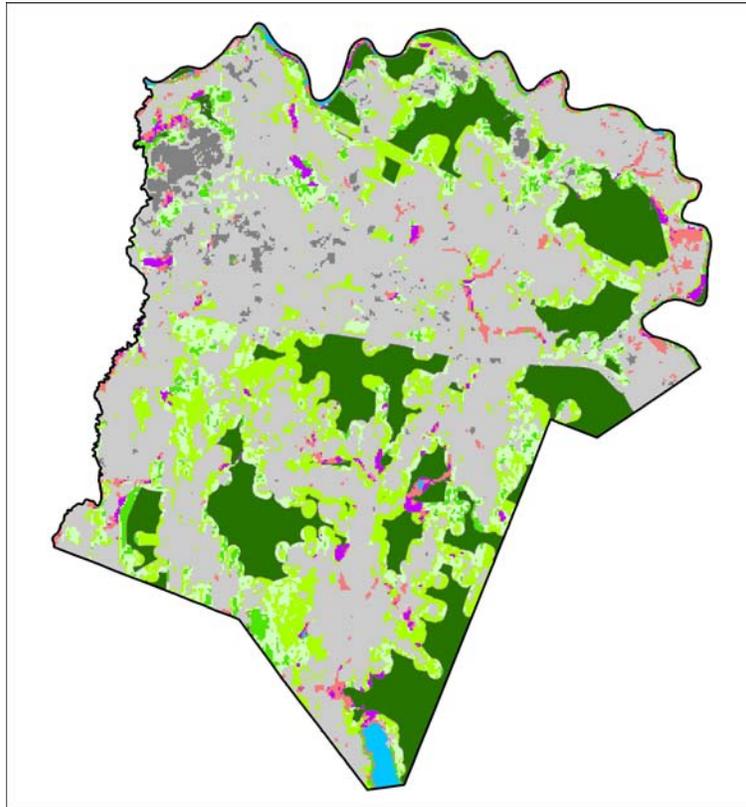


An Assessment of Wildlife Habitat in

Williston, Vermont



**David Capen, Tina Scharf, Sean MacFaden,
and Ernest Buford**

**Spatial Analysis Laboratory
Rubenstein School of Environment and Natural Resources
University of Vermont, Burlington VT**

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Introduction

In December 2004, the Town of Williston issued a request for proposals to assess wildlife habitat in selected parts of the town that contain the largest undeveloped areas of habitat for wildlife, seven “wildlife units.” In January, a contract for this work was established between Williston and the Spatial Analysis Laboratory at the University of Vermont. The essence of the proposed work was to combine the use of available sources of natural resources data—mostly available from libraries of GIS data—and field assessments to record observations of wildlife and characteristics of habitat. This report describes those assessments and offers thoughts on the important wildlife resources of Williston and suggestions for further conservation of those resources.

Methods

Three experienced wildlife biologists, Tina Scharf, Ernie Buford, and Sean MacFaden, conducted field assessments of all seven wildlife units from January until June 2005. During winter months, field work focused on looking for tracks of mammals left in fresh snow, but also included observations of birds and assessment of forest communities and their conditions. In April and May, Ernie and Sean surveyed wildlife units for birds and for vernal pools, essential habitat for a number of amphibian species. In total, the three biologists conducted field surveys for 29 days.

We also conducted a remote assessment of wildlife habitat in the Spatial Analysis Laboratory. Most importantly, Sean examined recent aerial photographs and created a digital database of different habitat types. He did this by interpreting 1:5000-scale black-and-white orthophotographs taken in 1999, and by using 1:40,000 color orthophotographs, taken in summer 2003, to aid with interpretation of land-cover types. (Sources of digital data and details about these data are presented in the Appendix). This land-cover/land-use data layer was suitable for quantifying acreages of cover types and land-uses in each of the wildlife units and for analyzing configuration of habitat types.

The next step was to compile a list of wildlife species thought to be present in Williston and to derive simple habitat models for each species. Ernie Buford did this portion of the assessment, developing models for 30 species, and then linking the habitat models to the digital maps of habitat for each wildlife unit. The products of this work—predicted distributions of each species—are best suited for submission in a digital format that can be queried and analyzed by GIS software. However, we do present descriptions of habitat types used by these 30 indicator species.

Habitat Descriptions and Wildlife Observations

Wildlife units and their cover types are displayed in Figures 1 and 2. Tables 1 and 2 present a summary of the extent of cover types in each wildlife unit. Most units, especially Nos. 3-7, have a predominance of forest types with a small amount of agricultural land. Units 1,2, and 4 contribute the majority of wetland habitat, an important component of habitat for a number of wildlife species. Acres of housing and commerce are quite low in all but Unit 7, where 10% of the land area is classed as developed.

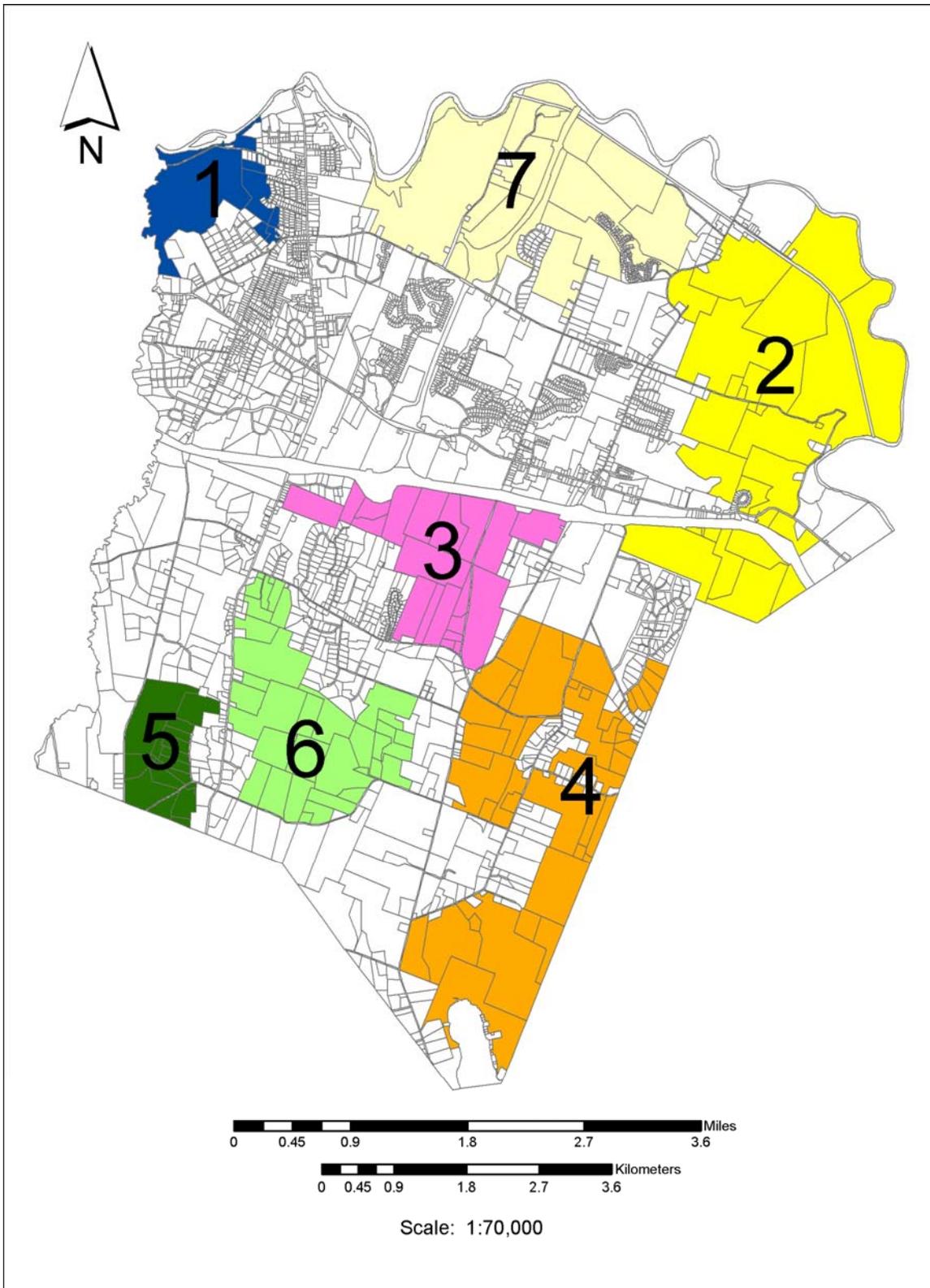


Figure 1. Wildlife units in Williston, Vermont.

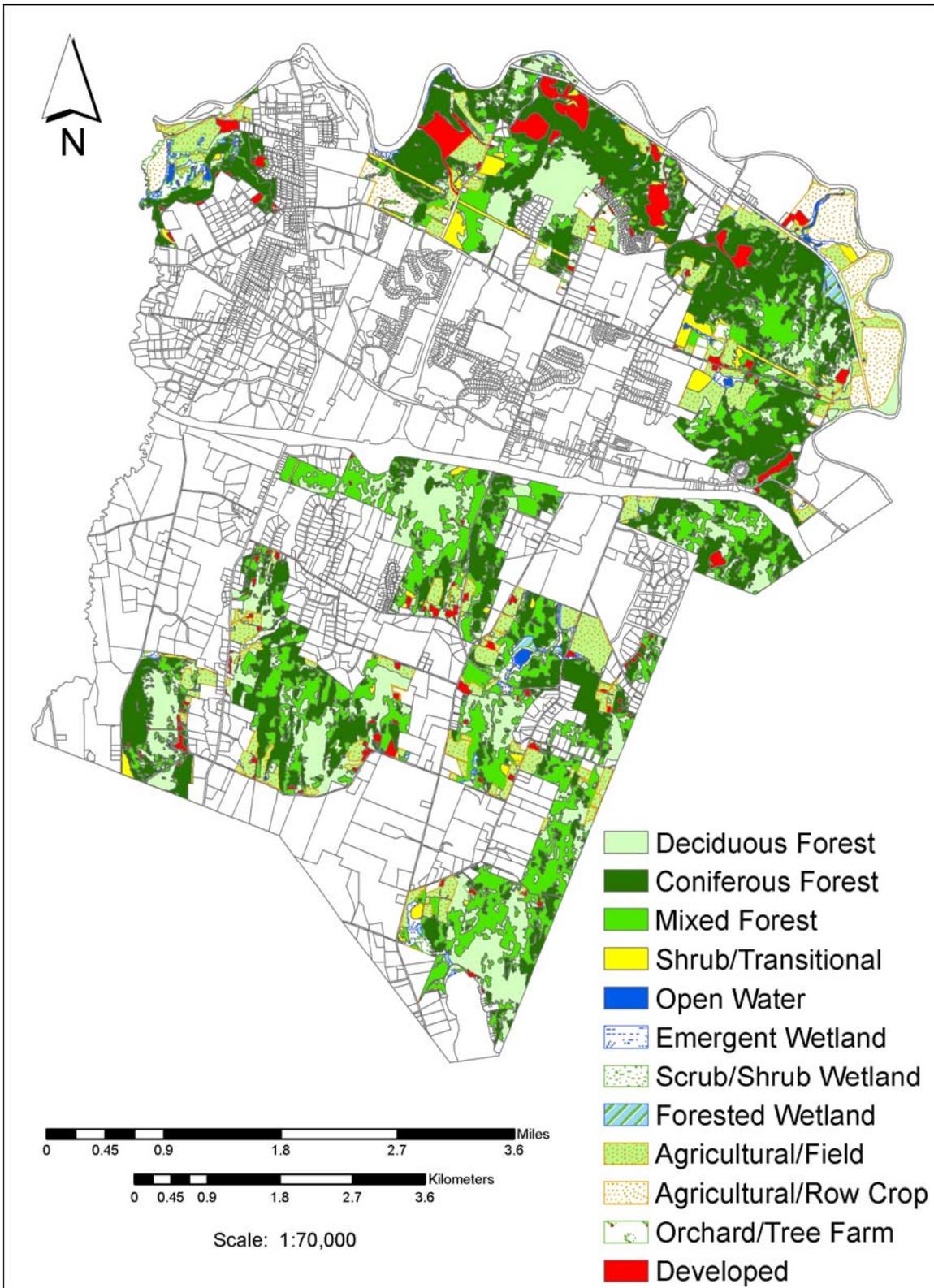


Figure 2. Land-cover classes in seven wildlife units in Williston, Vermont.

Table 1. Acres of land-cover types in seven wildlife units in Williston, Vermont.

Land-cover Class	Wildlife Unit						
	1	2	3	4	5	6	7
Deciduous Forest	26	309	258.8	404.7	109.7	264.4	281.8
Coniferous Forest	122.9	765.5	167.5	316.6	132.5	296.5	610.9
Mixed Forest	11.3	420.2	319.9	594.4	45.9	238.9	195.4
Shrub/Transitional	6.4	60.1	11.7	18.9	13.5	4	78.4
Open Water	17.1	14.4	0.2	10.1	0.4	1.6	0
Emergent Wetland	5.1	24.1	0.3	37.1	2.1	0.5	8.8
Scrub/Shrub Wetland	41.3	2.5	0.5	26.1	2.7	7.8	4
Forested Wetland	14.6	19.3	0	13.2	0	0.5	0
Agricultural/Row Crop	26.1	259.1	0	0	0	0	50.6
Agricultural/Field	64.9	252.4	29.4	253.8	24.8	103.1	127.4
Orchard/Tree Farm	0	14.3	0	2.1	0	1.6	36.7
Developed	24	69.9	15.9	39.1	10.2	28.2	165.6
Total	359.8	2210.9	804.4	1716.1	341.7	947.2	1559.6

Table 2. Percentages of land-cover types in seven wildlife units in Williston, Vermont.

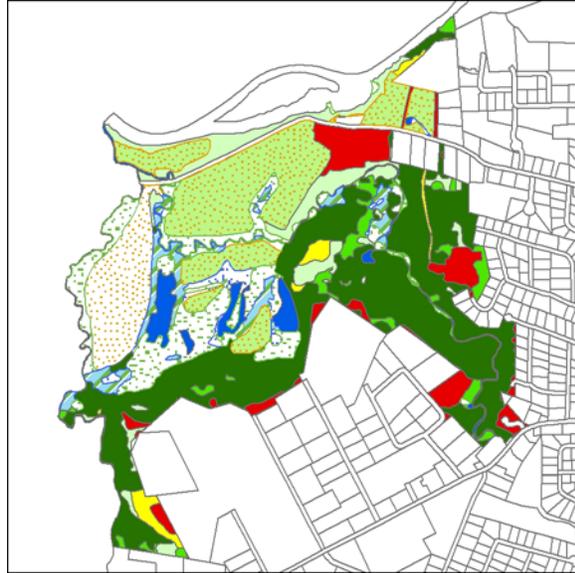
Land-cover Class	Wildlife Unit						
	1	2	3	4	5	6	7
Deciduous Forest	7.2	14	32.2	23.6	32.1	27.9	18.1
Coniferous Forest	34.2	34.6	20.8	18.5	38.8	31.3	39.2
Mixed Forest	3.1	19	39.8	34.6	13.4	25.2	12.5
Shrub/Transitional	1.8	2.7	1.5	1.1	3.9	0.4	5
Open Water	4.8	0.7	0	0.6	0.1	0.2	0
Emergent Wetland	1.4	1.1	0	2.2	0.6	0.1	0.6
Scrub/Shrub Wetland	11.5	0.1	0.1	1.5	0.8	0.8	0.3
Forested Wetland	4.1	0.9	0	0.8	0	0.1	0
Agricultural/Row Crop	7.3	11.7	0	0	0	0	3.2
Agricultural/Field	18.1	11.4	3.7	14.8	7.2	10.9	8.2
Orchard/Tree Farm	0	0.6	0	0.1	0	0.2	2.4
Developed	6.7	3.2	2	2.3	3	3	10.6
Total	100	100	100	100	100	100	100

A summary of wildlife observations compiled during our surveys is presented in Table 3. Twenty-five mammal species were detected during winter surveys. Many were found in all wildlife units, but some of the more significant species were restricted to only two or three of the units. More than 80 species of birds were observed in the field. For all species, we acknowledge that they may be more widespread than indicated in Table 3. This is the reason for identifying habitats where they should be expected to occur, the objective of predictive models included in the Appendix. Descriptions of habitat in the wildlife units and significant observations of wildlife species follow.

Wildlife Unit 1

This unit, in the northwestern corner of Williston, has two geographic areas: the Winooski River floodplain and the steep sandy ridge rising out of the floodplain. Most of the floodplain is field and wetland, with a thin band of riparian woodland along the river. The ridge is forested with an overstory dominated by eastern white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*).

The floodplain has wetlands associated with Muddy and Alan Brooks, which flow through the unit and into the Winooski River. There is some shrub swamp, but most of it is marsh with open water and emergent vegetation. The invasive plants *Phragmites australis* and barberry (*Berberis* sp.) occur here, but a cattail (*Typha augustifolia*) marsh still exists and probably provides good wildlife habitat.



Open fields in the floodplain are actively farmed. There are narrow bands of shrubs and trees at the edges of the fields, which include riparian species such as American basswood (*Tilia americana*), red (*Acer rubrum*) and silver maple (*Acer saccharinum*), black willow (*Salix nigra*), and American elm (*Ulmus americana*). The shrubs are mostly honeysuckle (*Lonicera* sp.) and buckthorn (*Rhamnus* sp.), two invasive species. Meadow voles (*Microtus pennsylvanicus*) actively use the fields, providing a prey base for predators.

With its overstory of white pine and hemlock, woodlands in this unit have little or no understory vegetation. Overbrowsing by white-tailed deer (*Odocoileus virginianus*) may contribute to this problem, but these forests are generally characterized by scant understory. Deer are present in this habitat, but there is little food available for them. However, the coniferous overstory provides protective cover, especially in winter. The area is bordered by industrial development, where there is much human activity and noise from machinery. Deer travel along the edge of this development.

The forested habitat in this unit is relatively poor for wildlife, lacking a shrub layer and ground cover. Red squirrels (*Tamiasciurus hudsonicus*), however, feed on pine and hemlock cones. Despite the presence of invasive shrubs, which outnumber native species in some places, the wetlands are in better condition. This observation is also true for the thin band of riparian woodlands along the Winooski River, which shelters a diversity of wildlife species in an otherwise heavily-developed area.

This wildlife unit is most notable for a diversity of birds, containing a combination of open water and emergent and scrub/shrub wetlands that are relatively uncommon in Williston. These habitat types support important waterfowl species and other wetland-associated species, including green herons (*Butorides virescens*), Virginia rails (*Rallus limicola*), wood ducks (*Aix sponsa*), hooded mergansers (*Lophodytes cucullatus*), marsh wrens (*Cistothorus palustris*), and willow flycatchers (*Empidonax traillii*). Its fields also provide nesting habitat for bobolinks (*Dolichonyx oryzivorus*) and other grassland species, which are generally rare in Vermont.

The wetlands in this unit, along with at least one identified vernal pool, also provide habitat for frogs and salamanders, and probably for turtles. However, amphibian and reptile populations in

this section of town probably do not function as sources for populations in adjacent areas; the unit is heavily circumscribed by roads, industrial zones, and residential development, imposing substantial stormwater inputs and likely preventing effective movements of amphibians and reptiles.

Wildlife Unit 2

This unit encompasses a large, diverse area in the northeastern corner of town. Along the Winooski River, the floodplain has been largely converted to agricultural fields, but interesting habitat features still exist, including the presence of many young black walnuts (*Juglans nigra*) growing at the field edges. The riparian edge is narrow, but has mature box elders (*Acer negundo*), silver maples, black willows, basswoods, and hackberries (*Celtis occidentalis*). Shrubs include staghorn sumacs (*Rhus typhina*), *Rubus* spp., and wild grapes (*Vitis* spp.). No invasive species were apparent during field surveys. Red foxes (*Vulpes vulpes*), coyotes (*Canis latrans*), and minks (*Mustela vison*) use the area; small prey includes meadow voles and a shrew species (Soricidae). No deer tracks were noted during winter tracking surveys, but very cold temperatures likely limited deer movement at that time.



The escarpment that frames the Winooski River floodplain is covered by dense forest. Mature white pines and hemlocks of all age groups dominate. The area is very steep, with several deep ravines. There is little or no browse for deer. Red squirrel, coyote and fisher (*Martes pennanti*) tracks were found during surveys; fisher tracks in particular were numerous and included scent posts. This wildlife unit is relatively flat south of the escarpment and is dominated by pine-hemlock forest, which provides good winter shelter habitat for deer. Farther south, deciduous trees dominate the forest composition, including American hophornbeams (*Ostrya virginiana*), American beeches (*Fagus grandifolia*), paper (*Betula papyrifera*) and yellow birches (*B. alleghaniensis*), sugar maples (*Acer saccharum*), and northern red oaks (*Quercus rubra*). The understory contains these species, indicating successful regeneration, and also striped maples (*Acer pensylvanicum*) and beaked hazelnuts (*Corylus cornuta*). Deer, red squirrels, and red foxes were observed commonly in this habitat during winter surveys. Numerous snags and large woody debris exist here, including many dead butternuts (*Juglans cinera*). Butternuts were probably once common in this woodland, but many apparently have been killed by butternut canker (*Sirococcus clavignenti-juglandacearum*), a fungal pathogen.

Near Governor Chittenden Road and the Catamount Family Center, many old fields have grown into shrubs and young forest. White pines, elms, nannyberries (*Viburnum lentago*), and red maples are common, but apples (*Malus* spp.), white ashes (*Fraxinus americana*), sugar maples, and hemlocks also occur. Invasive plants such as barberries, honeysuckles, and buckthorns are scattered among the native plants. Deer are common in this habitat, and tracks of eastern cottontails (*Sylvilagus floridanus*) and ruffed grouse (*Bonasa umbellus*) were identified among dense shrubs during winter surveys.

Between the Catamount Family Center and Route 2, a rich northern hardwood forest contains mast-producing red oaks, beeches, and black cherries (*Prunus serotina*). Although deer and coyotes were observed here, prey species were noticeably absent. Closer to Route 2, a pine-hemlock forest is marked by deep ravines. Little understory exists in this forest, except by the streams. Mink tracks were found along the streambeds.

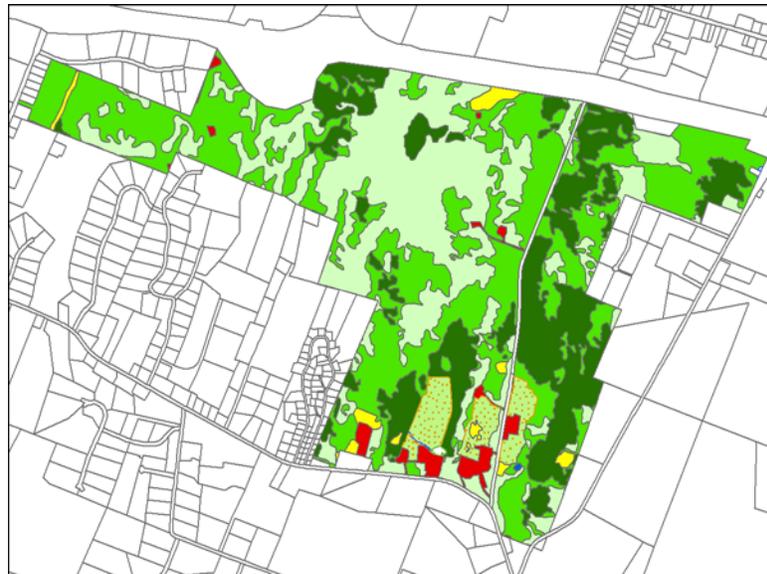
The extensive woodlands of this wildlife unit form one of the largest contiguous blocks of forested habitat in Williston. Accordingly, this unit provides habitat for a diversity of forest birds, including blue-headed vireos (*Vireo solitarius*), least flycatchers (*Empidonax minimus*), and pileated woodpeckers (*Dryocopus pileatus*). A ridge in the northeastern corner of the unit, adjacent to the Winooski River floodplain, may also serve as an important stopover location for migratory birds; most of the warblers that migrate through or to Vermont were observed during one 15-minute period in May.

This unit also provides other types of bird habitat, including grasslands and shrub/transitional zones. For example, the Catamount Family Center contains fields with bobolinks, eastern meadowlarks (*Sturnella magna*), and Savannah sparrows (*Passerculus sandwichensis*). These fields are especially notable because the management practices conducted here may be more compatible with nesting grassland birds than those typically needed for intensive agriculture (i.e., grassland birds generally require fields that are mowed annually, but the first mowing must be delayed until early summer, after the breeding season). Transitional zones, where old fields have regenerated into shrub habitat, support chestnut-sided warblers (*Dendroica pensylvanica*), veeries (*Catharus fuscescens*), and other species that frequent early-successional forests. A powerline right-of-way traversing this wildlife unit also provides shrub habitat.

No vernal pools were identified in this unit during 2005 field surveys, but at least one pool was previously identified on the Catamount Family Center (Carney et al. 1996). The area's unusual topography, which encompasses floodplains, ravines, and knobby hills, suggests that others likely exist. This probability, combined with the size and contiguity of forestlands, indicates that the area constitutes an important breeding habitat for amphibians, especially those species that spend a part of their life cycle in upland habitat.

Wildlife Unit 3

This unit lies south of Interstate 89 and north of Old Creamery Road. The topography is gently rolling, and both hardwood and softwood forests occur extensively in this area. Most of the forests are mature, although one property was logged about 20 years ago. Substantial browse exists in one part of the logged area; in another location the stand is pole-sized with little browse. A variety of hard mast trees is present here, including hophornbeams, red and white oaks (*Quercus alba*), shagbark hickories (*Carya ovata*), and a few bitternut hickories (*C. cordiformis*). Soft mast woody plants include black cherries, downy serviceberries (*Amelanchier arborea*), some *Rubus* spp., and wild grapes.



Other important plants include apples, hawthorns (*Crataegus* sp.), and nannyberries, which occur along the edge of an old field. During winter tracking surveys, ruffed grouse sign was identified in this old field, including snow roosts. Various mammals also use this field, including gray (*Sciurus carolinensis*) and red squirrels, fishers, coyotes, and deer. The squirrels are likely prey items for the fishers and coyotes.

Large, wide-ranging mammals use this wildlife unit. Moose (*Alces alces*) sign was observed during surveys, and local residents have reported moose crossing Oak Hill Road from the Mud Pond area. In addition, a mature male black bear (*Ursus americanus*) was recently struck by a car in the same vicinity. The woodlands connecting Mud Pond to this wildlife unit likely provide sufficient cover for animals with large home ranges, providing an effective movement corridor. The source populations for these large mammals probably occur in and beyond the Richmond Ridge area, in Wildlife Unit 4, which lies to the southeast.

Deciduous forest cover dominates the central and western sections of Wildlife Unit 3, but white pine stands occur near the Interstate 89 corridor. Other interesting features include a series of small rocky knolls with oaks and hemlocks, the presence of black birches (*Betula lenta*), noticed only in this unit, and occasional butternuts. As elsewhere, the butternuts are mostly diseased or already dead, making poor mast trees but good den trees and snags. Additional mast trees include hophornbeams, bitternut hickories, and beeches. A good shrub layer exists, although invasive buckthorns and barberries occur in some locations. Mammals identified in this section included fishers and another smaller weasel (most likely ermine, *Mustela erminea*), eastern chipmunks (*Tamias striatus*), red and gray squirrels, and coyotes.

As another relatively large, intact wooded tract, this unit supports a diversity of forest songbirds, including ovenbirds (*Seiurus aurocapillus*), scarlet tanagers (*Piranga olivacea*), and wood thrushes (*Hylocichla mustelina*). Upland game birds are also present, including wild turkeys (*Meleagris gallopavo*, observed during winter tracking), ruffed grouse, and American woodcock (*Scolopax minor*). The concentration of dead and dying trees provides foraging sites for woodpeckers, most notably the pileated woodpecker and yellow-bellied sapsucker (*Sphyrapicus varius*).

This unit likely supports breeding populations of amphibians; several high-quality vernal pools were identified during field surveys, each containing tadpoles or adult amphibians. One of the pools was located between a set of oak knolls, suggesting that other pools may occur in similar topography on other sections of the unit. These isolated vernal pools are especially important because they provide breeding habitat in upland environments and promote wide population distributions. Although none were observed during field surveys, the oak knolls probably also provide habitat for various snake species.

Wildlife Unit 4

This unit includes the southeastern corner of Williston, extending from Lake Iroquois north past Mud Pond. The forests in this area are diverse, with a good mix of deciduous and coniferous stands. The coniferous stands lack an understory layer, but they could serve as deer wintering habitat. The deciduous forests include northern hardwood and rich northern hardwood communities. Various wetland types are also present, including forested wetlands, scrub/shrub, and open marshland. The Mud Pond area is particularly diverse; the pond edge supports plants that occur only in bogs and fens. Diverse natural communities generally provide good habitat for a multitude of wildlife species.

Various mast trees occur in this area, including red oak, musclewood (*Carpinus caroliniana*), American hophornbeam, and beech. Black ash trees (*Fraxinus nigra*), a fairly rare tree in Vermont, also occur near Mud Pond. The shrub layer is not particularly diverse, but deciduous stands generally have adequate regeneration. Little deer sign



was observed during winter tracking, but old moose bark stripping was noted on red maples, and local landowners have reported moose moving through the area. Coyotes, red foxes, fishers, and minks also were observed in this unit, despite a relative scarcity of prey items (i.e., squirrels, mice, rabbits, and ruffed grouse).

At Lake Iroquois, a mix of forest age classes is apparent. Near Oak Hill Road the forest composition includes apples, elms, ashes, and red maples, with red-osier dogwoods (*Cornus stolonifera*), honeysuckles, wild grapes, speckled alders (*Alnus rugosa*), and ostrich ferns (*Matteuccia struthiopteris*) in the understory. In contrast, the Lake Iroquois recreation trail passes through mature northern hardwoods with some rocky outcroppings. An old beaver lodge exists in an adjacent wetland.

Northeast of the lake, the topography rises to Richmond Ridge; this area is unique in Williston because it is on the edge of a fairly extensive forested highland with rough terrain. A combination of pines, hemlocks, and various deciduous tree species is found here. An outstanding feature of this area is the abundance of prey species. Snowshoe hare (*Lepus americanus*) tracks were common during winter tracking surveys, the only location in town where they were observed. Also, many mouse (*Peromyscus* spp.) and squirrel tracks were observed. Another unique feature of this site, relative to the Williston landscape, is the potential habitat for moose, black bears, and bobcats (*Felis rufus*). These species likely prefer the isolated ridgeline, most of which occurs in the town of Richmond, but occasionally they move downslope into Williston while foraging. A local resident has reported moose and black bears in the Mud Pond area, including one bear with cubs. Bears use wetlands extensively in the spring, and Mud Pond provides good foraging habitat for them; during winter tracking surveys, one bear-clawed beech tree was observed. Another local resident also recently observed a bobcat. Consequently, wildlife diversity in Williston benefits greatly from the proximity of Richmond Ridge, even if only a small part of it actually lies within the town boundary.

As with other forested sections, this unit provides habitat for a wide variety of forest birds, most notably the blue-headed vireo, veery, and white-throated sparrow (*Zonotrichia albicollis*). However, the overall diversity of birds in this area is greatly enhanced by Mud Pond, Lake Iroquois, and their associated wetlands. Wetland or water-dependent species that were observed here include alder flycatchers (*Empidonax alnorum*), belted kingfishers (*Ceryle alcyon*), blue-gray gnatcatchers (*Polioptila caerulea*), Louisiana waterthrushes (*Seiurus motacilla*), northern waterthrushes (*Seiurus noveboracensis*), and ospreys (*Pandion haliaetus*). Mud Pond was also the only site where the Canada warbler (*Wilsonia canadensis*) was observed, a species that breeds in wet coniferous and northern hardwood forests.

Several vernal pools were located in the Lake Iroquois area; in conjunction with the various wetland classes in this unit, they probably provide suitable breeding habitat for frogs and salamanders.

Wildlife Unit 5

This unit is dominated by Brownell Mountain, which is steep and ledgy on the west side, has a sharp steep ridgeline, and moderates on the east side. The northern end has a small swamp and marsh that form a part of the Sucker Brook drainage. The southeastern end has a small area of old field that is succeeding to forest.

The mountain has a diverse forest community, including white pines, hemlocks, and northern hardwoods. Hemlocks dominate steep slopes on the entire west side, the ridgeline, and close to the ridgeline on the east side; white pines dominate the south and southwestern ends. Northern hardwoods are dominant on more moderate slopes on the east side, primarily sugar maples, beeches, white ashes, hophornbeams, red oaks, a few black oaks (*Quercus velutina*), and paper and yellow birches. The understory is well developed, with various saplings (including many hophornbeams) and native shrubs such as alternate-leaf dogwoods (*Cornus alternifolia*) and witch-hazels (*Hamamelis virginiana*). Deer have browsed some of the shrub layer, but it is still largely intact. Snags and much large and small woody debris further add to the complex structure of these woods. One landowner reported plentiful Jack-in-the-pulpit (*Arisaema triphyllum*) in the deciduous forest on the east side, suggesting enriched soils and wet ground. Invasive honeysuckles and buckthorns are encroaching into the northern end of the unit from a powerline right-of-way and also occur along field edges on the east side.



Tracks of coyotes, red foxes, and bobcats were numerous during winter surveys, and at least one gray fox (*Urocyon cinereoargenteus*) was present. No rabbits were observed, and few mice and voles (Cricetidae), but tracks of gray and red squirrels were common. Little sign of deer was observed, but browse is available and landowners have reported deer activity.

The wetland complex along Sucker Brook is vegetated with native species such as willows (*Salix* spp.), alders and northern white-cedars (*Thuja occidentalis*), but some reed canary grass (*Phalaris arundinacea*) is also present. Recent beaver activity was observed.

The small shrubby area on the southwest side of the mountain has many small white pines and shrubs such as nannyberries and red-osier dogwoods. Invasive buckthorns and honeysuckles are present but limited. This area is likely habitat for eastern cottontails, but none were observed during surveys. However, foxes and coyotes routinely traverse it.

Brownell Mountain is a unique landscape feature that provides a large, contiguous forest tract in the southwestern corner of Williston, an area that is otherwise dominated by agriculture and developed land-uses. It also provides a possible habitat corridor to Shelburne Pond and other ecologically-significant areas to the west. The diversity of habitats in this area, including wetlands, a hemlock forest, and rich northern hardwoods, supports a similarly high diversity of birds. Notable songbird observations included chestnut-sided warblers, an early-successional species, and blackburnian (*Dendroica fusca*) and pine warblers (*D. pinus*), species that prefer coniferous-forest habitat. Wetland species included wood ducks and spotted sandpipers (*Actitis macularius*). A previous study identified one vernal pool near the summit of Brownell Mountain (Brough et al. 1995); no others were located during spring field surveys.

Wildlife Unit 6

This unit occurs between Butternut and Sunset Hill Roads. The highest point in this area, Five Tree Hill, is a dry oak ridge with grassy openings. Its slopes also have regenerating forest with good shrub cover, including *Spirea* sp., wild grapes, apples, eastern redcedars (*Juniperus virginiana*), common junipers (*J. communis*), sumacs, and young white ashes and white pines. Some invasive honeysuckles and buckthorns also are present. This area is good habitat for eastern cottontail rabbits, and abundant rabbit tracks were found here during winter surveys. The forest is a mix of white pines, hemlocks, red and sugar maples, white ashes, beeches, red oaks, paper and yellow birches. Hophornbeam, an excellent mast species, is also prevalent. Basswoods, bitternut hickories, serviceberries, and musclewoods are less common. Understory plants are numerous, and some have been browsed by deer. Many understory trees are beeches, which can sometimes indicate overbrowsing, but it is not clear whether this phenomenon applies here. During winter surveys, dog tracks precluded identification of foxes or coyote tracks, but various prey species were present (e.g., red squirrels, chipmunks, and mice). Deer tracks were common.



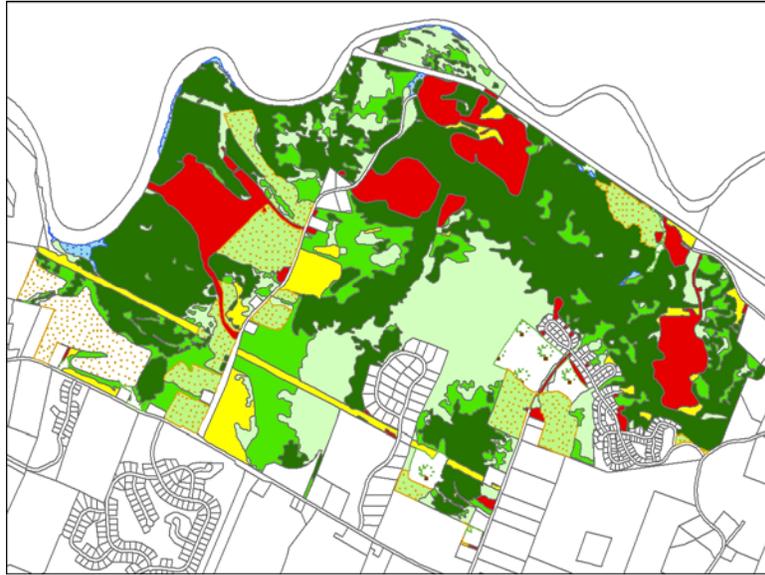
East of Five Tree Hill, the forest is young and structure is limited to pole-sized trees without much browse underneath. There is also an older forest stand that may have been a sugarbush. Farther south are small openings with old apple trees and aspens (*Populus* spp.), along with an older forest containing numerous mast species (e.g., shagbark hickories, bitternut hickories, red oaks, beeches, and hophornbeams). Young stands of white pines and white-cedars also exist here, which could develop into good deer wintering shelter.

To the southwest, the area between Five Tree Hill and Route 2A is dominated by coniferous forest, with small deciduous pockets. A fine beaver (*Castor canadensis*) wetland is associated with Sucker Brook in this area, with alders, cattails, and other wetland species. Minks, fishers and coyotes travel here, and a fox den was found nearby. Invasive buckthorns and honeysuckles are common, but recent logging in a few areas will likely increase understory density. A deer wintering area exists in a dense hemlock stand, although a snowmobile trail bisects it. Downstream, Sucker Brook has cut a deep ravine in sandy soils, and the relative isolation facilitated by the brook and ravine probably limit human disturbance from Route 2A.

Bird diversity in this wildlife unit is similar to other forested sections of Williston. The mixed topography of ridges and ravines, however, produces unique habitat for amphibians and reptiles. Several high-quality vernal pools were identified in Five Tree Hill Country Park during spring surveys, and the presence of multiple life stages (e.g., egg masses, tadpoles, adults) confirmed amphibian breeding. One or more of these pools were also identified by previous studies (Meisler et al. 1998), indicating their long-term importance to amphibian populations. Additional vernal pools likely are supported by similar rolling, rocky terrain in other parts of the unit. In contrast, the dry ledges that are the other noteworthy topographical feature of this unit likely provide habitat for snakes.

Wildlife Unit 7

This area in north-central Williston has a large, fairly flat upland as its core but also extends to the Winooski River. Northern hardwoods dominate the deciduous forest west of the Williston Woods sub-division, but bitternut hickories, basswoods, hophornbeams, and black cherries also are present. This stand has little shrub growth; saplings are 20-30 feet high, out of reach of browsing animals. Moving north, downhill toward the Winooski River, a coniferous forest becomes dominant, with white pines and hemlocks. Small streams cut deep ravines through the upland to reach the Winooski, creating steep hills along the floodplain edge.



Other interesting features in this area include ample eastern cottonwoods (*Populus deltoides*), an important food for ruffed grouse, and evidence of recent logging, which will create more browse and cover. Also, a sandpit exists in the northeastern corner of the unit. The sandpit itself is barren, but it is a good site for the pine-oak-heath sandplain forest natural community, which is quite rare in Vermont.

In the western section of the unit, near Redmond Road, the forest is younger and the ground wetter, supporting a slightly different species composition. In an old field on the corner of Redmond Road and Mountain View Road, many native shrubs and herbaceous plants are present, along with invasive honeysuckles and buckthorns. The powerline right-of-way running east-west through this area has a similar plant diversity. The young forest north of the right-of-way comprises eastern cottonwoods, quaking aspens (*Populus tremuloides*), serviceberries, red maples, gray birches (*Betula populifolia*), and many hophornbeams. Many butternuts are present, but most are dead or dying. Understory plants include hawthorns, old apple trees, Virginia creepers (*Parthenocissus quinquefolia*), and buckthorns.

In the northwestern corner of the unit, coniferous forest is again dominant. These woods are heavily used by deer, which cross Redmond Road in several places. Near the Winooski River, a young riparian forest exists on the floodplain. An old field occurs along the railroad right-of-way, containing many apple and butternut trees (most dead and dying). Various animals use the old field, most notably coyotes and deer. The Chittenden Solid Waste District facility is an apparent draw for animals; many tracks were observed here during winter tracking surveys. Also observed in this vicinity were fishers, skunks, river otters (*Lutra canadensis*), raccoons (*Procyon lotor*), red foxes, mice, and red and gray squirrels. However, no rabbits were detected.

For birds, the most notable feature of this wildlife unit is the relatively intact floodplain forest along the Winooski River; this habitat type is rare in Williston because much of it has been converted to agriculture. Various upland forest and shrub habitats also exist, complementing similar habitat in other sections of town. One vernal pool of marginal quality was observed in the unit, which generally contains fewer wetland features than other parts of town, so this area may have comparatively less breeding habitat for amphibians.

Table 3. Observed mammal and bird species during winter and spring surveys, 2005, in seven wildlife units of the town of Williston. Additional records of species occurrence are included in the Appendix.

Species	Wildlife Unit						
	1	2	3	4	5	6	7
<i>Mammals</i>							
Beaver	X ^a			X	X	X	
Black Bear			X	X		X	
Bobcat				X	X		
Coyote	X	X	X	X	X	X	X
Eastern Chipmunk	X		X	X	X	X	
Eastern Cottontail	X			X	X	X	X
Ermine	X		X				
Field Mouse	X						
Fisher	X	X	X	X		X	X
Gray Fox					X		
Gray Squirrel	X		X	X	X	X	X
Meadow Vole	X	X					
Mink	X	X		X		X	
Moose	X		X	X		X	
Muskrat	X	X		X			
Porcupine				X			
Raccoon	X						X
Red Fox	X	X	X	X	X	X	X
Red Squirrel	X	X	X	X	X	X	X
River Otter							X
Snowshoe Hare				X			
Shrew <i>sp.</i>	X			X	X		
Striped Skunk							X
White-footed or Deer Mouse		X	X	X	X	X	X
White-tailed Deer	X	X	X	X	X	X	X
<i>Birds</i>							
Alder Flycatcher				X			X
American Crow	X	X	X	X	X	X	X
American Goldfinch	X	X	X	X	X	X	X
American Kestrel				X			
American Redstart	X		X	X	X		
American Robin	X	X	X	X	X	X	X
American Woodcock			X		X		
Bank Swallow	X						
Baltimore Oriole	X	X	X				X
Barn Swallow	X	X					
Black-and-white Warbler		X		X	X	X	X
Black-billed Cuckoo					X		
Bay-breasted Warbler					X		
Black-capped Chickadee	X	X	X	X	X	X	X
Belted Kingfisher	X			X			X
Blue-gray Gnatcatcher				X			

Brown-headed Cowbird	X	X	X	X	X	X	X
Blue-headed Vireo		X		X			X
Blackburnian Warbler		X	X	X	X	X	X
Blue Jay	X	X	X	X	X	X	X
Blackpoll Warbler	X				X		
Bobolink	X	X				X	
Brown Creeper		X	X	X			X
Brown Thrasher		X					
Black-throated Blue Warbler		X	X	X	X	X	X
Black-throated Green Warbler		X	X	X	X	X	
Broad-winged Hawk		X					X
Canada Goose	X			X			
Canada Warbler				X			
Cedar Waxwing		X					
Chimney Swift	X	X					
Cliff Swallow	X						
Common Grackle	X	X			X		
Cooper's Hawk	X						
Common Yellowthroat	X	X	X	X	X	X	X
Chestnut-sided Warbler		X	X	X	X		X
Double-crested Cormorant	X						
Dark-eyed Junco		X		X			
Downy Woodpecker	X			X	X		X
Eastern Kingbird	X				X		
Eastern Meadowlark		X					
Eastern Phoebe	X		X	X	X		
Eastern Wood-Pewee			X	X	X		X
European Starling		X					
Evening Grosbeak					X		
Great-crested Flycatcher	X	X	X	X	X	X	X
Gray Catbird	X	X	X	X	X	X	X
Green Heron	X						
Hairy Woodpecker	X		X	X	X	X	X
Hermit Thrush		X	X	X	X	X	X
Hooded Merganser	X						
House Wren	X	X	X				X
Least Flycatcher	X	X	X	X			
Louisiana Waterthrush				X			
Mallard	X						
Magnolia Warbler		X	X		X	X	
Marsh Wren	X						
Mourning Dove	X		X		X		X
Nashville Warbler			X				
Northern Cardinal	X	X	X		X	X	X
Northern Flicker	X				X		X
Northern Parula		X					
Northern Waterthrush				X			
Northern Rough-winged Swallow	X						
Osprey				X			
Ovenbird	X	X	X	X	X	X	X

Pine Warbler					X		
Pileated Woodpecker		X	X				X
Purple Finch			X				
Rose-breasted Grosbeak		X	X	X	X	X	X
Ring-billed Gull						X	
Red-breasted Nuthatch	X	X	X	X	X	X	X
Red-eyed Vireo	X	X	X	X	X	X	X
Red-shouldered Hawk				X			
Red-tailed Hawk	X		X		X		
Ruffed Grouse	X		X	X	X		
Red-winged Blackbird	X	X		X	X	X	
Savannah Sparrow		X		X			
Scarlet Tanager		X	X	X	X	X	X
Solitary Sandpiper	X						
Song Sparrow	X	X	X	X	X	X	X
Spotted Sandpiper	X				X		
Swamp Sparrow	X			X			
Tree Swallow	X	X		X	X		
Tufted Titmouse	X	X	X	X	X	X	X
Veery	X	X		X		X	X
Virginia Rail	X						
Warbling Vireo	X					X	
White-breasted Nuthatch		X	X	X	X	X	X
Willow Flycatcher	X						
Wild Turkey	X	X					
Winter Wren						X	
Wood Duck	X				X		
Wood Thrush		X	X	X	X	X	X
White-throated Sparrow		X		X		X	X
Yellow-bellied Sapsucker		X	X	X		X	X
Yellow-rumped Warbler	X	X	X	X	X	X	X
Yellow Warbler	X	X		X	X		

X^a - Some mammal presences include recent reports from knowledgeable landowners.

Habitat Quality and Connectivity— Expert Assessment of Habitat Attributes and Conservation Needs

The Williston landscape has experienced extensive changes in the last 50 years, as agriculture has declined and suburban development has intensified. During this period natural land cover has increased, with abandoned pastures and hayfields growing into various forest types, but intensive residential and commercial development has also increased significantly, replacing vegetated land cover (both natural and agricultural) with impervious artificial surfaces. The northwestern section of town, in particular, has been converted to developed land uses, but all sections have been affected by suburbanization. These changes have important ramifications for wildlife populations, affecting the quality and distribution of breeding and foraging habitat. They also affect the ability of wildlife to move among different habitat types in Williston and adjacent towns.

Both natural and human-made landscape features affect habitat connectivity and wildlife movements. The most important natural feature is the Winooski River, which constitutes the town's northern and northeastern boundary. The river limits regular movements by most mammals, amphibians, and reptiles, but it is not imposing enough to prevent seasonal dispersal of most species. The most significant human-made feature is Interstate 89; this limited-access highway essentially divides the town and creates a substantial barrier to north-south wildlife movement. Together, these features may isolate the northern third of Williston from adjacent natural areas, creating a habitat zone that might support less wildlife diversity. Fewer non-flying animals are likely to move into this area, and fewer would be expected to emigrate to other regions. Therefore, this part of town may represent a population sink for many species, rather than a source of dispersing individuals. Birds and other flying animals, of course, are not restricted by these ground features, but the region's relative isolation may limit its suitability for species that require extensive, contiguous forest tracts. Further field surveys and detailed studies of selected species should be considered to evaluate the sink-versus-source theory in this region of town.

Wildlife Units 1, 2, and 7 occur in this isolated zone between the Winooski and Interstate 89. Wildlife Unit 1 is an island of habitat wedged between the Burlington airport, industrial development, and the developed zone along Route 2A. The development surrounding this unit effectively isolates the area from all other wildlife units (Figure 3). This isolation is further compounded by the relatively large distances between this unit and other significant habitats for wildlife. The unit does not contain high-quality upland habitat, but its wetland habitat is diverse, especially given the proximity to the Winooski River. Although the most urgent conservation needs may be in wildlife units in the southern part of town, the importance of this unit should not be underestimated. Wide-ranging mammal species (e.g., bobcats) apparently use the Winooski River riparian corridor. Wetlands and riparian zones are priorities for protection and enhancement wherever they occur in Vermont. In this unit, there are clear opportunities for conservation work to better control and manage stormwater runoff, to control exotic species, and to enhance forested habitat along the Winooski River. Additional wildlife projects might include restoration of wider strips of trees and shrubs between plowed fields.

Wildlife Unit 2 encompasses one of the largest remaining undeveloped tracts in Williston and contains a variety of habitat types, including various forest and wetland classes. It should be valued for its diversity of wildlife habitats: forested ridges, riparian habitat along the Winooski River, agricultural fields, fallow fields, and shrublands. Habitat management priorities in this unit should encourage management of hay fields and fallow fields to benefit grassland birds; protection and enhancement of riparian habitat; and practices for maintaining early successional shrubs in crop fields that have been abandoned. There are numerous opportunities for restoring

wooded or shrubby connections between patches of riparian forest and large blocks of forest south and west of the railroad right-of-way.

Wildlife Unit 7 has some interesting, if unusual, features that benefit wildlife. However, the proposed circumferential highway would divide this unit in half, imposing a significant barrier to east-west movement for most wildlife species. A sand pit north of the Williston Woods neighborhood would likely support the restoration of a pine-oak-heath sandplain natural community. Likewise, the Chittenden Solid Waste District facility has the potential to maintain some unique grassland habitat types when landfill activities are resumed and disposal sites are restored. Mixed forests, old fields, and the Winooski River riparian zone further diversify habitat types. Protection of the forest along the river is the most obvious conservation need in this part of Williston.

Wildlife Units 3, 4, 5, and 6, which are distributed throughout the southern two-thirds of Williston, are generally better connected with each other and to ecologically important areas in adjacent towns. This is apparent in Figure 3, which depicts patches of core forest in Williston and forested connections to similar habitat in neighboring towns. In addition to the corridor from Unit 4 to Richmond Ridge and points east, significant forest tracts exist south of Units 5 and 6 in St. George. Although less forest cover exists to the southwest, Units 5 and 6 also connect to Shelburne Pond through a series of wetlands, hedgerows, agricultural fields, and shrub/transitional areas. Similar features connect the southern units to the Southeast Quadrant of South Burlington. This area currently contains mostly agriculture and old field habitat types, but it is the focus of ongoing conservation efforts and may ultimately play an important role in maintaining local biological diversity and assuring connectivity among wildlife habitats in this region of the county.

These units are noteworthy for high-quality forested habitat and some significant blocks of unfragmented forest. Wildlife Unit 3 is perhaps the least diverse of this group. Although it is largely forested and supports an array of common wildlife species, it is immediately adjacent to the barrier of Interstate 89 on the north, and several fingers of development extend into it. Nevertheless, there remains a very significant connection of forested cover between the southeastern corner of this unit and Wildlife Unit 4, which contains Mud Pond and the largest extent of core forest in the area. A high priority conservation project would be to assure protection of this linkage, perhaps even enhancing the amount of woody cover between Mud Pond and Oak Hill Road.

Wildlife Unit 4 is the only location where black bears and snowshoe hares were confirmed during field surveys; these species, along with moose and bobcats, likely enter Williston from Richmond Ridge. The Mud Pond area is a probable destination, a site that is very rich in habitat types and quality and one that supports an important diversity of plants and animals. Fortunately, the town and private landowners have conserved the pond and an adjacent property that provides linkage to the extensive forested areas of the ridge. The connection of forested habitat between Mud Pond and Lake Iroquois still is being fragmented by residential development, however, so additional conservation projects to maintain core forest in this area should have high priority.

Wildlife Unit 5 provides outstanding habitat diversity and perhaps the most important link among natural areas in the town. Brownell Mountain has ledges, a ridgeline, hemlock-pine woods, deciduous woods, and wetlands, all in a relatively small area. Ample food is available here for mammals, including browse and hard mast from various tree species. Snags are also abundant here, possibly dating from the 1998 ice storm. Very few invasive plants occur in this unit, another indication of high quality habitat for wildlife. Bobcat sign was observed here frequently during field surveys, suggesting that the area is an important component of an individual animal's home range. It is quite likely that bobcats, and numerous other species move into Williston from the large natural area surrounding Shelburne Pond, which is a short distance west of Brownell

Mountain. It is, thus, important to maintain good forest cover along the adjacent portion of South Brownell Road. Fortunately, a significant parcel in the unit already is owned by the town.

A short distance to the northeast, Wildlife Unit 6 encompasses a similar selection of habitats, including an interesting mix of upland (e.g., Five Tree Hill and the dry ledges of Gramma Ridge) and wetland habitat (e.g., shrub wetland along Sucker Brook). It also contains a deer wintering area and several notable vernal pools. The summit at Five Tree Hill was the only other location, besides the Catamount Family Center, where eastern cottontail tracks were found. Sucker Brook and adjacent cover probably constitute the most important corridor for wildlife in this region, and should be a priority for habitat conservation. We believe, also, that it would be worthwhile to extend the reach of unit 6 and consider some of the forested cover that runs into St. George and becomes part of a large patch of forest.

Although roads of varying size and traffic intensity traverse Wildlife Units 3, 4, 5, and 6, they do not impose a barrier to animal movement that is comparable to Interstate 89. Collisions with automobiles undoubtedly occur, and perhaps they constitute a significant mortality factor for some species. In general, sufficient cover exists to link units 3, 4, 5, and 6, and to facilitate movement of wildlife; in connections without forest cover, hedgerows and shrub/transitional zones often provide adequate concealment. We highly recommend that town officials or members of an appropriate volunteer board establish a system for monitoring and recording the number of reported wildlife collisions with vehicles in areas where wildlife likely cross busy roads. Although it is rewarding to protect habitat corridors that assure landscape linkages, it is sometimes more advisable to manipulate cover to discourage animals from crossing roads.

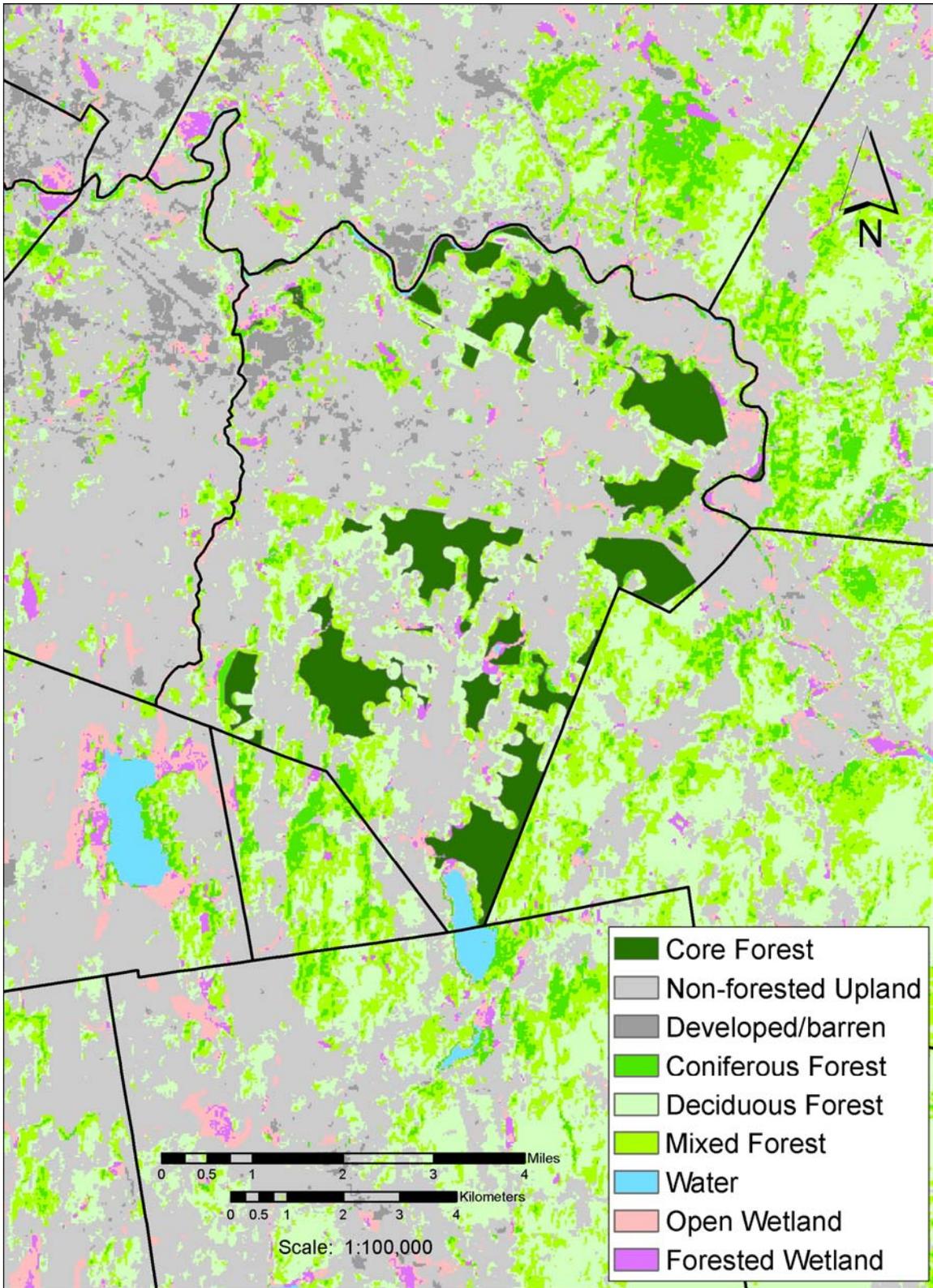


Figure 3. Patches of core forest in Williston. Core forest is defined as forest that is more than 100 meters from an edge or another type of land cover.

Habitat Models and Predicted Distributions

As described earlier, we developed a land-cover/land-use (LCLU) GIS coverage for the seven wildlife units in Williston. We then assembled a list of wildlife species—amphibians, birds, mammals, and reptiles—thought to be present in the town. For each species in this list, we indicate the LCLU classes where the species would be expected to be found. The species-habitat matrix does not project “preferred” habitat, but rather all habitat classes that would fall within the normal home range of a species. Thus, a wide-ranging mammal, such as a coyote, would be associated with most of the habitat (LCLU) classes in the database.

The species-habitat matrix, linked to the LCLU coverage in a GIS, can easily be used to project a map of the expected distribution for any of the wildlife species in the matrix. For this purpose, we have compiled a geodatabase for ArcMap GIS that links the species-habitat matrix with the LULC coverage and have included it as part of the digital appendix for this report.

The entire list of wildlife in the species-habitat matrix may be used to produce maps of species richness. This involves predicting the distribution of each species in the database, then overlaying all distribution maps and identifying areas where the greatest number of species occurs. This approach is often used in conservation planning for large geographic areas, but may be too cumbersome, or even misleading, for habitat planning in a single town. Such “hotspots” of species richness in a town would likely feature areas where different land-cover types intersect, and thus might identify a highly fragmented region.

Another approach is to select “habitat indicator species.” Some wildlife species show narrow preferences for certain habitat conditions; e.g., the indigo bunting is a bird that is found during the breeding season in fields with abundant brush, such as small hardwood trees. In contrast, other species, such as the red fox, survive best in areas where several habitat types converge, providing abundant edge habitats where the fox finds prey species. A suite of species that collectively require a diversity of habitat types comprise the habitat indicators for an entire planning unit. Habitat indicators should be species that are reasonably abundant and easy to identify and monitor. We selected a subset of 30 wildlife species from the species-habitat matrix that meet these criteria and generated maps of predicted distributions from the database (included in appendix). No rigorous method was used to identify these species, and certainly others could be just as appropriate.

Our objective for this section of the report, and the associated appendices, is to promote citizen participation in assessing and monitoring wildlife habitat. Field activities to locate and monitor selected wildlife species will serve to validate predictions from the species-habitat matrix and to identify best examples of habitats for each of the species monitored.

Our habitat indicators include the following species and habitat types:

Grassland habitats:

- Bobolink—a conspicuous bird in the breeding season that nests successfully in large, dense hay fields that are not mowed until mid-July. Should be monitored during June and July when males establish breeding territories. Migratory in winter.
- Horned lark—an inconspicuous species that is seen most often in spring and fall in fields that have patches of grass and ample areas of bare ground. Should be monitored in different seasons.
- American kestrel—a small raptor that nests in cavities of trees in the open and feeds on large insects and small mammals found in a variety of grasslands. Should be monitored from May through August. Migratory in winter.

Deciduous forest habitats:

- Pileated woodpecker—a conspicuous bird that prefers old forests with decaying trees; usually found in large blocks of forest or small forest patches in close proximity to each other. Can be monitored in all months, resident and territorial throughout the year.
- Wild turkey—a species that prefers mature hardwood forests with mast-producing trees, but will feed—especially in winter—in adjacent farm fields. Can be monitored in all months. Forest habitat is essential during breeding season in May and June; will wander widely in winter in search of food.
- Jefferson salamander—restricted to forested areas close to seasonal wetlands where eggs are laid in spring. Monitoring for this species should be during the breeding season.
- Scarlet tanager—prefers core forest and usually found in forest patches more than 200 acres in size. Monitor in breeding season, May-July. Migratory in winter.
- Great horned owl—widespread in large blocks of forest, often in mixed deciduous/coniferous forest. This species is territorial throughout the year and can be detected by call.
- Red-backed salamander—very common under logs and leaves in the deciduous forest, except where soils become flooded. Can be monitored throughout the warm months.

Coniferous forest habitats:

- Red-breasted nuthatch—A year-round resident found most often in coniferous forests. Can be monitored at any time of year.
- Fisher—Prefers conifers or mixed forests, but sometimes wanders into other habitat types in search of food. A good species to monitor in winter when tracks can be seen. In the Lewis Creek watershed, this species would most likely be found at elevations above 1000 feet.
- Northern goshawk—A raptor that is often found in mixed forests. May be a good indicator of interior forests habitat. Difficult to detect except near territories during the nesting season. Monitoring is often done by playing tape-recorded calls.
- Northern raven—Found in remote forested regions during the nesting season. Look for nesting pairs from March-May, especially in higher elevations of the watershed. Wanders widely during fall and winter.

Shrubland, or transitional, habitat (a declining habitat type in New England and one with a number of habitat specialists):

- Blue-winged/golden-winged warbler—these two species have identical habitat requirements and often hybridize when found together. They have very specific requirements for sparse growth of hardwood saplings, a classic old-field condition. Monitoring should be done during the breeding season. Migratory in winter.
- Indigo bunting—More abundant than the warblers listed above, but occupies the same habitat conditions. Monitoring should be during breeding season. Migratory in winter.
- Willow flycatcher—Found in shrubs along edges of wetlands. Also found in shrub/scrub wetland habitats. Should be monitored during breeding season. Migratory in winter.

Forested wetlands:

- Spotted salamander—Should be monitored in spring when active for breeding.
- Four-toed salamander— Should be monitored in spring when active for breeding.
- Wood frog—Most easily detected by voice in the spring.

Scrub/shrub wetlands:

- American beaver—Found along a variety of watercourses and often responsible for creating scrub/shrub wetlands. An excellent species to monitor because beaver flowages provide habitat for many other wildlife species.

Emergent wetlands:

- Swamp sparrow—A species found in cattail marshes that is easy to locate and monitor because of its conspicuous song during the breeding season. Migratory in winter.

- Muskrat—Should be present in large emergent wetlands. Easy to observe; present throughout the year.
- Marsh wren—Like the swamp sparrow, usually present in cattail marshes and is easy to locate and monitor because of a conspicuous song and obvious nests. Migratory in winter.

Rivers, streams, lakes, and ponds:

- Mink—Banks of rivers, streams, and ponds with ample natural cover should have healthy populations of minks. They can be most easily detected in the winter by tracks or any time of years when low water leaves muddy banks.

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Appendices

Appendices for this report are submitted as digital databases, suitable for display and further analyses when used with ArcMap GIS software. Metadata (details about the data) are submitted also, in a format compatible with standards of the Vermont Center for Geographic Information. The following data files comprise the appendices:

1. Wildlife Units in Williston. The digital data used to produce maps of the seven wildlife units and as the basis for summaries of land-use and land-cover types in each unit.
2. Land use/land cover. These data represent the digitizing of landscape polygons and interpretation of land use and land cover from aerial photographs. There are two databases, one restricted to the area within wildlife units, and a second that includes some of the lands adjacent to wildlife units.
3. Winter Tracking Transects. This database shows locations of transects followed in the field during winter tracking for mammal tracks.
4. Vernal Pools. Vernal pools are represented by point locations indicating locations of pools found during fieldwork in April and May 2005, as well as vernal pools identified in earlier reports.
5. Species-habitat Matrix. A listing of wildlife species expected to be found in Williston and the land-use/land-cover types where they should occur. This database can be linked with land use/land cover to predict distribution of any species in the matrix.
6. Preferred Habitat for Indicator Species. The predicted distributions for 30 species selected as habitat indicators.
7. Mammals Detected on Winter Surveys, 2005. This is a database of mammals species detected in the field and their locations along winter tracking transects.
8. Birds Identified during Spring Surveys, 2005. Birds observed during field surveys are associated with ownership parcels.