens</i>	Yellow Forest Violet	Violaceae	herb
<i>Viola rotundifolia</i>	Round-Leaved Violet	Violaceae	herb
<i>Acer spicatum</i>	Mountain Maple	Sapindaceae	shrub
<i>Alnus incana</i>	Speckled Alder	Betulaceae	shrub
<i>Aronia melanocarpa</i>	Black Chokeberry	Rosaceae	shrub
<i>Celastrus scandens</i>	American Bittersweet	Celastraceae	shrub
<i>Clematis virginiana</i>	Virginia Virgin's-Bower	Ranunculaceae	shrub
<i>Cornus alternifolia</i>	Alternate-Leaved Dogwood	Cornaceae	shrub
<i>Corylus cornuta</i>	Beaked Hazelnut	Betulaceae	shrub
<i>Diervilla lonicera</i>	Bush-Honeysuckle	Caprifoliaceae	shrub
<i>Dirca palustris</i>	Eastern Leatherwood	Thymelaeaceae	shrub
<i>Gaylussacia baccata</i>	Black Huckleberry	Ericaceae	shrub
<i>Hamamelis virginiana</i>	American Witch-Hazel	Hamamelidaceae	shrub
<i>Ilex mucronata</i>	Mountain Holly	Aquifoliaceae	shrub
<i>Lonicera canadensis</i>	American Honeysuckle	Caprifoliaceae	shrub
<i>Lonicera morrowii</i>	Morrow's Honeysuckle	Caprifoliaceae	shrub
<i>Lonicera tatarica</i>	Tatarian Honeysuckle	Caprifoliaceae	shrub
<i>Lonicera xbella</i>	Bell's Honeysuckle	Caprifoliaceae	shrub
<i>Parthenocissus quinquefolia</i>	Virginia-Creeper	Vitaceae	shrub
<i>Rhododendron prinophyllum</i>	Early Azalea	Ericaceae	shrub
<i>Ribes cynosbati</i>	Eastern Prickly Gooseberry	Grossulariaceae	shrub
<i>Ribes hirtellum</i>	Hairy-Stemmed Gooseberry	Grossulariaceae	shrub
<i>Ribes lacustre</i>	Bristly Swamp Currant	Grossulariaceae	shrub
<i>Rubus allegheniensis</i>	Common Blackberry	Rosaceae	shrub
<i>Rubus hispidus</i>	Bristly Blackberry	Rosaceae	shrub
<i>Rubus idaeus</i>	Red Raspberry	Rosaceae	shrub
<i>Rubus odoratus</i>	Flowering Raspberry	Rosaceae	shrub
<i>Rubus pubescens</i>	Dwarf Raspberry	Rosaceae	shrub
<i>Salix discolor</i>	Pussy Willow	Salicaceae	shrub
<i>Salix sericea</i>	Silky Willow	Salicaceae	shrub
<i>Sambucus nigra</i>	Black Elderberry	Adoxaceae	shrub
<i>Sambucus racemosa</i>	Red Elderberry	Adoxaceae	shrub
<i>Spiraea alba</i>	White Meadowsweet	Rosaceae	shrub
<i>Spiraea tomentosa</i>	Rosy Meadowsweet	Rosaceae	shrub
<i>Taxus canadensis</i>	American Yew	Taxaceae	shrub
<i>Vaccinium angustifolium</i>	Common Lowbush Blueberry	Ericaceae	shrub
<i>Vaccinium myrtilloides</i>	Velvet-Leaved Blueberry	Ericaceae	shrub
<i>Vaccinium pallidum</i>	Hillside Blueberry	Ericaceae	shrub
<i>Viburnum acerifolium</i>	Maple-Leaved Viburnum	Adoxaceae	shrub
<i>Viburnum lantanooides</i>	Hobblebush	Adoxaceae	shrub
<i>Viburnum nudum</i>	Withe-Rod	Adoxaceae	shrub
<i>Viburnum opulus</i>	Highbush-Cranberry	Adoxaceae	shrub
<i>Vitis riparia</i>	River Grape	Vitaceae	shrub
<i>Abies balsamea</i>	Balsam Fir	Pinaceae	tree
<i>Acer pensylvanicum</i>	Striped Maple	Sapindaceae	tree
<i>Acer rubrum</i>	Red Maple	Sapindaceae	tree
<i>Acer saccharum</i>	Sugar Maple	Sapindaceae	tree

Amelanchier sp.	Shadbush	Rosaceae	tree
Betula alleghaniensis	Yellow Birch	Betulaceae	tree
Betula lenta	Cherry Birch	Betulaceae	tree
Betula papyrifera	Paper Birch	Betulaceae	tree
Betula populifolia	Gray Birch	Betulaceae	tree
Carpinus caroliniana	American Hornbeam	Betulaceae	tree
Crataegus sp.	Hawthorn	Rosaceae	tree
Fagus grandifolia	American Beech	Fagaceae	tree
Fraxinus americana	White Ash	Oleaceae	tree
Fraxinus nigra	Black Ash	Oleaceae	tree
Juglans cinerea	Butternut	Juglandaceae	tree
Larix laricina	American Larch	Pinaceae	tree
Malus sp.	Apple	Rosaceae	tree
Ostrya virginiana	Hop-Hornbeam	Betulaceae	tree
Picea abies	Norway Spruce	Pinaceae	tree
Picea rubens	Red Spruce	Pinaceae	tree
Pinus resinosa	Red Pine	Pinaceae	tree
Pinus strobus	Eastern White Pine	Pinaceae	tree
Populus balsamifera	Balsam Poplar	Salicaceae	tree
Populus tremuloides	Quaking Poplar	Salicaceae	tree
Prunus serotina	Black Cherry	Rosaceae	tree
Prunus virginiana	Choke Cherry	Rosaceae	tree
Quercus alba	Eastern White Oak	Fagaceae	tree
Quercus montana	Mountain Chestnut Oak	Fagaceae	tree
Quercus rubra	Northern Red Oak	Fagaceae	tree
Sorbus americana	American Mountain-Ash	Rosaceae	tree
Thuja occidentalis	Northern White-Cedar	Cupressaceae	tree
Tilia americana	Basswood	Malvaceae	tree
Tsuga canadensis	Eastern Hemlock	Pinaceae	tree
Ulmus americana	American Elm	Ulmaceae	tree

**Figure 1a. Study Area:
Middlebury College
Mountain Lands
Addison County, VT**

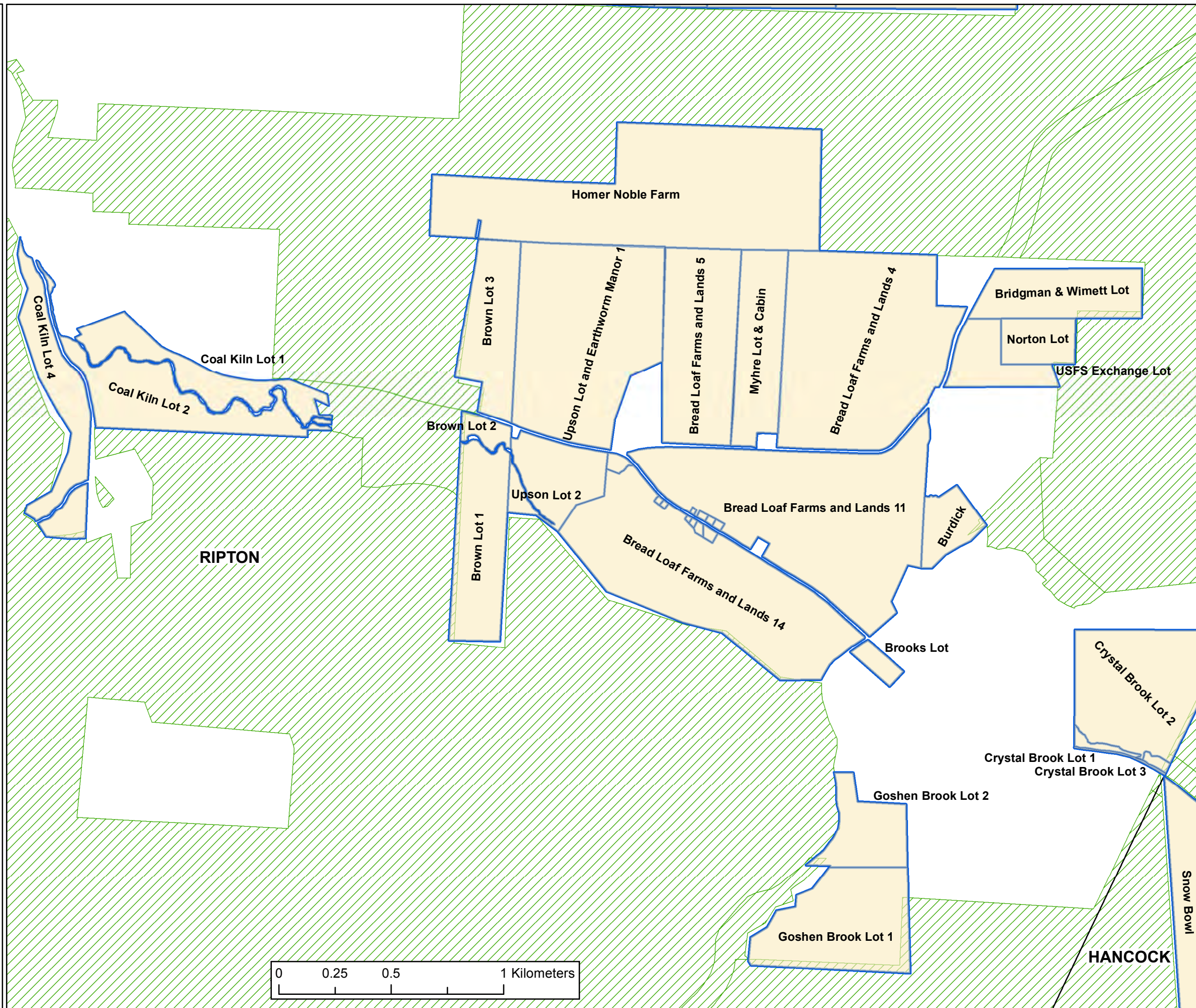
-  Middlebury College Lands
-  Green Mountain National Forest
-  Towns



Sources:
Middlebury College Lands: Middlebury College
Green Mountain National Forest boundary:
www.vcgl.org

Figure 1b. Parcel Names for the Middlebury College Bread Loaf Contiguous Lands and Neaby Parcels Addison County, VT

-  Middlebury College Lands
-  Midd_College_Parcels
-  Midd_College_Parcels_Sold
-  Green Mountain National Forest
-  Towns



Sources:
 Middlebury College Lands: Middlebury College
 Green Mountain National Forest boundary: www.vcgi.org

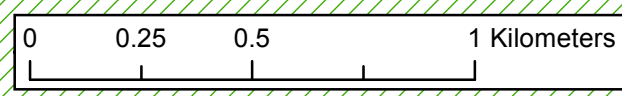


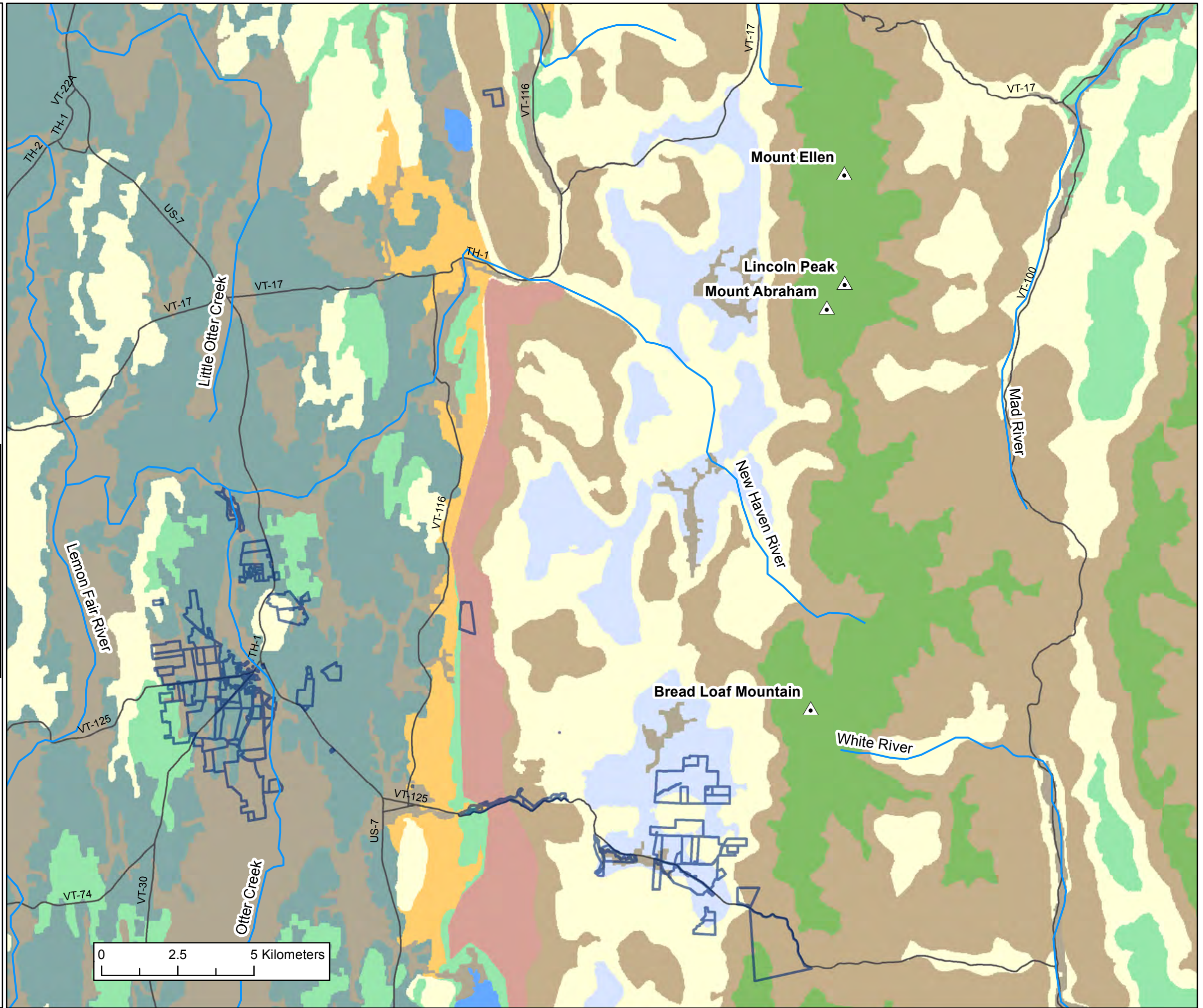


Figure 2.
Land Type Associations:
Middlebury College Lands
Addison County, VT

Landtype Association

- 1: Vermont escarpment
- 2: Low rolling upland
- 3: Hills/footslopes
- 4: Mountain slopes
- 5: Upper mountain slopes/mountaintops
- 9: Lake/reservoir > 200 acres
- 11: Rolling low- to mid-elevation calcareous/metamorphic hills
- 25: Precambrian plateau
- 81: Valley floor glacial lake/marine plains
- 82: Glaciolacustrine, glaciomarine, glaciofluvial coarse sediments
- 99: Valley bottom; floodplain-riparian (Champlain Valley)

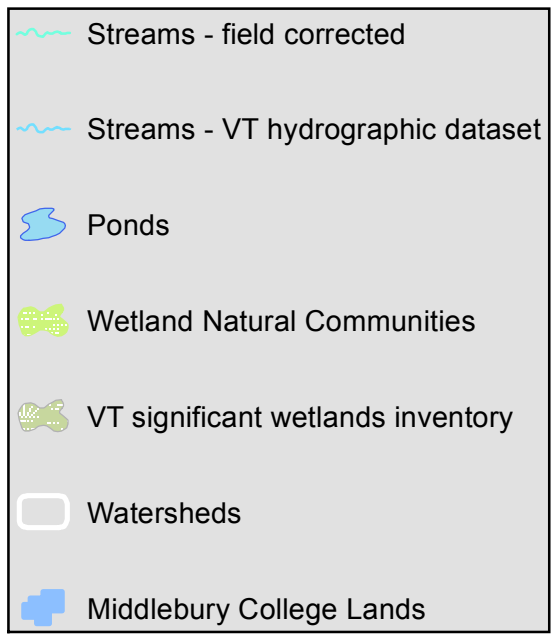
 Middlebury College Lands
 Major rivers



Sources:
 Land Type Associations: Ferree and Thompson, 2008
 Middlebury College property: Middlebury College
 Green Mountain National Forest boundary:
www.vcgi.org

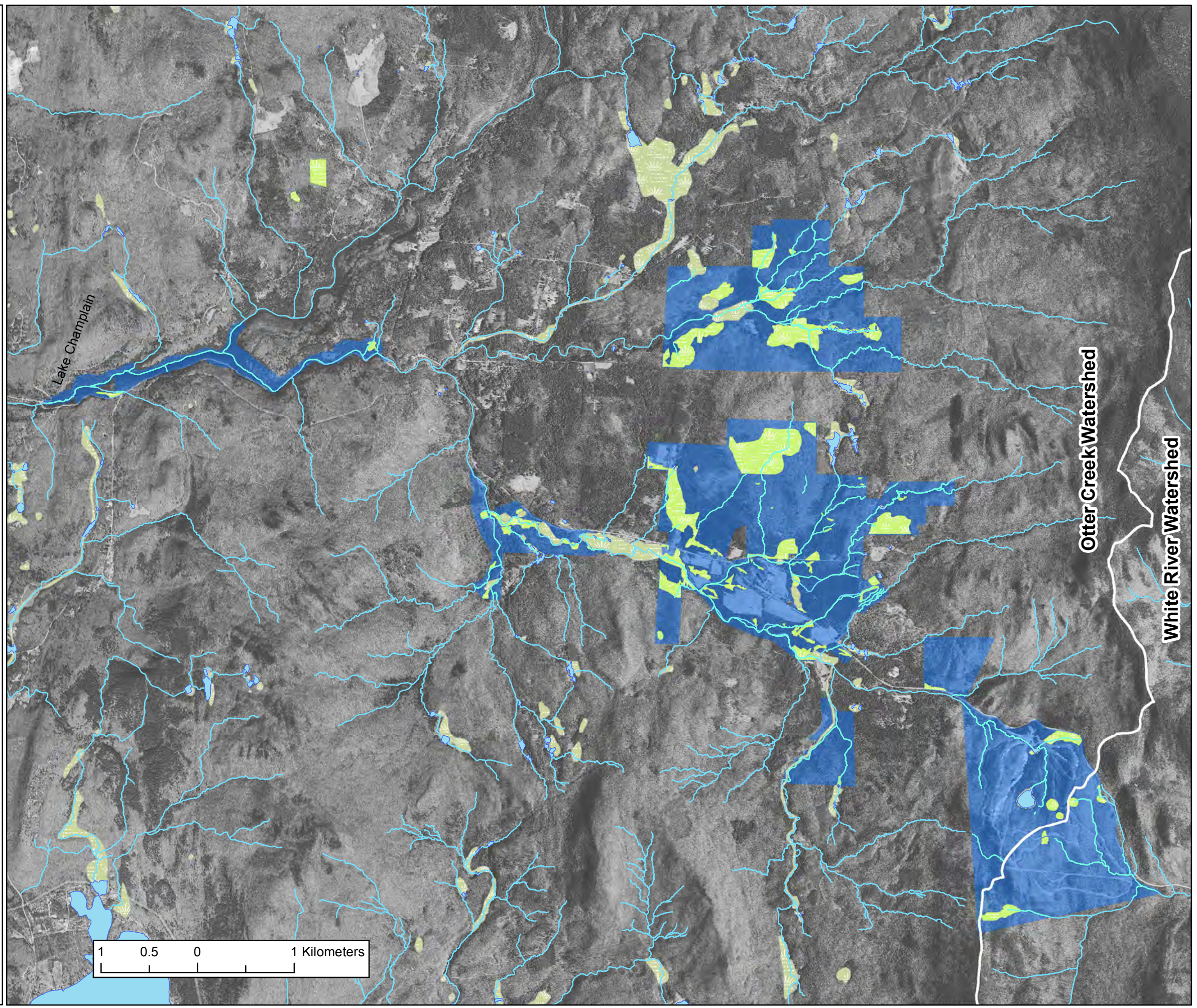


**Figure 3. Surface Waters and Wetlands
Middlebury College
Mountain Lands
Addison County, VT**

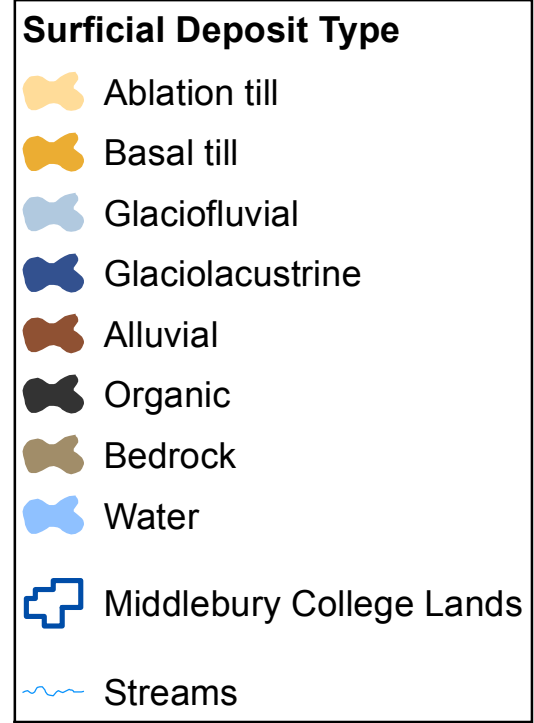


Sources:
Streams - field corrected & Wetland Natural Communities:
original work
Middlebury College Lands: Middlebury College
all other layers: www.vcgi.org

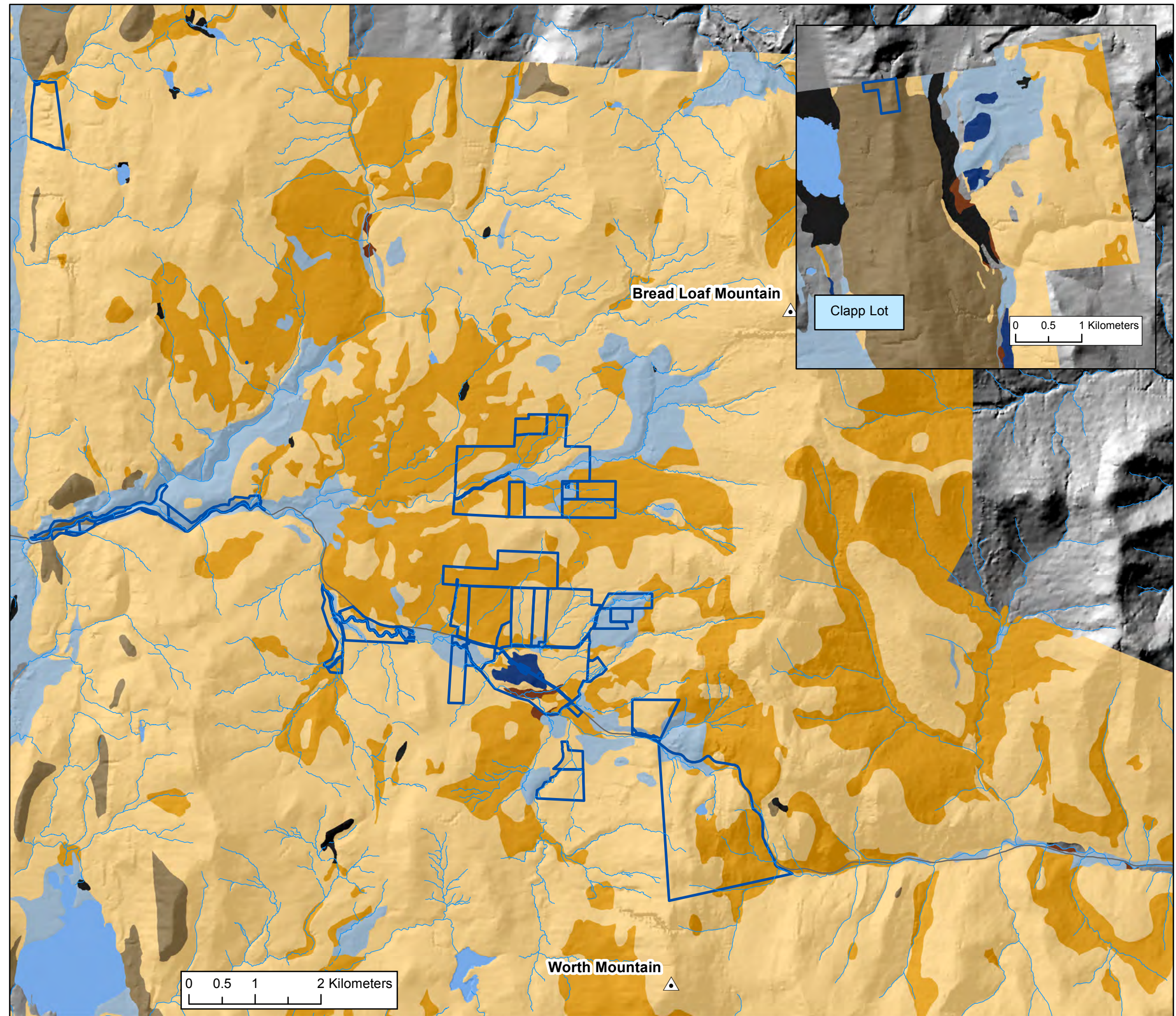
Basemap:
VT Digital Orthophotography, 2012



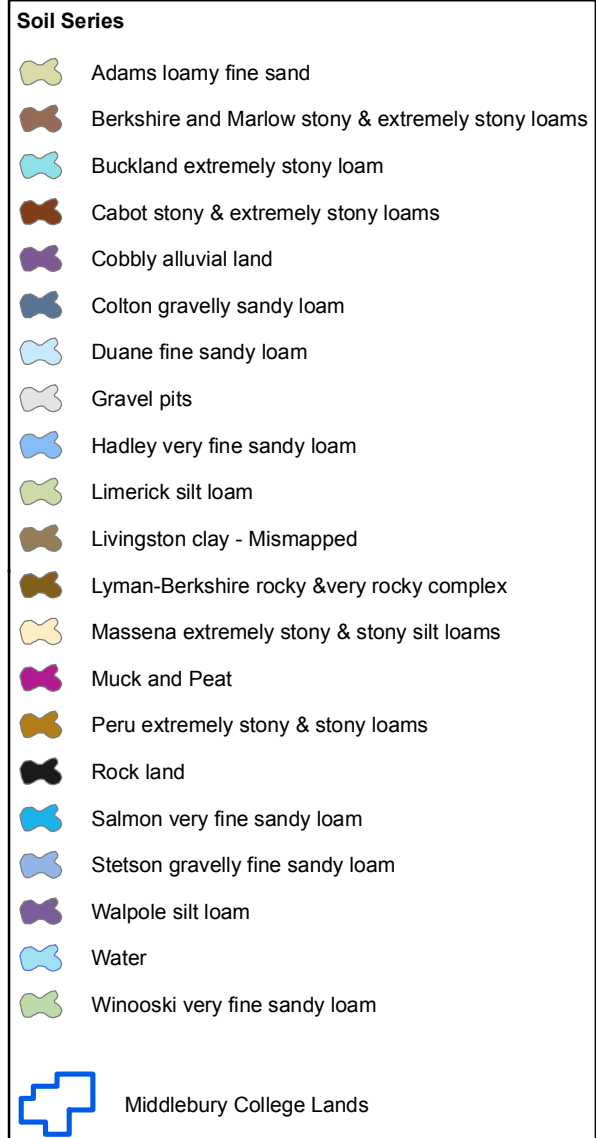
**Figure 4. Surficial Deposits
Middlebury College
Mountain Lands
Addison County, VT**



Sources:
 Surficial Deposit Type: based on county soils mapping available digitally from soils.usda.gov, slightly modified by field work
 Middlebury College Lands: Middlebury College
 Streams: VHD from www.vcgi.org, field corrected on college lands



**Figure 5. Soils
Middlebury College
Mountain Lands
Addison County, VT**



Sources:
Soils: soils.usda.gov via www.vcgi.org
Middlebury College Lands: Middlebury College

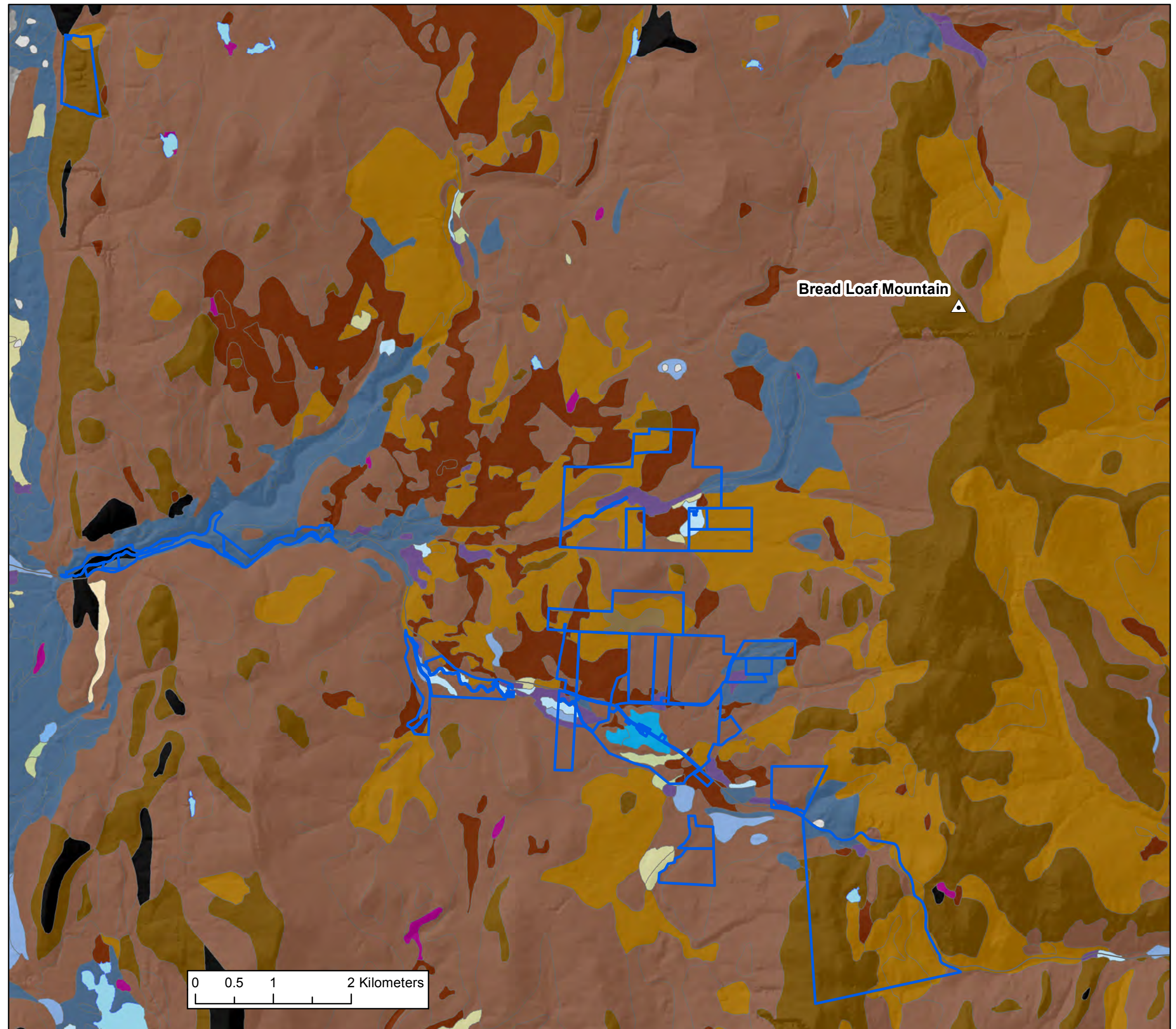


FIGURE 6.

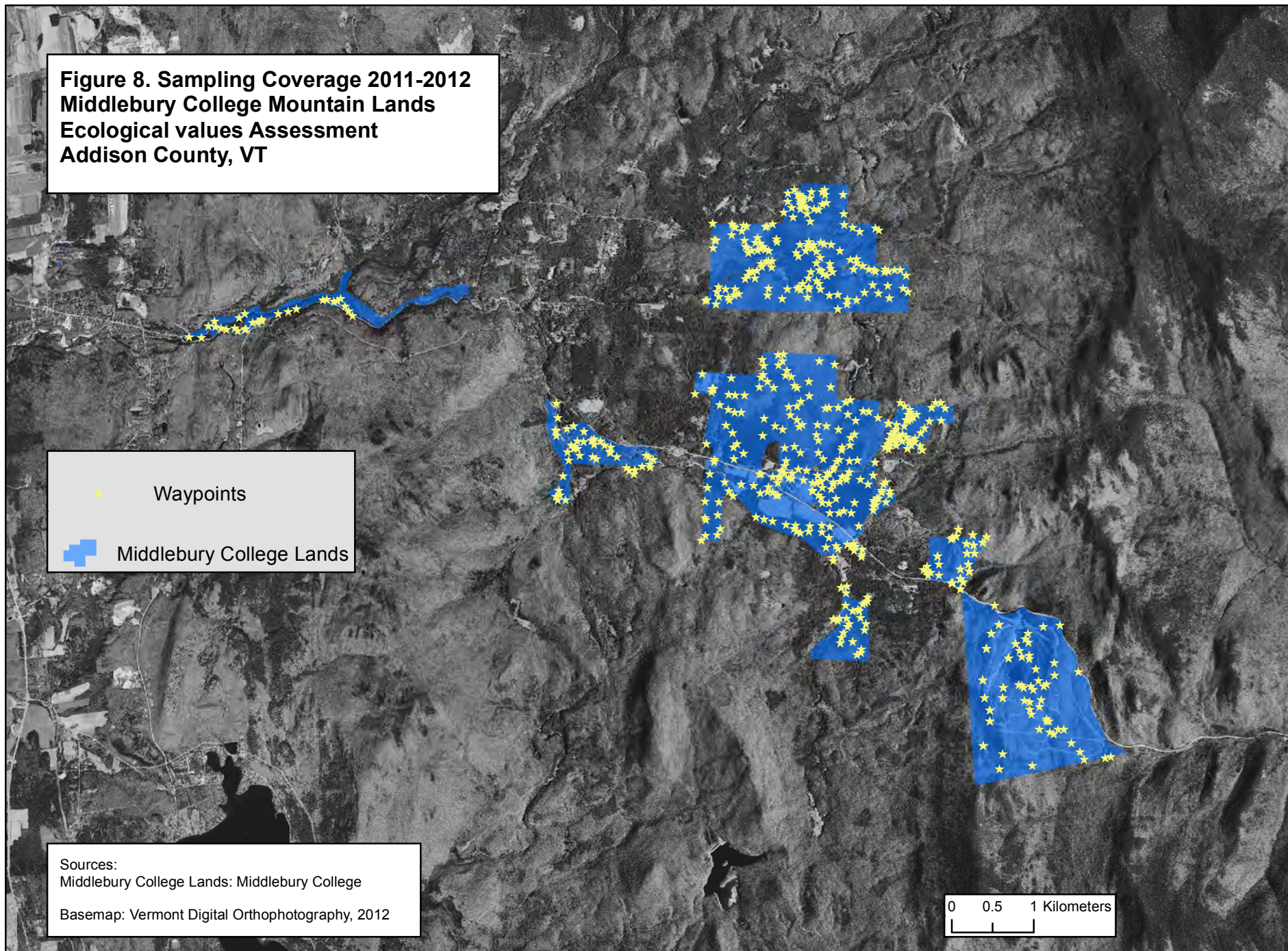
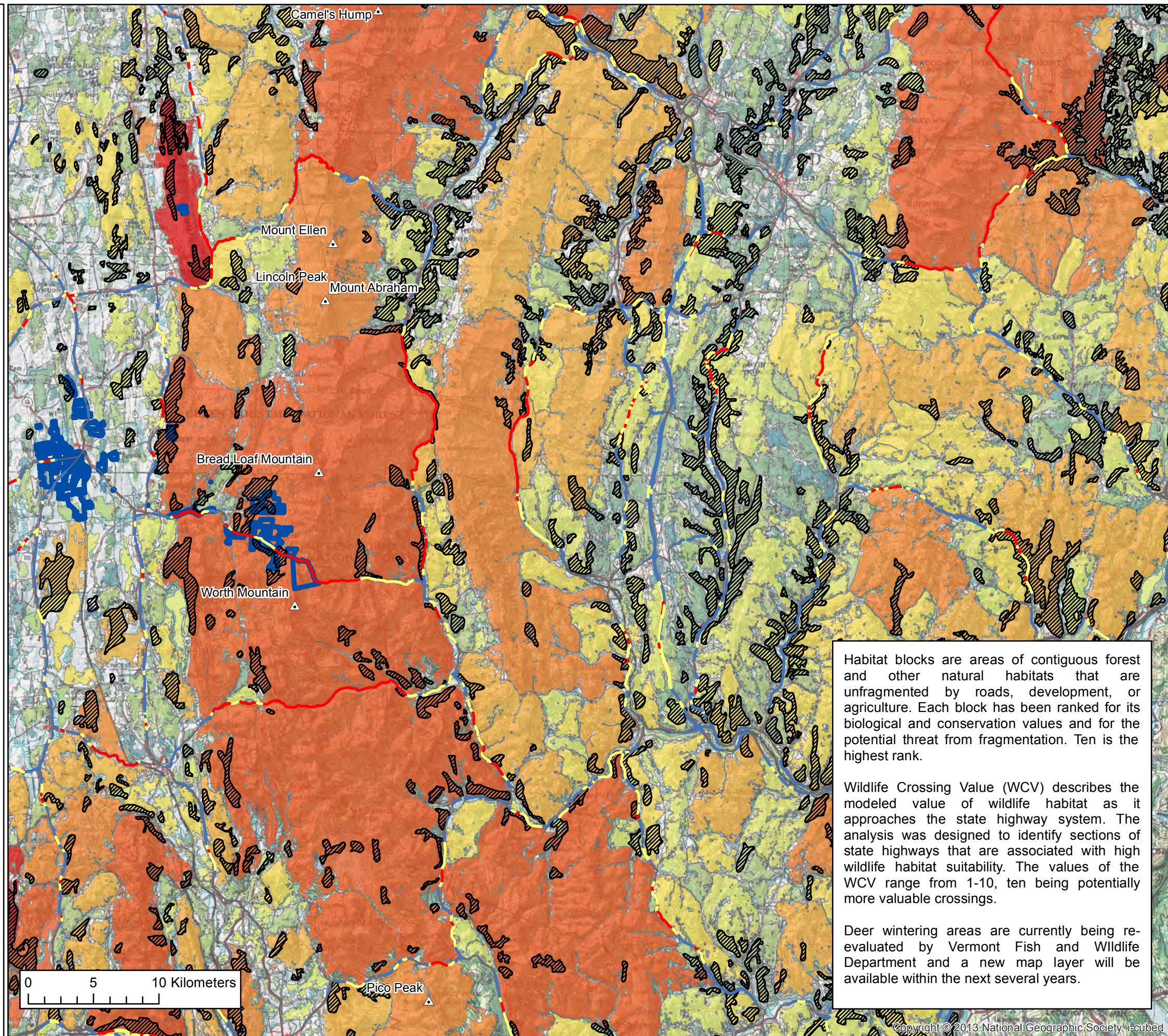
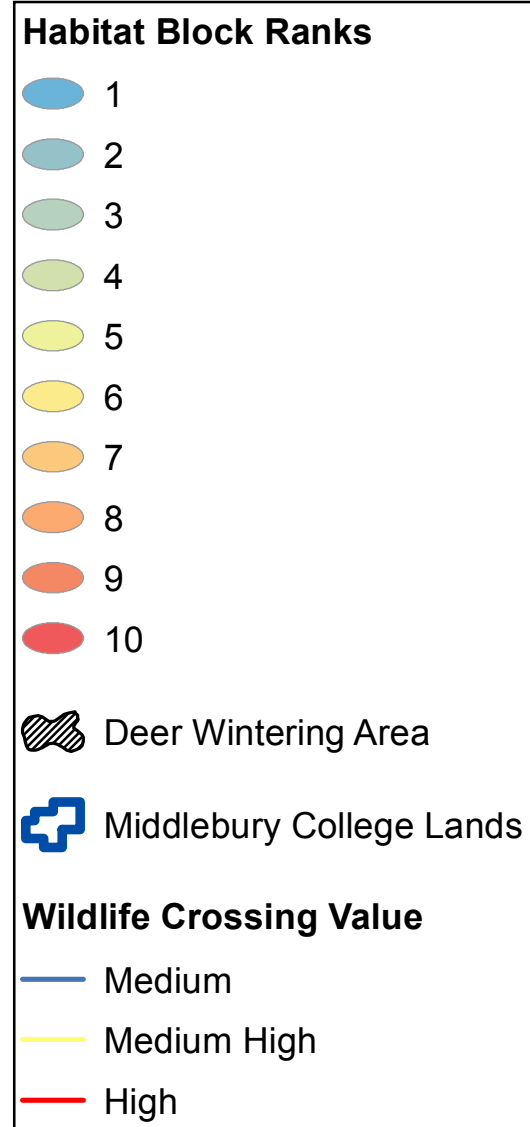


Figure 7. Middlebury College Lands in the context of Vermont Habitat Blocks, Deer Wintering Areas and Wildlife Crossing Values



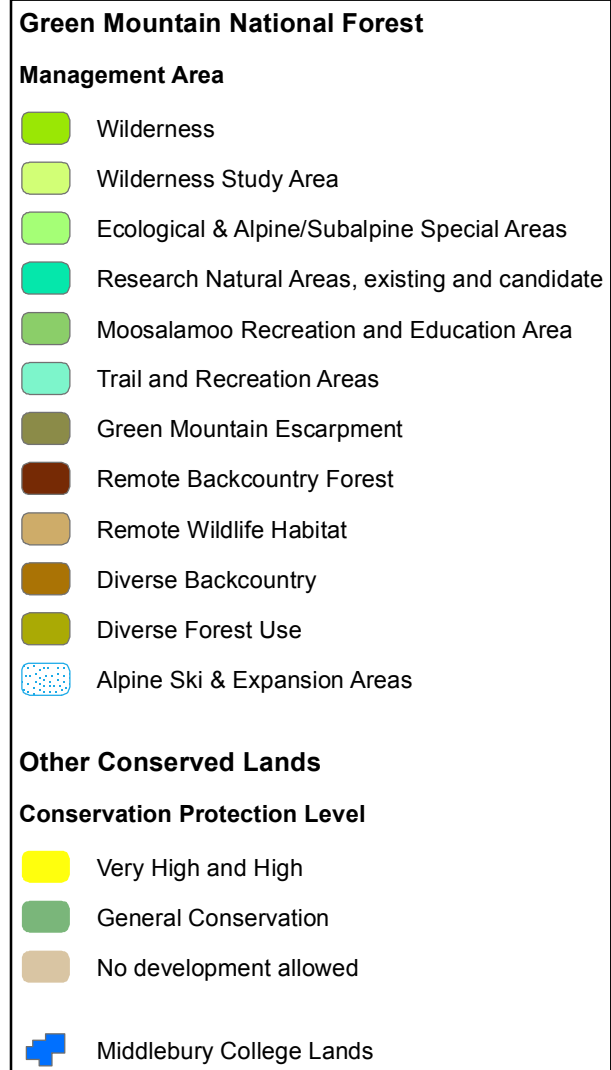
Habitat blocks are areas of contiguous forest and other natural habitats that are unfragmented by roads, development, or agriculture. Each block has been ranked for its biological and conservation values and for the potential threat from fragmentation. Ten is the highest rank.

Wildlife Crossing Value (WCV) describes the modeled value of wildlife habitat as it approaches the state highway system. The analysis was designed to identify sections of state highways that are associated with high wildlife habitat suitability. The values of the WCV range from 1-10, ten being potentially more valuable crossings.

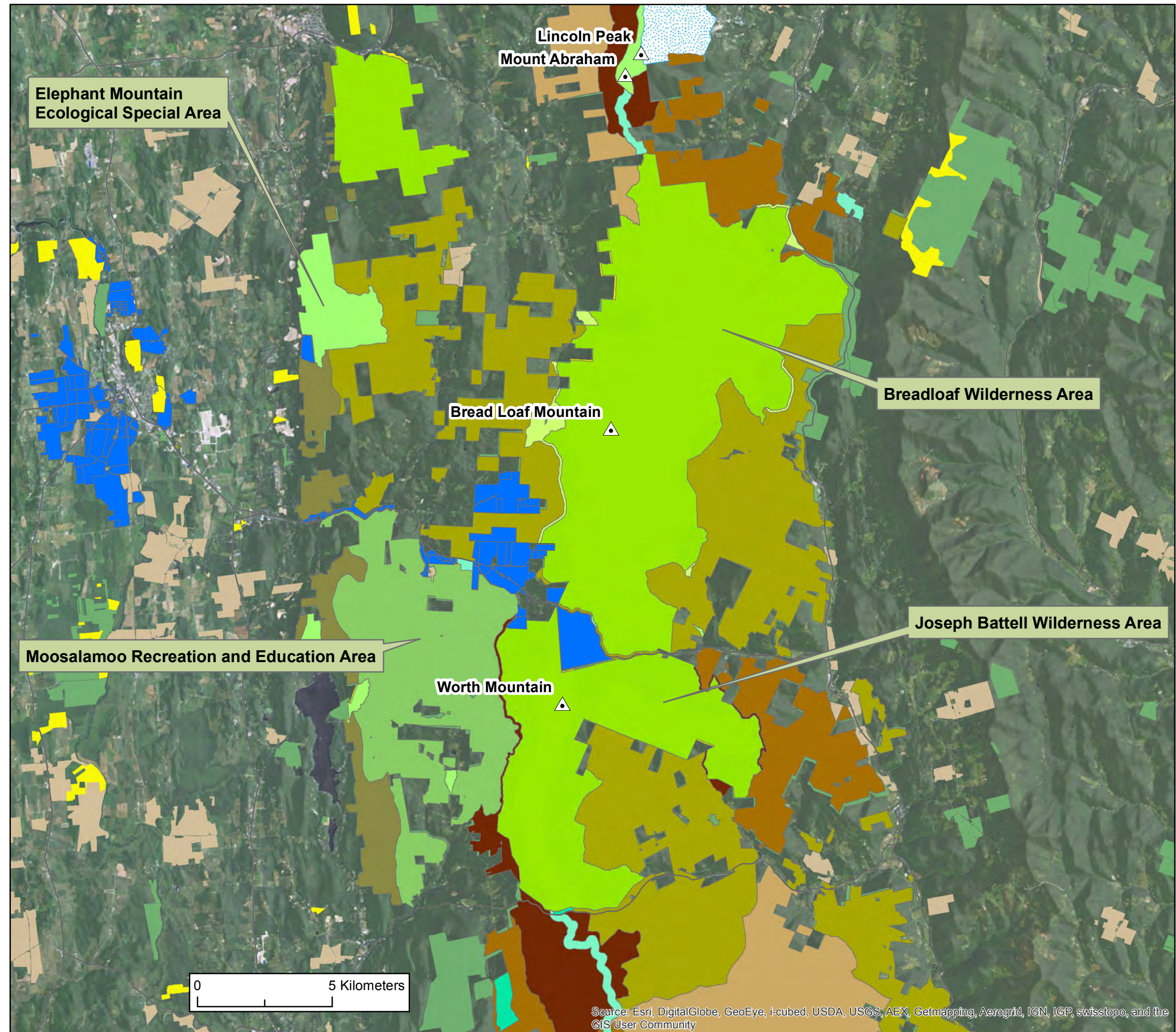
Deer wintering areas are currently being re-evaluated by Vermont Fish and Wildlife Department and a new map layer will be available within the next several years.

Sources:
 Habitat Blocks, Deer Wintering Areas, and Wildlife Crossing Value: VT Agency of Natural Resources, www.vcgl.org
 Middlebury College Lands: Middlebury College

Figure 8. Middlebury College Mountain Lands in the context of Conserved Lands Addison County and adjacent area, VT



Sources:
 Green Mountain National Forest: www.vcgi.org
 Other Conserved Lands: UVM Spatial Analysis Laboratory
 Middlebury College Lands: Middlebury College



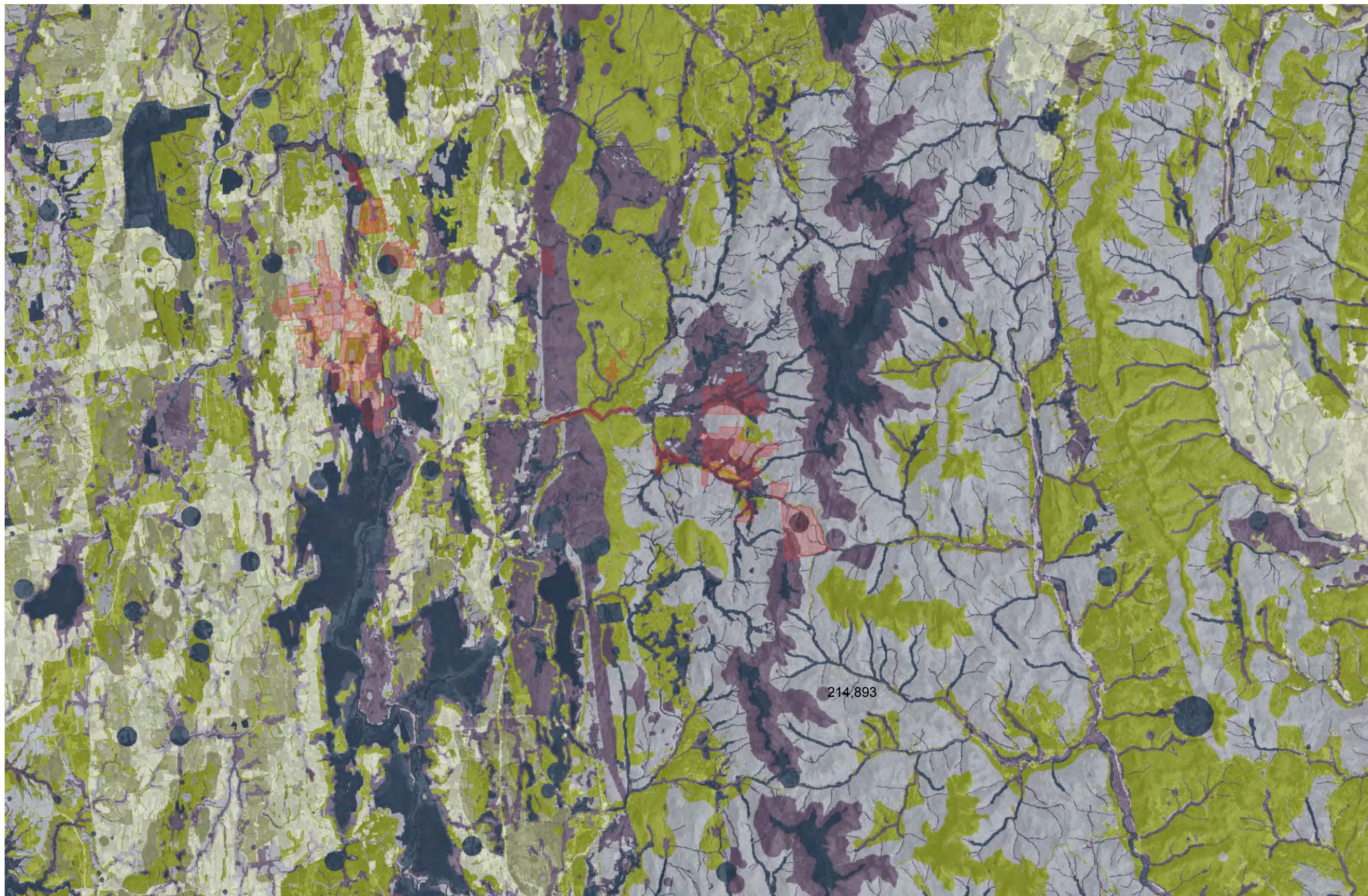


LEGEND

Component Concentration

- Tier 1 = Greatest
- Tier 2 = Very High
- Tier 3 = High
- Tier 4 = Moderate
- Tier 5 = Low
- Tier 6 = Insufficient Data

Figure 9. Middlebury College Lands in the context of Vermont Agency of Natural Resources Tiered Contribution to Biodiversity.



0.0 0 0.00 0.0 Miles

WGS_1984_Web_Mercator_Auxiliary_Sphere
© Vermont Agency of Natural Resources

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

1: 15,043

August 30, 2013



NOTES

Figure 10.
Natural Communities of
Middlebury College
Mountain Lands
Addison County, VT



Sources:
 Natural Communities: original work
 Streams: VHD from www.vcgi.org, field corrected on college lands
 Long Trail System: www.vcgi.org
 Basemap: Vermont Digital Orthophotography, 2012

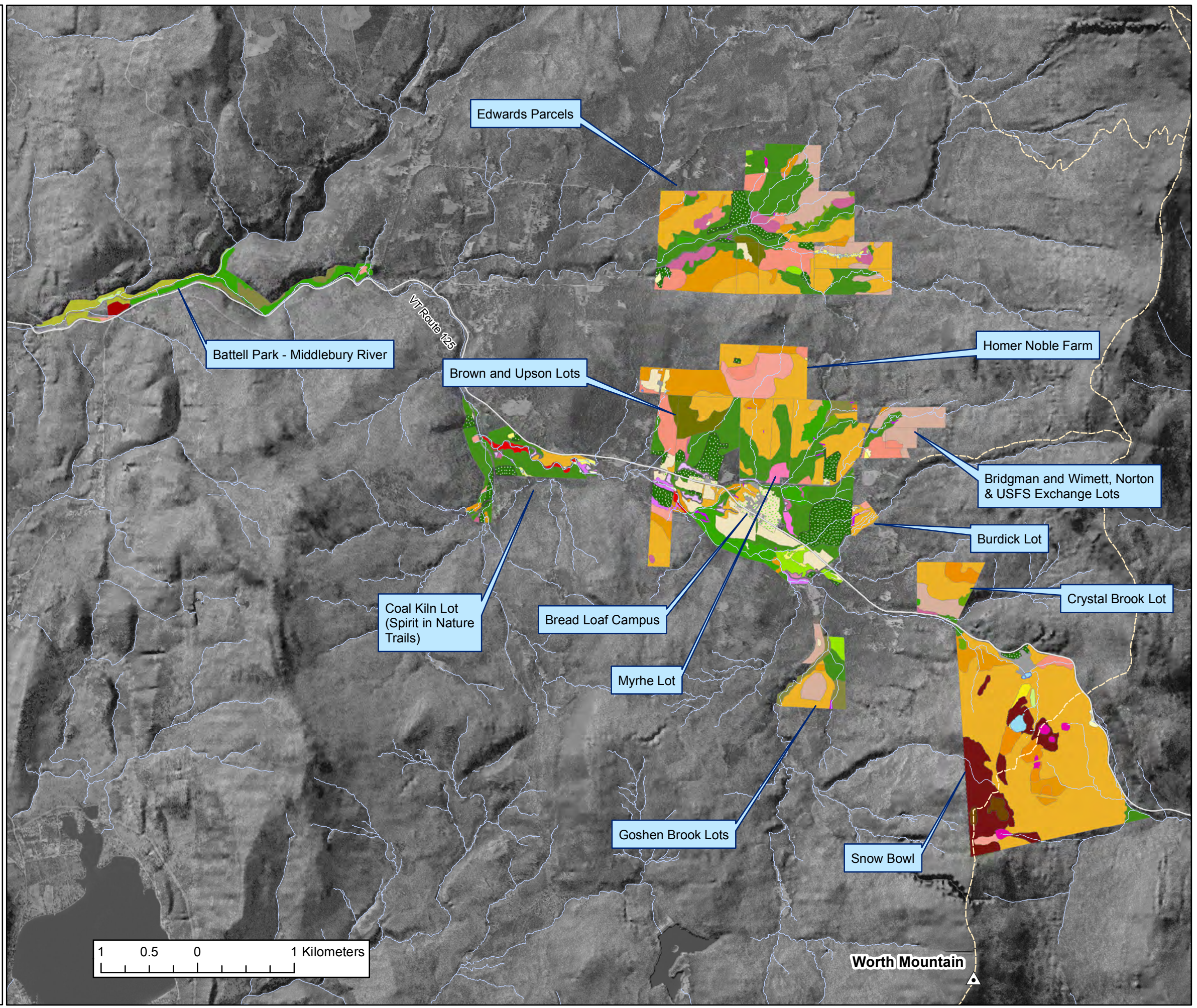
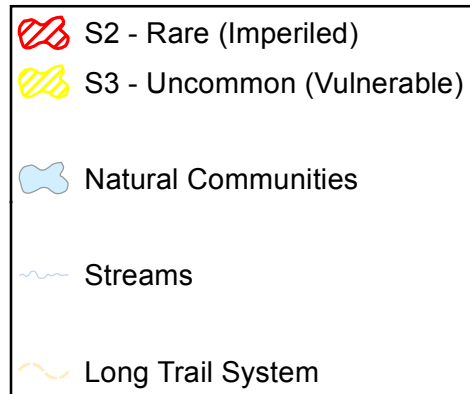


Figure 11.
State Rarity Ranks
of Natural Communities of
Middlebury College
Mountain Lands
Addison County, VT

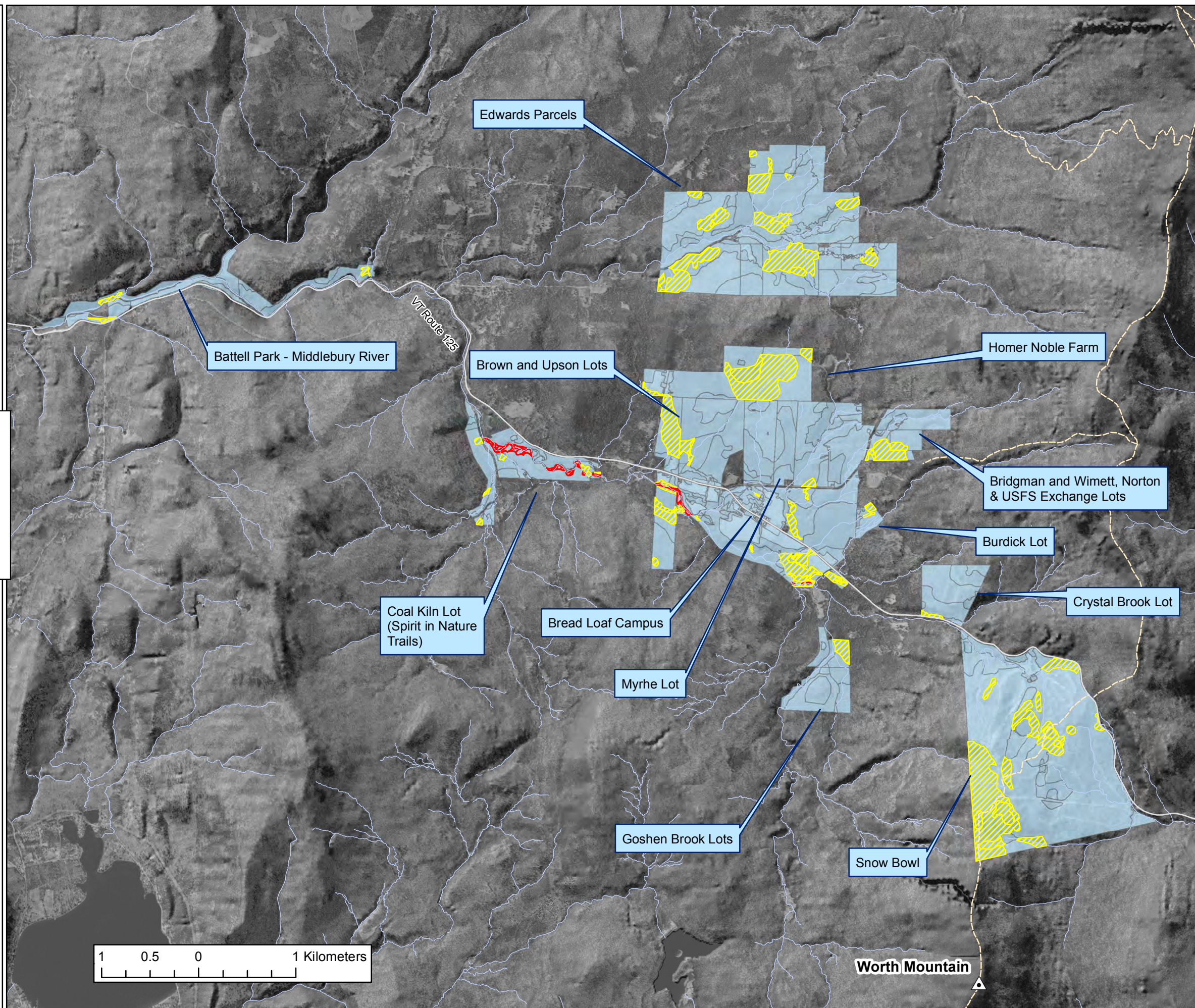


State Rank	Status
1	Very Rare (Critically imperiled)
2	Rare (Imperiled)
3	Uncommon (Vulnerable)
4	Locally Uncommon or Widely Scattered (Apparently secure)
5	Common (Secure)

State ranks denote relative rarity; they are applied to all species and natural community types by natural heritage programs in each state. In Vermont the ranks are assigned by the Vermont Fish and Wildlife Department's Natural Heritage Inventory Project, in consultation with other ecologists, zoologists and botanists. Ranks are assigned based on a community type's rarity and level of threat to its continued ecological integrity or viability.

Sources:
 Natural Communities: original work
 Streams: VHD from www.vcgi.org, field corrected on college lands
 Long Trail System: www.vcgi.org

Basemap: Vermont Digital Orthophotography, 2012







Worth Mountain

Figure 12.
State Significant Natural
Communities

Middlebury College
Mountain Lands
Addison County, VT

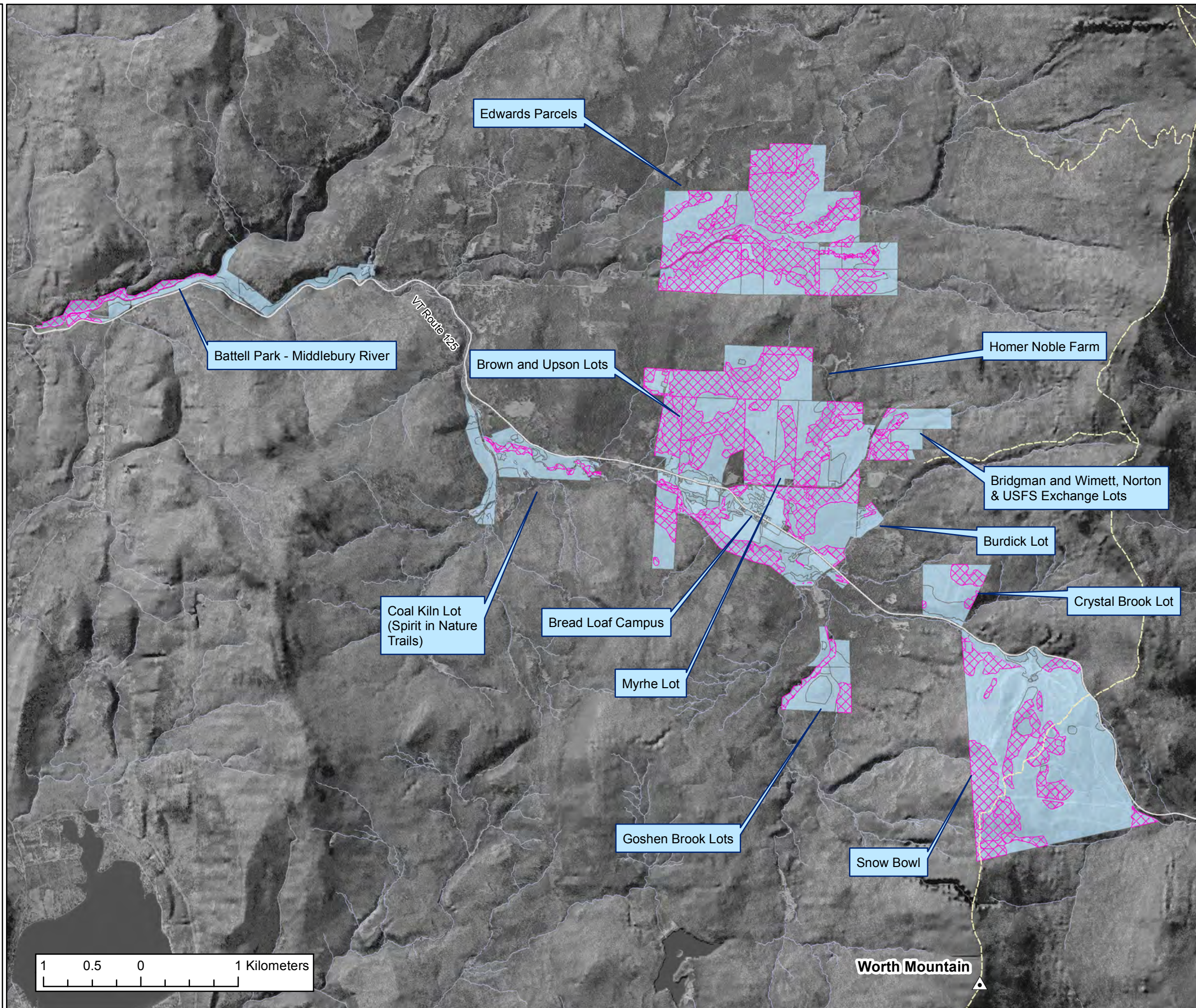
"State Significance" is determined by a combination of natural community quality (EO Rank) and rarity/commonness of the natural community type within Vermont (State Rank). Such significance indicates that the Vermont Natural Heritage Inventory Project records and track the site in its database. No legal or regulatory significance is involved, although the information in the database would be consulted during proceedings such as Act 250 hearings and the like. Significance guidelines were distributed by Vermont Fish and Wildlife Department in March 2001.

Natural community mapping by Dr. Marc Lapin, Max Odland '12 and Ford Van Fossen '13. Ranking and assessment of state significance completed by Dr. Lapin using Vermont Natural Heritage Inventory

-  State-Significant Natural Community
-  Natural Communities
-  Streams
-  Long Trail System

Sources:
 Natural Communities: original work
 Streams: VHD from www.vcgi.org, field corrected on college lands
 Long Trail System: www.vcgi.org

Basemap: Vermont Digital Orthophotography, 2012



**Figure 13.
Element Occurrence Ranks
of Natural Communities of
Middlebury College
Mountain Lands
Addison County, VT**

EO Rank	Estimated Viability
A	excellent
B	good
C	fair
D	poor

■ A
■ B
■ BC
■ C
■ not yet ranked
 Streams
 Long Trail System

Element Occurrence (EO) Ranks provide an assessment of estimated viability, or probability of persistence, of a natural community or species occurrence. For natural communities EO Ranks are calculated based on natural community condition (i.e., naturalness), occurrence size, and landscape context (the condition of the surrounding landscape). Full methodology is published in NatureServe's 2002 "Element Occurrence Data Standard" available at <http://www.natureserve.org/prodServices/eodraft/all.pdf>.

Most of the "not ranked" communities are Northern Hardwood Forest, which forms a very large occurrence that includes adjacent lands, such as those in Green Mountain National Forest. When considered together with these, the Northern Hardwood Forest occurrence receives an A rank.

Natural community mapping by Dr. Marc Lapin, Max Odland '12 and Ford Van Fossen '13. EO Ranks calculated by Dr. Lapin.

Sources:
 Natural Communities: original work
 Streams: VHD from www.vcgi.org, field corrected on college lands
 Long Trail System: www.vcgi.org
 Basemap: Vermont Digital Orthophotography, 2012

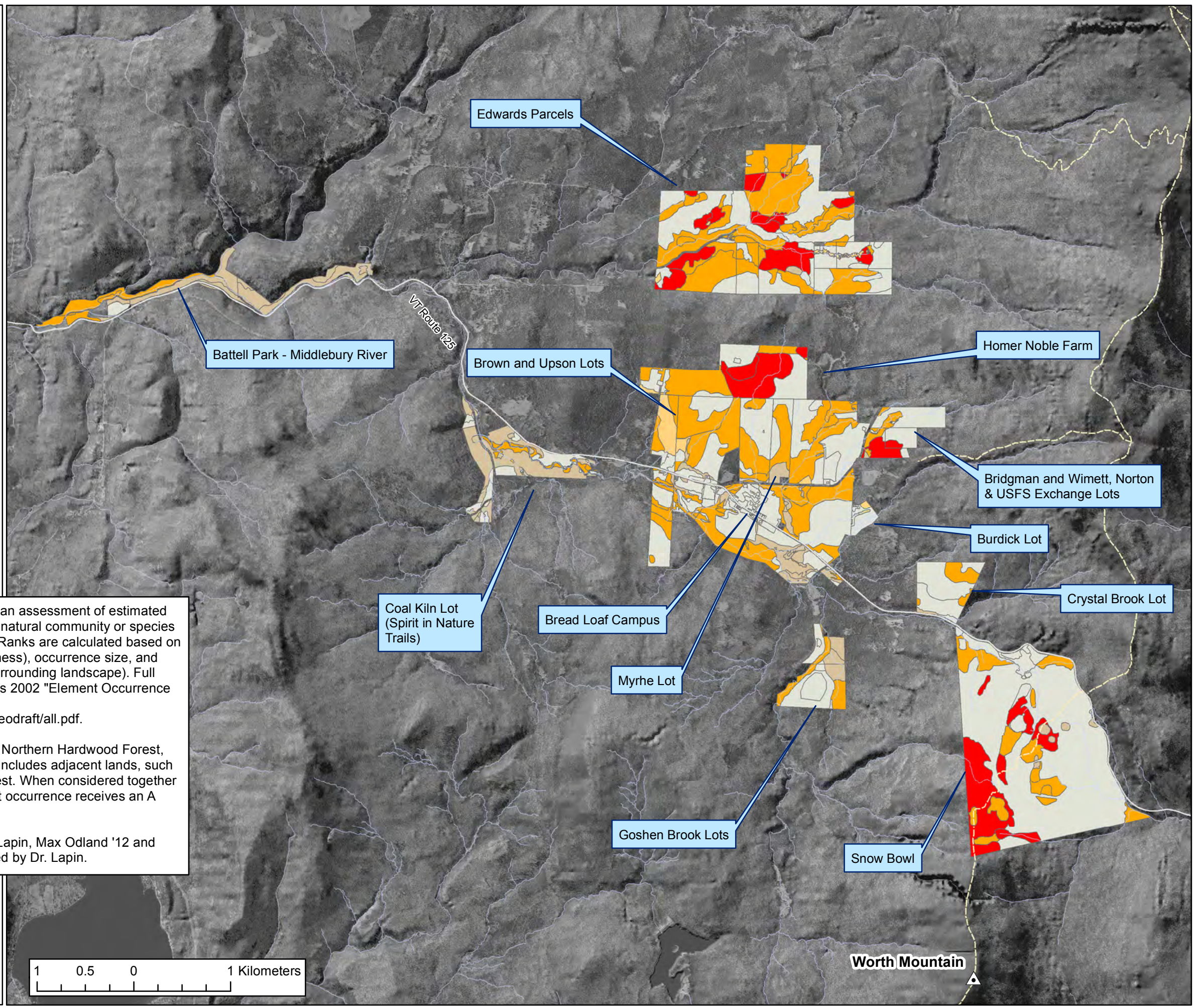





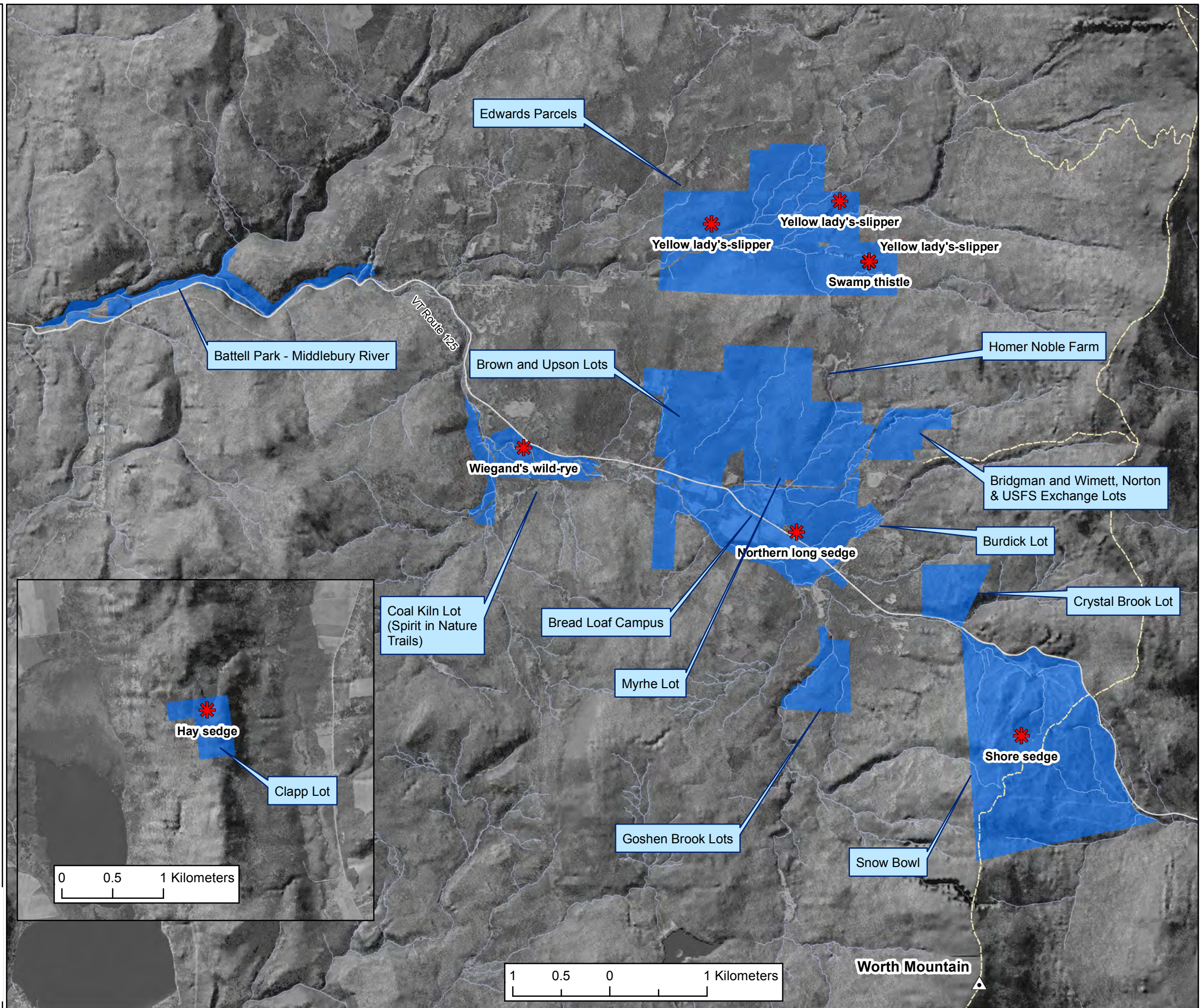


Figure 14.
Rare and Uncommon Plants
Middlebury College
Mountain Lands
Addison County, VT

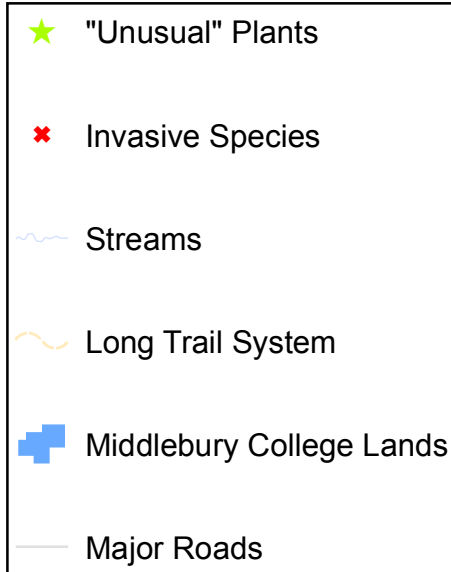
-  Rare and Uncommon Plants
-  Middlebury College Lands
-  Streams
-  Major Roads
-  Long Trail System



Sources:
 Middlebury College Lands: Middlebury College
 Roads and Long Trail System: www.vcgi.org
 Streams: www.vcgi.org, field corrected for College Lands

Basemap: Vermont Digital Orthophotography, 2012

Figure 15.
"Unusual" Plants and
Invasive Plants
Middlebury College
Mountain Lands
Addison County, VT



"Unusual" plants are those species that either we consider not typical of or not common in the broader study landscape or that formerly were considered rare or uncommon in Vermont but have been found to be common enough to be given S4 ranks.

Sources:
 Middlebury College Lands: Middlebury College
 Roads and Long Trail System: www.vcgi.org
 Streams: www.vcgi.org, field corrected for College Lands

Basemap: Vermont Digital Orthophotography, 2012

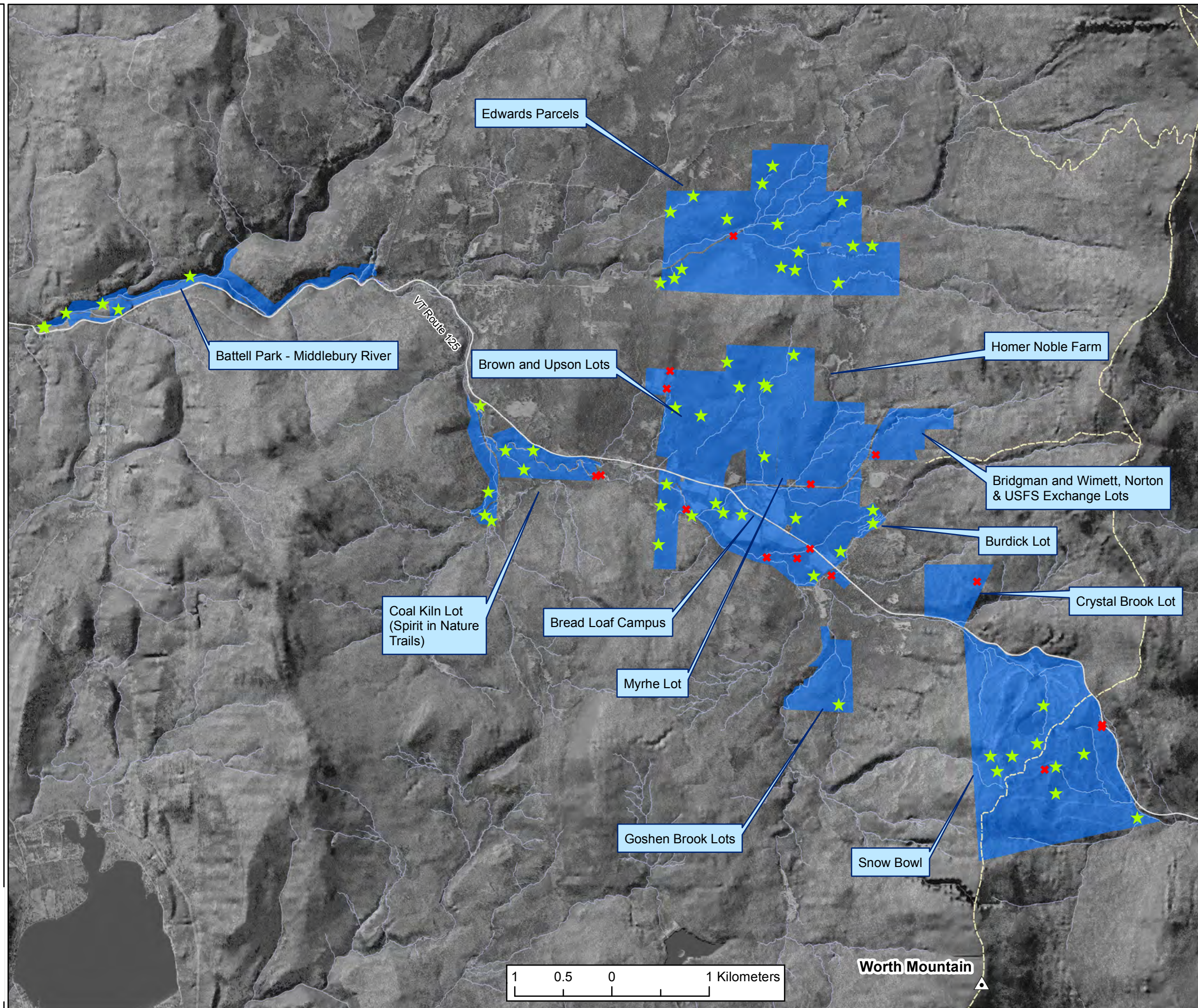


Figure 16.
Wildlife Sign:
Casual Observations
Middlebury College
Mountain Lands
Addison County, VT

Wildlife Sign or Observations

- ▲ Amphibian
- ▲ Bear scat or marked tree
- ▲ Bear-scarred beech groves
- ▲ Moose feeding
- ▲ Wood duck brood
- ▲ Woodcock

+ Middlebury College Lands

Streams

Long Trail System

Major Roads

The mapped data represent casual observations that were made in the course of field work. No particular effort was made to systematically inventory wildlife sign or use of particular habitats. Map does not include observations from Battell Research Forest or Clapp Lot.

Sources:
 Middlebury College Lands: Middlebury College
 Roads and Long Trail System: www.vcgi.org
 Streams: www.vcgi.org, field corrected for College Lands

Basemap: Vermont Digital Orthophotography, 2012

