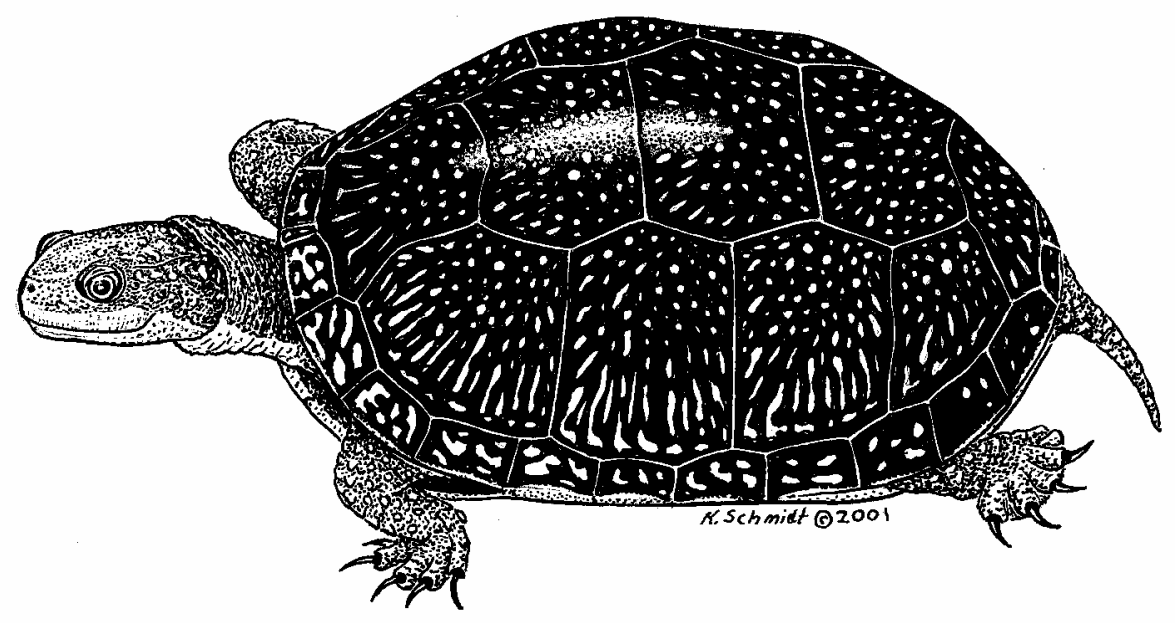
BLANDING'S TURTLE HABITATS IN SOUTHERN DUTCHESS COUNTY



Report to the
Marilyn Milton Simpson Charitable Trusts
and New York State Department of Environmental Conservation
Hudson River Estuary Program

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EXECUTIVE SUMMARY

Hudsonia Ltd. identified and mapped known and potential habitats for the Blanding's turtle, a New York State Threatened Species, in six towns in southern Dutchess County. This work was funded with grants from the Marilyn Milton Simpson Charitable Trusts and the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State Department of Environmental Conservation (DEC), and with programmatic support from the Educational Foundation of America.

Blanding's turtles are rare throughout their range (centered on the Great Lakes region in the United States and Canada), and occur only in isolated populations in the Northeast. Isolated populations and their habitats are important to a species' viability, providing genetic diversity and potential refugia as climate changes. Blanding's turtles use a diverse array of wetland and upland habitats in a large area, and provide an important ecological link between wetlands and the surrounding uplands. We consider the Blanding's turtle an "umbrella species," in that protecting land for the Blanding's turtle also protects habitats for many other rare and common wildlife species. Rare species in general, and in particular those that use large and diverse areas, act as "canaries in a coal mine" that indicate the quality of the environment for humans. The glacial outwash deposits of Blanding's turtle landscapes, in particular, are important groundwater aquifers in Dutchess County, and the organic soils of the core (regularly used) wetlands store carbon and may be important in mitigating climate change.

Through map analysis, aerial photograph interpretation, and field observations, we mapped locations and configurations of potential Blanding's turtle habitat complexes throughout Beekman, Fishkill, LaGrange, Poughkeepsie, Union Vale, and Wappinger. Altogether, we identified 173 potential core wetlands and 3926

associated (irregularly used) wetlands as well as many potential nesting areas. The "Blanding's Turtle Zone," which contains a 2000 meter-wide area around each core wetland, is continuous in the six towns. In this report, we describe potential habitats in each town and discuss conservation measures that can help protect these habitats and the turtle populations, including landscape-level measures for protecting habitat complexes, on-site mitigation at construction sites, and backyard practices for residences and businesses. We also recommend procedures for review of development proposals within Blanding's turtle habitat zones and discuss a short list of the highest quality habitat areas that we think deserve special attention.

We produced a large-format habitat map for each town; those maps and this report are intended as tools for conservation planning and decision-making. The maps provide town agencies, the DEC, and others information on areas that are potentially of concern, and those that are not of concern, for Blanding's turtle conservation. The maps can help landowners and developers choose sites for development that will be the least detrimental to Blanding's turtles, and thus incur less time and expense in the environmental review process. The habitat information may be particularly useful in the State Environmental Quality Review (SEQR) process, which balances the needs of wild species with socioeconomic factors in making land use decisions. The maps and report can help practitioners identify areas of greatest ecological significance, develop conservation goals, and establish conservation policies and practices that will help to protect Blanding's turtles while serving the social, cultural, and economic needs of the human community.

INTRODUCTION

Purpose of this Study

The Blanding's turtle (*Emys [Emydoidea] blandingii*) is a Threatened species in New York State and is of conservation concern throughout most of its range in the United States and Canada. Although Threatened animal species are provided some legal protection by New York State, turtle populations in Dutchess County continue to be harmed by damage to their habitats and to the turtles themselves. The Blanding's turtle is a mobile species that uses a variety of wetland and upland habitats in a large area to meet its foraging, basking, nesting, drought refuge, and overwintering needs, and it provides an important ecological link between wetlands and the surrounding uplands. Traveling between these habitats increases the turtles' vulnerability to human-related hazards such as busy roads, intensely developed areas, agricultural or mowing equipment, and collection by humans.

There are approximately 12 known Blanding's turtle populations in the county, but incidental data indicate the presence of other undocumented populations. Local populations of Blanding's turtles are frequently harmed when their habitats are not identified in advance of land development or road-building. In fact, habitat loss is considered a major threat to the Blanding's turtle and appears to be a key factor in population declines throughout its range (Kofron and Schreiber 1985; Congdon and Gibbons 1996; Kiviat 1997; Piepgras and Lang 2000; Standing et al. 2000; Blanding's Turtle Recovery Team 2003). Hudsonia biologists have created a map of potential Blanding's turtle habitat in six towns in southern Dutchess County—Beekman, Fishkill, LaGrange, Poughkeepsie, Union Vale, and Wappinger—using map analysis, aerial photograph interpretation, and field observations. We hope these maps will help local, county, and state agencies, as well as landowners, developers, and residents, incorporate Blanding's turtle habitat protection into their planning and conservation efforts. This project was

funded with grants from the Marilyn Milton Simpson Charitable Trusts and the New York State Environmental Protection Fund through the Hudson River Estuary Program of the New York State DEC, and with programmatic support from the Educational Foundation of America.

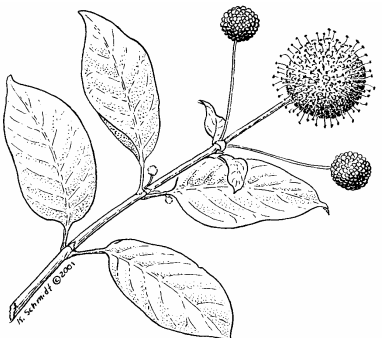
Introduction to the Blanding's Turtle

Natural History and Conservation Threats The Blanding's turtle is a medium-sized turtle with a dark, helmet-shaped carapace (shell) up to 25 cm (10 in) long and a bright, solid yellow chin and throat. It is listed as Threatened or Endangered in most of the states and provinces within its range and has been extirpated from several states (Hartwig 2004). The Blanding's turtle range is centered on the Great Lakes region in North America (Ernst et al. 1994), but isolated populations exist in New York, eastern Massachusetts, southern New Hampshire, southern Maine, and southern Nova Scotia (Ernst et al. 1994). In New York, the turtles occur in Dutchess County, Saratoga County (one known population), the eastern Ontario Lake Plain (one known population), Cattaraugus County (western New York), and the St. Lawrence River Valley (A. Breisch, *pers. comm.*).

Blanding's turtle (*Emys blandingii*)

Blanding's turtles use a variety of special habitats, many of which are damaged by human activities in our rapidly suburbanizing region. Blanding's turtles in Dutchess County use habitat complexes composed of "core wetlands," "associated wetlands," upland nesting areas, and other upland areas used for basking or refuge from unfavorable water temperatures.

We define "core wetlands" for the Blanding's turtle as the regularly used wetlands typically occupied during the winter, spring, early summer, and fall. They are deep enough to normally remain unfrozen at their bottoms and contain abundant aquatic vegetation. Core wetlands function as overwintering, foraging, and thermoregulation habitat. In Dutchess County, core wetlands are typically, but not always, kettle shrub pools. A kettle shrub pool is a seasonally or permanently flooded shrub-dominated pool located in a glacial kettle—a depression formed by the melting of a stranded block of glacial ice within glacial outwash materials. Soils such as Hoosic gravelly loam, derived from glacial outwash, are usually adjacent to or near the pools. Buttonbush, an aquatic shrub, is often the dominant plant, but other shrubs such as highbush blueberry and swamp azalea may also be abundant and buttonbush may be absent. Often, a shrub thicket is entirely or partly surrounded by an open water moat. The kettle shrub pool is usually ringed with mature hardwood trees and may have some small trees such as red maple or green ash in the pool interior, but typically lacks a forest canopy.



Buttonbush (*Cephalanthus occidentalis*)

Kettle shrub pool

Kettle shrub pools characteristically have no stream inlet or outlet, although some may have a small, intermittent inlet or outlet. In some cases the inlet or outlet is a ditch or channelized stream. Kettle shrub pools appear to be primarily fed by groundwater. Standing water is normally present in winter and spring but may disappear by late summer, or remain only in isolated puddles. Surface sediments in kettle shrub pools are normally organic although

mineral sediments may be present due to surrounding land use. Hudsonia has found two state-listed rare plants (spiny coontail and buttonbush dodder) and three regionally-rare plants (the moss *Helodium paludosum*, short-awn foxtail, and pale alkali-grass) in kettle shrub pools in Dutchess County. Kettle shrub pools are also used by spotted turtle, wood duck, mallard, American black duck, and many other wildlife species.

We use the term "associated wetland" to describe other wetland habitats that are used by Blanding's turtles from late winter through late summer. Associated wetlands contain some standing water for at least part of the growing season, and include deep ponds or lakes, acidic bogs, marshes, forested wetlands, slow-moving streams and riparian wetlands, ditches, and woodland pools. They apparently provide food during times of scarcity in core wetlands or peak productivity of food resources in associated wetlands, reduced competition, refuge from undesirable water temperatures or water depths, shelter and rehydration for females during nesting migrations, and shelter for other traveling turtles. Certain associated wetlands may also supply year-round habitat for juvenile Blanding's turtles, which apparently prefer shallower, more densely vegetated areas than the adults (Hartwig 2004).

Blanding's turtles engage in two different types of movement: annual home range movement and long distance travels (Kiviat 1997; Hartwig 2004). Annual home range movement includes movements that occur regularly on a day-to-day or seasonal basis, such as travel within and between wetlands and nesting migrations by females. These movements are related to seasonal selection of habitats—such as finding suitable water temperatures or depths, foraging areas, nesting sites, and overwintering sites, seeking mates, and possibly seeking refuge from competition—and can include long distance movements, particularly by females during nesting season. Movements exceeding 1000 m (3300 ft) were

common in a Massachusetts population (Butler 1997), and have also been observed in Dutchess County (Hudsonia Ltd., unpublished data).

Long distance journeys other than nesting migrations occur on a less-than-annual basis, are typically greater than 1000 m (3300 ft), and appear to be associated with individual turtles' habitat requirements or preferences. Long distance travel enables Blanding's turtles to select alternate habitats within a landscape as habitats or social dynamics change. While long distance movements by females are common during the nesting season, both male and female Blanding's turtles travel long distances unrelated to nesting activity (Table 1). These turtles establish residency in new wetlands (Rowe and Moll 1991; Power et al. 1994; Butler 1995; Hall and Cuthbert 2000; Hudsonia Ltd., unpublished data), mate (Joyal et al. 2000), or eventually return to their previous home ranges (Rowe and Moll 1991). It should be noted that, although we have distinguished between these two movement patterns for ease of discussion, a population of turtles typically exhibits a continuum of movement patterns from normal annual movement to long distance movements.

Table 1. Long distance movements by Blanding's turtles not related to nesting

Location	Distance (m)	Sex	Date	Reference
Illinois	895 – 1400	Female, male	Late May to July	Rowe and Moll 1991*
Illinois	722 – 1000	Female, male	--	Rubin et al. 2001
Maine	1330	Female	June or July	Joyal 2000
Massachusetts	1000 – 1600	Female, male	--	Butler 1995
Minnesota	2200	Male	July	Hall and Cuthbert 2000*
Minnesota, Weaver Dunes	5632	Male	Mid-May	Lang 2001*
Nebraska, Sandhills	~3200	Male	Late April to early June	Farrar 2003*
New York, Dutchess County	2600	Female	--	Hudsonia Ltd., unpublished data
Nova Scotia	5000 – 11,500	Male	--	Power et al. 1994
Wisconsin	900, 1240	Male	July	Wilder 2003*

*Data for these turtles were available for only one year, or the duration of the study was unknown; so we cannot be certain these were not annual movements.

Blanding's turtles in Dutchess County usually spend the winter in core wetlands below the ice in 30–60 cm (12-24 in) of water (Hudsonia Ltd., unpublished data). They survive the cold temperatures and low oxygen levels by greatly reducing their metabolic activity—to the point that, even though turtles are air-breathing animals, they receive the oxygen they need to survive through their digestive system. In late March or April, the turtles become more active and venture out to find food and warmer water temperatures or basking areas. Often, they leave their overwintering wetland to take advantage of abundant food or warm water in associated wetlands, such as woodland pools or marshes. Basking areas tend to be plentiful in Blanding's turtle habitat, but their composition varies. Blanding's turtles bask on logs, tussocks, woody hummocks, muskrat lodges, and even partially submerged in neuston—the floating layer of living and dead plant material on the water's surface (Kiviat 1993; Ernst et al. 1994). Blanding's turtles may also spend time on land, often under leaf litter or vegetation, to escape cool waters (Rowe and Moll 1991; Joyal et al. 2001; Lang 2001). They are sometimes found resting in upland forested areas over 100 m (328 ft) from the nearest wetland (Lang 2001).

By late summer when surface water is shallow or absent in many wetlands, many turtles move to deeper water bodies, which serve as "drought refuges." Drought refuges are usually springfed ponds, lakes, or deep water wetlands and can be 250-900 m (820-2950 ft) from the nearest core wetland (Kiviat 1997). Throughout the warm months Blanding's turtles also move among a variety of wetlands searching for food (Ross and Anderson 1990). During very warm periods, the turtles often estivate, becoming inactive for an extended period of time. Dutchess County Blanding's turtles have estivated in saturated muck in wetlands, in a small isolated pool in a stream bed, under shrubs in dry wetlands, and under shrubs, leaves, or dead branches in upland areas (Hudsonia Ltd., unpublished data).

The females are particularly vulnerable to travel-related hazards from late May through early July, when they travel long distances to find suitable nesting sites. In Dutchess County, females have been documented traveling less than 20 m (66 ft) to more than 1500 m (0.9 mi; Hudsonia Ltd., unpublished data). Throughout their range, Blanding's turtles have traveled from 100 m (328 ft) to 2900 m (1.8 mi) to lay their eggs (Linck et al. 1989; Ross and Anderson 1990; Rowe and Moll 1991; Herman et al. 1994; Butler 1997; Kiviat 1997; Joyal et al. 2000; Piepgras and Lang 2000; McNeil 2002; Farrar 2003). They often make use of upland areas, wetlands, or other water bodies to rest after laying their eggs and during their journey from or back to their core wetland. Nesting females rest in dense vegetation, brush piles, or leaf litter on land, intermittent woodland pools, wooded swamps, shallow marshes, deep marshes, ornamental ponds, and open water areas before and after nesting (Eckler and Breisch 1988; Rowe and Moll 1991; Kiviat 1997; Sajwaj et al. 1998; Standing et al. 1999; Congdon et al. 2000; Piepgras and Lang 2000; McNeil 2002; Kiviat et al. 2000).

The females take great care in choosing a nest site, often spending a week or longer in their search. Nest sites are usually in open, well-drained areas such as agricultural fields, lawns, and gravelly road shoulders (Petokas 1986; Kiviat 1997; Linck et al. 1989; Standing et al. 1999; Lang 2001; Blanding's Turtle Recovery Team 2003; Lang 2003). Nests may also be in small pockets of soil on rock outcrops, in ornamental plantings in house yards, in powerline rights-of-way, and in cut-and-fill soils of construction sites. Once she has found an acceptable site, the female spends many hours (3 – 7 or more) digging a hole, laying her clutch of 8 to 16 eggs, and then covering it—all under the shelter of night (Hudsonia Ltd., unpublished data). She then returns to the water. Blanding's turtles do not exhibit parental care for the eggs or the hatchlings.

Many eggs and hatchlings are lost to predators, including skunks, raccoons, foxes, and opossums (Power 1989; Mitchell and Klemens 2000). These animals thrive in suburban areas, adding to the pressures on the young turtles (Mitchell and Klemens 2000). After their first or second year, however, the turtles are larger and develop a hard shell which protects them from most predators. Barring interference from human-related hazards such as habitat loss and encounters with vehicles, most Blanding's turtles that survive to two years live a long, productive life, reaching reproductive maturity at about 15 years and breeding until they die, at about 70 years. The oldest known Blanding's turtle was 80.

Status of the Blanding's Turtle in Dutchess County

During the past 20 years, Blanding's turtle populations have been documented at a dozen locations in the western three-fourths of Dutchess County. There are a few dozen additional locations where single turtles have been found (mostly crossing roads) or where the turtles formerly occurred but have not been confirmed recently. Some of these locations are near potential core habitat and may well support populations. In other cases, potential core habitat exists between known populations. Thus there may be local populations of Blanding's turtle that have not been documented. Local populations tend to occur like beads on a necklace, following the county's gravelly outwash plains along stream corridors. In some areas, there are a few, well-defined "beads" in clearly-identifiable habitat complexes, whereas in other areas (such as a large part of the Town of Hyde Park), there appears to be a very widespread and sparse population occupying numerous small wetlands not all of which are on outwash.

This information may suggest that Dutchess has plenty of Blanding's turtles, and perhaps we should not be so concerned about their future. Most of the documented populations, however, appear to be small, comprising perhaps 5-15 adults. Furthermore, all the known populations, and virtually all (if not all) the

potential habitat we have identified on the maps, are under a high level of threat from land use change, road mortality, and other human-caused problems. Even the populations on a nature reserve and a park are not fully protected, because the turtles range off the protected areas to nest or forage. An examination of the wetlands within a portion of the area we mapped indicated that perhaps half of the core wetland habitat had been destroyed (e.g. filled) historically (E. Kiviat, pers. obs.). And although we know that Dutchess Blanding's turtles lay eggs which produce hatchlings, we do not know how many young turtles recruit to the adult segments of the populations and how effectively adults lost to old age, road mortality, or collecting are replaced.

Current scientific knowledge of turtle population dynamics shows clearly that turtles depend on a very high rate of survival of adults from year to year to maintain a population. Eggs and perhaps hatchlings are relatively "cheap" and populations can sustain high rates of loss from predation on nests, but a small amount of additional adult mortality can cause populations to decline. This unnatural loss of adults can occur when they are hit by cars or other machinery, taken into captivity, or trapped in "pitfalls" such as swimming pools or storm drains. Although improving the survival of eggs and young is important, reducing the loss of adults is even more important to maintaining viable populations.

Legal Protection

The Blanding's turtle is listed as a Threatened species in New York State. A Threatened species is any that meets one of the following criteria: species with 6 to 20 extant sites or 1000-3000 individuals; species restricted to fewer than four USGS 7 ½ minute map quadrangles; or species listed as Threatened by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11 (Regulation 6NYCRR part 193.3; New York State Environmental Conservation Law Section 9-1503). According to New York State

Department of Environmental Conservation Regulation Part 182, no person may, except under permit from the DEC,

> "take, import, transport, possess or sell any endangered or threatened species of fish or wildlife, or any hide or part thereof, or sell or possess with intent to sell any article made in whole or in part from the skin, hide or other part of such species unless such species, hide or part thereof was in the possession of such person on or before the date such species was designated as endangered or threatened by the Secretary of the Interior or the department, and such possession must be evidenced by such legal proof as may be required by the commissioner."

"Take" is defined broadly, and includes harassing, harming, killing, trapping, capturing, and collecting (Percival et al. 1996).

In addition, the New York State Freshwater Wetlands Act (Article 24 of the Environmental Conservation Law) classifies any wetland that is resident habitat for a Threatened or Endangered species as a Class 1 wetland (part 664.5), bringing it under New York State jurisdiction as a regulated wetland whether or not it meets the standard minimum size requirement of 5 ha (12.4 acres). The Freshwater Wetlands Act prohibits filling, draining, clearcutting, construction, and pesticide application in any regulated wetland without a permit.

STUDY AREA

The study area for this project consists of six towns (Beekman, Fishkill, LaGrange, Poughkeepsie, Union Vale, and Wappinger) and two cities (Poughkeepsie and Beacon) in southern Dutchess County (Figure 1).

Throughout most of Dutchess County, the bedrock is covered by glacial till deposits, mineral material that was carried by glaciers and deposited directly as the glaciers advanced or retreated. Till is made up of a mixture of particle sizes, from clay, silt and sand to cobbles and large boulders. There are also areas of

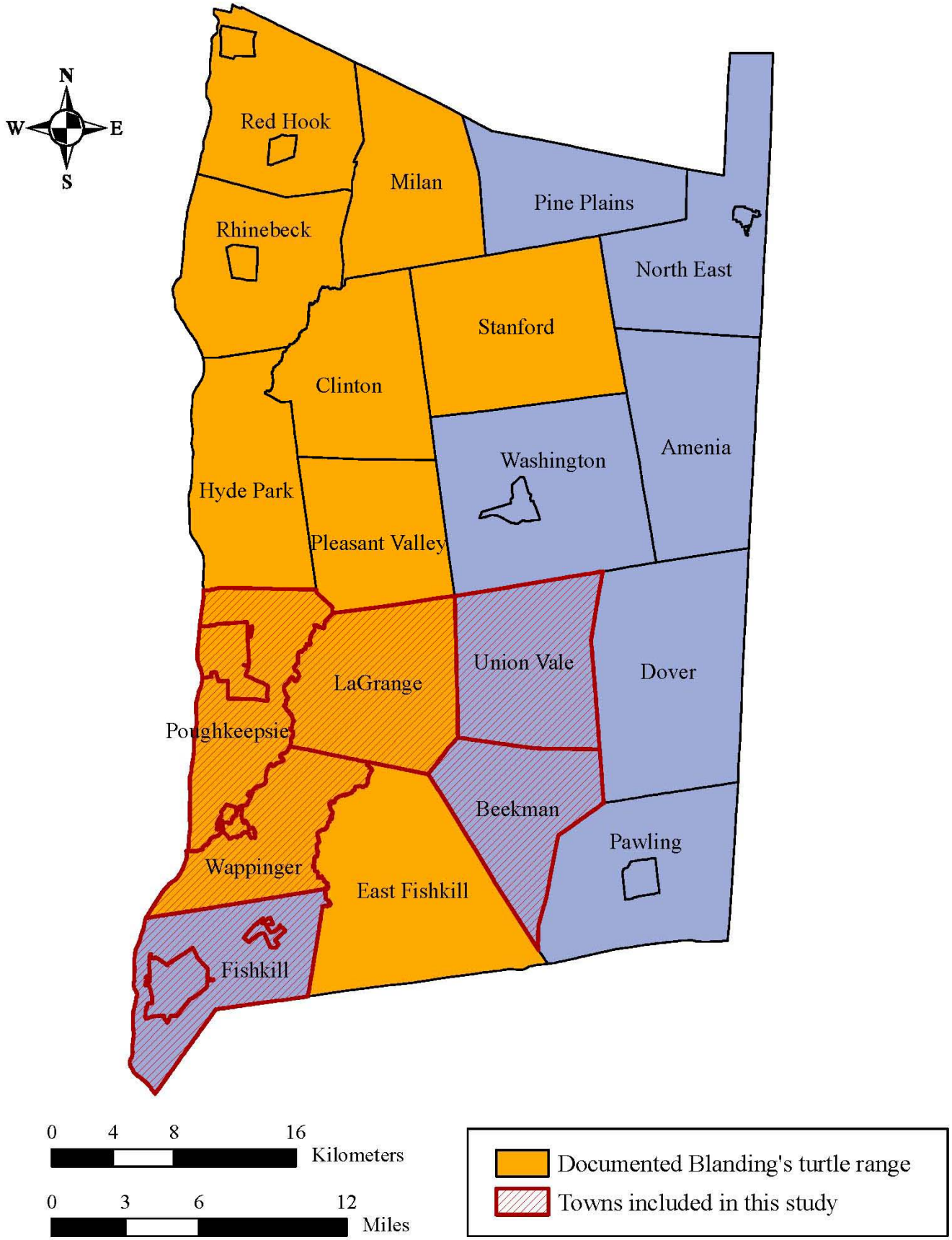


Figure 1. Towns in Dutchess County, NY with documented Blanding's turtle populations, and towns included in our six-town study of potential Blanding's turtle habitats. Hudsonia Ltd., 2009.

glacial outwash—gravelly and sandy material deposited by glacial meltwater streams. Outwash plains contain kettle shrub pools, the typical core habitat of the Blanding's turtle, and soils formed in outwash material provide prime nesting areas for the turtles.

Below we briefly describe the landscape and other characteristics of each town in the study area. Population figures and land areas given below are from the 2000 federal census (obtained from www.dutchessny.gov).

Beekman Much of the Town of Beekman is in rural residential and agricultural uses, but large areas in the eastern and southern parts of town are hilly, forested, and sparsely settled. The town still retains large tracts of undeveloped land. Most residential and commercial development and agricultural land uses occur in the lowlands, which generally parallel the Fishkill Creek through the center of the town in a northeast-southwest trend, and in the low hills in the northwest part of town. The town encompasses 78 km^2 (30 mi^2). In 2000 it had a population of 13,655 (including a correctional institution with a population of 2303) and an overall population density of 175 people per km^2 (455 people per mi^2). Beekman contains 180 km (112 mi) of roads—2.3 km of road per km^2 (1.4 mi/mi^2).

Most of the town is drained by Fishkill Creek, a major tributary of the Hudson River. A small section in the northeast part of town drains into the Tenmile River, a tributary of the Housatonic River, and a small part in the south section drains to the Croton River watershed. Elevations range from 95 m (310 ft) in the farmland south of Sylvan Lake to 407 m (1336 ft) at the southern tip of the town, south of Pepper Hill Rd. The eastern and southern parts of town are hilly, and about half of this area is made up of large land parcels owned by New York State, the National Park Service, and private landowners. The northwestern

section of town is characterized by lowlands and low hills (elevations up to 260 m [850 ft]).

The eastern and southern hills are part of the Hudson Highlands physiographic region and include Depot Hill. Fisher et al. (1970) described the bedrock of the Hudson Highlands as composed of various types of gneiss and the soils are mostly derived from glacial till (Faber 2002). A narrow band of quartzite conglomerate and gneiss with amphibolite and calcsilicate rock separates the granitic gneiss from the floodplain material of the Fishkill Creek valley. The bedrock geology in the valley consists of limestone, dolostone, and shale, which influence the chemistry of the valley soils. Phyllite, schist, and meta-graywacke dominate the hills in the north part of town. Surficial geology in this area is primarily glacial till (Cadwell et al. 1989). Approximately 672 ha (1661 acres) of outwash soils exist along the various streams that drain the town, including Gardner Hollow Brook, Whaley Lake Stream, Fishkill Creek, Frog Hollow Brook, and Whortlekill Creek (calculated from Faber 2002).

Fishkill & Beacon The Town of Fishkill contains the Village of Fishkill and surrounds the City of Beacon. The northern part of town is highly suburbanized, but the southern hills are mostly undeveloped; large tracts are owned by New York State, Scenic Hudson Land Trust, and the Fresh Air Fund (an organization that operates camps for inner-city children). The Town of Fishkill encompasses 69 km^2 (27 mi^2). In 2000 it had a population of 17,521 and a population density of 254 people per km^2 (650 people per mi^2). The Village of Fishkill encompasses 2.3 km^2 (0.9 mi^2) and had a population of 1735. The town and village contain 206 km (128 mi) of roads—3 km per km^2 (1.9 mi/mi^2).

Most of Fishkill is drained by the Fishkill Creek. A few areas along the western border drain directly into the Hudson River. Elevations in Fishkill range from

0 m on the Hudson River shore to 491 m (1610 ft) on South Beacon Mountain. The southern hills are part of the Hudson Highlands, and include South Beacon Mountain, Sugarloaf Mountain, and Beacon Hill. Fishkill's northern half is characterized by less rugged terrain and, in less developed areas, extensive wetlands. The bedrock in Fishkill is composed mostly of graywacke, shale, argillite, and chert, with some limestone and dolostone in the eastern part of town (Fisher et al. 1970), and surficial material is mostly glacial till (Cadwell et al. 1989). Some glacial lake deposits occur in the southwest end of town in the lowlands north of the Hudson Highlands. Soils formed in glacial outwash are scattered along the Fishkill Creek valley and the valleys of its tributaries, including Clove Creek and Bloomer Brook. A pocket of outwash soils also exists in the northwest corner of town. Fishkill contains 716 ha (1770 acres) of outwash-derived soils (calculated from Faber 2002).

The City of Beacon is intensively developed, but contains undeveloped land along most of its perimeter. The Fishkill Correctional facility owns a large area of undeveloped land in the northeast corner, including some working farmland. The City of Beacon encompasses 12.4 km^2 (4.8 mi^2), and in 2000 had a population of 14,810 and a population density of 1194 people per km^2 (3085 people per mi^2).

The City of Beacon drains into the Hudson River directly and through the Fishkill Creek. The southeast section is in the foothills of the Hudson Highlands and the topography is quite steep. The rest of the city is characterized by small hills and lowlands. Bedrock geology is highly variable, and includes graywacke, shale, argillite, chert, and granitic gneiss (Fisher et al. 1970). Surficial materials are derived mostly from glacial till, but there are outwash deposits near the mouth of the Fishkill Creek and in the north part of the city (Cadwell et al. 1989). Outwash-derived soils comprise 275 ha (680 acres) in Beacon (calculated from Faber 2002).

LaGrange The Town of LaGrange is characterized by suburban and rural residential uses, commercial development, and agricultural land uses. It encompasses 103 km^2 (40 mi^2), and in 2000 had a population of 14,928 and a population density of 145 people per km^2 (373 people per mi^2). LaGrange contains 277 km (172 mi) of roads—2.7 km per km^2 (1.7 mi/mi^2). New York State owns 239 ha (590 acres) of relatively undeveloped land (James Baird State Park) in the center of town, and there are several other fairly large parcels of undeveloped land owned by private individuals.

A little over half of the town drains into the Fishkill Creek, almost entirely through Sprout Creek. The western half of the town drains into Wappinger Creek, another major tributary of the Hudson River. LaGrange's topography is much less rugged than that of Beekman and Fishkill; elevations range from 34 m (110 ft) along the Wappinger Creek to 247 m (810 ft) in the hilly northeastern part of the town. LaGrange's bedrock geology is varied. According to Fisher et al. (1970), much of the bedrock is composed of shale, argillite, and siltstone along the Sprout Creek and Fly Sprout (a tributary of Sprout Creek) corridors. The section of town east of the Fishkill Creek is mostly underlain by schist with minor meta-graywacke lenses. Other bedrock in the town includes amphibolite, limestone, conglomerate, and quartzite. Surficial material is mostly composed of glacial till, but there are outwash deposits along Jackson Creek, Sprout Creek, Fly Sprout, and Wappinger Creek and its tributaries (Cadwell et al. 1989). LaGrange contains 1433 ha (3540 acres) of outwash-derived soils (calculated from Faber 2002). Shale outcrops are common throughout the town.

Poughkeepsie The Town of Poughkeepsie is intensively developed, but still retains a few large areas of undeveloped land owned by various entities, including Vassar College, Dutchess Golf Club, IBM, Dutchess County, private landowners, and private development corporations. The Town of Poughkeepsie

encompasses 75 km^2 (29 mi^2), and in 2000 had a population of 41,800 and a population density of 560 people per km^2 (1441 people per mi^2). The town contains part of the Village of Wappingers Falls and partially envelops the City of Poughkeepsie. Wappingers Falls straddles the Towns of Poughkeepsie and Wappinger. The part of the Village of Wappingers Falls that is within the Town of Poughkeepsie encompasses 1 km^2 (0.4 mi^2) and has a population of 977 people. The Town of Poughkeepsie contains 325.5 km (202.3 mi) of roads; 4.4 km per km^2 (7.1 mi/mi^2).

The eastern third of the town drains into the Wappinger Creek. The rest of the town drains directly into the Hudson River through smaller tributaries, including the Fall Kill and Casper Creek. Poughkeepsie's terrain is gently rolling, with elevations ranging from 0 m (along the Hudson River) to 146 m (480 ft) in the northeast part of town. According to Fisher et al. (1970), the bedrock is mostly graywacke and shale in the northwest and southeast parts of town, with shale, argillite, and siltstone running southwest to northeast through the center of town. A prong of limestone, dolostone, and shale extends from just north of Casper Creek up to the southeast end of the City of Poughkeepsie. Surficial material in the Town of Poughkeepsie is mostly glacial till, with outwash deposits occurring along Wappinger Creek, Casper Creek, the Fall Kill, in central Poughkeepsie about 800 m [2624 ft] east of the Hudson River shore, and north of an unnamed Hudson River tributary in the northwest corner of town (Cadwell et al. 1989). In the southern part of town, north of the Wappinger Creek corridor, soils are influenced by underlying limestone (Faber 2002). Poughkeepsie contains 1126 ha (2782 acres) of outwash-derived soils (calculated from Faber 2002).

The City of Poughkeepsie is very intensively developed, although it contains two pockets of undeveloped land in the northeast and southeast corners, owned by the city and Vassar College, respectively. The City of Poughkeepsie

encompasses 13.2 km^2 (5.1 mi^2), and in 2000 had a population of 29,871 and a population density of 2263 people per km^2 (5857 people per mi^2).

The City of Poughkeepsie drains into the Hudson River directly and through the Fallkill and Casper Creeks. Topography is nearly level, except for two small hills in the northeast and southeast corners. Bedrock geology is dominated by graywacke and shale and surficial materials are mostly glacial till (Fisher et al. 1970, Cadwell et al. 1989). Outwash-derived soils occur in the southeast corner of the city and comprise 116 ha (287 acres; calculated from Faber 2002).

Union Vale The Town of Union Vale has a rural character, and is composed of low-density residential areas and farmland concentrated in the valleys and low elevation hills. Union Vale encompasses 97.6 km^2 (37.7 mi^2) and in 2000 had a population of 4546 and a population density of 47 people per km^2 (121 people per mi^2). The town contains 137 km (85 mi) of roads—1.4 km per km^2 (0.9 mi per mi^2).

Most of Union Vale drains into the Fishkill Creek. A small section of the town's eastern side drains into the Tenmile River. Union Vale is quite rugged, with elevations ranging from 122 m (400 ft) along the Sprout Creek in the northwestern part of town to 424 m (1390 ft) at Clove Mountain; approximately half of the town is more than 245 m (800 ft) above sea level. There are extensive wetlands associated with the Clove Valley in the central part of town. Bedrock geology is composed mostly of phyllite, schist, and meta-graywacke, with limestone, dolostone, and shale along the Fishkill and Clove Valley Creek (the same as Clove Brook) corridors (Fisher et al. 1970). Surficial geology in Union Vale is primarily glacial till, with numerous bedrock outcrops (Cadwell et al. 1989). Glacial outwash occurs mostly along the Clove Valley Creek, Sprout Creek, Jackson Creek, and Willow Brook. Clove and Fishkill valley soils contain

limestone from the bedrock (Faber 2002). Union Vale contains 311 ha (678 acres) of outwash soils (calculated from Faber 2002).

Wappinger Much of the Town of Wappinger is intensively developed, but some active farmland remains. The few remaining large forests are mostly owned by development corporations. New York State owns 115 ha (285 acres; Stony Kill Farm) of partially undeveloped land in southern Wappinger. Wappinger encompasses 69 km^2 (27 mi^2), and in 2000 had a population of 26,274 and a population density of 381 people per km^2 (973 people per mi^2). The Town of Wappinger encompasses part of the Village of Wappingers Falls, which straddles the towns of Wappinger and Poughkeepsie. Within Wappinger, Wappingers Falls encompasses 2.1 km^2 (0.8 mi^2) and had a population of 3952. The Town of Wappinger contains 254 km (158 mi) of roads—3.7 km per km^2 (2.3 mi/mi^2).

Approximately one-third of the town drains into the Sprout Creek, a tributary of the Fishkill Creek. Most of the rest of the town drains into Wappinger Creek, except for a small section along the Hudson River that drains directly into the river through a small tributary. Wappinger's topography is gently rolling, ranging from 0 m along the Hudson River to 165 m (540 ft) in the southeast part of town. According to Fisher et al. (1970), most of Wappinger's bedrock is composed of graywacke and shale, particularly the western and northern parts of town. Other bedrock includes schist, amphibolite, phyllite, argillite, and siltstone. Surficial materials are mostly glacial till, but there are outwash deposits along the Sprout Creek and the Wappinger Creek and its tributaries (Cadwell et al. 1989). Soils formed in outwash comprise 550 ha (1359 acres) of the Town of Wappinger (calculated from Faber 2002).

METHODS

Hudsonia employs a combination of laboratory and field methods in the habitat identification and mapping process, including map and aerial photo analysis to predict the occurrence of habitats; field observations to verify, correct, and refine those predictions; and digital preparation of the final habitat map.

Hudsonia biologists have studied Blanding's turtles by means of live-trapping and radiotelemetry for 13 years at the Arlington High School and James Baird State Park in the Town of LaGrange, as well as conducting short-term trapping or telemetry surveys at a number of other sites in the county, and we have analyzed vegetation, soils, and water levels in Blanding's turtle habitats. These studies have given us an understanding of habitat use and habitat requirements that allows us to predict the likelihood of Blanding's turtles occurring in complexes of wetlands where turtle surveys have not been conducted (Hartwig and Kiviat 2007, Kiviat 1993 and 1997, Kiviat and Stevens 2003, Kiviat et al. 2000 and 2004). Blanding's turtles are in some respects rather flexible in their abilities to use habitats, whereas in other ways they have stringent habitat requirements. The conceptualization of the core wetland – associated habitat system captures the habitat affinities of this species in a way that is useful for environmental planning and conservation. Below, we describe each phase in this project.

Gathering Information and Predicting Habitats

Over many years of habitat studies in the Hudson Valley, Hudsonia has found that, with careful analysis of existing maps and aerial photographs, we can accurately predict the occurrence of many habitats. We then use combinations of map features (e.g. soil texture and drainage, topography) and aerial photo signatures to predict the locations and extent of ecologically significant habitats—in this case core and associated Blanding's turtle habitats. In addition to published and unpublished information from our own archives and from

other biologists who have worked in the area, citizen reports of Blanding's turtle sightings, and data provided by the New York Natural Heritage Program, we used the following resources for this project:

- *1:40,000 scale color infrared aerial photograph prints* from the National Aerial Photography Program series taken in the spring of 1994 and 1995, obtained from the U.S. Geological Survey. Viewed in pairs, stereoscopic aerial photograph prints provide a three-dimensional view of the landscape and are extremely useful for identifying vegetation cover types, wetland and upland habitats, streams, and cultural landscape features. For interpretation of aerial photograph prints, we used a Luminos Photo stereoscope, model PS-4a.
- For onscreen mapping, we used *high resolution (1 pixel = 7.5 inches [19 cm]) true color digital orthophotos* taken in spring 2000 and obtained from the Dutchess County Office of Real Property Tax and *panchromatic digital orthophotos (1 pixel = 24 inches [61 cm])* taken in spring 2004, obtained from the NYS GIS Clearinghouse (http://www.nysgis.state.ny.us). These digital aerial photos were used for on-screen digitizing of habitat boundaries.
- *U.S. Geological Survey topographic maps* (Hopewell Junction, Oscawana Lake, Pleasant Valley, Poughkeepsie, Poughquag, Verbank, Wappingers Falls, and West Point 7.5 minute quadrangles). Topographic maps contain information such as elevation, contours, surface water features, and significant cultural features. Elevation contours on topographic maps can be used to predict the occurrence of such habitats as intermittent woodland pools, other wetlands, intermittent streams, and seeps.
- *Soil Survey of Dutchess County, New York* (Faber 2002). Specific attributes of soils, such as depth, drainage, texture, and pH, can tell us a great deal about the types of habitats that are likely to occur in an area. Poorly and very poorly drained soils, for example, often indicate the location of wetland habitats, such as swamps, marshes, and wet meadows. Outwash

soils, such as Hoosic and Knickerbocker soils, can be an indication of Blanding's turtle habitat.

- *GIS data layers.* GIS enables us to overlay multiple data layers on the computer screen, greatly enhancing the efficiency and accuracy with which we can predict a variety of habitats that are closely linked to local topography, geology, hydrology, and soil conditions. GIS also enables us to create detailed, spatially accurate maps. We obtained most of our GIS data layers from the Dutchess County Environmental Management Council (EMC), the Dutchess County/Cornell Cooperative Extension GIS laboratory, and the New York State GIS Clearinghouse (http://www.nysgis.state.ny.us), including coverages for roads, streams, soils, bedrock geology, surficial geology, and wetlands (National Wetlands Inventory data prepared by the U.S. Fish and Wildlife Service). We also obtained 10 ft contour data from the Dutchess Land Conservancy, and tax parcels from the Dutchess County Real Property Tax office. We re-projected all GIS layers into New York State Plane NAD 1983.

Preliminary Habitat Mapping & Field Verification

Hudsonia biologists Tanessa Hartwig and John Sullivan prepared a preliminary habitat map based on analysis of maps, aerial photos, and published data. Our general approach was to first identify potential core habitat; then identify wetlands and nesting areas associated with the core habitats, and finally map these areas. We digitized the predicted habitats onscreen over the 2000 orthophoto images using ArcView 3.2 mapping software (Environmental Systems Research Institute, Inc.). Hartwig, Gretchen Stevens, or Sullivan then visited as many of the mapped core wetlands as possible to verify their presence and extent.

Preliminary mapping At the preliminary mapping stage, we used the following criteria to remotely identify potential core wetland habitat for Blanding's turtles using aerial prints viewed stereoscopically and GIS map layers:

- below 245 m (800 ft) in elevation
- outwash-derived soils (Hoosic or Knickerbocker) within 1 km (0.6 mi)
- shrubby appearance
- open canopy
- moats, pools, or deep water
- tree fringe surrounding wetland
- no significant inlet or outlet
- proximate to other wetlands; part of a complex of wetlands

Because core wetlands can be quite variable, we did not require that a wetland meet all of these criteria to be considered for preliminary mapping. Based on Hudsonia biologists' experience, certain qualities (e.g. shrubby vegetation structure and a moat or pool areas) were given greater consideration than other qualities. For instance, if a wetland near outwash soils appeared to be shrubby and contained a discernible moat, but lacked a tree fringe, we would map it as potential core habitat.

Before going into the field, we contacted many individual property owners for permission to access their land. We identified landowners using tax parcel data obtained from the Dutchess County Real Property Tax office. In addition to conducting field work on private land, we also viewed habitats from public roads, from other public properties, and from adjacent lands.

Field methods We viewed as many mapped habitats as possible in the field to verify their potential as core habitats. We also looked for certain qualities that could not be assessed remotely. Following are characteristics that indicated core Blanding's turtle habitat in the field (Kiviat 1993 and 1997, Hartwig and Kiviat 2007):

- shrubby wetlands, particularly wetlands containing buttonbush
- deep organic sediments
- open canopy or canopy cover less than 50%
- no flowing water; preferably no inlet or outlet with significant flow
- abundant neuston (living or dead material floating on the surface of the wetland), particularly duckweeds (*Lemna minor*) and floating liverworts (*Riccia fluitans* and *Ricciocarpus natans*)
- tree fringe surrounding wetland
- water ≥ 30 cm (11.8 in) deep in spring and early summer
- open water, moats, or moat-like areas

As in the preliminary mapping, we used these characteristics as guidelines, rather than requirements for individual wetlands. Therefore, a wetland that was dominated by purple loosestrife—a plant that is intermediate between an herb and a shrub—but had most of the other characteristics would still be mapped as potential core habitat. We also used our knowledge of Blanding's turtle occurrence in Dutchess County wetlands to determine potential core habitats, depending partially on a wetland's overall structure.

Due to access limitations (e.g. unwilling landowners), not all core habitats were field checked. Ultimately we visited 144 of the 173 potential core habitat units that we mapped. We expect that areas of the habitat map that were field checked are generally more accurate than areas we did not visit in the field. However, as we viewed more wetlands in the field, we were able to extrapolate our findings to determine the potential of wetlands we were unable to gain access to.

Mapping Once a potential core habitat was verified in the field, Hartwig and Sullivan digitized the information in ArcView 3.2 and ArcMap 9.2 software (Environmental Systems Research Institute, Inc.). We then identified and mapped all wetlands within a 1 km (0.6 mi) radius from the perimeter of each core wetland; these are the "associated" wetlands that may be used by the turtles

in spring, summer, and fall. Inasmuch as we were unable to field check many of the associated wetlands, we have not assessed the probability that Blanding's use a particular wetland. Some of these wetlands are highly suitable for Blanding's turtle use and others may be unsuitable. In certain towns, we found wetland types that are rare in the region, and marked these on the large-format wall maps. In addition, we identified and mapped areas of open fields or disturbed lands larger than 25 m (82 ft) wide as potential nesting habitat for the turtles. It is important to understand, however, that Blanding's turtles have been known to nest in any disturbed area within 2.9 km (1.8 mi) of their habitat complex. This includes gardens, dirt piles, and yards. We only mapped those areas with greater potential for conservation, so that agencies and landowners can direct their conservation efforts and resources accordingly.

We delimited 200 m (660 ft), 1000 m (3300 ft) and 2000 m (6600 ft) radius zones around the perimeter of each core habitat to illustrate the Blanding's turtle Priority Zone, Conservation Zone, and Area of Concern, respectively (Figure 2). These zones are based on Hudsonia's experience with Blanding's turtles in Dutchess County and on a review of Blanding's turtle habitat use in other areas (Kiviat 1993; Kiviat 1997; Hartwig 2004; also see natural history section of this report). Each zone represents an area that Blanding's turtles use in different ways, and with variable frequency, and requires attention from the perspective of Blanding's turtle conservation. Blanding's turtle zones were delimited on a coarse scale. Therefore, the conservation zones may include areas not likely to support Blanding's turtles, such as areas with pavement or buildings, elevations greater than 245 m (800 ft), and intensively developed areas. However, it should be noted that Blanding's turtles may also occasionally be found traveling in these areas. Width of zones begins at the wetland boundary of the core wetland(s), not in the center of the wetland.

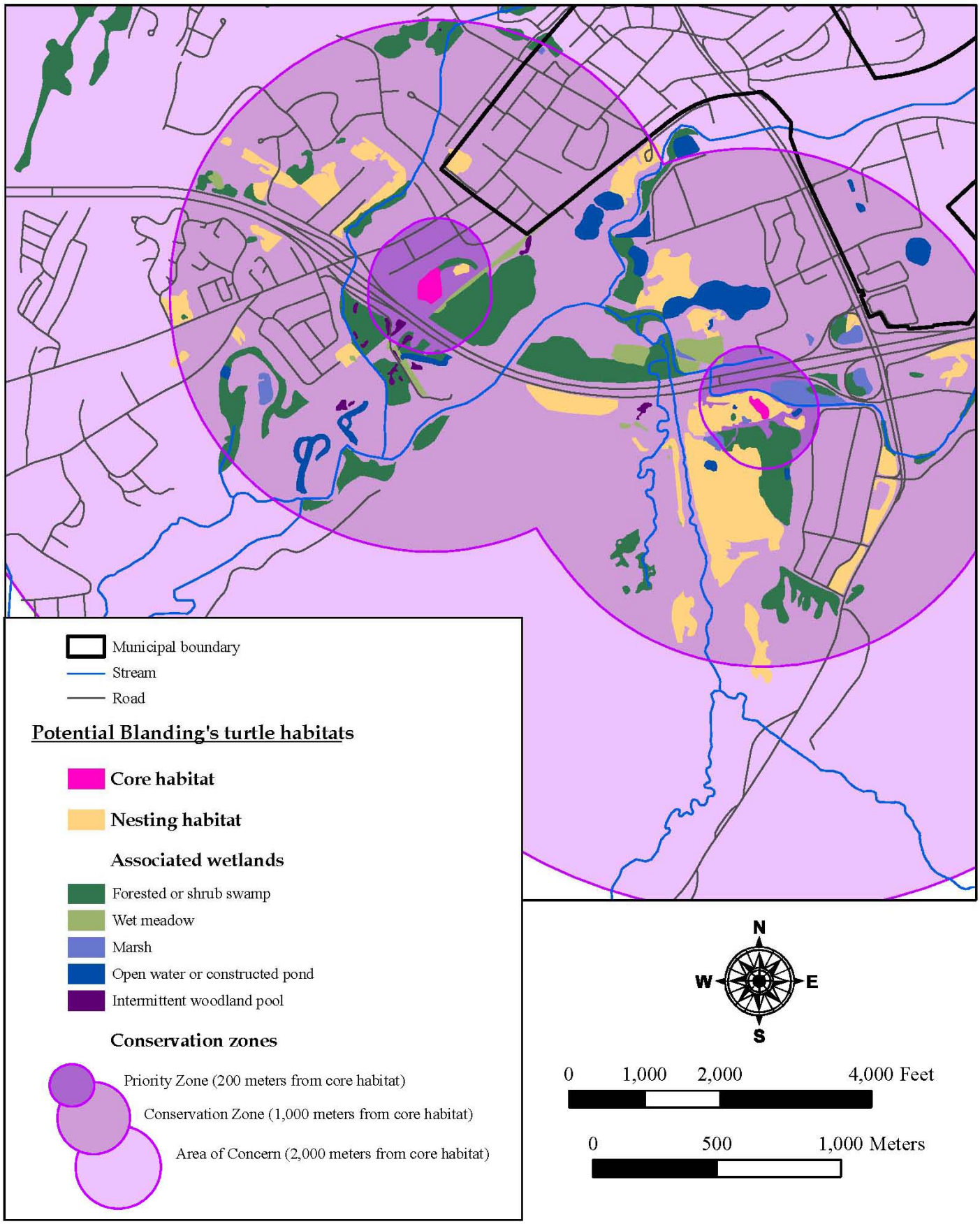


Figure 2. Sample area of Blanding's turtle habitat map, depicting potential core wetlands, nesting habitat, and associated wetlands, as well as zones important for Blanding's turtle conservation. Hudsonia Ltd., 2009.

Below is a description of each zone:

- The 200 m **Priority Zone** is the area immediately surrounding the core wetland. This upland area is often used by the turtles to bask or to escape cool or warm waters; the turtles may stay here for a week or longer at a time (Hartwig 2004) during the warmer months of the year (April through October). Nesting areas may also occur in this zone.

- The 1000 m **Conservation Zone** is the area that encompasses the wetlands that the turtles use regularly on a seasonal basis, most of the nesting areas, and most of the travel corridors. One can expect turtles regularly in this zone throughout the active season (April through October).

- The 2000 m **Area of Concern** encompasses the Priority Zone and the Conservation Zone, and also includes the landscape within which the Blanding's turtle travels to explore new wetlands, and sometimes to nest. One can expect a few turtles from a particular core wetland in this zone each year.

RESULTS

Within the study area, we identified 173 core wetlands and 3926 associated wetlands. The "**Blanding's Turtle Zone**," which includes the entire contiguous area encompassed by all of the Areas of Concern, extends from the northern and eastern portion of Poughkeepsie through LaGrange to the western quarter of Union Vale, south to northwest Beekman, through Wappinger and the north half of Fishkill, and then west to the Hudson River (Figure 3). Most of LaGrange and Wappinger are within this region of potential Blanding's turtle occurrence.

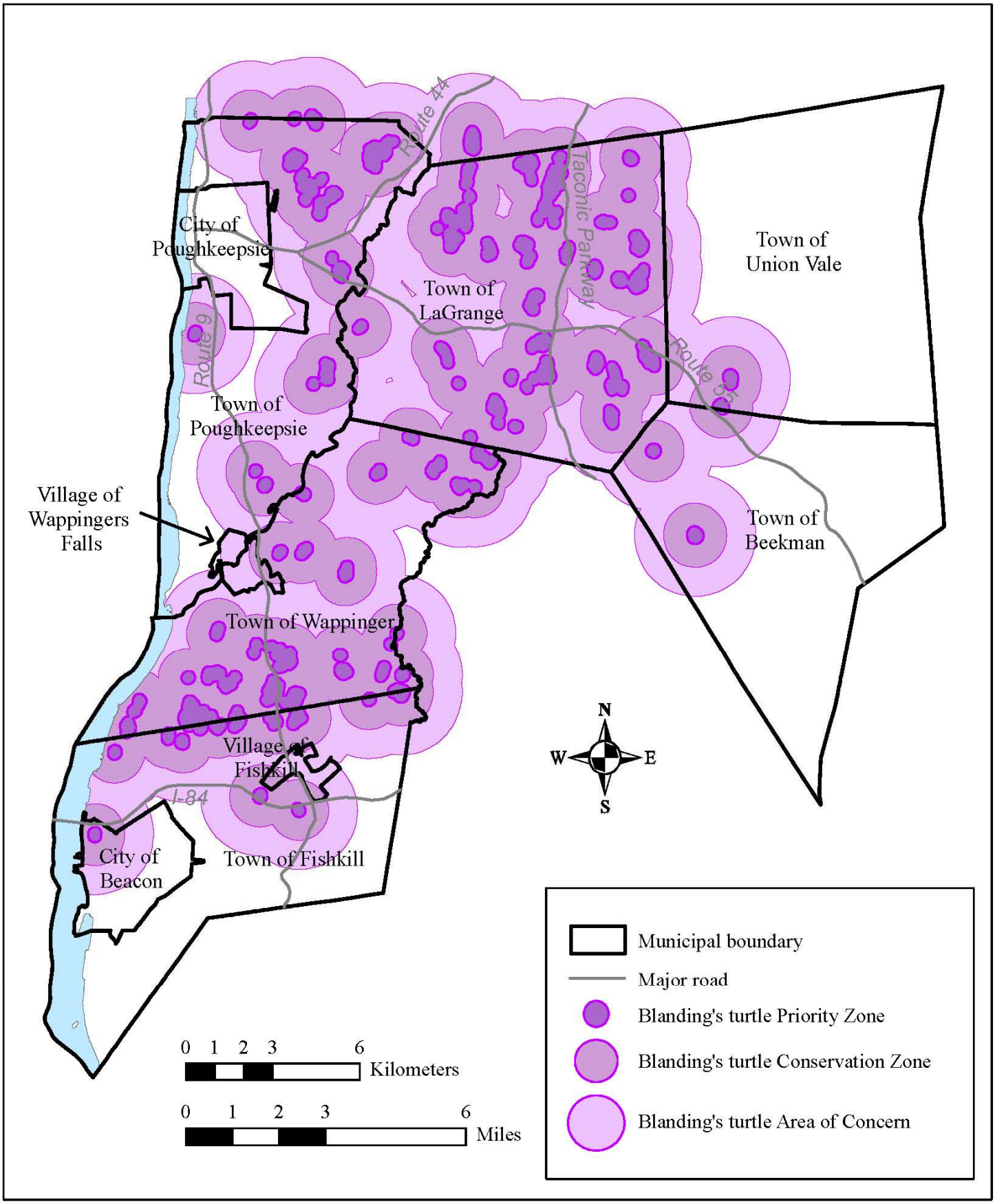


Figure 3. Blanding's turtle Priority Zones (within 200 meters of core habitat), Conservation Zones (within 1,000 m of core habitat), and Areas of Concern (within 2,000 m of core habitat) in six towns in southern Dutchess County, NY. Hudsonia Ltd., 2009.

Common associated wetlands were: constructed ponds, hardwood & shrub swamps (deciduous forested and shrub swamps), intermittent woodland pools (small ephemeral pools in forested settings, well-known to support large numbers of amphibians and other wildlife), marshes (inundated wetlands dominated by herbaceous vegetation), open water areas (naturally formed ponds, lakes, and large pools lacking emergent vegetation), and wet meadows (wetlands dominated by herbaceous vegetation and lacking standing water most of the growing season). Although wet meadows can be important for other fauna and flora, they are not often used by adult Blanding's turtles; we do not know if they are habitat for juvenile Blanding's turtles. Whether or not they are used by the turtles now, these wetlands may become suitable habitat in the future. All associated wetlands, and core wetlands, need to be assessed on a site-specific basis for their potential importance to Blanding's turtles. See Kiviat and Stevens (2001), Stevens and Broadbent (2002), and Tabak and Stevens (2008) for detailed descriptions of wetland habitats in the region. Below is a summary of our findings for each town.

Beekman The northwestern section of the Town of Beekman, characterized by lowlands and low hills (elevations up to 262 m [860 ft]), contains a few potential Blanding's turtle habitat complexes (Figure 4). We identified two potential core wetlands, one just east of Sylvan Lake and one in the northwest corner of town, just north of Whortlekill Creek and south of Clapp Hill Road. In addition, a Blanding's turtle Conservation Zone associated with core habitat in Union Vale overlaps the northwest corner of Beekman. Within the town, we mapped 130 associated wetlands near the core habitats in Beekman, including 31 constructed ponds (several of which are rather large and may serve as good drought refuges), 5 open water habitats, 11 intermittent woodland pools, 4 marshes, and 22 wet meadows. Hardwood & shrub swamps were the most

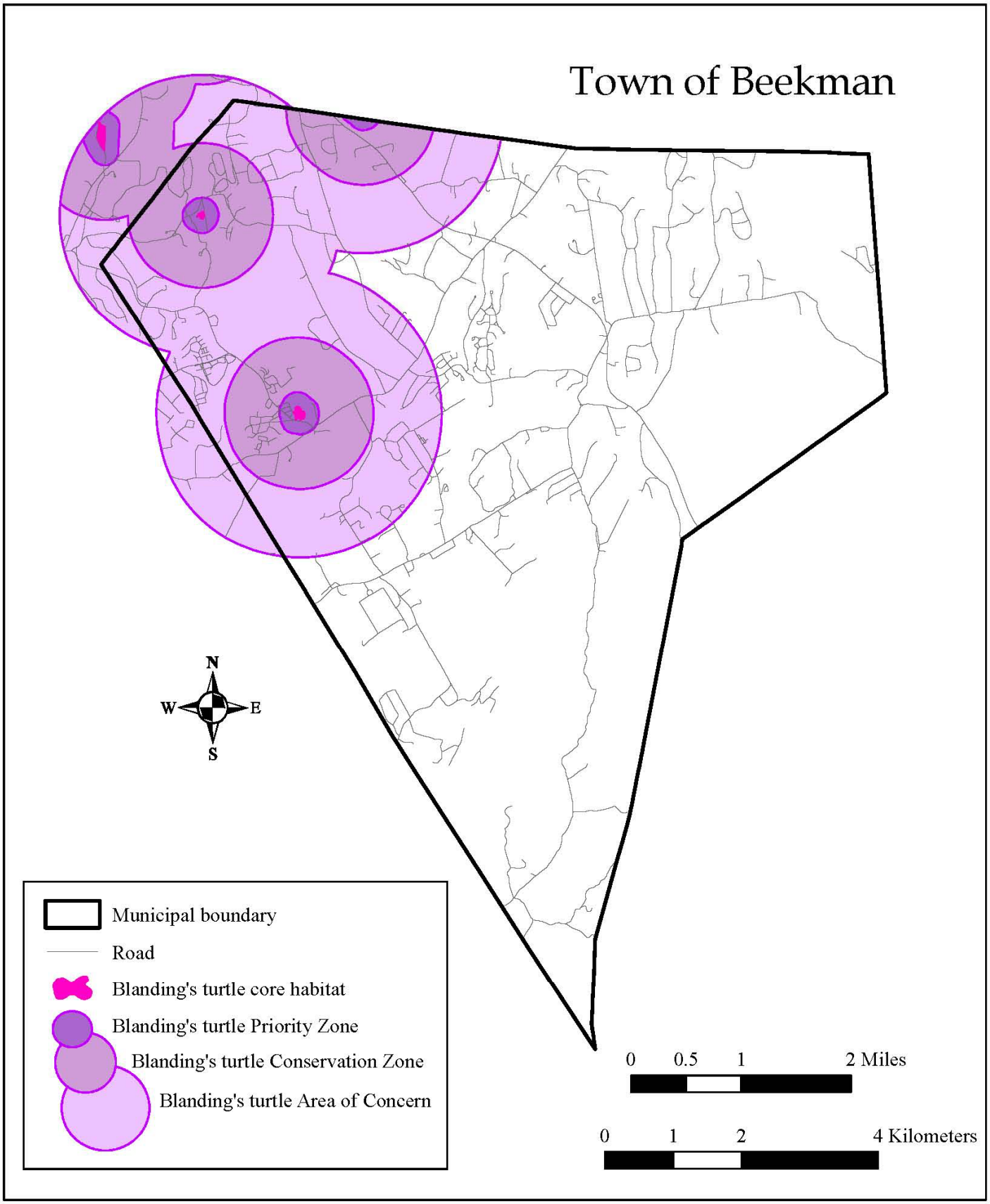


Figure 4. Blanding's turtle potential core habitat, Priority Zones (within 200 meters of core habitat), Conservation Zones (within 1,000 m of core habitat), and Areas of Concern (within 2,000 m of core habitat) in the Town of Beekman, Dutchess County, NY. Hudsonia Ltd., 2009.

common wetland or water body; we mapped 57 swamps in the Conservation Zones.

Land uses within the Conservation Zones include medium-density residential development, agricultural fields, orchards, and forested areas. There are a few areas of high-density residential development, particularly around Sylvan Lake. NYS Rt 55, a heavy-duty highway, intersects one of the Conservation Zones. In addition, there are several medium-duty roads within the Conservation Zones: Beekman Rd, Clapp Hill Rd, Green Haven Rd, and Sylvan Lake Rd. Clapp Hill Rd and Sylvan Lake Rd pass within 20 m (66 ft) of potential core wetlands. We found no potential Blanding's turtle habitat in the eastern and southern parts of town, which are characterized by high hills.

Fishkill & Beacon Most of Fishkill's potential Blanding's turtle habitat is concentrated along the northern border (Figure 5), where wetlands are more numerous and the terrain less rugged than in the south. There are also two potential core wetlands in the lowlands south of the Village of Fishkill—just north and south of Interstate Rt 84—and one potential habitat complex in central Fishkill about 500 m (1640 ft) from the Hudson River—just south of I-84. We identified 16 core wetlands and 304 associated wetlands in Fishkill; the latter comprised 1 calcareous (calcium-rich) wet meadow, 54 constructed ponds, 10 open water areas, 145 hardwood & shrub swamps, 1 conifer swamp, 29 intermittent woodland pools, 22 marshes, 36 wet meadows, 2 tidal marshes, and 4 tidal swamps. To date there are no reports of Blanding's turtles using tidal wetlands, but they have been reported in riparian habitats.

Land uses within the Conservation Zones include: intensive and moderate residential and commercial development, golf courses, agricultural fields, and forested land. Within the Conservation Zones, 300 ha (742 acres) are owned by the Scenic Hudson Land Trust and by the New York State DEC. Several heavy-

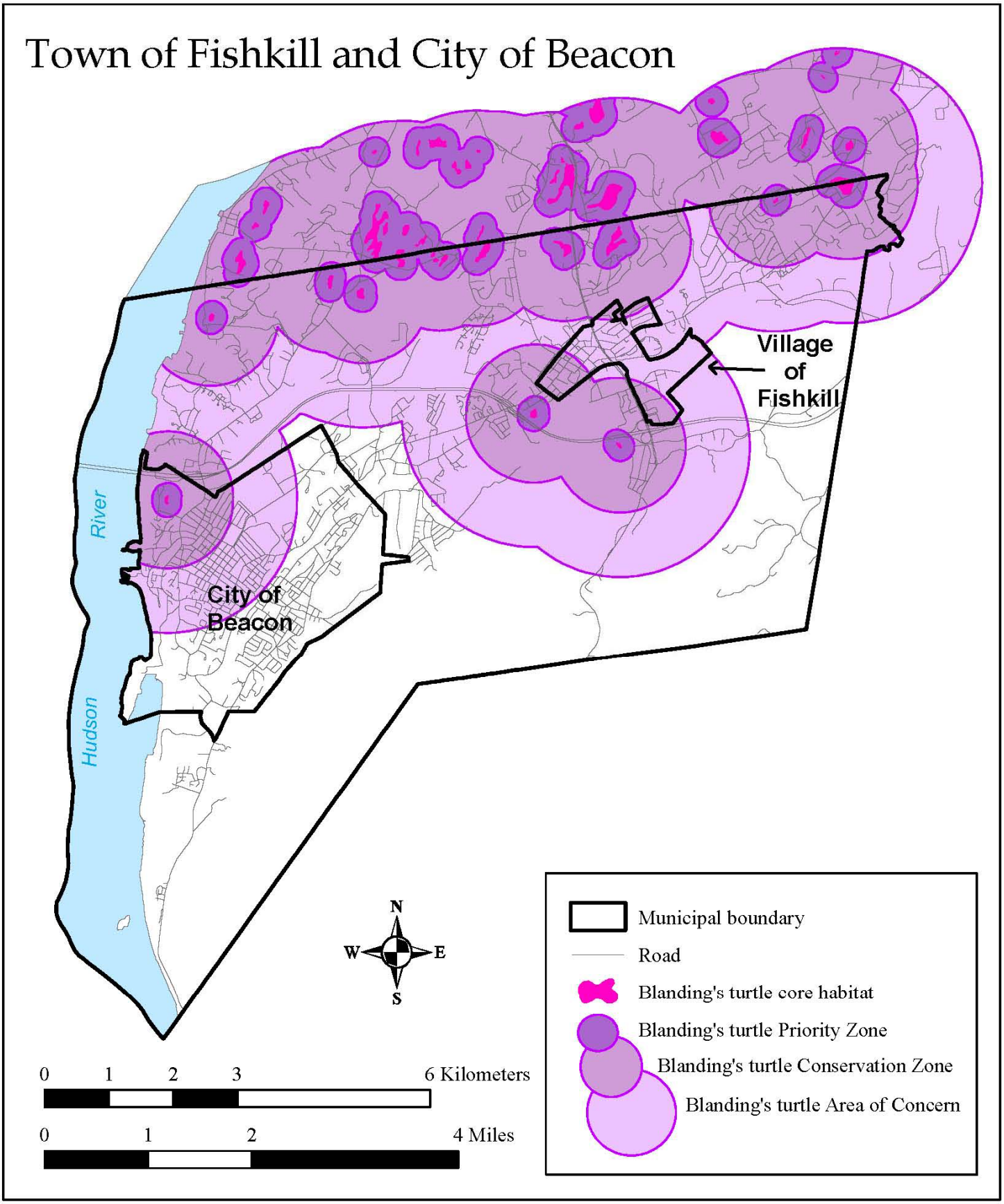


Figure 5. Blanding's turtle potential core habitat, Priority Zones (within 200 meters of core habitat), Conservation Zones (within 1,000 m of core habitat), and Areas of Concern (within 2,000 m of core habitat) in the Town of Fishkill and City of Beacon, Dutchess County, NY. Hudsonia Ltd., 2009.

duty roads pass through the Conservation Zones, including NYS Rts 9, 9D, 52, and 82, and I-84. Medium-duty roads include Baxtertown Rd and Osborne Hill Rd. Several Conservation Zones contain high-density developed areas, including portions of the City of Beacon and the Village of Fishkill, and hence many roads. In fact, one potential core habitat is almost completely surrounded, up to its shoreline, by residential housing. Baxtertown Rd, NYS 9, NYS 9D, and I-84 all pass within 50 m (164 ft) of potential core habitats. No potential Blanding's turtle habitat was found in the southern part of the town.

The City of Beacon contained one potential Blanding's turtle core wetland in its northwest part (Figure 5). We mapped 8 associated wetlands in Beacon, including 1 constructed pond, 1 hardwood & shrub swamp, 2 tidal marshes, and 4 tidal swamps. Land uses within the Conservation Zone include high-density residential areas, forested land, and a golf course. Heavy-duty roads include I-84 and NYS 9D. Many light-duty residential roads are within the Conservation Zone.

LaGrange We found potential Blanding's turtle habitat throughout the Town of LaGrange (Figure 6). We mapped 69 potential and known core habitats and 1560 associated wetlands, which included 9 calcareous wet meadows, 3 conifer swamps, 298 constructed ponds, 39 open water habitats, 755 hardwood & shrub swamps, 2 mixed forest swamps (forested wetland containing a mix of deciduous and conifer species), 117 intermittent woodland pools, 70 marshes, and 264 wet meadows. We also mapped 3 kettle shrub pools which, in these particular cases, we consider associated habitat but not core habitat. We made this decision based on ongoing long-term studies at Hudsonia; it takes many years of study to confirm that turtles aren't using a kettle shrub pool as core habitat. Kettle shrub pools are, however, rare in the region, and often support

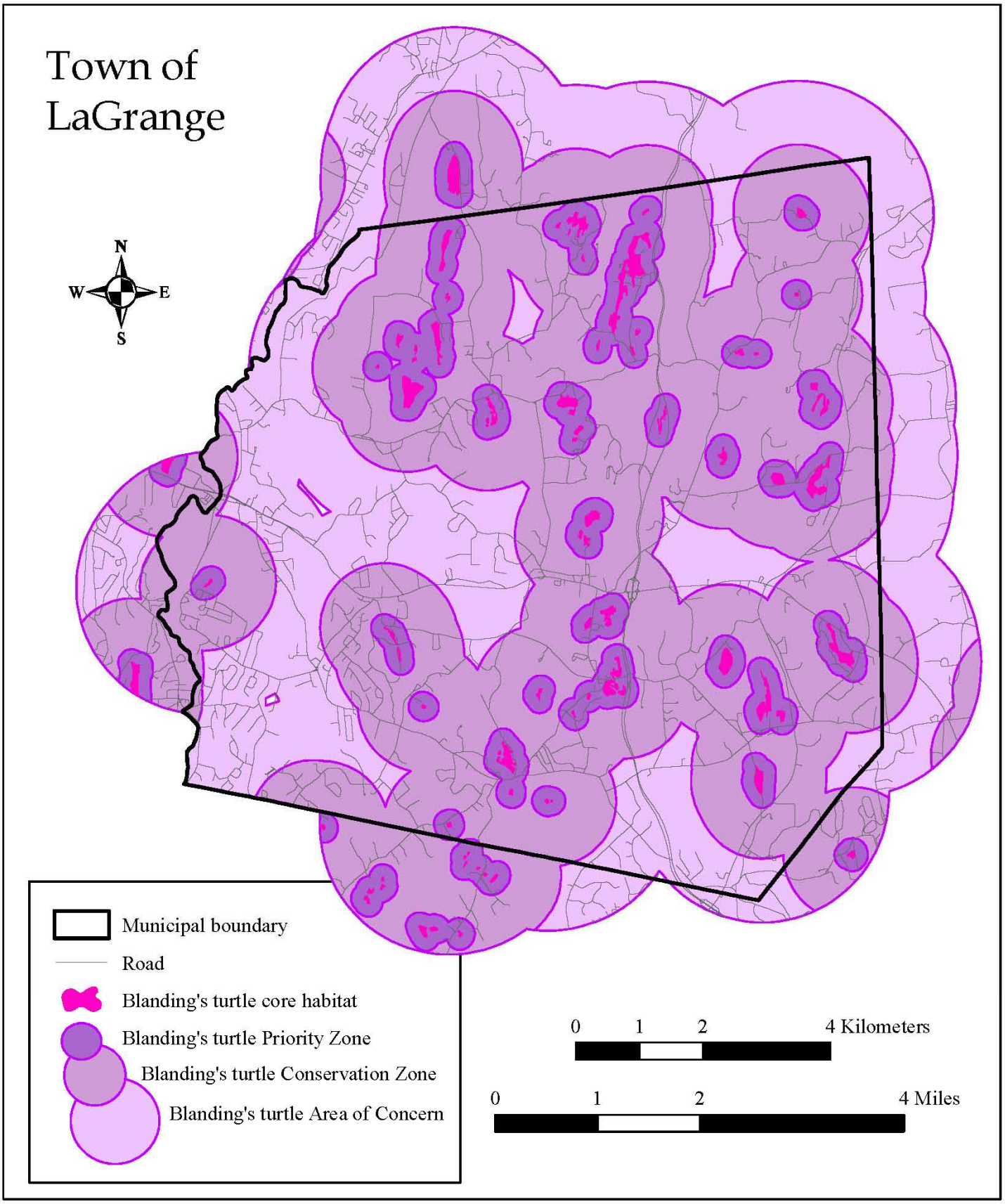


Figure 6. Blanding's turtle potential core habitat, Priority Zones (within 200 meters of core habitat), Conservation Zones (within 1,000 m of core habitat), and Areas of Concern (within 2,000 m of core habitat) in the Town of LaGrange, Dutchess County, NY. Hudsonia Ltd., 2009.

other rare species (Kiviat and Stevens 2001). Therefore, they still deserve special attention when planning for development and conservation.

Land uses within the Conservation Zones include: agricultural fields, medium-density residential and commercial development, forested land, athletic fields, orchards, a golf course, and soil mines. Most of the core wetlands in LaGrange have roads within their 200 m (660 ft) Priority Zone—many of these roads pass within 120 m (394 ft) and in several cases within 50 m (164 ft) of core wetlands. Medium-duty roads that bisect Conservation Zones include Arthursburg Rd, Emans Rd, Freedom Plains or Freedom Rd, Noxon Rd, Overlook Rd, Pleasant Valley Rd, Stringham Rd, and Titusville Rd. In addition, many light-duty or residential roads are within Conservation Zones.

It is evident from Figure 6 that most of the town is within the Blanding's Turtle Zone, so it may seem that the protection of Blanding's turtles while allowing for new development in the town is impractical. We are not recommending, however, that the Blanding's Turtle Zone be completely protected, but rather that, to varying degrees—depending on which zone is under consideration—Blanding's turtles be considered in the planning process. See the recommendations below (starting with "Landscape Recommendations") for ideas on bringing Blanding's turtle conservation into land use planning and decision-making.

Poughkeepsie Most of Poughkeepsie's potential habitat complexes are in the north section of town, where large undeveloped land areas remain (Figure 7). There are also a few complexes in the southeast and central parts of town. In all, we mapped 26 potential and known core habitats and 671 associated wetlands in Poughkeepsie. Associated wetlands included 85 constructed ponds, 26 open water areas, 270 hardwood & shrub swamps, 3 buttonbush pools, 31 intermittent

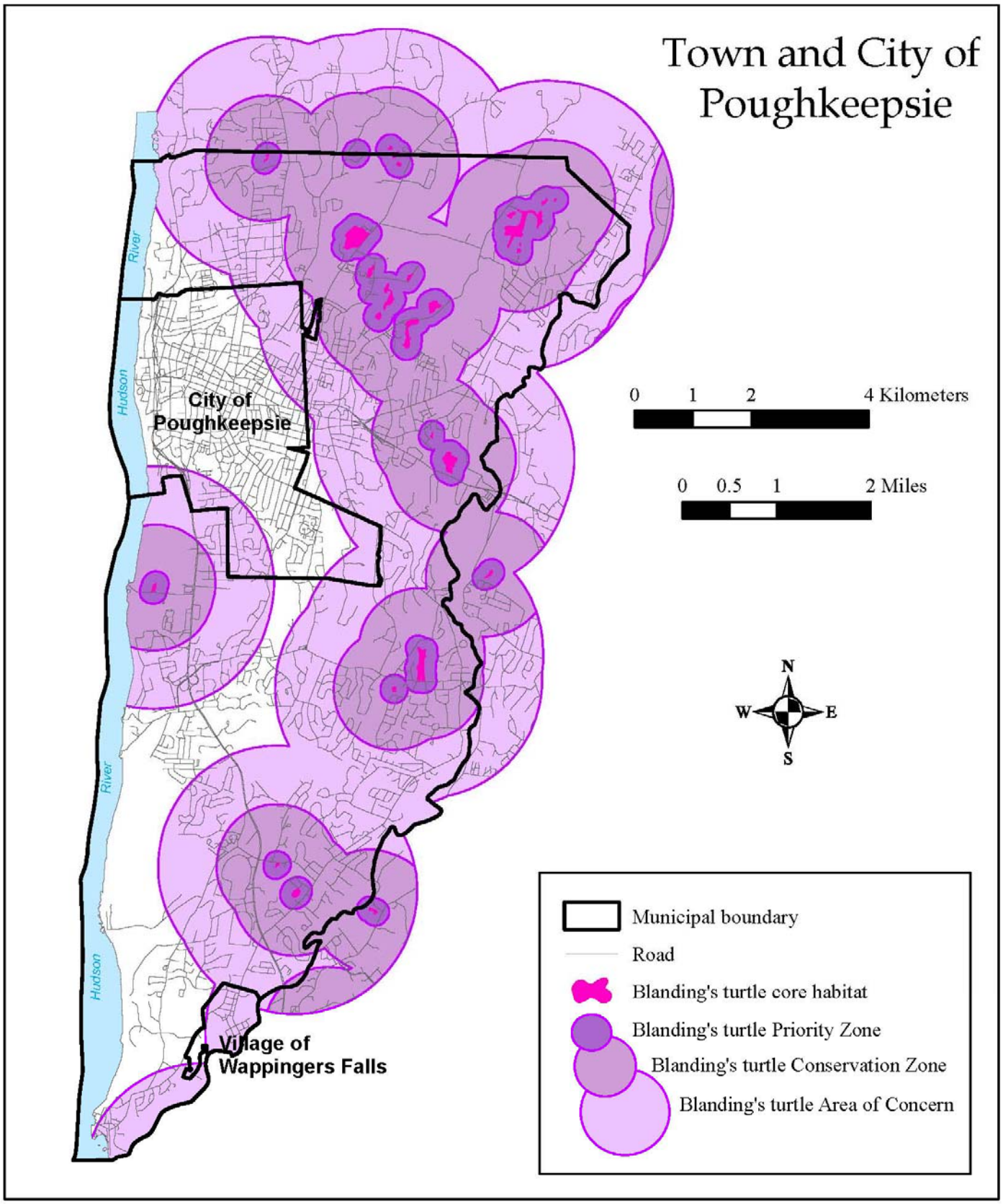


Figure 7. Blanding's turtle potential core habitat, Priority Zones (within 200 meters of core habitat), Conservation Zones (within 1,000 m of core habitat), and Areas of Concern (within 2,000 m of core habitat) in the Town and City of Poughkeepsie, Dutchess County, NY. Hudsonia Ltd., 2009.

woodland pools, 46 marshes, 198 wet meadows, 11 calcareous wet meadows, and 1 tidal marsh. Blanding's turtles have not been reported using tidal wetlands, but have been reported in riparian habitats. Buttonbush pools are shrub swamps dominated by buttonbush but not situated in the vicinity of glacial outwash soils, which differentiates them from kettle shrub pools dominated by buttonbush. Buttonbush pools are uncommon in the region and have not been studied much, but we believe they may have unique biodiversity values. We have identified most buttonbush pools as potential core habitat for Blanding's turtles, but even those not identified as such may deserve special attention during planning for development and conservation.

Land uses within the Blanding's Turtle Zone include agricultural fields in the north part of town, medium- to high-density residential and commercial areas, a capped landfill, and athletic fields. All of the core wetlands in Poughkeepsie contain roads within their 200 m (660 ft) Priority Zone. Heavy duty roads that pass through the 1000 m (3300 ft) Conservation Zones include NYS Rts 9, 9D, 9G, 44, 55, and 376. NYS 55 passes within 20 m (66 ft) of a core wetland. Medium-duty roads that pass through Conservation Zones include Bedell Rd, Boardman Rd, Bower Rd, Cedar Valley Rd, Channingville Rd, Cottage Rd, Creek Rd, Jackson Rd, Old Post Rd, Overocker Rd, Peach Rd, Salt Point Turnpike, Spackenkill Rd, Spring Rd, Underhill Rd, and Van Wagner Rd. Old Post Rd, Salt Point Turnpike, Spackenkill Rd, Underhill Rd, and Van Wagner Rd are all within 30 m (98 ft) of core wetlands. In addition, many light-duty roads are within the 1000 m (3300 ft) Conservation Zone.

The City of Poughkeepsie contains no potential Blanding's turtle core wetlands and is within the Conservation Zone of no core wetlands (Figure 7). It is, however, within the Area of Concern of at least 4 core wetlands in the adjacent town. Land uses within the Areas of Concern include high-density residential and commercial, a golf course, fields, and forested land.

Union Vale Union Vale contains two potential core wetlands in the southwest section of town, both in the headwaters of a tributary to Jackson Creek (Figure 8). In addition, several Blanding's turtle Conservation Zones and Areas of Concern in LaGrange extend beyond its eastern border into Union Vale. There are extensive wetlands associated with the Clove Valley in the central part of town, but none were deemed potential Blanding's turtle habitat. We also found no core wetlands in the northern and eastern parts of town, which are quite rugged. We mapped 84 associated wetlands in Union Vale, including 22 constructed ponds, 1 open water habitat, 35 hardwood & shrub swamps, 5 intermittent woodland pools, 3 marshes, and 18 wet meadows.

Land uses within the Conservation Zones include light residential, forested land, agricultural fields, orchards, and an airport runway. NYS 55, a heavy-duty road, passes through two Conservation Zones. Several medium-duty roads pass through Conservation Zones, including Clapp Hill Rd and Noxon Rd. Noxon Rd is within 25 m (82 ft) of a core wetland.

Wappinger Potential Blanding's turtle habitat is found throughout the Town of Wappinger, with core habitats concentrated in the northeast and southwest sections (Figure 9). We mapped 59 potential and known core wetlands and 921 associated wetlands in the Town of Wappinger. Associated wetlands included 1 circumneutral bog, 128 constructed ponds, 22 open water habitats, 560 hardwood & shrub swamps, 1 mixed forest swamp, 63 intermittent woodland pools, 24 marshes, 120 wet meadows, 1 tidal marsh, and 1 tidal swamp. Blanding's turtles have not been reported using tidal wetlands, but have been reported in riparian habitats.

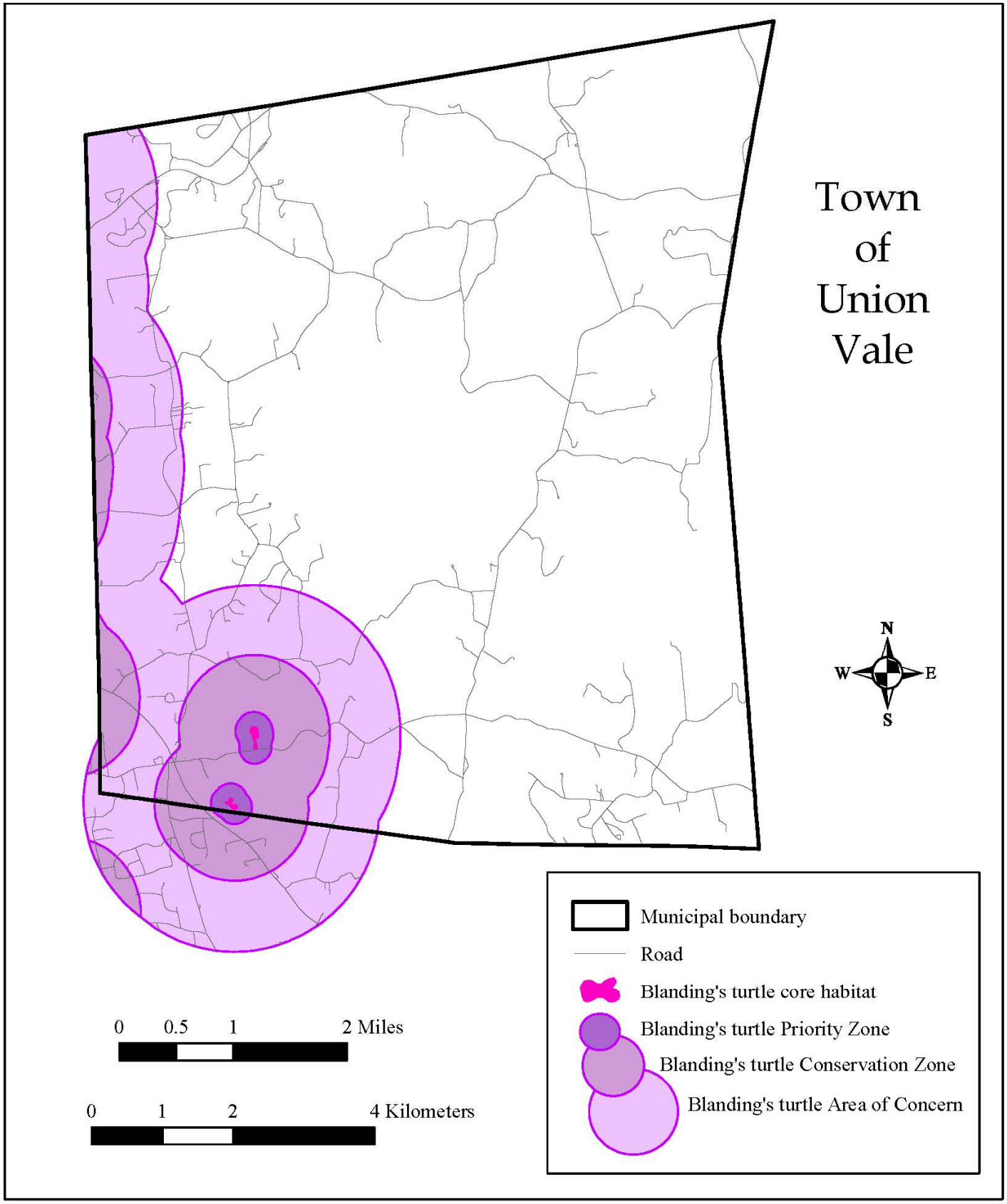


Figure 8. Blanding's turtle potential core habitat, Priority Zones (within 200 meters of core habitat), Conservation Zones (within 1,000 m of core habitat), and Areas of Concern (within 2,000 m of core habitat) in the Town of Union Vale, Dutchess County, NY. Hudsonia Ltd., 2009.

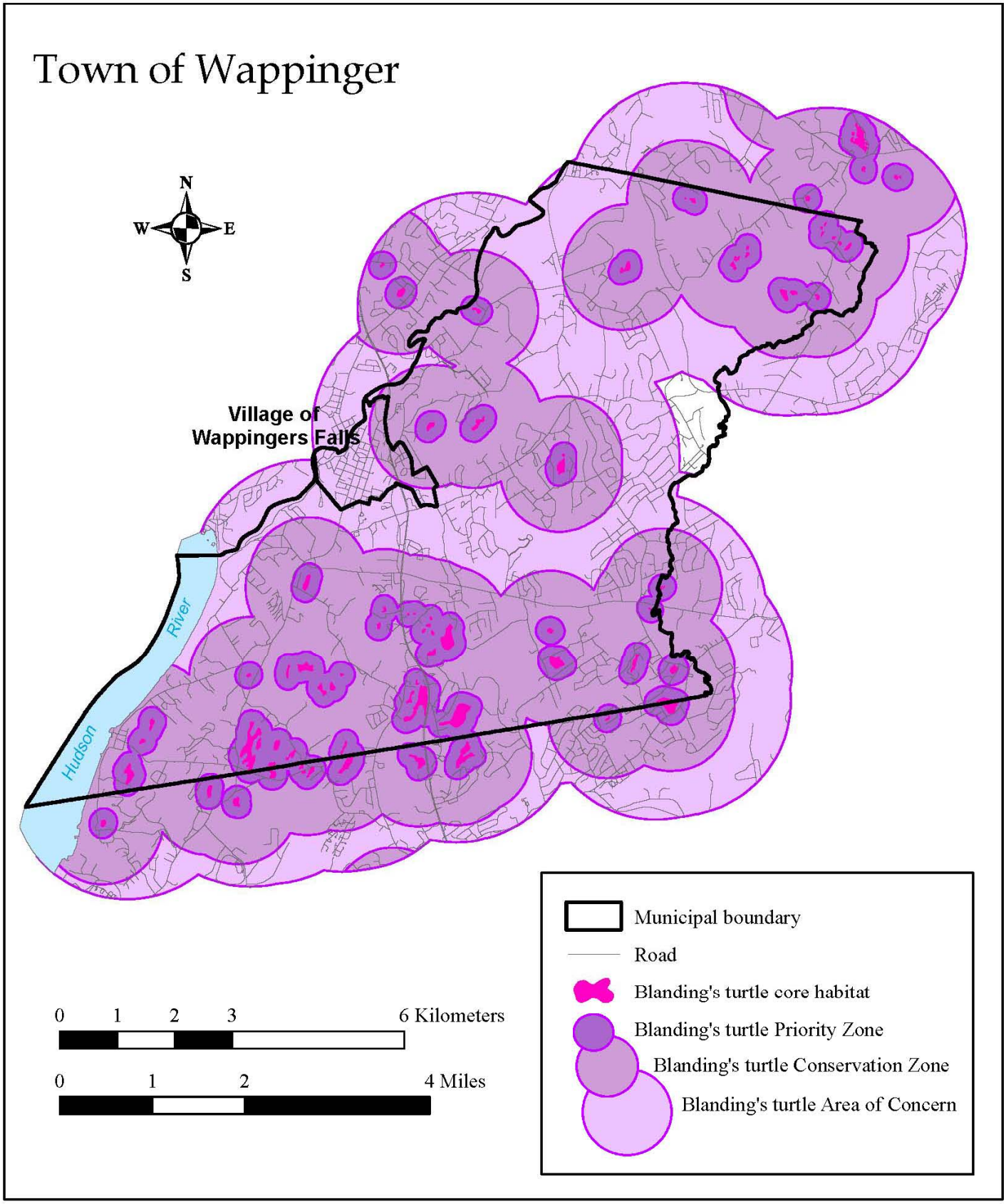


Figure 9. Blanding's turtle potential core habitat, Priority Zones (within 200 meters of core habitat), Conservation Zones (within 1,000 m of core habitat), and Areas of Concern (within 2,000 m of core habitat) in the Town of Wappinger, Dutchess County, NY. Hudsonia Ltd., 2009.

Circumneutral bogs are wetlands that support vegetation of both acidic bogs and calcareous wetlands. They often contain a mosaic of shrubby and herbaceous vegetation, and usually have floating peat mats. Circumneutral bogs are similar to the circumneutral bog lakes described in Kiviat and Stevens (2001), but have less open water. These wetlands are very rare in the region, and usually support rare plants and animals. The circumneutral bog in Wappinger should be given special conservation attention during environmental reviews of activities in nearby areas.

Land uses within the Conservation Zones include medium- to high-density residential and commercial development, athletic fields, agricultural fields, forested land, an airport, and orchard. Heavy-duty roads include NYS 9, 9D, 82, and 376. NYS 9 and NYS 9D pass within 75 m (246 ft) of core wetlands. Medium-duty roads include All Angels Rd, Chelsea Rd, Diddell Rd, Hopewell Rd, Kent Rd, Ketchamtown Rd, Myers Corners Rd, New Hackensack Rd, New Hamburg Rd, Old State Rd, Osborne Hill Rd, Robinson Lane, Rives Rd, Wheeler Hill Rd, and Widmer Rd. All Angels Hill Rd, Chelsea Rd, Ketchamtown Rd, New Hackensack Rd, Old State Rd, Osborne Hill Rd, and Robinson Lane all pass within the 200 m (660 ft) Priority Zone of core wetlands—often within 50 m (164 ft). In addition, many light-duty roads are within the 1000 m (3300 ft) Conservation Zone.

As in LaGrange, it appears from Figure 9 that most of the town is within the Blanding's Turtle Zone, so it may seem that the protection of Blanding's turtles while allowing for new development in the town is impractical. We are not recommending, however, that the Blanding's Turtle Zone be completely protected, but rather that, to varying degrees—depending on which zone is under consideration—Blanding's turtles be considered in the planning process. See the recommendations below (starting with "Landscape Recommendations")

for ideas on bringing Blanding's turtle conservation into land use planning and decision-making.

DISCUSSION AND RECOMMENDATIONS

Ecological and Cultural Significance of Blanding's Turtles

The decline or disappearance of a rare native species, particularly one that uses a variety of wetland and upland habitats, can indicate collapses in other parts of the local ecosystem which supports not only many other species of plants and animals but humans as well. Intact ecosystems make the earth habitable by providing such basic services as climate moderation, oxygen production, soil formation, nutrient transformation, and production and decomposition of organic matter. Protecting native biodiversity is a means to the larger end of preserving the integrity and resilience of ecosystems. Although we cannot predict the effects of losing any particular species, we know that each organism, including inconspicuous organisms such as fungi, insects, mice, and turtles, plays a unique role in the maintenance of biological communities.

Blanding's turtles are rare throughout their range, and occur only in isolated populations in the Northeast. Isolated populations and their habitats are important to a species' viability, providing genetic diversity and potential refugia as climate changes. Rare species in general, and especially those that use large and diverse areas, act as "canaries in a coal mine" that indicate the quality of the environment for humans. The glacial outwash deposits of Blanding's turtle landscapes, in particular, are important groundwater aquifers in Dutchess County, and the organic soils of the core wetlands and certain associated wetlands store carbon and may be important in mitigating climate change. Maintaining the full complement of native species in a region is thought to allow an ecosystem to withstand or rebound from stresses and adapt to changing environmental conditions. For these reasons we believe that the wisest course is

to use the best information available to maintain native biological diversity wherever possible.

Because of its sensitivity to changes in the environment, its large home range, and its use of a whole complex of habitats, we consider the Blanding's turtle an "umbrella species;" habitat protected for Blanding's turtles protects many other species that co-occur in those habitats. Several of those species are of conservation concern or of cultural importance in New York State, including the pied-billed grebe, wood duck, American black duck, spotted turtle, wood turtle, ribbon snake, mole salamanders, and several rare plants.

In addition, Blanding's turtles have proven useful in medical and biological research. After reaching sexual maturity at about 15 years, the Blanding's turtle is able to reproduce throughout its long life. Study of this phenomenon may help researchers understand the aging process in humans. Also, the isolated populations in the Northeast, such as those in Dutchess County, are genetically different from populations in the Great Lakes region (S. Mockford, *pers. comm.*). This has important implications for the species' conservation in Dutchess County and their potential value to both medical and evolutionary research.

The Blanding's turtle habitat maps offer the opportunity to protect existing Blanding's turtle habitat complexes despite the advancing suburbanization of Dutchess County, through planning new development—such as restricting new road construction and locating new buildings away from Blanding's turtle wetlands and nesting areas—before expensive habitat restoration becomes necessary. The maps provide town agencies, the DEC, and others information on areas that are potentially of concern, and those that are not of concern, for Blanding's turtle conservation. The maps can help landowners and developers choose sites for development that will be the least detrimental to Blanding's turtles, and thus incur less time and expense in the environmental review

process. The habitat information may be particularly useful in the State Environmental Quality Review (SEQR) process, which balances the needs of wild species with socioeconomic factors in making land use decisions.

With limited financial resources to devote to conservation purposes, towns and other entities must decide how best to direct those resources to achieve the greatest conservation results. While it may be impossible to implement all of the measures listed below, we hope this information will help towns think strategically about land-use planning and conservation, and that towns will consider implementing these measures as best as they are able. Any such practices will contribute to the viability of the Blanding's turtle in Dutchess County.

Below we describe landscape conservation measures that town agencies, state agencies, land trusts, and others can use to protect Blanding's turtle habitat, and highlight some areas of particular conservation significance within the six towns. We also suggest specific measures that can be taken by town or state agencies when reviewing development applications or assessing habitat on a proposed development site, measures that can be taken by developers for on-site planning and design, and measures that can be adopted by individual landowners. The latter are formatted so that they can be photocopied and given to individuals, such as Planning Board or Conservation Advisory Council members, developers, landowners, or interested residents separately from the rest of this report. We ask that material distributed in this fashion be clearly credited to Hudsonia Ltd.

Areas of Highest Conservation Significance

Although all areas mapped in Figures 4-9 may be important to the Blanding's turtle, the habitat complexes described below are those that we consider particularly important to protect due to their proximity to known Blanding's

turtle habitats or the overall quality of the habitats in the Conservation Zone. Beekman and Union Vale have only a few core wetlands each, so should probably consider all of their potential habitats to be significant. While all mapped habitats should be considered for protection, we felt that highlighting a few specific high quality areas may help towns to prioritize limited resources in the near term. If appropriately protected, the Areas of Highest Conservation Significance in key portions of our study area should form corridors that allow Blanding's turtles (and other wildlife) to move from one core wetland to another.

Fishkill (Figure 10)

- The 2 core wetlands east and west of NYS 9D (on DEC property) and associated habitats.
- The core wetland (on DEC property) just north of Baxtertown Rd where it intersects with Baxtertown Rd Extension, and associated habitats.
- The core wetland east of NYS 9 and associated habitats.

LaGrange (Figure 11)

- The 3 core wetlands between NYS 55 and Todd Hill Rd, east and west of Stringham Rd, and the 4 core wetlands south of Todd Hill Rd and east of Stringham Rd and their associated habitats.
- The 7 core wetlands between Mountain Rd and NYS 55, just west of the Taconic Parkway, and their associated habitats. Much of this land is part of James Baird State Park.
- The core wetland north of Carter Rd and west of McDonnell Rd and associated wetlands.
- The 8 core wetlands north of Overlook Rd and south of the town border and associated habitats. Currently, the Nature Conservancy owns 55 ha (135 acres) around the southernmost wetland.
- The northernmost core wetland east of Skidmore Rd and associated habitats.

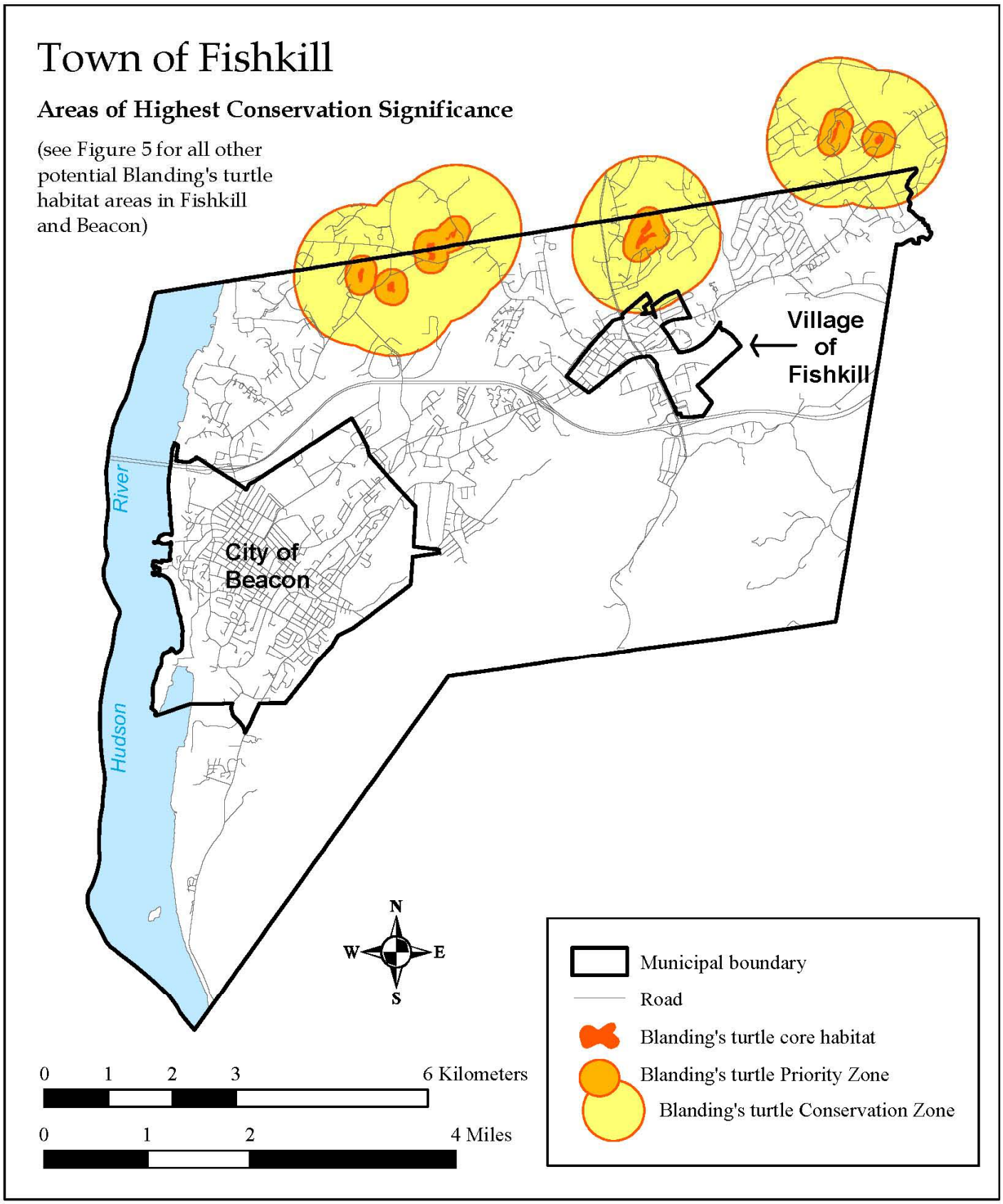


Figure 10. Blanding's turtle habitats of highest conservation significance: core habitats, Priority Zones (within 200 meters of core habitat), and Conservation Zones (within 1,000 m of core habitat) in the Town of Fishkill and City of Beacon, Dutchess County, NY. Hudsonia Ltd., 2009.

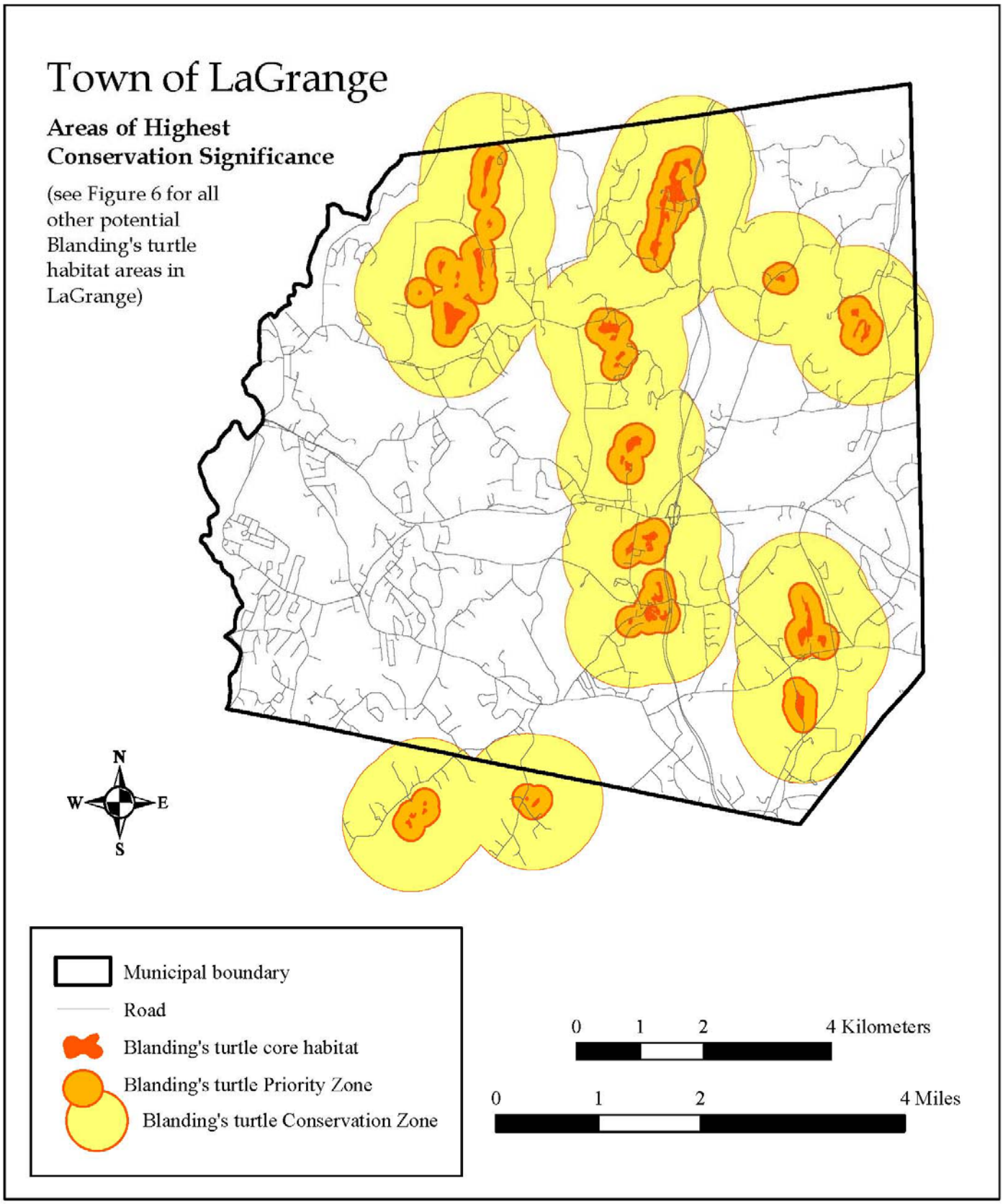


Figure 11. Blanding's turtle habitats of highest conservation significance: core habitats, Priority Zones (within 200 meters of core habitat), and Conservation Zones (within 1,000 m of core habitat) in the Town of LaGrange, Dutchess County, NY. Hudsonia Ltd., 2009.

- The 2 core wetlands west of NYS 82, just north of the junction of NYS 82 and Barmore Rd, and associated habitats.
- The 3 core wetlands north and south of Noxon Rd, and associated habitats.

Poughkeepsie (Figure 12)

- The 4 core wetlands between Salt Point Turnpike and Van Wagner Rd, plus the 2 core wetlands just north of Salt Point Turnpike and south of Van Wagner Rd and their associated habitats.
- The 6 core wetlands east of Van Wagner Rd and south of Bower Rd, and associated habitats.

Wappinger (Figure 13)

- The core wetland at the intersection of All Angels Rd and Park Hill Dr and its associated habitats.
- The core wetland just west of the above wetland, south of Pine Ridge Dr, and its associated habitats.
- The 6 core wetlands east of NYS 9 and south of McFarland Rd, and associated habitats.
- The 3 core wetlands east of Robinson Lane, and associated habitats.
- The 4 core wetlands south of Diddell Rd, along the powerline right-of-way, and associated habitats.
- The 2 larger core wetlands west of Ketchamtown Rd and south of Marc Ridge Lane. Portions of these wetlands are owned by the DEC.
- The core wetland west of Stonykill Rd (the second wetland north of Baxtertown Rd) and associated habitats. This wetland is on DEC property.

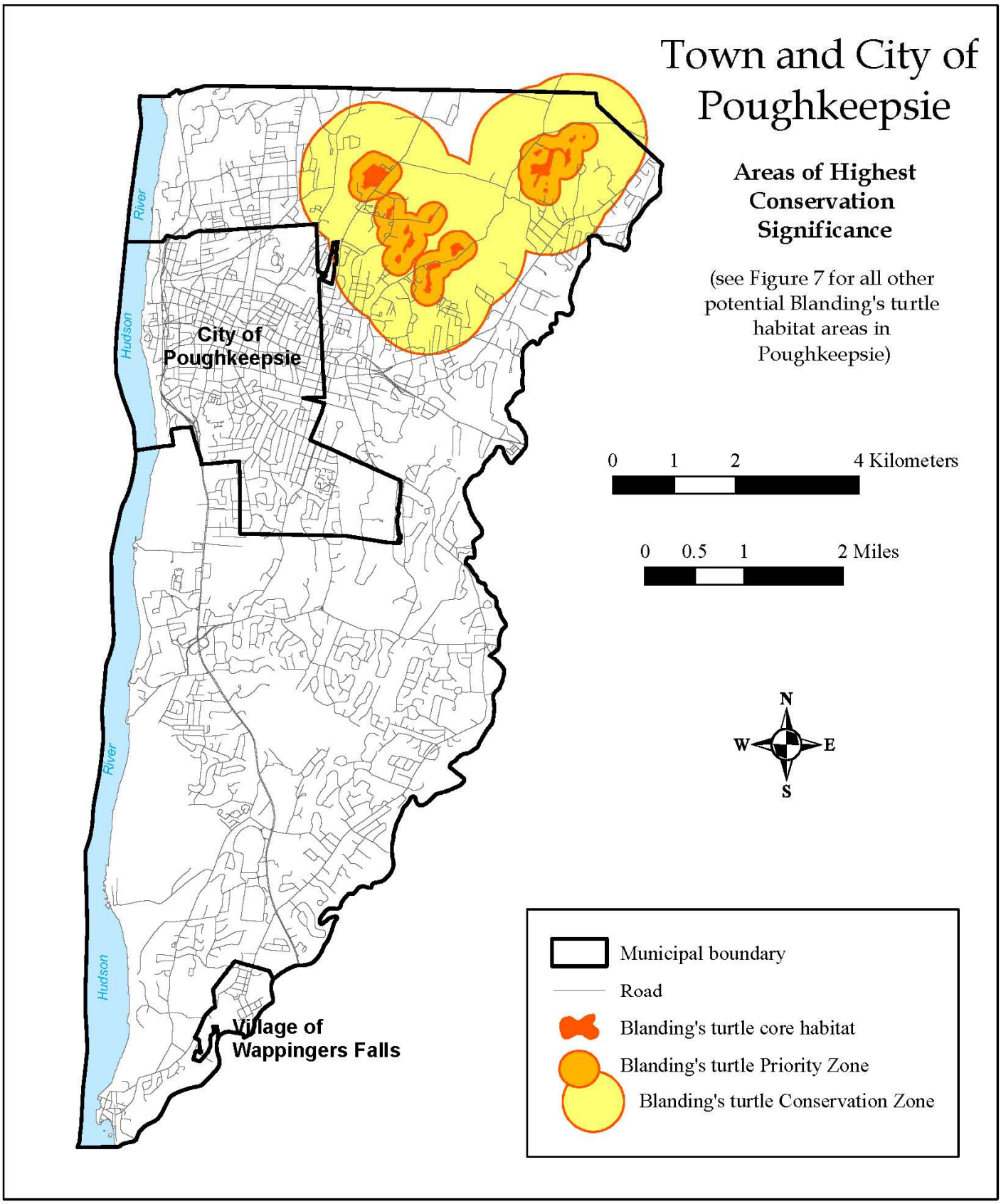


Figure 12. Blanding's turtle habitats of highest conservation significance: core habitats, Priority Zones (within 200 meters of core habitat), and Conservation Zones (within 1,000 m of core habitat) in the Town and City of Poughkeepsie, Dutchess County, NY. Hudsonia Ltd., 2009.

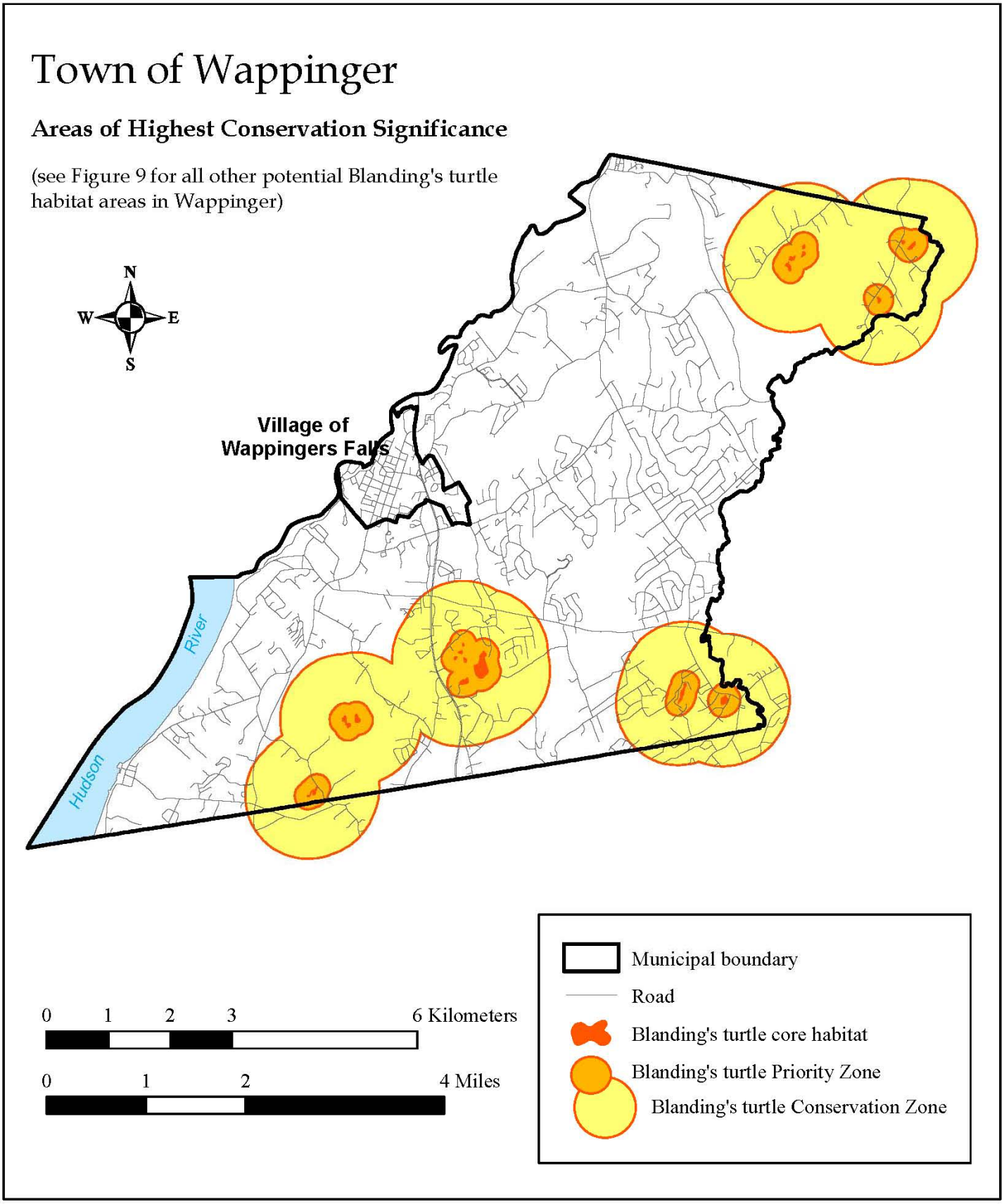


Figure 13. Blanding's turtle habitats of highest conservation significance: core habitats, Priority Zones (within 200 meters of core habitat), and Conservation Zones (within 1,000 m of core habitat) in the Town of Wappinger, Dutchess County, NY. Hudsonia Ltd., 2009.

Landscape Recommendations (for state, county, and town agencies and land trusts)

Because biological communities, habitats, and ecosystems do not coincide with property or municipal boundaries, the best approach to biodiversity conservation is from the perspective of whole landscapes. These recommendations are designed to assist local and state agencies and land trusts in conservation planning at the landscape scale.

The Blanding's turtle requires large areas of undeveloped or minimally developed landscapes in order to maintain populations that are viable in the long term. In order to effectively conserve the species, these landscapes and the habitat complexes they contain must be protected from changes to hydrology, soils, vegetation, and land uses that would reduce survival rates in the population or the health of individual turtles. Areas that have already been altered by development should be evaluated for potential mitigation measures.

As a New York State-listed Threatened species, the Blanding's turtle should be fully considered in municipal planning in all of Dutchess County *except* the towns of North East, Amenia, Dover, and Pawling, which are outside the known or potential range of the species. Blanding's turtle assessments (e.g. habitat assessments, trapping surveys, and conservation planning) must be carried out or advised by a qualified biologist familiar with Blanding's turtles and their habitats in Dutchess County.

In the other 12 towns, natural resource inventories, master plans (comprehensive plans), and zoning ordinances should address the conservation of Blanding's turtle habitat complexes to the extent possible. Planning for Blanding's turtle conservation can not only help avoid destruction and degradation of the habitats

of a Threatened species and mortality of individual turtles, but can also prevent costly delays and other problems for landowners and developers, highway departments, and other entities.

Below are some general guidelines for the conservation of Blanding's turtles in Dutchess County.

THE BLANDING'S TURTLE AREA OF CONCERN: THE 2000-METER ZONE

Although the turtles occasionally travel farther, most Blanding's turtle activities occur within 2000 meters (6600 ft) of a core Blanding's turtle wetland. The Area of Concern encompasses this area, including the Conservation Zone and Priority Zone discussed below. If followed, these general measures, and the more specific measures following, will go a long way toward protecting the turtles and their habitats.

Protect wetland habitats from filling, dumping, drainage, incursion of wheeled or tracked equipment, siltation, polluted runoff, groundwater contamination, and alterations to surface or groundwater hydrology.

Maintain the spatial and temporal patterns of surface water and groundwater entering and leaving wetlands.

Maintain broad corridors of undeveloped land within the Area of Concern between all 1000 m (3300 ft) Conservation Zones.

Minimize the extent of new roads through undeveloped land.

Maintain broad buffer zones (e.g. at least 30 m [100 ft] width) of natural soil and vegetation around all wetlands, including unregulated wetlands.

Minimize or eliminate pesticide use on lawns, gardens, and agricultural fields, and prevent movement of soil and nutrients into wetlands.

Educate landowners about the Blanding's turtle and its conservation. Educational materials such as the "Backyard Turtle Conservation" section below and "The Blanding's Turtle" brochure (Hartwig et al. 2006) can be given to residents within the Area of Concern. If priorities need to be established, landowner education should start within the Priority Zones, then the Conservation Zones, and, lastly, the entire Area of Concern.

Consider a variety of regulatory and non-regulatory means to achieve conservation goals, including volunteer conservation efforts, master planning, zoning ordinances, tax incentives, land stewardship incentives, permit conditions, land acquisition, and conservation easements. For example, local conservation organizations can consider establishing a contest for the best "backyard turtle habitat." Section 4 in the *Biodiversity Assessment Manual* (Kiviat and Stevens 2001) provides information on general conservation strategies. A publication from the Metropolitan Conservation Alliance (2002) offers a model local ordinance to delineate a conservation overlay district that can be integrated into a municipal master plan and adapted to the local zoning ordinance.

THE BLANDING'S TURTLE CONSERVATION ZONE:

THE FIRST 1000 METERS

The area within 1000 meters (3300 ft) of a core Blanding's turtle wetland is where the turtles are likely to be traveling frequently between wetlands and ponds of all kinds during the active season and traveling to and from upland nesting areas. In addition to the general measures listed above for the Area of Concern, the measures below are especially designed for this zone of more intensive turtle activity.

In reviews of all applications for **Freshwater Wetlands permits, Stormwater Management permits, and Mined Lands permits**, consider the impacts to Blanding's turtle habitat complexes. Stormwater management permits and mining permits should be written to ensure that sediment from work areas (including suspended clay and silt) does not enter core or associated wetland habitats. Typical silt fence and hay bale structures for siltation control are inadequate for this purpose. Instead, stormwater should be diverted from Blanding's turtle habitats, and stormwater basins should be constructed to remove sediment and ensure maximum onsite infiltration of stormwater runoff. Petroleum hydrocarbons, de-icing salts, and other pollutants, however, may not be effectively removed by stormwater basins.

When siting domestic or municipal **water supply wells**, consider the impacts of water table drawdowns to Blanding's turtle core and associated wetlands.

When siting **septic systems and other sewage treatment systems**, assess the impacts of the movement of nitrogen and phosphorus compounds into Blanding's turtle wetlands. Most important Blanding's turtle wetlands occur on

or near glacial outwash deposits, which are very permeable to the movement of groundwater and septic leachate.

Use the Conservation Zone to help **identify high-priority areas** for special protection; e.g. for acquisition of conservation land by public or private entities, or for designing conservation easements on privately-owned land. Keep in mind that the turtles need broad corridors in the Area of Concern to move between Conservation Zones and to move among habitats within the Area of Concern.

Foster municipality-wide and intermunicipal cooperation in planning to preserve habitat complexes and minimize hazards to turtles. Where large development projects or multiple adjoining development projects can be planned simultaneously, design contiguous greenways or other types of open space reserves to protect Blanding's turtle habitat complexes. (An example of a multi-development and intermunicipal greenway created to protect habitat for species other than Blanding's turtle was described by Kiviat [2003].)

BLANDING'S TURTLE PRIORITY ZONE: THE FIRST 200 METERS

Blanding's turtles regularly use the upland areas within 200 m (660 ft) of a core wetland to bask and estivate (rest during periods of hot weather), as well as to nest. Special measures should be taken in this zone to prevent harm to the turtles and to protect the important wetland and upland habitat features. A 200 m-wide buffer of natural vegetation and undisturbed soils around a core wetland will help maintain hydrology and water temperatures, prevent pollution from toxic chemicals or silt, and provide food resources for the turtles (Blanding's turtles eat a variety of aquatic invertebrates, many of which are thought to depend on leaf litter as a food resource).

In addition to the recommendations for the Conservation Zone and the Area of Concern, the following measures will help to protect the turtles near their core wetlands.

Within the Blanding's turtle Priority Zone, we recommend **no new buildings, pavement, lawns, roads, or other structures** unless there are no feasible alternatives.

Keep vehicle speeds low on internal subdivision and other roads by means of posted speed limits, wildlife crossing signs, and speed bumps.

Consider constructing **turtle underpasses** for medium- and heavy-duty roads within the Priority Zone. Although Blanding's turtles are known to use culverts occasionally, little is known about mitigating the impacts of roads on wildlife by building underpasses. Therefore, any underpasses should be carefully designed, constructed, and monitored to determine their actual usefulness to the turtles. Highway agencies may be able to install underpasses in connection with other improvements to roads, culverts, or storm drains.

Consider **retrofitting** any structures currently within the Priority Zone using the following guidelines:

--Build fences or other barriers around in-ground swimming pools to keep turtles of any size out of the pools. Fencing mesh must be less than 2.5 cm (1 in) wide to exclude turtles as small as 2.5 cm carapace length; barriers must be at least 25 cm (10 in) high to exclude turtles up to 25 cm carapace length.

--Require spaces beneath potential barriers to turtle movement either on land or in the water, including stone walls, chain-link fences, and curbs. Spaces must be no less than 10 cm (4 in) high and no more than 25 m (82 ft) apart, to allow turtles free movement across the landscape.

--Retrofit storm drain grates so that turtles (including hatchlings of carapace length 2.5 cm [1 in]) cannot fall in, or design catch basins such that turtles and other small animals can readily exit if they do fall through the grate.

--Retrofit window wells with either permanent grates (maximum 2 cm [0.8 in] mesh size), or lips at least 25 cm high (that adult Blanding's turtles of carapace length up to 25 cm cannot climb over).

--Maintain or restore a "tree fringe" (a belt at least two trees deep, preferably with most trees greater than 30 cm dbh [12 in caliper]) encircling each core wetland.

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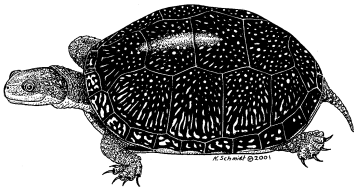

Recommendations for
Review of Development Proposals
(for state, county, and town agencies)

These procedures are recommended for review of any land development project within the 1000 m (3300 ft) Conservation Zone of a known or potential Blanding's turtle core wetland.

In most cases, trapping surveys to determine the presence or absence of Blanding's turtles are not recommended, for two reasons:

1. A trapping survey will not establish the absence of Blanding's turtles in a particular wetland.
2. Blanding's turtle populations require a network of habitats across the landscape. Certain wetlands are used in the winter and spring, and others are used spring through fall or during droughts or other extreme conditions. Any of these may be critical to the survival of the Blanding's turtle population, but any one of them may be unoccupied at the time of the trapping survey. Furthermore, the turtles must be able to move from one habitat complex to another so that they can adapt to changing wetlands, population pressures, and competition. A wetland not currently used by Blanding's turtles may be used by them in the future. Patterns of habitat use may vary from year to year.

However, if there is a need to discover movement patterns, such as travel to potential nesting areas or travel corridors between wetlands, we recommend trapping and subsequent radio-tracking with the caveat that at least two years of data (preferably more), including a drier-than-average and wetter-than-average year, are needed to even partially understand the turtles' movement patterns.

For any proposed development project:

1. When a development proposal is submitted for a site within the Conservation Zone notify the New York State Department of Environmental Conservation.

2. Require that the applicant submit an onsite Blanding's turtle habitat assessment (see Recommendations for Habitat Assessments, below) with their draft development proposal. A worthwhile habitat assessment must be conducted by a qualified biologist with specialized knowledge and

experience with the Blanding's turtle in Dutchess County, and must include assessment of all core and associated wetlands, potential upland nesting habitats, and potential upland, wetland, and stream travel corridors between habitats. The evaluation must also include assessment of offsite areas to the extent possible (e.g. using field observations, analysis of aerial photographs, analysis of other maps, etc.).

3. Compare the results of the habitat assessment to the Blanding's Turtle Habitat Map, and have a third party (e.g. Conservation Advisory Council or Planning Board representative, or independent biologist) visit the site to resolve unexplained discrepancies.

4. If suitable wetland or upland habitats, or unobstructed corridors connecting those habitats, are not found on or near the site, then simply design permit conditions to follow the general recommendations for the Area of Concern and the Conservation Zone, outlined in the Landscape Recommendations in Hartwig et al. 2009.

5. If suitable wetland or upland habitats or corridors are found on the proposed development site, require the following:

    a. The potential Blanding's turtle habitats must be clearly mapped and labeled on the site plan.
    b. The site plan and description must show the following:
    --no direct disturbance of the potential upland or wetland Blanding's turtle habitats on the site, including ample corridors between them; core wetlands should be surrounded by 200 m (660 ft) of undisturbed land. Buffer zones should be designed to protect associated wetlands in consideration of their ecological functions and values;
    --no disturbance of corridors between onsite and offsite habitats;
    --no potential contamination of surface waters by sediments, nutrients, or toxic pollutants;
    --no potential contamination of groundwater from septic leachate or other sources;
    --no potential alteration of groundwater elevation or flows in the vicinity of known or potential Blanding's turtle wetlands;
    --no paving of or other disturbance to potential nesting sites, except if alterations are specifically designed (in consultation with a Blanding's turtle specialist) to enhance the quality of the nesting habitat.
    c. The site plan must show the limits of clearing, the locations and extent of all roads, driveways, structures, other hardened or impervious surfaces, septic leachfields, and stormwater

infrastructure, including drains, swales, and detention/retention basins.

d. New driveways should be as short as possible, and located so that likely travel corridors between known or potential Blanding's turtle wetland and upland habitats are avoided.
e. Any window wells, walls, curbs, fences, pitfall hazards, storm drains, culverts, and catch basins must be especially designed to accommodate safe turtle passage:
   --Require low barriers or fencing around in-ground swimming pools to keep turtles of any size out of the pools. Fencing must exclude turtles as small as 2.5 cm (1 in) carapace length; barriers must be at least 25 cm (10 in) high to exclude turtles up to 25 cm carapace length.
   --Require spaces beneath other potential barriers to turtle movement either on land or in the water, including stone walls, chain-link fences, and curbs. Spaces must be no less than 10 cm (4 in) high and no more than 25 m (82 ft) apart, to allow turtles free movement across the landscape.
   --Design storm drain grates so that turtles (including hatchlings of carapace length 2.5 cm) cannot fall in, or design catch basins such that turtles and other small animals can readily exit if they do fall through the grate.
   --Design window wells with either permanent grates (maximum 2 cm (0.8 in) mesh size), or lips at least 25 cm high (that adult Blanding's turtles of carapace length up to 25 cm cannot climb over).
   --Use "Cape Cod" curb design to allow turtles to navigate curbs.
f. Wherever possible, roads should be equipped with speed bumps, posted low speed limits, and wildlife crossing signs.
g. Any new driveways exceeding 100 m (328 ft) should be equipped with speed bumps.
h. Construction crews and eventual residents must be educated to look for turtles under cars, construction equipment, or mowing machines before operating or driving.

For more information, see: Hartwig, T., G. Stevens, J. Sullivan, and E. Kiviat. 2009. Blanding's turtle habitats in southern Dutchess County. Report to the Marilyn Milton Simpson Charitable Trusts and NYS DEC Hudson River Estuary Program. Hudsonia Ltd., Annandale, NY.

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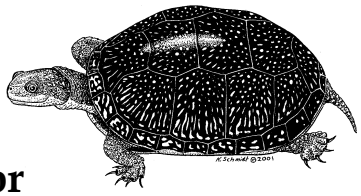

Recommendations for
Habitat Assessments
(for state agencies, town agencies, and consultants)

A Blanding's turtle habitat assessment should be required for any development proposal within the 1000 m (3300 ft) Conservation Zone of a known or potential Blanding's turtle core wetland. Because habitats change over time, and because Hudsonia biologists were not able to check every area in the field during our habitat mapping project (Hartwig et al. 2009), a habitat assessment is required to confirm mapped habitats. This assessment must be conducted by a qualified biologist with specialized knowledge of and experience with Dutchess County Blanding's turtles. All wetlands on the site and selected wetlands nearby should be assessed for their potential as either core or associated habitat, and potential nesting habitats and travelways should be evaluated. Below are guidelines for determining core wetland, associated wetland, and nesting habitat suitability for Blanding's turtles.

Core wetlands

Following are characteristics that may indicate core Blanding's turtle habitat:

- shrubby wetlands, particularly those containing buttonbush, highbush blueberry, and swamp azalea
- deep organic soil layer
- open canopy or canopy cover less than 50%
- little or no flowing water; preferably no inlet or outlet with high flow
- abundant neuston (living or dead material floating on the surface of the wetland), particularly duckweeds and floating liverworts, during the growing season
- tree fringe or forest surrounding wetland
- water ≥ 30 cm (11.8 in) deep for most of the year
- open water, moats, or moat-like areas

These characteristics should be considered guidelines rather than requirements for individual wetlands. Therefore, a wetland with mostly purple loosestrife—a plant with properties intermediate between a shrub and herb—but few shrubs and most of the other characteristics may still be considered core habitat. Assessors must use existing literature and their own knowledge of Blanding's turtle wetlands in Dutchess County to determine potential habitats, depending partially on a wetland's overall structure.

Associated Wetlands
Associated wetlands used by Blanding's turtles are quite variable in structure, vegetation, and hydroperiod. They provide refuge from warm or cold water temperatures or from drying wetlands, supplemental food supply, shelter for traveling turtles, and year-round habitat for hatchlings and juveniles. Blanding's turtle habitat complexes include, but are not limited to, forested swamps, shrub swamps, bogs, marshes, wet meadows, intermittent woodland pools, ponds, and lakes. Human-made as well as natural wetlands or ponds may be used. Wetland size varies; Blanding's turtles have been known to use wetlands from about 0.05 ha to 327 ha (0.1 to 808 acres; Hartwig 2004 and unpublished observations). Blanding's turtle habitat assessors should identify wetlands within 1000 m (3300 ft) of a potential core habitat with standing water during part of the year as an associated wetland for Blanding's turtles, and describe the wetland characteristics so that the configuration and quality of the wetland complex can be evaluated and on-site mitigation measures can be applied as needed.

Nesting Habitat
All potential nesting habitat should be investigated and mapped. Investigators should look for open (non-forested) upland areas with well-drained, loose, gravelly-loam soils. The best nesting habitats receive plenty of sunlight, have plenty of bare or sparsely vegetated, uncompacted soils, and flat to gentle slopes. Exposed soils on road shoulders or banks, idle areas of soil gravel mines, cultivated gardens, house yards, utility corridors, pockets of soil on rock outcrops, and fields have all been used in Dutchess County. Usually 20 cm (8 inches) or more of the surface soil is loose (friable). It should be noted, however, that whereas most Blanding's turtles nest in habitats similar to those described above, an occasional turtle nests in an unusual spot such as hard-packed turf or a steeply sloping dirt pile. Any unshaded, and unpaved, area in the Conservation Zone may provide nesting habitat; however, areas similar to the habitats described above should be conserved as such wherever possible.

Habitat Assessment Map
Once core, associated, and nesting habitats have been identified, they should be clearly mapped. In addition, broad upland areas between wetlands and between wetlands and nesting sites should be mapped as potential corridors. Any perennial or intermittent streams in the Conservation Zone should also be mapped as potential corridors, and a 200 m (660 ft)-wide Priority Zone should be drawn around all known and potential core wetlands.

Hartwig, T.S. 2004. Habitat selection of Blanding's turtle (*Emydoidea blandingii*): a range-wide review and microhabitat study. M.S. Thesis, Bard College, Annandale, NY.

For more information, see: Hartwig, T., G. Stevens, J. Sullivan, and E. Kiviat. 2009. Blanding's turtle habitats in southern Dutchess County. Report to the Marilyn Milton Simpson Charitable Trusts and NYS DEC Hudson River Estuary Program. Hudsonia Ltd., Annandale, NY.

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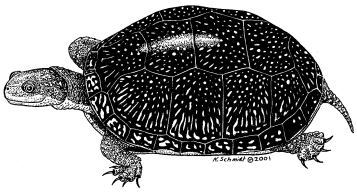

Recommendations for
On-Site Mitigation of Development Projects
(for state and town agencies, and developers)

Require the following for any development project within the 1000 m (3300 ft) Conservation Zone of a known or potential Blanding's turtle core wetland:

Maintain the groundwater table. Decreased groundwater elevations will reduce wetland hydroperiod and water depths in most or all core wetlands and some associated wetlands, altering turtle habitats. Assess individual and cumulative impacts of existing and proposed land uses, including impervious surfaces, stormwater management, and groundwater withdrawals for their effects on the groundwater table, groundwater flows, and impacts to nearby wetlands.

Maintain quality of surface and ground waters. There is evidence that reptiles are susceptible to poisoning by heavy metals, PCBs, and certain pesticides. The Blanding's turtle is likely to be sensitive to a variety of toxic substances potentially emanating from past, present, and proposed dumps, industrial sites, automobile garages and junkyards, golf courses, farms, septic systems, lawns, highways, and other sources. Furthermore, Blanding's turtle core wetlands and many associated wetland habitats are normally relatively low in the plant nutrients phosphorus and nitrogen. Groundwater and surface water discharging into Blanding's turtle wetlands should be protected from nutrient inputs from the sources listed above as well as other potential sources. In addition, core wetland habitats have deep organic sediments that we believe are important to the Blanding's turtles; therefore movement of mineral sediments into wetlands from roads, driveways, farms, residential lots, construction sites, mines, and other sources should be prevented. Use of de-icing salts should also be prohibited in the vicinity of core and higher quality associated wetlands, as many of the potential prey species of Blanding's turtle are sensitive to chloride.

Tightly cluster new houses and other development features to preserve the maximum amount of unfragmented open space and reduce impacts on Blanding's turtle habitat complexes. Spatial distribution of buildings, infrastructure, and open space on development sites and in neighborhoods should be designed in consultation with a Blanding's turtle specialist.

Minimize motor vehicle traffic on roads crossing or adjoining Blanding's turtle habitat complexes. Road mortality is one of the greatest threats to Blanding's turtle populations. Adult Blanding's turtles have been observed using culverts in experimental studies (Lang 2000) and passing under highways (unpublished data, Hudsonia Ltd.); however, no drift fence and underpass system has ever been specifically constructed for Blanding's turtles and proven to function successfully. This level of uncertainty forces us to recommend that:

1. The length and width of roads, driveways, and other paved areas within the Conservation Zone be minimized to the greatest extent possible.
2. If construction of new roads or increased traffic on existing roads cannot be avoided, underpass systems be considered as a last resort in development situations.
3. Blanding's turtle underpasses be constructed and then turtle use carefully monitored wherever road improvements or maintenance coincide with a Blanding's turtle habitat complex.

Prohibit the building of new roads crossing or adjoining Blanding's turtle habitats within the 1000 m (3300 ft) Conservation Zone of a core wetland or within 200 m (660 ft) of any core wetland. This applies to public and private roads of all kinds including driveways.

Keep vehicle speeds low on entrances and internal subdivision roads by means of posted speed limits, wildlife crossing signs, and speed bumps.

Construct fences or other barriers around in-ground swimming pools to keep turtles of any size out of the pools. Fencing must exclude turtles as small as 2.5 cm (1 in) carapace length; barriers must be at least 25 cm (10 in) high to exclude turtles up to 25 cm carapace length.

Construct spaces beneath other potential barriers to turtle movement either on land or in the water, including stone walls, chain-link fences, and curbs. Spaces must be no less than 10 cm (4 in) high and no more than 25 m (82 ft) apart, to allow turtles free movement across the landscape. (See exceptions below for temporary exclusion fencing.)

Design storm drain grates such that turtles (including hatchlings of carapace length 2.5 cm [1 in]) cannot fall in, and design catch basins and storm sewers such that animals that fall through gratings can easily escape.

Install temporary exclusion fences. Under certain circumstances (to be determined by the New York State Department of Environmental Conservation or a Blanding's turtle specialist) temporary exclusion fencing should be erected around a construction site to keep Blanding's turtles out of the work area

immediately preceding and during construction. This pertains especially to construction areas that are within 200 m (660 ft) of core and associated Blanding's turtle wetlands or construction areas that may be situated between wetlands and nesting areas if construction is to occur between 25 May and 10 July (inclusive dates) but may pertain to other areas as well. Temporary exclusion fencing should consist of filter fabric with the bottom buried 20 cm (8 in) deep in the soil. Gate(s) for passage of people and equipment should be designed and maintained such that turtles of all sizes are unable to pass through. Gates must be kept tightly closed at all times except when in active use.

Avoid coarse mesh backing on filter fabric silt fencing used for soil management or temporary exclusion fencing. These meshes (e.g. 2-3 cm [0.8-1.2 in] square mesh size) can trap turtles and snakes. Erosion control fabrics, geotextiles, or landscaping fabrics should be selected and installed such that they do not present an entanglement hazard to turtles.

Construct no window wells unless they are fitted either with permanent grates (maximum 2 cm [0.8 in] mesh size), or vertical lips at least 25 cm high (that adult Blanding's turtles of carapace length up to 25 cm cannot climb over).

Enforce immediate (same day) backfilling of any excavations (soil test pits, foundation holes, utility ditches, etc.), or else install gently-sloping (e.g. 30° or less from horizontal) earthen or wooden ramps to allow turtles and other animals to climb out.

Train equipment operators and comparable personnel to watch for Blanding's turtles and move them safely out of the way to reduce the risks of injury or death to the turtles from construction equipment, mowing machinery of all kinds, automobiles, and farm equipment. This is especially important during the nesting season (25 May through 10 July) and the period of hatchling emergence (15 August through 27 September).

Protect and restore the "tree fringe" around the margins of core and associated wetlands.

Instruct workers and residents to look for turtles under cars, construction equipment, or mowing machines before operating or driving. Blanding's turtles often rest beneath vehicles, especially during the nesting season. Blanding's turtles may rest beneath parked cars in driveways, enter open garages, hide beneath wood piles or brush piles, or rest concealed or partially covered in leaf litter or grass clippings, beneath shrubs, or next to logs.

Provide educational materials on the Blanding's turtle to construction workers and residents. Suitable materials include the color-illustrated pamphlet "Blanding's turtle" (Hartwig et al. 2006) and the article "Tale of Two Turtles" (Kiviat 1993), available from Hudsonia.

Hartwig, T.S., G. Stevens, and E. Kiviat. 2006. The Blanding's turtle. New York State Office of Parks, Recreation, and Historic Preservation, Albany, NY. Brochure.

Kiviat, E. 1993. A tale of two turtles; Conservation of the Blanding's turtle and bog turtle. News from Hudsonia 9(3):1-6.

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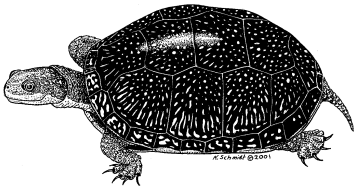

Backyard Turtle Conservation:
Recommendations for Landowners

The conservation of Blanding's turtles in Dutchess County will require long-term protection of wetland and upland habitat complexes that can accommodate the various needs of the turtles. These complexes must include different kinds of wetlands for overwintering, foraging, and refuge from drought, as well as suitable upland nesting sites and safe corridors for travel between habitats.

Anyone living within the range of Blanding's turtles in Dutchess County, or who is concerned about all species of turtles, can take steps in their everyday life to help protect turtles. Many of these steps will also protect other wildlife, including other species of reptiles and amphibians, small mammals, and birds, which face many of the same threats as the Blanding's turtle.

- During the active season (April-October), check for turtles underneath your parked car before driving.

- Drive carefully to avoid accidents with turtles and other wildlife. If you see a "rock" in the road, slow down—it may be a turtle! When you encounter a turtle on the road, stop and move it off the road in the direction it was heading. Do not take it home or move it more than 90 m (300 ft). Be careful not to endanger yourself in traffic.

- Watch for turtles when mowing or using motorized equipment, especially during the June nesting season when Blanding's turtles may be traveling long distances overland.

- Eliminate pitfall hazards such as abandoned swimming pools, open excavations, unscreened window wells, ditches, and unscreened storm drains which can trap turtles and other small animals. In-ground swimming pools that are in use should have fencing with spaces less than 2.5 cm (1 in) apart to keep small turtles and other animals out.

- Alter vertical barriers such as stone walls, stockade fences, or chain-link fences so that turtles can pass under them. Spaces should be no less than 10 cm (4 in) high and no more than 25 m (82 ft) apart, to allow turtles and other wildlife free movement across the landscape.

- Create no new lawn areas. Consider natural landscaping, such as shrub thickets, sparse wildflower/grass gardens, and brush piles to replace parts of your current lawn.

- If you have a dirt pile or other areas of loose, exposed soil, refrain from digging in it between May 26 and September 30. If you have a garden, consider fencing it. Otherwise, you may accidentally dig up turtle eggs!

- Keep cats indoors during the active season (April to October) or supervise them when they are outdoors. Supervise dogs when they are outdoors. Cats and dogs may harass or injure small and adult turtles and are known to kill hatchlings of many species of turtles (Mitchell and Klemens 2000). Keeping cats indoors and supervising dogs outdoors not only contributes to the safety of your pet and Blanding's turtles, but also protects many other wildlife species; see www.abcbirds.org/abcprograms/policy/cats/index.html or www.audubon.org/bird/at_home/SafeCats.html for more information on the contribution of domestic animals towards the decline of wildlife species and on turning your outdoor cat into a happy, safe indoor cat.

- Refrain from using pesticides, herbicides, and other toxic substances on your lawn or garden; instead use the many natural alternatives now available.

- Dump no toxic substances, such as used motor oil, antifreeze, or cleaning products, outside. These are toxic to turtles and other wildlife, and could potentially contaminate your drinking water. Dispose of them properly, according to the manufacturer's instructions.

- Keep garbage lidded and compost piles contained and feed pets indoors to discourage predators of turtle eggs and hatchlings, such as raccoons, skunks, and opossums.

- Do not collect turtles. Protect turtles from collectors, and help to educate would-be turtle collectors. The New York Environmental Conservation Law imposes a fine of up to $1000 per occurrence for collecting without a permit, harassing, or killing a Blanding's turtle.

- Protect wetlands, streams, and upland areas from drainage, channelization, filling, dumping, pollution, and other damage. According to state law, it is illegal to modify any wetland known to be used by Blanding's turtles.

- Encourage your Planning Board and Conservation Advisory Council to incorporate Blanding's turtle habitat protection measures into their planning and decision-making.

- Contact Hudsonia if you would like more information on designing land use changes on your property to accommodate Blanding's turtles.

If you find a Blanding's turtle, please do the following:
1. Make a written note of the exact location, date, and number if it is tagged. If possible, take a photograph or make a sketch of the turtle for verification purposes.
2. As soon as possible, report this information to Hudsonia (845-758-0600).
3. If the turtle is in an area of high risk, move it a short distance out of harm's way but do not take it away with you.

Mitchell, J.C. and M.W. Klemens. 2000. Primary and secondary effects of habitat alteration. P. 5-32 in: M.W. Klemens, ed. Turtle Conservation. Smithsonian Institution Press, Washington, DC.

For more information, see: Hartwig, T., G. Stevens, J. Sullivan, and E. Kiviat. 2009. Blanding's turtle habitats in southern Dutchess County. Report to the Marilyn Milton Simpson Charitable Trusts and NYS DEC Hudson River Estuary Program. Hudsonia Ltd., Annandale, NY.

CONCLUSIONS

In the suburban and rural landscapes of southern Dutchess County there are still significant opportunities for Blanding's turtle conservation. Although land development has disturbed and fragmented many habitats, strategic land use and conservation planning can mitigate past damages, prevent future damage, and ensure that Blanding's turtles and their ecosystems are protected for the long term. Through our habitat mapping work, Hudsonia hopes to equip town agencies, state agencies, local residents, and others with baseline information about local Blanding's turtle habitats so they can take steps to protect these resources.

The "habitat approach" to conservation, however, is quite different from the traditional parcel-by-parcel approach to land use decision-making. It requires examining the landscape beyond the boundaries of any particular land parcel, and considering the size and juxtaposition of habitats in the landscape, the kinds of biological communities and species they support, and the ecological processes that help to maintain those species. After conveying the completed Blanding's turtle habitat map, GIS database, and report to the six towns of the study area, Hudsonia hopes to have the opportunity to assist town officials, local landowners, and other interested individuals and groups in interpreting the map, understanding how Blanding's turtle habitats relate to the landscape, and devising ways to integrate this new information into land-use planning and decision making.

We believe that the town-wide habitat map is an invaluable tool for land use and conservation planning. The map provides a bird's-eye view of the landscape, illustrating the location and configuration of Blanding's turtle habitats in relation to other habitats and cultural features. At the printed scale of 1:10,000, many interesting ecological and land-use patterns emerge, such as the location and

extent of nesting sites, the areas where core habitats are concentrated, and the patterns of habitat fragmentation caused by roads and residential development. This kind of general information can help the town think about where future development should be concentrated and where future conservation efforts for the Blanding's turtle should be targeted.

At the site-specific scale, we hope the map will be used as a resource for routine deliberations over development proposals and other proposed land use changes. The map and report bring an independent body of information to environmental reviews, and will help users raise questions about important biological resources that might otherwise be overlooked. We strongly emphasize, however, that the map has not been exhaustively field-checked and should therefore be used only for general planning purposes. In an area proposed for development, for example, the habitat map can illustrate the general locations of potential Blanding's turtle habitats. The map, however, should never be considered a substitute for a site visit by a qualified Blanding's turtle biologist. During site visits, the presence and boundaries of important habitats can be verified and the site can be assessed for habitat quality and additional ecological values. This detailed, up-to-date information is essential to making informed decisions about specific development proposals. Because the natural landscape and patterns of human land use are dynamic, it is important for the town to consider refining and/or updating the habitat map over time.

Conservation of habitats is one of the best ways to protect biological resources. Incorporating this approach into planning and decision making will help to minimize the adverse effects of human activities, to integrate the needs of the human community with those of the natural landscape, and to protect the ecological patterns and processes that support the human community and the rest of the living world.

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Appendix A

Common and scientific names of plants and animals mentioned in this report. Scientific plant names follow the nomenclature of Mitchell and Tucker (1997) and scientific bird names follow Levine (1998).

Common Name	Scientific Name
Plants	
ash, green	*Fraxinus pensylvanica*
azalea, swamp	*Rhododendron viscosum*
blueberry, highbush	*Vaccinium corymbosum*
buttonbush	*Cephalanthus occidentalis*
coontail, spiny	*Ceratophyllum echinatum*
dodder, buttonbush	*Cuscuta cephalanthi*
duckweed, greater	*Spirodela polyrhiza*
duckweed, lesser	*Lemna minor*
foxtail, short-awn	*Alopecurus aequalis*
grass, pale alkali-	*Torreyochloa pallida* v. *pallida*
loosestrife, purple	*Lythrum salicaria*
(a liverwort, floating)	*Riccia fluitans*
(a liverwort, floating)	*Ricciocarpus natans*
maple, red	*Acer rubrum*
(a moss)	*Helodium paludosum*
Animals	
duck, American black	*Aix rubripes*
duck, wood	*Aix sponsa*
fox, red and gray	*Vulpes vulpes*, *Urocyon cinereoargenteus*
mallard	*Aix platyrhynchos*
opossum	*Didelphis virginiana*
raccoon	*Procyon lotor*
salamanders, mole	*Ambystoma* spp.
skunk, striped	*Mephitis mephitis*
turtle, spotted	*Clemmys guttata*