North Castle Biodiversity Plan

Armonk 1926

Armonk 2004

Metropolitan Conservation Alliance

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North Castle Biodiversity Plan

by

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***Front cover**:* Left: Hamlet of Armonk, 1926. Courtesy of John Fava. From the Westchester Parks Commission and Airmap Corporation of America. Plate No. 522.
Right: Hamlet of Armonk, 2004. Courtesy of New York State Office of Cyber Security & Critical Infrastructure Coordination.
***Back cover**:* Male box turtle, North Castle, New York ©WCS/James W. Vellozzi

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Introduction

Project Background
The North Castle Biodiversity Study is a joint project between Michael W. Klemens, LLC, the Wildlife Conservation Society's Metropolitan Conservation Alliance (MCA) and the Town of North Castle, New York that began in 2006. The purpose of this project is to identify the portions North Castle within the study area that are of high biodiversity value in order to provide the Town with the information it needs to improve planning to protect these resources.

Regional Overview
Like many parts of the United States, Westchester, once a rural county of farms and villages, has become suburbanized by a pattern of development known as "sprawl." Sprawl is low-density, automobile-dependent development that is characterized by strip malls, cookie-cutter "big box" stores, industrial parks, oversized houses (i.e., "McMansions), and anonymous housing developments. As sprawl takes over, we lose what is special about the place we live, in terms of both natural resources and community character. Sprawl began in the post-World War II era when people left declining cities in favor of greener surroundings. Ironically, many decades later, sprawl has reached a point where it has left few of the green, open spaces for which people originally left cities. Many Westchester residents recall woods, open fields, and farms from childhood that have since been built up or paved over. Most of us assume that this is "inevitable" or "the cost of progress," but is it really? At MCA, we believe that human societies can choose to grow in ways that serve the need for economic growth while maintaining the health of the ecology. In this report, we offer tools to help North Castle move toward this ecologically-friendly model of development.

North Castle is the ninth town in Westchester to form a partnership with MCA in order to identify biodiversity resources, map them, and improve land use planning practices to maintain them. The towns of Cortlandt, New Castle, Somers, and Yorktown (along with Putnam Valley in Putnam County) are partner to the Croton-to-Highlands Biodiversity Plan in northwestern Westchester, while the towns of Lewisboro, North Salem, and Pound Ridge are partner to the Eastern Westchester Biotic Corridor, recently joined by Bedford. North Castle joins a growing movement among municipalities that are proactively protecting their resources by using innovative land use planning tools. This project is an important first step to contain sprawl and maintain the special "sense of place" unique to North Castle.

Concepts and Issues

Biodiversity in the Lower Hudson Valley

The rich tapestry of genes, species, ecosystems, and their interactions are collectively referred to as "biological diversity," often shortened to "biodiversity." The lower Hudson Valley, including North Castle, is home to significant habitats and rich assemblages of wildlife due to a unique convergence of factors:

1. The geographic position of the lower Hudson Valley is at an ecological crossroads, which contributes to the diversity of plants and animals found here. At the close of the Wisconsin glaciation (ca. 15,000 years ago) plants and animals moved into and repopulated southern New York from a variety of routes, including the Wallkill Valley, the Atlantic Coastal Plain, and from the Midwest via the Mohawk Valley. These routes converged in southeastern New York's lower Hudson Valley.

2. The historic development pattern of small rural villages with intervening open space has fostered both the scenic and biodiversity values of the area. This type of development – intensive but limited in scope – has preserved many of the ecological treasures of the region. Although sprawl is changing this rapidly in some areas, a few tracts of relatively undeveloped land remain in the region.

3. Biodiversity within the region is represented by both widespread species and species that are declining in the lower Hudson Valley and throughout the Northeast, including many that are on state and federal lists of endangered, threatened, and special concern wildlife. Species such as the box turtle are near the northern limit of their natural range in the lower Hudson Valley. The stewardship of such species becomes increasingly important as the world's climate changes, potentially causing their ranges to expand northward. Stewardship of all of the region's biodiversity has conservation value that extends far beyond the towns, adding value to broader conservation efforts in New York State and throughout the Northeast.

Importance of Biodiversity to North Castle

It is often argued that biological diversity has its own inherent value, that it is our obligation to preserve biodiversity for its own sake. However, when development and sprawl collide with biodiversity concerns, land use practitioners need more than ethical arguments based on inherent value to make a decision in favor of biodiversity. Therefore, it is important to note that communities directly benefit in many ways from their biological resources and that these services can often be measured in tangible terms, including those of economics and human welfare. The following paragraphs provide a rationale for including biodiversity as one of the fundamental foundations of sound land use decisions.

✍**Human Health**

A major benefit of biodiversity is its direct impact on human health, including the prevalence of Lyme disease. Research conducted in southeastern New York has revealed that the diversity of small mammals (e.g., mice, moles, voles, shrews) is reduced by forest fragmentation. The small mammal that ends up dominating these isolated fragments—the

white-footed mouse—is the primary carrier of the Lyme bacterium. The risk of Lyme disease is much lower in intact forest ecosystems where the infection rate is suppressed by a diversity of small mammals. By maintaining larger tracts of interconnected forest habitat, we can maintain high biodiversity levels and simultaneously reduce human health risks (Allan et al. 2003).

✍**Recreation**

Biodiversity provides important recreational opportunities, including hunting, fishing, hiking, bird watching, and photography, contributing to the high quality of life that North Castle residents enjoy. In addition, recreational opportunities often directly translate into economic gain for communities, sustaining businesses that cater to outdoor enthusiasts such as outdoor equipment suppliers and canoe/kayak rental and touring outlets.

✍**Natural Beauty**

Biodiversity provides a scenic backdrop to the daily activities of residents. Rocky ridgelines cloaked in green forests, maple swamps glowing red as their leaves turn in autumn, grassy fields shining with dew on spring mornings—these are the stages on which we act out our daily routines. These settings can reduce stress and bring peace of mind back into our busy lives.

✍**Education**

Forests, wetlands, fields, and associated wildlife and plant communities serve as important outdoor laboratories used by schools and nature centers to educate our young people and the park visitors.

✍**Ecosystem Services: Pollination**

Bees, butterflies, and other pollinators have a direct influence on agricultural crop yields and the vitality of gardens. These factors benefit the economy and human welfare. Bee pollination alone is required for an estimated $14 billion of agricultural production in the United States (Morse & Calderone 2000). Bees are also essential for pollinating some of our favorite local garden produce such as apples, plums, cherries, blueberries, raspberries, squashes, melons, and pumpkins (Cane 2005).

✍**Ecosystem Services: Wetlands**

Research goals of the scientific community have begun to shift. Rather than focusing on the negative impacts that humans have on the environment, researchers are beginning to ask more pertinent and useful questions such as "do people benefit when they protect and maintain the environments in which they live?" Wetlands provide an excellent case study of how, by maintaining biodiversity, humans can reap substantial benefits. Many wetlands are extremely biologically diverse, which is sometimes a rationale provided for their protection. But wetlands protected for their biodiversity also provide a variety of ecological services to people (Smith et al. 1995). Because of their ability to temporarily store floodwaters during storms, they help to reduce and eliminate damaging floods. Wetlands uptake and store pollutants, resulting in cleaner, safer water. Their dense vegetation and unique soils store carbon, reducing global warming. Some wetlands recharge groundwater aquifers and maintain water flow in streams and rivers during drought. Wetlands and waterways also

provide corridors for flora and fauna to disperse and alter distributions in response to global warming.

✍**Ecosystem Services: Forests**
Forest ecosystems provide a multitude of services to people. For example, they: stabilize stream banks, prevent erosion, reduce stormwater runoff, allow rain to infiltrate groundwater aquifers, retain and transform lawn and agricultural fertilizers, filter pollutants from our air, provide oxygen, cool air temperatures during the summer, and reduce greenhouse gases by absorbing atmospheric carbon, among other benefits.

✍**Ecosystem Services: Water Quality**
Actions to protect and plan for biodiversity in North Castle will aid in broader, ongoing efforts to improve water quality in the watersheds of the Hudson River and Long Island Sound. For example, maintaining the ecological integrity of wetlands allows them to continue filtering water of pollutants, water that eventually flows to these larger bodies of water.

The diversity of wildlife populations, or biodiversity, within a town or region is a direct measure of ecosystem health; therefore, biodiversity is also a measure of the ability of these ecosystems to provide important and cost-effective services to our communities. The benefits of maintaining North Castle's biodiversity are far-reaching. Issues of water quality, water quantity, rural aesthetics, community character, and human health are all closely intertwined with biodiversity. A biologically diverse landscape is resilient to change and provides an "insurance policy" that the ecological services in our communities will continue, now and into the future.

Biodiversity and Local Land Use Planning
Biodiversity receives some protection through state and federal regulations. These laws, however, are not designed to protect ecological function. Federal and state species protection encompasses a small subset of biodiversity—only those species that are at greatest risk of disappearing. These threatened and endangered species are akin to critically ill patients in a hospital who require an extraordinary allocation of resources in order to recover. Work by MCA has demonstrated that as much as 75% of the region's reptiles and amphibians (far more than are on state or federal lists) are in long-term, non-cyclical declines (Klemens 2000). Reliance on regulations is insufficient to protect these species and increased regulatory strictures are often politically unpalatable. In addition, it is not feasible to preserve (through land acquisition or easement) the entire network of extensive, interconnected habitats that would be necessary to maintain the region's biodiversity.

We discard the premise that municipalities have merely one tool—land preservation—to conserve biodiversity. The idea that properties must either be completely preserved or completely destroyed through development is overly simplistic. This premise must be replaced by one which recognizes that thoughtful development adds value to and interconnects protected areas. Even Westchester County's largest protected area, the 4,300 acre Ward Pound Ridge Reservation, cannot survive without appropriate planning in the surrounding privately held, developable lands (Miller and Klemens 2002).

Therefore, protection of North Castle's biodiversity will require additional proactive action at the local land use decision-making level. Apart from sustaining biodiversity at the local level, a

scientifically informed, landscape-scale approach to biodiversity management will prevent site-by-site conflicts over the ecological value of lands. This approach will help focus development into areas where it will have less impact on the ecological fabric and function of the region. By planning with nature in mind, North Castle can create quality communities for future generations where human progress is in greater harmony with the natural world.

Project Premises and Goals

All too often, land use decisions are made at the municipal level without the benefit of baseline biological information or without any mechanisms to integrate such information into the planning process. This occurs despite significant efforts of concerned citizens and municipal officials. The gap between information providers (scientists) and information users (local decision-makers) creates a major obstacle. MCA has identified three fundamental challenges that lead to this situation:

1. *Baseline data are generally not available.* Without such data, it is impossible to plan for economic growth while simultaneously ensuring environmental integrity. Baseline ecological data can be used to identify areas of biological significance worthy of protection and to identify areas of lesser significance. Development could be channeled toward the latter areas, thus reducing the level of impact on more ecologically-sensitive areas. For these reasons, one of the project goals was to collect new biological data. These data have been used to generate a map, indicating areas of greatest importance for biodiversity within the North Castle study area.

2. *Even where data are already available, mechanisms rarely exist to translate the information into policy.* To address this problem, MCA has been developing a set of tools—a "conservation toolbox"—that will aid planners and other decision-makers in the application of biological data. These tools, which include this report, are published as the MCA Technical Paper Series, and are targeted at a broad constituency to address land use issues within the tri-state region. See Appendix E for the list of reports in the Technical Paper Series.

3. *Biological data and conservation tools are ineffective unless they are accepted as part of a community's goals and integrated consistently into land use planning practices.* Those concerned with the protection of biodiversity need to more fully embrace the legitimacy of competing goals and uses on the land. Environmental advocates are often very good at saying "no," but much less adept at asking "how?" How can we work together to create patterns of development that are more biologically sensitive and sustainable? MCA strives to raise awareness and understanding of biodiversity concerns among land use decision-makers, including municipal staff and volunteers, land trust personnel, landowners, and others who influence the patterns of development upon our landscapes. We accomplish this by serving in an advisory capacity to planning boards, conservation boards and other entities, providing workshops that focus on the relationship between biodiversity and land use planning, and promoting inter-municipal, cooperative efforts to plan for biodiversity.

To summarize the above statements, the primary goal of this project is to address the impacts of sprawl on natural ecosystems by: (1) providing baseline scientific information, (2) developing

tools that translate information into policy, and (3) integrating those elements into the land use decision-making process. These steps will create a platform for more thorough municipal and intermunicipal discussions of opportunities and challenges.

Land Use Changes and Biodiversity

Changing Patterns of Land Use

The tri-state region surrounding New York City has undergone substantial and widespread land use changes over the past several hundred years. Before settlement by European immigrants, the landscape was primarily composed of extensive, unfragmented forests, interspersed with open habitats such as coastal plains, beaver-created wet meadows, and forest gaps created by fire. By the 18th and 19th centuries, most of the forested habitat had been converted to agricultural lands, and the beaver, a landscape architect, was nearly extinct. During this agricultural period, areas unsuitable for farming (e.g., wetlands and very steep slopes) served as "refugia" for much of the region's wildlife communities. Although current development pressures impinge on such areas, they remain some of our most biologically rich and unique habitats. More recently, farms have been abandoned as agricultural land uses shifted to states further west. Through natural successional processes, most former farm fields have reverted back to forests; some are still in a transitional state, consisting of meadow or shrubland habitat.

The key element that allowed wildlife to survive these changing land use patterns was habitat connectivity. As land uses changed over time, many wildlife species were able to adapt and even thrive. For instance, with the onset of agriculture, bog turtles began to make use of wet meadows maintained as open habitat through the light grazing of domestic cattle, rather than their traditional wildfire-created or beaver-maintained habitats. Certain grassland dependent birds, such as the bobolink and the eastern meadowlark, made use of hayfields as a surrogate for their native grassland breeding habitats.

However, today's land use patterns are entirely different from those of historic times. In the current wave of sprawl, permanent structures are erected. Highways, parking lots, and subdivisions fence in remaining tracts of habitat, fragment them into smaller pieces, and isolate them from other tracts. These permanent land use changes that sever habitat connections make it difficult, if not impossible, for wildlife to adapt in the face of changing land use, increasing the likelihood of local extinctions of species in the near-term. Compounding the problem for wildlife is that at the same time that habitat connectivity is diminishing, it will become increasingly important in the long-term, as global warming proceeds. Species will need to migrate northward or upslope to higher elevations to adapt to new temperature regimes and resulting changes in habitat structure and composition; where sprawl blocks this migration, species are likely to face extinction. The transitions that are occurring within our landscape today are more permanent than past changes and they do not accommodate our native biodiversity. The few wildlife species that have adapted to such changes are opportunistic and invasive species that thrive at the expense of a more diverse and balanced biological community (e.g., white-tailed deer, Canada geese, snapping turtles).

Landscape Configuration: Planning at the Landscape Level

As sprawl proceeds, large tracts of habitat within our landscape are fragmented into ever- smaller components. *To maintain biodiversity, we must ensure that remaining habitats are of sufficient*

acreage to support viable wildlife populations and that they are arranged in such a way to allow dispersal of animals across the landscape. Although careful planning can mitigate some of the adverse impacts of sprawl, most planning occurs on a site-specific scale, and does not consider much larger landscape-scale ramifications. Ironically, the land review process, as required by the New York State Environmental Quality Review Act (SEQR), may actually foster fragmentation by considering too small an area in the review process.

To ensure that development is compatible with biodiversity, core wildlife habitat areas and the corridors that connect them must be accommodated. In general, larger core areas are better able to support healthy, viable wildlife populations than smaller areas. The connections between core areas are of paramount importance as they enable dispersal of animals among the core areas, maintaining gene pools and preventing extirpations. Such connections have traditionally been referred to as "corridors." Corridor is an appropriate name because it implies movement from one area to another. However, that name can also be misleading. A wildlife corridor is not a narrow, linear green strip between habitats. It is highly unlikely that such strips, which are often associated with walking paths or bike trails, would be used by most wildlife. Instead, MCA's definition of a corridor is a broad swath of habitat that connects core habitat areas. Although these swaths may not be as pristine as the parks or the hubs that they connect, they do provide secondary habitat in addition to their role as dispersal corridors. The movement of wildlife across the landscape can be likened to the sheet flow of water across land during a flood. Development should be located so that there are sufficient spaces for wildlife to move through and around development nodes, rather than attempting to force wildlife movements into human-created linear configurations.

Because we are making permanent changes to our landscape, it is imperative to carefully identify where the matrix of wildlife habitats and corridors occurs. It is not sufficient to randomly protect small parcels of habitat across the region in the hope that they will be beneficial to wildlife. Instead, we must discover where species already occur (i.e., which habitats are most valuable) and use this information as a template for making future land use decisions. If we apply this template to guide development patterns, it may be possible to maintain biodiversity and ecological health. Without this template to guide us, loss of biodiversity is a certainty.

This approach may sound simple, but it constitutes a 180-degree shift from the way development has been planned for to-date. Instead of erroneously assuming that natural resources will rearrange themselves around a development, we must understand the resources by gathering data and then fit the development in appropriate places. This approach is not only logical but is also cost-effective in the short- and long-term. In the short-term, it provides transparent, easily accessible information upon which to base land use decisions. By having an agreed-upon set of data, the planning conversation shifts from lengthy, contentious discussions about the quality of the data to a much more useful discussion about the implications of the data. This results in better, more ecologically sound projects and avoids protracted and costly arguments between opposing viewpoints concerning the impacts of development. In the long-term, ecosystems are protected in their entirety because decisions are made with a regional ecological context in mind, which prevents fragmentation of the ecosystem into smaller, dysfunctional units, avoiding mitigation that is both costly and, often, ineffective.

Methods

Study Area Delineation & Site Access

The North Castle Biodiversity Survey study area is approximately 1,000 acres (see map in Appendix A). MCA and representatives of the Town of North Castle delineated the study area based on a combination of factors including a) land within the town that is relatively undeveloped/ unfragmented and therefore likely to contain significant wildlife resources, b) land that is at risk of development, and c) lands that are contiguous, as opposed to being fragmented by I-684. While all roads fragment habitat to some degree, I-684, being a major highway with multiple lanes, rapidly moving traffic, and median blockades is an insurmountable obstacle for the vast majority of wildlife species. Unfortunately, I-684 bisects the Town of North Castle into two separate ecological zones, one to the east and the other to the west of I-684. Because this study aims to identify remaining quality habitat and connections between them, an effort was made to delineate the study area so that it was contained within one of those zones. Therefore, the North Castle study area is in the west zone with the exception of a small fraction of the study area that is in the east zone, adjacent to Baldwin Road. This fraction in the east zone was included because it is a large parcel of unfragmented habitat that may contain sensitive species, and because the I-684 underpass along Baldwin Road could, theoretically, provide some level of habitat connectivity with the west zone.

Once the study area was delineated, MCA coordinated with the Town of North Castle to request access to private land for biodiversity surveys. Supervisor Berman's office mailed letters to the 139 landowners of all 164 parcels in the study area requesting permission to access the land, as well as providing informational materials describing the study. In order to publicize the study to town leaders and the public, MCA provided a concise PowerPoint presentation to the North Castle Town Board on April 11, 2007, and an extended PowerPoint presentation and question-and-answer session the next day, April 12, 2007, in a public forum directed at landowners. Both sessions took place at North Castle Town Hall in Armonk, New York at 7:30pm. The evening time slot was chosen to facilitate landowner attendance.

While most of the estimated 1000 acre study area was surveyed by field biologists, portions of the study area were not surveyed due to two factors; first, because of lack of site access permission by landowners for certain parcels, and, second, because the northwest portion of the study area has been recently been fragmented by housing developments (too recently to be seen on remote imagery used to delineate study areas) and therefore did not merit surveying. Nonetheless, we were able to survey a sufficient amount of acreage to make a determination on the biodiversity levels within the study area. In fact, the positive landowner response rate was comparable to previous MCA biodiversity studies. Of the 164 parcels in the study area, we received permission to survey 48, or a 29.3% positive response rate.

Field Data Collection

All sites were surveyed in 2007 for all three classes of animals (amphibians, birds, and reptiles), and most sites were surveyed on multiple occasions in order to maximize the likelihood of encountering wildlife species inhabiting the site. The land in the study area is mainly under private ownership by individuals and a not-for-profit organization (The Nature Conservancy's Eugene and Agnes Meyer Nature Preserve).

The MCA field ornithologist conducted breeding bird surveys during the breeding season (mid-May through early July) at peak song period, starting approximately thirty minutes before sunrise when weather conditions were calm (winds less than 10 mph, no rain), until approximately 12:00 noon, assuming weather conditions remained favorable. Species detection rates are maximized at these times and under these conditions. The territory covered in a survey was based on habitat quality, the likelihood of encountering uncommon breeding birds, and accessibility. Most data was collected through auditory cues (i.e., listening to bird songs and calls). Playbacks (recordings of bird songs and calls) were used to help confirm or document uncommon birds, or common birds that had not yet been detected in an area. Less often, birds were visually observed by the field ornithologist.

MCA field herpetologists conducted surveys between late March and late June, concentrating on adult amphibians in March-April and reptiles in April-June. Survey techniques consisted primarily of visual searches and the turning over of cover objects (logs, rocks, and other debris).

The Focal Species Approach

MCA concentrates survey efforts on wildlife species which respond specifically to development impacts including habitat loss and habitat fragmentation. Such species can be further divided into two broad categories. Many focal species experience population declines as a result of urbanization. These species, referred to as "Development-Sensitive" focal species, are usually habitat specialists with relatively narrow ecological requirements and/or complex life-history requirements that involve use of multiple, interconnected habitat types. These specialized habitats and interconnections are often compromised by development. Examples include Neotropical migrant bird species, vernal pool-breeding amphibians, and long-lived species such as box turtles. Because of poor dispersal abilities, herpetofauna (amphibians and reptiles) are initially more affected by fragmentation than birds (see LaBruna, et al. 2006). Such animals tend to disappear from the landscape as their habitats are altered or fragmented. Populations of other focal species increase in response to urbanization. These species, referred to as "Development-Associated" focal species, are usually habitat generalists. That is, they can use a variety of habitat types because they do not have highly specific habitat requirements. Human alterations to landscapes favor, or "subsidize" (see Mitchell and Klemens 2000), these generalists which tend to be found in areas that have already been degraded or along habitat edges, such as highway right-of-ways. Examples of such species include Corvids (crows and jays), Canada geese, bullfrogs, snapping turtles, raccoons, and white-tailed deer. As urbanization proceeds, Development-Sensitive species are out-competed by Development-Associated species which tend to increase and, over time, replace Development-Sensitive species, resulting in an overall reduction of biodiversity.

MCA refers to the process of evaluating the mix of focal species, and its implications for ecosystem health and land use, as the "Focal Species Approach," or "FoSA." The results of FoSA analysis can enhance planning efforts by assessing the importance of individual sites for conservation. For example, development should be discouraged within areas that support healthy populations of Development-Sensitive focal species, and redirected toward sites that are already degraded (i.e., those that are dominated by Development-Associated species). Note that some species do not respond to development with either a clear increase or decrease in number. As a

result, they are not useful indicators of habitat quality and are not used in FoSA. We call these "Development-Neutral" species.

FoSA represents an innovative departure from traditional conservation efforts. By expanding the scope of investigation beyond federal or state listed threatened and endangered species, we are able to more proactively conserve natural resources. There are many species, currently unlisted and unprotected, whose populations are declining in response to sprawl. At the current pace of urbanization, these species are highly likely to be candidates for official listing in the near future. Rather than waiting until they are on the brink of extinction (when recovery efforts are not only dangerously uncertain, but also very expensive), it is wiser to attempt to address their habitat requirements and to stabilize their populations now. In addition, ecosystems contain complex interactions among many species. FoSA evaluates systems more reliably by considering a much broader suite of species and their relative abundances, as opposed to basing land use recommendations on a single threatened or endangered species. The FoSA method is not intended to replace the existing and necessary efforts to conserve threatened and endangered species; instead, it complements ongoing conservation efforts.

Lists of Development-Sensitive focal species vary from region to region because species ranges, habitat requirements, and responses to development also vary. The creation of the North Castle focal species list was based on a review of literature that addressed development-sensitivity within the New York/New England region (e.g., Andrle and Carroll 1988, Klemens 1990, Klemens 1993, Bull 1998, Klemens 2000) and on observations of species distribution trends in the field. MCA focused, in particular, on amphibians, birds, and reptiles. Besides being particularly "reactive" to development pressures (and therefore good indicators of ecosystem condition), the presence and status of these three groups of animals can be rapidly assessed in a relatively cost-efficient manner using established field techniques. Birds also show differing responses to fragmentation than do amphibians and reptiles. When used in tandem, these three groups provide a robust evaluation of ecosystem integrity.

In order to determine the relative quality of an area's habitat, we normally compare the proportion of Development-Sensitive to Development-Associated species. But because North Castle is located in a highly fragmented suburban matrix, Development-Associated species were observed regularly at nearly every survey site. Therefore, we focused on presence of Development-Sensitive species to delineate the areas that are most important for sustaining biodiversity. That is, presence of abundant Development-Associated species was not used heavily as a rationale to exclude an area from the Biodiversity Area map, nor was lack of Development-Associated species used heavily as a rationale to include an area in the Biodiversity Area map.

An effort was made to be as consistent as possible and use the same criteria, that is, the same Development-Sensitive species, to delineate biodiversity areas in this study as in previous studies in Westchester. In light of this, fourteen bird species observed in the current study that are identified as "Development-Sensitive" were not used to delineate biodiversity areas because they were not observed in a previous Westchester study and could therefore not be used for delineation in that study. See notations in Appendix C for these special cases.

Data Management & Analysis
Field survey data were stored in a Microsoft Access relational database, while spatial data, both species location and survey site location, were stored in shapefiles created in ArcGIS 9.0.

The data were analyzed and the Biodiversity Areas Map was created using ArcGIS 9.0.

Step 1 – FoSA Designation
For each observation of a bird, amphibian, or reptile, we attributed the appropriate FoSA category for that species, either: Development-Associated, Development-Neutral, or Development-Sensitive.

Step 2 – Habitat Mapping
Mapping herpetofauna habitat required a somewhat different approach than mapping bird habitat due to behavioral differences between these two groups of animals.

Herpetofauna
An animal's "home range" is the habitat area it needs in order to fulfill its life requirements such as obtaining food, water, and shelter. For most herpetofauna, home range size tends to be restricted and therefore a useful tool for mapping herpetofauna biodiversity areas. To approximate the home range habitat area used by observed individuals, using the ArcGIS 9.0 "buffer" function, we mapped a circular area around each Development-Sensitive herpetofauna point equal to that species' home range (with a buffer radius equal to home range radius). This technique assumes that the individual was observed at the center of its home range. Due to the relatively small size of most herpetofaunal home ranges, we considered this a reasonable assumption.

Birds
Birds tend to have large home ranges, so a) delineating home ranges would produce a large mapped area instead of pinpointing the most important bird habitat and b) the likelihood that the location where a bird is observed is at/near the center of its home range is smaller than that for herpetofauna, which would make mapping by this method less accurate. Therefore, we chose a different approach for mapping bird habitat. We mapped bird habitat not by estimating home range but rather according to how bird observations were spatially clustered. Rather than mapping individual circles around each point, we mapped the habitat area immediately surrounding a cluster of bird points and contiguous habitat of similar type.

Step 3 – Map Riparian Corridors
In recognition of the important role that rivers and their riparian corridors play as habitat and dispersal routes for wildlife, we mapped a 1000-foot-wide riparian corridor (500 feet from each side) along the Byram River and Wampus River Tributary.

Step 4 – Editing & Extrapolation
To further refine the map and avoid unnecessarily including low quality habitat areas, we made changes informed by additional GIS layers such as hydrography, wetlands, road networks, tax parcels, topography, and orthoimagery. We excluded from those sections that were already heavily fragmented (i.e., housing subdivisions), and included areas that either connected existing

mapped areas or were both adjacent to existing mapped areas and of high habitat quality (i.e., not fragmented by development).

Step 5 – Synthesis
All mapped layers were merged to form the final North Castle Biodiversity Area Map (see Appendix B).

Results & Discussion

Development-Sensitive Species of North Castle

Of all species observed in the study area, eighteen are designated by MCA as Development-Sensitive and used for delineation of biodiversity areas. See tables below for lists of these species (four amphibians, one reptile, and thirteen birds). For a comprehensive list of all species observed in the North Castle study area, see Appendix C.

Table 1-3. Common and Latin names of 18 Development-Sensitive species observed in the North Castle study area. "Status" column indicates any special status afforded by federal, state, or county governments, or Audubon Society WatchList status (birds only).

Table 1. Development-Sensitive Amphibians		
Common Name	**Latin Name**	**Status**
Spotted salamander	*Ambystoma maculatum*	
Four-toed salamander	*Hemidactylium scutatum*	
Red-spotted newt	*Notophthalmus viridescens*	
Wood frog	*Rana sylvatica*	

Table 2. Development-Sensitive Reptiles		
Common Name	**Latin Name**	**Status**
Eastern box turtle	*Terrapene carolina*	Special Concern (New York State); Threatened (Westchester Co.)

Table 3. Development-Sensitive Birds		
Common Name	**Latin Name**	**Status**
Pileated woodpecker	*Dryocopus pileatus*	
Eastern kingbird	*Tyrannus tyrannus*	
Field sparrow	*Spizella pusilla*	
Eastern towhee	*Pipilo erythrophthalmus*	
Scarlet tanager	*Piranga olivacea*	
Warbling vireo	*Vireo gilvus*	
Black-and-white warbler	*Mniotilta varia*	
Worm-eating warbler	*Helmitheros vermivorum*	Special Concern (Westchester Co); Declining (Audubon)
Chestnut-sided warbler	*Dendroica pensylvanica*	
Ovenbird	*Seiurus aurocapilla*	
Wood thrush	*Hylocichla mustelina*	Special Concern (Westchester Co); Declining (Audubon)
Veery	*Catharus fuscescens*	
Eastern bluebird	*Sialia sialis*	

The Biodiversity Area

Eugene and Agnes Meyer Nature Preserve

Central to the Biodiversity Area is The Nature Conservancy's Eugene and Agnes Meyer Nature Preserve. It is not surprising that this 247 acre preserve, protected from development and fragmentation, is a vital part of the Biodiversity Area. The Preserve provides habitat for many of the Development-Sensitive species we observed, including wood thrush, ovenbird, warbling vireo, field sparrow, worm-eating warbler, Eastern towhee, scarlet tanager, pileated woodpecker, wood frog, red-spotted newt, spotted salamander, and the only four-toed salamander and black-and-white warbler observed in the entire study area. The ovenbird, veery, and worm-eating warbler are highly area-sensitive birds, typically found in large forest patches. The wood thrush is also area-sensitive, though somewhat less so. Observations of these four species are an indication of large areas of quality forest habitat. Yet the Biodiversity Area extends beyond the boundary of the Preserve into unprotected lands. This is because these areas, though somewhat fragmented by houses and roads, still host both herpetological and avian Development-Sensitive species. It is important that these ecological linkages to the Preserve be maintained and not severed by ecologically-inappropriate development.

Beyond the Preserve

While the importance of the Eugene and Agnes Meyer Nature Preserve is not surprising, what is surprising is that the portion of the study area south of the Preserve contains as many Development-Sensitive species as it does. This is unexpected for two reasons – this area's narrow width, which contributes to vulnerability to "edge effects" which degrade wildlife habitat, and its proximity to I-684, a major highway. The effects of highways on local wildlife are highly detrimental because a highway is not only a cause of mortality but also poses an insurmountable physical obstacle for most wildlife, limiting their ability to meet life and reproductive requirements such as finding food, burrows, mates, and nest sites. The area's proximity to I-684 also means that it was subject to the forces of civil engineering when the interstate was being constructed. Mining, filling, and dredging were likely conducted along the interstate's periphery, activities which would have been destructive to wetlands. For these reasons, it is rather unexpected that three wetlands of relatively good quality exist in close proximity (one within 60 feet) to I-684. Wood frog and spotted salamander, two Development-Sensitive species, were observed in these wetlands. Further, we observed evidence that the wood frog and spotted salamander populations are reproducing by the presence of wood frog tadpoles and spotted salamander egg masses. The presence of wood frogs and spotted salamanders indicates that there are still functional wetlands with sufficient adjacent upland habitat to sustain these two Development-Sensitive species, and potentially other wetland species as well. Although a portion of the wetland adjacent to I-684 contains a large stand of *Phragmites* (an invasive that crowds out native vegetation and an indicator of disturbed/degraded habitat), it is possible to contain the spread of *Phragmites* through manual techniques (cutting and careful herbicide application), as well as addressing the underlying degradation issues (often salt or chemical pollution from runoff). Such management efforts may help to maintain the quality of the wetland, but should be undertaken with the understanding that the wetland's proximity to the interstate, a source of pollution, limits its restoration potential. Also, it appears that this wetland is within the interstate right-of-way, and as such the New York State Department of Transportation should be involved in planning any management activities. Exact locations of the

three wetlands discussed above are not available in this report but will be provided to the North Castle Conservation Board.

Beyond these particular wetlands, observations of several Development-Sensitive bird species (including wood thrush, scarlet tanager, warbling vireo, veery, chestnut-sided warbler, and worm-eating warbler) and the only box turtle observation in the entire study area compelled us to include the southern portion of the study area in the Biodiversity Area. This portion of the Biodiversity Area is so narrow that further infringement by development would undoubtedly result in the loss of these species. A large portion of this area is owned by The Children's Land Preserve, which has put the land up for sale as of the publication of this report. We strongly recommend that the Town utilize the tools at its disposal to protect this habitat for the multiple Development-Sensitive species found on this land (see "Recommendations for Implementation" which elaborates on those tools). Due to housing developments located in the center of the study area, three "constriction points" exist (see points 1, 2 and 3 in Appendix B). A constriction point is a location within the Biodiversity Area where the ecological connection is tenuous and in danger of being cut off altogether. Protecting these connections is a high priority.

The Box Turtle Population

The box turtle observation should be interpreted with caution. While this observation is evidence that the species still exists within the Biodiversity Area, the fact that only a single individual was found could be an indication that their numbers in North Castle are diminishing. Additionally, box turtles are long-lived species, so presence of adults does not necessarily indicate a healthy, reproducing population. Older individuals can remain long after the population has ceased to reproduce. Or, if reproduction is still occurring, the predation rate on hatchlings may be so high that none survive to reproductive age (the Development-Associated raccoon, skunk, and opossum all prey on turtle hatchlings). Only observation of a variety of age classes is evidence that the population is reproducing. The individual observed in the study area was an adult male of thirty to forty years and therefore, unfortunately, does not illuminate the reproductive status of the population.

MCA observed a similar phenomenon in southern Westchester in the Pocantico Hills Biodiversity Study which was conducted at Rockefeller State Park Preserve and adjacent Rockefeller family lands (see LaBruna et al. 2006). Surveys there revealed a remnant, non-sustainable box turtle population, and MCA recommended that a mark-recapture study be conducted with the potential of a box turtle reintroduction program. However, we do not recommend a reintroduction program in the North Castle Biodiversity Area because, unlike Pocantico Hills, the habitat in North Castle retains ecological connections to adjacent turtle habitat and therefore reintroduction efforts could introduce diseases and maladaptive genes into the wild turtle population, harming the population more than helping it. Instead, we advocate that land owners and managers protect, manage, and restore turtle habitat with the expectation that, in time, the turtles will respond with a growth in population.

The Former Seven Springs Estate

The Biodiversity Area also includes the North Castle portion of the former Seven Springs estate. While the current owner did not provide MCA field biologists with permission to access the land for biodiversity surveys, the land is included in the Biodiversity Area Map because

Development-Sensitive species were observed on its border with the Eugene and Agnes Meyer Nature Preserve. This fact, combined with the fact that the parcel is relatively unfragmented by roads and housing developments (as seen in aerial imagery and road maps), strongly indicates that these species are present on Seven Springs land as well. A 1997 study conducted by Michael W. Klemens of MCA and Erik Kiviat of Hudsonia, Ltd. (see Klemens & Kiviat 1997) produced mixed results. They described the herpetofauna as "surprisingly species-poor," likely due to "previous intensive use of the site for agriculture and other activities," however; they did find three box turtles and two wood frogs. The presence of these two Development-Sensitive species is further support for inclusion of the Seven Springs estate in the Biodiversity Area.

Portions Excluded from Biodiversity Area Map

The Biodiversity Area map does not include the small fraction of the study area east of I-684 as this area, though undeveloped, contains few Development-Sensitive species. Sandwiched between two heavily traveled roads, I-684 and Bedford Road, the "edge effects" from these two roads may be a reason that few Development-Sensitive species were observed there. The history of the area for use as a work site during the construction of the interstate may also play a role (J. Fava, personal communication, Oct 3, 2007). Also excluded from the Biodiversity Area are portions of the study area that are fragmented by housing developments as this type of development provides low-quality habitat that only Development-Associated species can use. This includes most of the western "panhandle" of the study area, as well as two sections in the middle of the study area (see "Excluded Areas" on Biodiversity Area Map).

In summary, the Biodiversity Area was delineated to encompass the above-described vernal pools, their adjacent upland habitat (utilized by the vernal pool-dependent wood frog and spotted salamander), forest habitat utilized by numerous Development-Sensitive birds for both foraging and breeding, and box turtle habitat. While these Development-Sensitive species deserve protection in and of themselves, to reiterate, they are indicators of quality habitat, thus protecting their habitat also protects many other species.

Improving Habitat Quality

The purpose of this project is to identify the extent of biodiverse habitat remaining in the study area. However, we would be remiss if we did not also address the importance of habitat *quality* to wildlife survival. When we speak of habitat quality, we are referring to: (1) abundance of vegetation, (2) plant species diversity, (3) structural complexity (for forests this means layers of vegetation including mature trees and an understory composed of smaller trees/saplings, shrubs, and a layer of herbaceous undergrowth), and (4) control of any invasive plants or predators (e.g., Japanese barberry, domestic cat). Salamanders, hatchling turtles, and ground-nesting birds use the forest understory as cover from predators, while the latter also use the understory for nesting. Habitat quality also affects the ability of Neo-tropical migrant birds to survive their fall migration. After the breeding season, the adult bird population density increases dramatically due to dispersal of fledgling birds. Therefore, bird populations require greater food and habitat resources between the time birds fledge the nest and the time migration begins. During this critical time of post-breeding dispersal (approximately July to September, depending on the species), birds extend their range beyond the breeding territory (this is when you are more likely to see uncommon bird sightings, such as hummingbirds, in your backyard) and Neo-tropical migrants begin to store fats in preparation for migration, provided they can access a sufficient

diversity and abundance of food resources (insects, fruits, and/or nuts, depending on bird species). Thus, the ability of the habitat to provide those food resources (i.e., habitat quality) is vital to the birds' survival.

Utilize Deer Exclosures

A major threat to forest habitat quality in Westchester is deer overbrowse (excessive foraging), which strips forests of understory vegetation, reduces tree diversity, diminishes forest structural complexity, and encourages establishment of invasive plants. White-tailed deer proliferate in suburbanized landscapes as they benefit from the large amount of "edge" habitat (where forest meets field) made available by fragmentation. However, this also means that the remaining tracts of forest in the landscape experience more deer browse than they can sustain, resulting in a forest with minimal, degraded understory. A practical method property owners and managers can utilize to improve habitat quality is to install deer exclosures (fencing that excludes deer from a given area). Exclosures do not necessarily need to encircle the entire property; indeed, for large properties the cost of doing so may be prohibitive. But even an exclosure of limited size will see the vegetation within it rebound and thrive in the absence of deer. If you have several different habitat types on your property, such as wetlands, moist woods, and dry woods, consider installing a deer exclosure that encompasses portions of all of these habitat types. We recommend fencing that has large enough holes to allow smaller wildlife to pass through so that only deer are excluded.

It is important to note that the value of deer exclosures is limited to small-scale protection. This is helpful in providing localized habitat restoration for birds and other wildlife; however, it will not solve the regional problem of deer overpopulation, as exclosures may increase the density of deer in non-exclosed areas. Since roadways and right-of-ways fall into this category, and because deer readily used these corridors, increased numbers of traffic collisions could be a real concern. Long-term reduction and stabilization of the deer herd in Westchester will require multiple management techniques at multiple scales and the involvement of the New York State Department of Environmental Conservation (DEC). Representatives of the DEC, Westchester County, and conservation, education, hunting, and humane organizations banded together in 2006 to deal with the deer overpopulation issue, forming the Westchester County Forest Regeneration Citizens' Task Force. The group plans to release a report in early 2008 that provides guidelines to towns, villages, and the county on options for controlling the deer population. You can also contact the DEC Region 3 Wildlife Department at (845) 256-3098 to inquire about what they are doing to control the deer herd in Westchester.

"Naturalize" Your Land

Landowners and land managers can improve habitat quality by "naturalizing" manicured lawns and gardens. The following are ways to make your land more hospitable to wildlife:

- ✍ since lawns are ecological "deserts," reduce lawn size in favor of forest, grassland or wetland,
- ✍ decrease use of biocides (pesticides, insecticides, and herbicides), particularly near waterways,
- ✍ allow a "buffer" zone of shrubs to grow where there is currently an abrupt transition between lawn and forest to benefit bird species like brown thrasher, chestnut-sided warbler, and blue-winged warbler,

- ✍ mow fields every three-to-five years instead of annually to create "old field" habitat to benefit bird species such as pheasant, yellow warbler, blue-winged warbler, and ruffed grouse, and
- ✍ allow a complex, multi-layered vegetation structure to grow in your forest instead of pruning, raking, and otherwise simplifying it.

Keep Cats Indoors

Reducing the number of invasive predators in wildlife habitat will also help protect North Castle's native biodiversity. The domestic cat, a Development-Associated invasive species, is a skilled hunter that hunts a wide variety of prey, ranging from birds and amphibians to reptiles and small mammals. The cat has made the World Conservation Union's list of "100 of the World's Worst Invasive Alien Species" (Lowe et al. 2000) due to the damage cats inflict on native biodiversity throughout the world. One conservative estimate states that the combined outdoor pet cat and feral cat population of 71 million kills 568 million birds per year in the United States alone (Pimentel et al. 2000). MCA supports the American Bird Conservancy's call on cat owners to keep their cats indoors to protect wildlife. For more information on the "Cats Indoors!" campaign, go to www.abcbirds.org/cats/.

Opportunities for Future Studies

Unlike previous Biodiversity Areas delineated by MCA, the North Castle Biodiversity Area is contained within one municipality. This is intentional and due to the limited scope of the original project. However, there is an opportunity to investigate expanding the North Castle Biodiversity Area due to a relative lack of development northward in Bedford and northwest in New Castle, two towns which are already partners with MCA from previous biodiversity studies. A future study should include Butler Memorial Sanctuary in Bedford, but should go no further east than I-684, and should extend westward to Whippoorwill Road in New Castle. The northern border for the study should stretch no further north than Route 172, South Bedford Road. Unfortunately, there are no opportunities to extend the North Castle Biodiversity Area east or south due to the ecological barriers of I-684 and heavy residential development, respectively. However, there are opportunities to investigate biodiversity resources in other portions of North Castle, such as within the Kensico and Mianus Watersheds, and we encourage the town to pursue these opportunities as well.

Summary of "Results & Discussion" Recommendations

1. Maintain the ecological linkages on unprotected lands to the Meyer Preserve.
2. Protect the southern portion of the Biodiversity Area and the three "constriction points" from development.
3. Consider controlling spread of Phragmites in wetland adjacent to I-684.
4. Protect, manage, and restore turtle habitat within Biodiversity Area.
5. Control North Castle's deer population by (A) Using deer exclosures for small-scale habitat protection, and (B) becoming involved in regional deer control.
6. Encourage "naturalizing" of lawns and gardens.
7. Encourage pet owners to keep cats indoors.
8. Conduct future biodiversity studies (A) at other sites within North Castle and (B) with the potential of extending the North Castle Biodiversity Area to Bedford and New Castle.

Recommendations for Implementation

The following sections outline tools and techniques that can be employed to achieve the goal of this biodiversity plan—a sustainable balance between development and conservation within North Castle and the larger lower Hudson Valley region.

Important Considerations and Caveats

a. Mapped areas are not being recommended solely for land preservation.

Preservation of all the land within the mapped Biodiversity Area through purchase or easement is not a prerequisite to conservation. Some of the mapped areas contain privately owned land with homes and contribute, through taxes, to the economic health and sustainability of the towns. Instead, within the Biodiversity Area, we propose a balanced approach to conservation and development that incorporates the diverse suite of land use planning and conservation tools presented below.

b. Development outside of the delineated Biodiversity Area needs to remain mindful of environmental and land use issues.

Exclusion from the mapped Biodiversity Area does *not* provide "carte blanche" for development activities. The map is intended for broad-scale planning efforts, not for development planning and review at a site-specific scale. Regardless of location, individual development proposals—both inside and outside of the mapped area—should undergo careful review and consideration of potential biological impacts.

c. Conservation opportunities may occur outside of the Biodiversity Area.

Small or isolated habitats outside of the mapped areas may contain significant species or natural communities that have high conservation value (e.g., a fen, bog, or remnant patch of old-growth forest). They may have been excluded from our maps because (1) they were not detected during surveys and analyses, or (2) no connectivity could be established with a larger ecological corridor or system. While careful planning within the mapped area will contribute significantly to the long-term maintenance of biodiversity at a regional scale, additional conservation opportunities should be considered.

Recommendations for Future Development and Economic Growth

To balance development with the conservation goals of this project, we propose that it continue to be concentrated in areas outside of those identified as the Biodiversity Area. In particular, we recommend continuing to encourage new development in and around existing development nodes (i.e., the hamlets of Armonk, Banksville and North White Plains). By doing this, it may be possible to alleviate development pressures in areas that are critical for biodiversity. Previously developed areas contain the infrastructure (roads, water lines, sewage lines, etc.) and services (schools, hospitals, stores, etc.) to support further development in a cost-effective manner. Conversely, development that sprawls into the Biodiversity Area would have both ecological and economic costs for the town. We must reiterate that development does not necessarily need to be excluded from the Biodiversity Area; instead, the towns should attempt to focus development in

areas that have already experienced such growth and simultaneously reduce the "ecological footprint" of development in the Biodiversity Area. Recommendations to achieve these goals are made in the following two sections.

Recommendations for Land Preservation

Although this project focuses on conservation through an expanded scale and scope of local land use planning, under certain circumstances land preservation remains the best route to maintaining biodiversity on select parcels.

a. Attempt to add area (through acquisition or easement) to existing protected areas.

The Nature Conservancy's Eugene and Agnes Meyer Nature Preserve is the core protected zone of the Biodiversity Area. Adding additional protected area to its periphery will buffer the existing protected habitat from externally caused degradations (e.g., runoff of polluted water from roads and parking lots, noise pollution). It will also help to reduce "edge effects," (e.g., changes in vegetation structure, temperature, predation levels, parasitism levels, and other factors near habitat edges), which can negatively impact many Development-Sensitive species, including those that are area-sensitive such as the pileated woodpecker and worm-eating warbler.

b. Attempt to preserve (through acquisition or easement) areas that are currently unprotected and have significant levels of biodiversity, or that contain populations of imperiled species.

Unlike the northern portion of the Biodiversity Area, the southern portion lacks a large protected area; however, it contains many Development-Sensitive species worthy of protection. Preserving some of the Biodiversity Area's southern portion through acquisition or easement would afford a degree of protection presently absent. There are no easements or preserves held by the Westchester Land Trust in this area.

c. Partner with local and regional land trusts and others to protect areas identified in this report.

d. Develop an open space preservation plan for your town that incorporates biodiversity issues or integrate biodiversity criteria, through amendments, into your existing open space plan.

North Castle's Open Space Committee has adopted a list of "Criteria for Identifying and Prioritizing Properties for Potential Open Space Acquisition" (Open Space Committee 2005). While the listed criteria include many important factors such as "presence of wetlands, lakes, ponds, streams, and other water bodies on the property" and "presence of habitats and role property plays as part of a nature corridor," which often, but not always, overlap with biodiverse areas, a property's degree of "biodiversity" is not specified as a criterion per se. We recommend that the Open Space Committee consider biodiversity and the presence of Development-Sensitive species as factors in prioritizing a property for acquisition or protection.

e. When considering proposals to subdivide and develop parcels, always opt for conservation easements and open space reservations instead of fee-in-lieu payments or other buyouts.

Continue choosing conservation easements before open space reservations and have those easements held by a land trust or municipality instead of a homeowner's association. Attempts should be made to consolidate the portions under easement, because one large protected area is more valuable from a conservation standpoint than numerous small, fragmented protected areas. If possible, the portion of a property to be protected in this manner should be selected based on its biodiversity value in relation to other portions. It is important to note that an applicant cannot usually receive a charitable donation for an easement that is a *requirement* of a development application. Individuals are advised to obtain professional advice on how to create conservation easements as part of the site development process *prior to* entering the formal land use permitting process.

Recommendations for Local Land Use Planning

The following recommendations (including procedures, steps, and tools) can help to maintain biodiversity in areas where land preservation is not feasible or desirable. These recommendations are not listed in order of priority.

a. Avoid large-lot zoning, including "upzoning."

Increasing the size of buildable residential lots, or "upzoning," is often perceived as a "quick fix" to sprawl. These zoning changes result in development patterns that appear to be "green," with fewer houses and more trees visible. In reality, however, upzoning encourages sprawl by spreading the impacts of development across a much larger area, destabilizing and often eliminating local populations of Development-Sensitive wildlife species while also creating large amounts of "edge" habitat. Statistics show that while the human population in the New York metropolitan region increased by only 8% between 1970 and 1990, land consumption during the same period increased by 65% (Diamond and Noonan, 1996). It is no surprise that wildlife, habitats, and ecosystem integrity are disappearing. A shift from large-lot zoning to a more centralized, compact pattern of development is critical to maintain the biodiversity and ecological health of our region. From an ecological standpoint, upzoning is only acceptable when accompanied by a *mandatory* cluster requirement (see next section and Klemens et al., 2006, section 3).

b. Consider novel types of development, including Conservation Subdivisions and Traditional Neighborhood Design.

To maximize the ecological benefits, siting of clusters should be based on knowledge of relative biodiversity levels and proximity to other developments. It is imperative that housing clusters take up no more than 25-50% of the parcel being considered for development. This allows 50-75% of the parcel to remain free of development, providing ecological connection to adjacent parcels. This makes it is possible to reduce the amount and impact of associated infrastructure, such as roads, reducing the "ecological footprint" of development to more closely match the "built footprint."

Traditional Neighborhood Design (TND) recreates traditional, village-style development by setting densely developed nodes in a matrix of large open space that enable wildlife to circumvent developed areas. TNDs are popular because they create a sense of character and

community that is often lacking in conventional, "cookie-cutter" style subdivisions. Creating TNDs with real conservation value may require modification of existing municipal regulations, zoning codes, and procedures in order to harmonize the goals of tight clusters with existing municipal standards.

Making incentives available to developers who build these types of eco-appropriate developments is an important consideration. Density bonuses (permitting a developer to build additional units of clustered housing), fast-tracking of the permitting process, and easing of other building standards are examples of incentives that the town may opt to utilize.

c. Pass a Conservation Overlay District Ordinance (e.g., MCA Technical Paper No. 3).

The purpose of a conservation overlay district ordinance is to maintain habitat connectivity. It does so by minimizing the impacts of development within the designated conservation overlay district. A conservation overlay district ordinance need not completely prohibit development; development can be allowed within the conservation overlay district, but additional development regulations would apply, as would incentives for eco-appropriate development.

Most municipal laws and regulations created to protect natural resources address one type of resource (wetlands ordinances, tree preservation ordinances, steep slope ordinances, etc.). They tend not to address the ecological connections between habitat types, the connections that must be maintained to conserve many wildlife species. A conservation overlay can "pick up" where a wetlands ordinance "drops off." For instance, North Castle's wetlands ordinance stipulates a 100-foot buffer (or 150-foot when slope exceeds 25%) around wetlands (Town of North Castle 2006). This is an adequate buffer width for water quality protection purposes; however, it is inadequate for purposes of wildlife habitat protection. For instance, vernal pool-dependent amphibians require at least a 750-foot buffer of forested upland habitat. Rather than revising the wetlands ordinance to increase buffer width, it is often more practical to create a conservation overlay district in which development would be strictly controlled in the 750-foot buffer around vernal pools.

A conservation overlay district ordinance should also address connections between different types of wetland habitat (e.g., between vernal pools, semi-permanent pools, and ponds) and connections within a single habitat type. For instance, to maintain the integrity of forest habitat, a conservation overlay district ordinance can require that housing developments be conservation (cluster) developments rather than conventional subdivisions. As discussed above in *"b"*, the town can provide incentives for eco-appropriate development in the conservation overlay district.

Rather than a strict regulatory approach where a map is adopted and development within that mapped area is restricted and requires a permit, the conservation overlay district ordinance allows for an information-based dialogue to take place between the applicant and the Town (most likely the Planning Board). This dialogue allows the Planning Board to weigh alternatives against complex ecological variables in order to arrive at the best possible solution for that particular situation, something that the rigidity of regulations does not allow for.

A conservation overlay district is a useful tool that allows a town, through home rule authority, to influence patterns of development within its borders in a way that minimizes impacts to wildlife and habitats. We recommend that North Castle consider such an ordinance, adopting the entire Biodiversity Area map as the conservation overlay district, with the potential for expansion pending future biodiversity studies in other portions of the town.

d. Integrate the recommendations and maps in this report into your town's Comprehensive Plan.

It is important to note that Comprehensive Plans can be amended at any point, even after an update has occurred, so it is possible to incorporate the findings and recommendations of this report into the current plan.

Comprehensive Plans need to be more than a "shopping list" of community desires; for each goal, a clear pathway to attaining that goal must be laid out. For example, if a community desires to encourage TNDs, it must amend many of its regulations and procedures. The specifics of these changes should be detailed in the Comprehensive Plan.

e. Formalize the intermunicipal relationship between the Town of North Castle and other municipalities.

This recommendation will be applicable if and when the Town of North Castle partners with the towns of Bedford and New Castle to expand biodiversity surveys and protection, as we suggest. When this occurs, we recommend that the three towns:

- adopt an intermunicipal agreement, and
- establish an intermunicipal council.

The intermunicipal council should focus on a broad array of land use issues (affordable housing, transportation, economic development, recreation opportunities, tourism, and others). Biodiversity conservation will not be successful unless it is carefully woven into a broader tapestry of land use issues, such as the issue of water quality in the Byram Lake Reservoir watershed.

f. Encourage the extension and application of biodiversity and planning concepts, tools and mapped areas into towns adjacent to North Castle communities.

Conservation efforts in neighboring towns can add value to those in the North Castle. This is particularly important for adjacent towns that share ecological linkages, for example, the towns of Bedford and New Castle.

g. Encourage better SEQRA reviews by:

- Considering impacts beyond individual project sites (that is, consider cumulative impacts of site-specific development proposals on wildlife, habitat connections, and biodiversity at town- and region-wide scales).

- Encouraging use of the Generic Environmental Impact Statement (GEIS) process. This is a planning process wherein the town creates an environmental impact statement for a large block of land. Then, as individual development projects are proposed, they are evaluated against the findings of the GEIS. The town recovers the costs of the GEIS through a pro-rated fee assigned to each development project.

- Requiring standards for wildlife surveys to ensure that adequate effort is being expended—at appropriate times of year and using established techniques—to assess wildlife resources for preparation of development proposals at specific sites. MCA has prepared standards to this effect that have already been adopted by towns in New York. The "Scoping" stage of the SEQR process is important because it is then that the type of studies and study methods are determined. The "Completeness Review" is also important because it is the point at which it is determined whether or not studies have been conducted in accordance with the Scoping. If not, then it is required that the studies be completed before the Draft Environmental Impact Statement is designated as "sufficiently complete for public review."

h. Seek out biodiversity training workshops and other educational forums for your town's land use decision-makers.

An informed group of decision-makers is empowered and motivated to ensure that their town's natural resources are maintained. Training and educational programs available in this region are offered by MCA and by our partner organizations, such as Hudsonia, Ltd., Glynwood Center, and Pace University's Land Use Law Center. NYS DEC's Hudson River Estuary Program coordinates a variety of training and educational opportunities. A new resource is MCA Technical Paper No. 10, "From Planning to Action: Biodiversity Conservation in Connecticut Towns" (Klemens et al., 2006) which contains guidance for land use planners and has direct applicability to New York towns. Consider instating a training requirement to encourage land use decision makers to utilize these resources.

i. Develop and support programs to educate citizens in your town about the importance of biodiversity.

An informed citizenry is a constituency that can empower elected officials to make decisions that benefit both people and the environment. An example of an action nearby towns have taken to this end is the public lecture series on issues related to biodiversity conservation planned by the Bedford-Somers Biodiversity Training Group.

j. Map vernal pools and other small wetlands within your town.

North Castle already has a strong wetlands ordinance (as amended in 2006) that protects multiple wetland types and wetlands of all sizes, as well as a surrounding buffer or 100 to 150 feet (depending on slope). However, to successfully protect small wetlands, which often support a unique assemblage of biodiversity that cannot be found in larger wetlands, one first needs to know where they are located. Broad-scale wetlands maps often fail to identify smaller wetlands and as a result, they tend to "slip" through regulatory "cracks." Proactively mapping small

wetlands is preferable to identifying wetlands reactively (as development proposals are submitted) because it provides town staff with a regional context which will assist them in making informed planning choices. Although a labor-intensive task, mapping vernal pools would be a prudent next step for North Castle to undertake. A volunteer, citizen-scientist mapping program may help to make this a practical task. Procedures and considerations for mapping vernal pools on a town-wide basis are provided in MCA Technical Paper No. 5 (Calhoun and Klemens 2002).

k. Formally adopt and apply "Best Management Practices" and "Best Development Practices" that can help to reduce impacts to biodiversity during both town-wide planning and individual site review processes.

An example of such a manual is MCA Technical Paper No. 5**, "**Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States" (Calhoun and Klemens 2002), which provides guidelines for protecting vernal pool species in areas being developed. Additional BMPs from other organizations and agencies may also prove to be useful.

l. Develop and adopt a Rare, Threatened, and Endangered species list that is specific to your town.

Federal and state lists do not take into account the decline or extinction of species at the scale of individual towns, groups of towns, watersheds, or counties. Some counties in New York have developed lists, but they have no jurisdiction outside of county parks. We recommend that North Castle develop and adopt its own list (in consultation with conservation organizations and local naturalists), and that the Town require listed species to be considered during review of development proposals. Such a list would not be regulatory in nature but would instead help to guide discussions and generate options in development proposals (e.g., where to locate open space areas created as part of the site approval process).

m. Ensure that all environmental regulations within your town are adequately enforced.

Enforcement should be a major focus of communities attempting to preserve their biodiversity resources because any lack of enforcement, or uneven enforcement, undermines the effectiveness of environmental regulations. However, enforcement can be expensive and time-consuming; therefore, communities with limited funds and time should consider hiring enforcement officers on cost-share and time-share bases with neighboring communities.

Placing multiple conditions on projects in order to approve them creates a series of follow-up tasks for local officials to monitor, overextending town resources. Although town officials often use "conditioning" out of an effort to be helpful, it is not the responsibility of the town to repair an inadequate proposal in this manner. It is better to deny an application and provide clear guidance to the applicant on how to remedy deficiencies in the next application rather than permit the application with numerous conditions (see Klemens, et al., 2006, section 11). This is because "conditioning" (1) rarely creates a successful project out of an inferior proposal and (2)

disenfranchises the public as conditions are to be met after the public review period has concluded.

n. Revise the formula used by your town to calculate housing density yields.

Like many other towns, in North Castle, residential housing density yields for subdivisions are calculated by dividing total property acreage by lot size, as established in zoning codes. While this formula in and of itself does not account for areas within properties that are not buildable due to environmental constraints, fortunately, town ordinances remove North Castle's wetlands, steep slopes, and floodplains from building consideration. This results in a "theoretical" number of house lots. The next step for a conventional housing subdivision, as required by the Westchester County Department of Health, would be to perc-test every site that requires a septic system to see if the soils can support such a system. This determines the final number of buildable house lots. However, when building a conservation (cluster) subdivision, what often happens is that the number of clustered house lots is based on the "theoretical" figure without perc-testing an adequate number of lots. According to Arendt (1999), a subset of at least 10% of the "theoretical" lots should be perc-tested to determine if the site can truly support that number of clustered lots. Subdivision regulations should stipulate these procedures. See Arendt (1999) for further details.

o. Strive to make the land use planning and review processes as inclusive and transparent as possible.

Land use planning and review procedures are often fraught with mistrust and tension, resulting in decisions that satisfy few or none. All interested parties should be included as early as possible in this process, preferably at a "pre-application" meeting, to incorporate the needs and goals of developers, landowners, local governments, agencies, environmental advocates, affordable housing advocates, and private citizens. Through inclusiveness and transparency, intractable differences may be avoided and acceptable solutions achieved before positions become entrenched.

p. Include the maintenance of biodiversity as a major goal in the management plans of parks, preserves, and other protected areas within the Biodiversity Area.

Most parks and preserves are protected for a variety of reasons, including recreation, aesthetics, protection of water supplies, and biodiversity, among others. Park development and management activities that target one of these goals may come at the expense of the others. For instance, clearing shrubs and ground layer vegetation to improve views within a park will negatively impact water quality and biodiversity. Such clearing may be appropriate for a small park within an urbanized area, where primary goals include picnicking and walking. However, parks and preserves within the Biodiversity Area should be carefully managed to ensure that biodiversity can persist. With careful planning, biodiversity conservation can be accomplished in harmony with other goals.

q. Consider opportunities for restoration of ecological connectivity when upgrading and maintaining roads and highways.

Roads and highways sever ecological connections. Where they cross the Biodiversity Area, these ecological connections should be improved during the upgrading and maintenance of the roads. For example, to enhance amphibian passage across roads, it is possible to build an underpass. To ensure that the passage is used by wildlife, it should meet certain specifications. Stream corridors can form natural connectivity across roads; culverts should be designed and installed to maximize this connectivity potential. For a complete discussion of road impacts on wildlife, along with potential solutions, see Forman et al. (2003).

Literature Cited

Allan, B.F., F. Keesing, and R.S. Ostfeld. 2003. Effect of forest fragmentation on Lyme disease risk. Conservation Biology 17:267-272.

Andrle, R.F. and J.R. Carroll, editors. 1988. Atlas of breeding birds in New York State. Cornell University Press, Ithaca, NY.

Arendt, R. 1999. Growing greener: Putting conservation into local plans and ordinances. Island Press, Washington, D.C.

Bull, J.L. 1998. Bull's birds of New York State. E. Levine, editor. Cornell University Press, Ithaca, NY.

Calhoun, A.J.K. and M.W. Klemens. 2002. Best development practices: Conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, NY.

Cane, J. H. 2005. Bees, pollination, and the challenges of sprawl. Pages 109-124 in E. A. Johnson and M. W. Klemens, editors. Nature in fragments: The legacy of sprawl. Columbia University Press, New York.

Diamond, H.L. and P.F. Noonan. 1996. Land use in America. Island Press, Washington, D.C.

Forman, R. T. T, D. Sperling, J. A. Bissonette, A. P. Clevenger, C. D. Cutshall, V. H. Dale, L, Fahrig, R. France, C. R. Goldman, K. Heanue, J. A. Jones, F. J. Swanson, T. Turrentine, T. C. Winter. 2003. Road ecology: Science and solutions. Island Press, Washington, D.C.

Klemens, M.W. 1990. The herpetofauna of southwestern New England. Ph.D. dissertation, University of Kent, Canterbury, UK.

Klemens, M.W. 1993. Amphibians and reptiles of Connecticut and adjacent regions. State Geological and Natural History Survey of Connecticut, Bulletin 112.

Klemens, M.W. 2000. Amphibians and reptiles in Connecticut: A checklist with notes on conservation, status, identification, and distribution. Connecticut Department of Environmental Protection, Bulletin 32.

Klemens, M. W. and E. Kiviat. 1997. Bog turtle assessment and survey, Seven Springs Farm proposed golf course site, Mt. Kisco, Westchester County, New York. Report to the Trump Organization. Hudsonia, Red Hook, NY.

Klemens, M. W., M. F. Shansky and H. J. Gruner. 2006. From planning to action: Biodiversity conservation in Connecticut towns. MCA Technical Paper No. 10, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

LaBruna, D. T., M. W. Klemens, J. D. Avery and K. J. Ryan. 2006. Pocantico Hills biodiversity plan, Rockefeller State Park Preserve and associated private lands: A public-private land stewardship initiative. MCA Technical Paper No. 12, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

Lowe, S., M. Browne, S. Boudjelas, and M. de Poorter. 2000. 100 of the world's worst invasive alien species: A selection from the global invasive species database. Invasive Species Specialist Group of the Species Survival Commission of the World Conservation Union. Available from http://www.issg.org/booklet.pdf (accessed 23 Oct 2007).

Mitchell, J. C., and M. W. Klemens. 2000. Primary and secondary effects of habitat alteration. Pages 5-32 in M. W. Klemens, editor. Turtle Conservation. Smithsonian Institution Press, Washington, D.C.

Morse, R. A. and N. W. Calderone. 2000. The value of honey bees as pollinators of U. S. crops in 2000. Bee Culture 128:1-15.

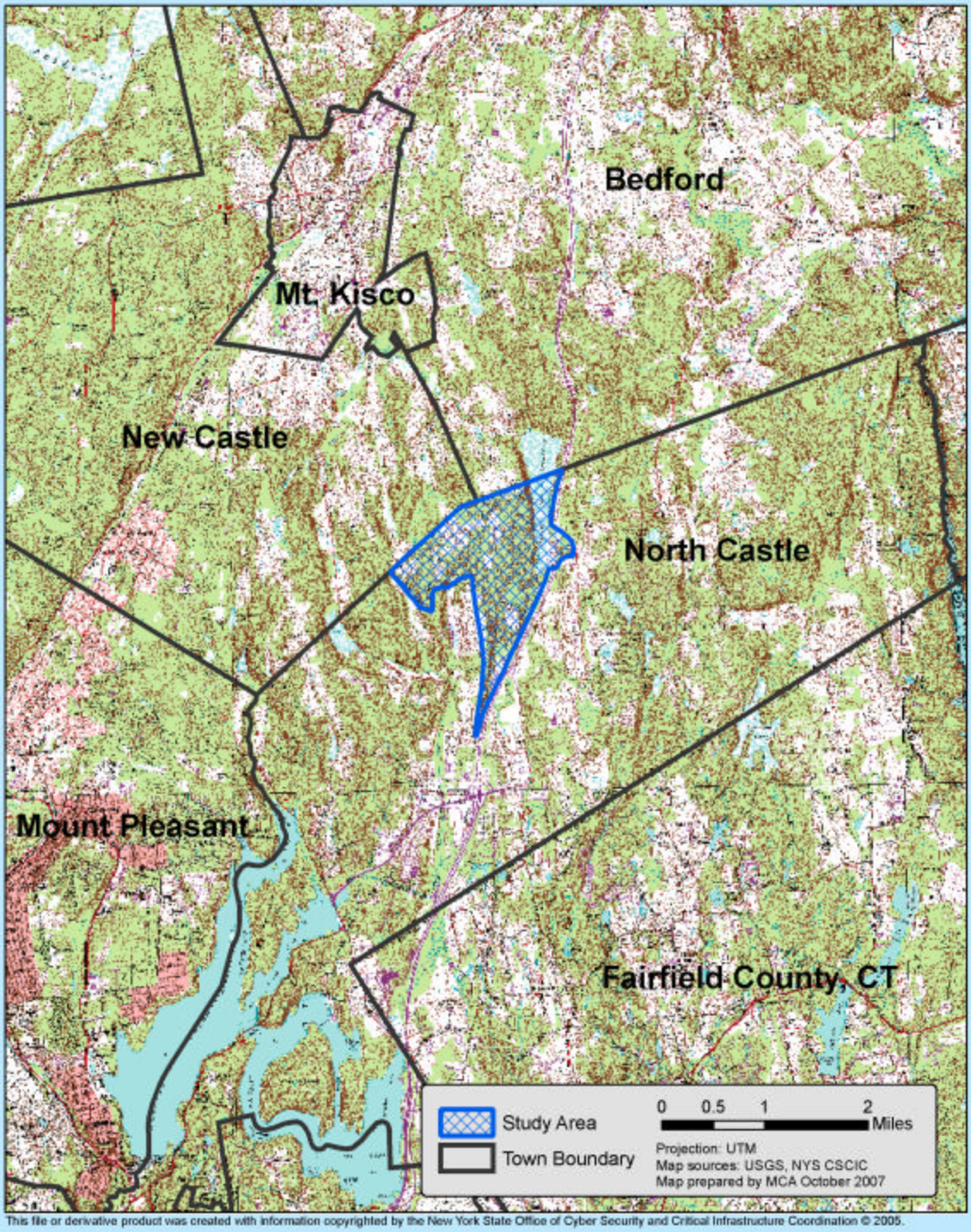
Open Space Committee. 2005. OSC Criteria for Identifying and Prioritizing Properties for Potential Open Space Acquisition. Town of North Castle. Available from http://www.northcastleny.com/hall_boards_committees_openspace.htm (accessed Sept 2007).

Pimentel, D., L. Latch, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs of nonindigenous species in the United States. BioScience 50: 53-65.

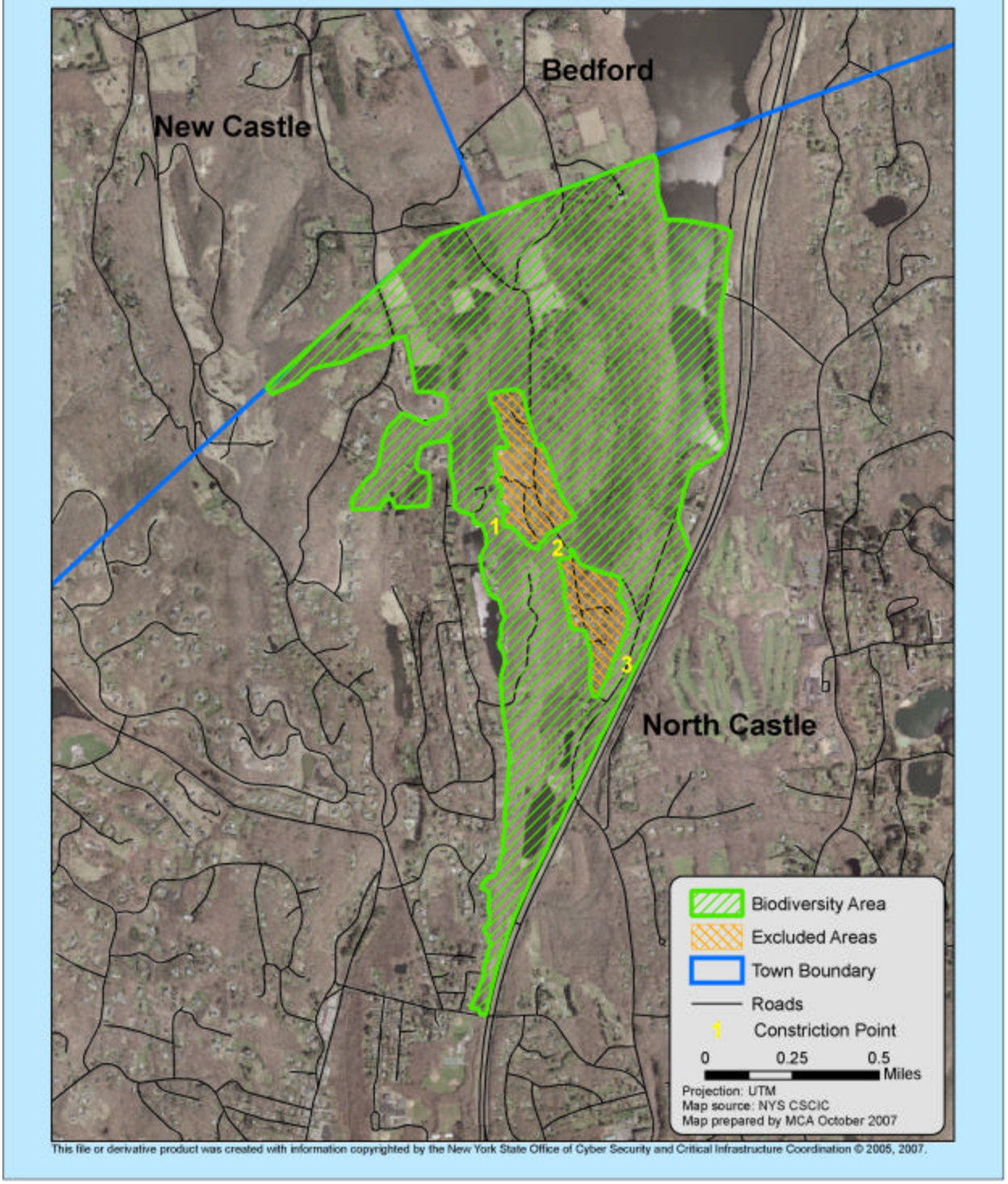
Smith, R. D., A. Ammann, C. Bartoldus, and M.M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Army Corps of Engineers. Washington, D.C.

Town of North Castle. 2006. Code of the Town of North Castle New York, Chapter 209: Wetlands and Drainage, Section 209-5 Definitions; word usage. General Code E-Code. Available from http://www.e-codes.generalcode.com/codebook_frameset.asp?t=tc&p=0492%2D209%2Ehtm&cn=1305&n=[1][142]) (accessed Sept 2007).

Appendix A:
North Castle Study Area Map



Appendix B:
North Castle Biodiversity Area Map



Appendix C: Species Observed in North Castle

FoSA Designation: DA=Development-Associated, DN=Development-Neutral, DS=Development-Sensitive
Federal, State and County Status: SC=Special Concern, T=Threatened

Amphibians

Common Name	Latin Name	FoSA Designation	Federal Status	NY State Status	Westchester Co. Status
Spotted salamander	*Ambystoma maculatum*	DS			
Northern two-lined salamander	*Eurycea bislineata*	DA/DN			
Four-toed salamander	*Hemidactylium scutatum*	DS			
Redback salamander	*Plethodon cinereus*	DA/DN			
Red-spotted newt	*Notophthalmus viridescens*	DS			
American toad	*Bufo americanus*	DN			
Northern spring peeper	*Pseudacris crucifer*	DA/DN			
Gray treefrog	*Hyla versicolor*	DN			
Bullfrog	*Rana catesbeiana*	DA			
Green frog	*Rana clamitans*	DA/DN			
Pickerel frog	*Rana palustris*	DN			
Wood frog	*Rana sylvatica*	DS			

Reptiles

Common Name	Latin Name	FoSA Designation	Federal Status	NY State Status	Westchester Co. Status
Common snapping turtle	*Chelydra serpentina*	DA			
Painted turtle	*Chrysemys picta*	DA			
Eastern box turtle	*Terrapene carolina*	DS		SC	T
Northern ringneck snake	*Diadophis punctatus edwardsii*	DN			
Northern water snake	*Nerodia sipedon*	DA			
Eastern garter snake	*Thamnophis s. sirtalis*	DA			

Breeding Birds

All birds listed below are breeding birds. Any birds observed that are believed to be migrants are not included on this list.

Common Name	Latin Name	FoSA Designation	Federal Status	NY State Status	Westchester Co. Status	Audubon WatchList Status
Canada goose	*Branta canadensis*	DA				
Mourning dove	*Zenaida macroura*	DN				
Turkey vulture	*Cathartes aura*	DN				
Black vulture	*Coragyps atratus*	DN				
Red-tailed hawk	*Buteo jamaicensis*	DN				
Barred owl	*Strix varia*	DS*				
Downy woodpecker	*Picoides pubescens*	DN				
Pileated woodpecker	*Dryocopus pileatus*	DS				
Red-bellied woodpecker	*Melanerpes carolinus*	DN				
Northern flicker	*Colaptes auratus*	DS*				
Ruby-throated hummingbird	*Archilochus colubris*	DN				
Eastern kingbird	*Tyrannus tyrannus*	DS				
Great crested flycatcher	*Myiarchus crinitus*	DS*				
Eastern phoebe	*Sayornis phoebe*	DN				
Blue jay	*Cyanocitta cristata*	DA				
American crow	*Corvus brachyrhynchos*	DA				
European starling	*Sturnus vulgaris*	DA				
Brown-headed cowbird	*Molothrus ater*	DA				
Red-winged blackbird	*Agelaius phoeniceus*	DN				
Baltimore oriole	*Icterus galbula*	DS*				
Common grackle	*Quiscalus quiscula*	DA				
House finch	*Carpodacus mexicanus*	DA				
American goldfinch	*Carduelis tristis*	DN				
Chipping sparrow	*Spizella passerina*	DN				
Field sparrow	*Spizella pusilla*	DS				
Song sparrow	*Melospiza melodia*	DN				
Eastern towhee	*Pipilo erythrophthalmus*	DS				
Northern cardinal	*Cardinalis cardinalis*	DN				
Rose-breasted grosbeak	*Pheucticus ludovicianus*	DS*				
Indigo bunting	*Passerina cyanea*	DS*				
Scarlet tanager	*Piranga olivacea*	DS				
Barn swallow	*Hirundo rustica*	DN				

Tree swallow	*Tachycineta bicolor*	DS*				
Bank swallow	*Riparia riparia*	DS*				
Cedar waxwing	*Bombycilla cedrorum*	DN				
Red-eyed vireo	*Vireo olivaceus*	DS*				
Warbling vireo	*Vireo gilvus*	DS				
Yellow-throated vireo	*Vireo flavifrons*	DS*				
Black-and-white warbler	*Mniotilta varia*	DS				
Worm-eating warbler	*Helmitheros vermivorum*	DS			SC	Declining
Blue-winged warbler	*Vermivora pinus*	DS*				Declining
Yellow warbler	*Dendroica petechia*	DN				
Chestnut-sided warbler	*Dendroica pensylvanica*	DS				
Blackpoll warbler	*Dendroica striata*	DN				
Black-throated green warbler	*Dendroica virens*	DS*				
Pine warbler	*Dendroica pinus*	DN				
Ovenbird	*Seiurus aurocapilla*	DS				
Louisiana waterthrush	*Seiurus motacilla*	DS*				
Common yellowthroat	*Geothlypis trichas*	DN				
Wilson's warbler	*Wilsonia pusilla*	DN				
American redstart	*Setophaga ruticilla*	DS*				
Northern mockingbird	*Mimus polyglottos*	DA				
Gray catbird	*Dumetella carolinensis*	DN				
Carolina wren	*Thryothorus ludovicianus*	DN				
House wren	*Troglodytes aedon*	DA				
White-breasted nuthatch	*Sitta carolinensis*	DN				
Tufted titmouse	*Baeolophus bicolor*	DN				
Black-capped chickadee	*Poecile atricapillus*	DN				
Wood thrush	*Hylocichla mustelina*	DS			SC	Declining
Veery	*Catharus fuscescens*	DS				
American robin	*Turdus migratorius*	DN				
Eastern bluebird	*Sialia sialis*	DS				

*These 14 DS bird species were not observed in a previous Westchester County study and, for sake of consistent methods between studies within the same region, were therefore not used to delineate biodiversity areas in the present study.

Appendix D: Glossary of Terms

Biodiversity	Short for "biological diversity," this term refers to the diverse forms of life on Earth at all scales of organization, from genes to species to ecosystems.
Built footprint	The area of land covered by built structures, including houses, garages, driveways, pools, roads, and other structures. Smaller than the "ecological footprint."
Conservation	Protection of wildlife and nature that emphasizes human use of nature in a manner that allows other species to continue to exist and allows ecological processes to be maintained (in contrast to "Preservation").
Development-Associated	A term coined by the MCA that refers to wildlife species that respond to development with an *increase* in number. Examples include "weedy" species such as the white-tailed deer, Canada goose, snapping turtle, and bullfrog. A high proportion of these species indicates degraded habitat. Abbreviation is "DA."
Development-Neutral	A term coined by MCA that refers to wildlife species that do not respond to development with either a clear increase or decrease in numbers, and are therefore not used as indicators of habitat quality. Contrast with Development-Associated and Development-Sensitive species.
Development-Sensitive	A term coined by the MCA that refers to wildlife species that respond to development with a *decrease* in number. Examples include many warbler species, the box turtle, and the spotted salamander. These species are used as indicators of quality wildlife habitat. Abbreviation is "DS."
Ecological footprint	The impact on the ecological function of the area surrounding built structures. This is a larger area than the "built footprint" and results from the effects of lighting, sound, fragmentation and other human activities on wildlife habitat.
Ecosystem	Short for "ecological system," this term refers to organisms (plants, animals, fungi, etc.) interacting with their non-living environment (water, soil, light, etc.). Ecosystems can be of any size, from a single log to a stand of trees to an entire forest, but this term is often used to refer to large-scale systems such as a "forest ecosystem" or "grassland ecosystem."
Edge effects	The difference in ecological processes at the edge of a forest as opposed to its interior. Edge effects include increased light, wind, and noise; lower air and soil moisture; and increased vulnerability to predatory, parasitic, and invasive species. These changes reduce

	habitat quality for many species, lowering their chances of survival, and effectively reducing available habitat. Forest fragmentation increases the amount of forest edge.
Fauna	Animal life.
Federally listed	A species that is listed by the U.S. Fish & Wildlife Service as either Endangered or Threatened under the provisions of the U.S. Endangered Species Act.
Flora	Plant life.
Habitat fragmentation	Occurs when wildlife habitat is cut into smaller, separate fragments by the building of roads, driveways, powerline right-of-ways, housing developments, and the like. Risk of local extinction is greater in fragments than the original, larger, intact habitat. Fragmentation of forest habitat contributes to edge effects (see above), lowering habitat quality.
Herpetofauna	A term used to refer to reptiles and amphibians collectively.
Preservation	Protection of wildlife and nature that emphasizes limiting or eliminating human use of nature (in contrast to “Conservation”).
Riparian	A term that refers to the banks of streams and rivers. Riparian habitats are important in that they tend to be biodiverse, biologically productive, and serve as dispersal corridors for wildlife.
Sprawl	Low-density, automobile-dependent development characterized by a dispersed pattern of single- and low-density uses. Sprawl typically consists of large-lot, single-family homes, office campuses, and strip malls. Sometimes described as "suburban sprawl," "urban sprawl" or "exurban sprawl," sprawl need not be defined by proximity to an urban center but by type of development, regardless of where it occurs.
State listed	A species that is listed by New York State Department of Environmental Conservation as Endangered, Threatened, or Special Concern.
Succession	The process by which a disturbed area (such as an old agricultural field or burned forest) progresses through the following ecological stages in sequence: grassland, shrubland, young forest, mature forest.

Appendix E: MCA Technical Paper Series

To download PDFs or to order hard-copy publications, go to www.metropolitanconservationalliance.org or www.wcs.org/mca.

North Castle Biodiversity Plan, MCA Technical Paper No. 14. MCA conducted this study in the Byram Lake Reservoir section of North Castle in 2007 and discovered a core area of biological diversity. Contains map of Biodiversity Area, land use recommendations to conserve biodiversity, and recommendations for future studies. By Danielle T. LaBruna and Michael W. Klemens, MCA 2007. *PDF available online.*

Northern Wallkill Biodiversity Plan: Balancing Development and Environmental Stewardship in the Hudson River Estuary Watershed, MCA Technical Paper No. 13. The Northern Wallkill Biodiversity Plan is the result of a multi-year partnership between MCA and the Town of Lloyd, the Town of New Paltz, and the Village of New Paltz, New York. This publication provides a map outlining the areas of highest biodiversity in the three municipalities as well as land preservation and land use recommendations to maintain this biodiversity. By Danielle T. LaBruna and Michael W. Klemens, MCA 2007. *PDF available online.*

Pocantico Hills Biodiversity Plan, Rockefeller State Park Preserve and Associated Private Lands: A Public-Private Land Stewardship Initiative, MCA Technical Paper No. 12 The Pocantico Hills Biodiversity Plan is the result of a public-private partnership between MCA, the New York State Office of Parks, Recreation and Historic Preservation, Rockefeller family members, Friends of the Rockefeller State Park Preserve, and the Rockefeller Brothers Fund. This report provides conservation, management, restoration, and public education recommendations to maintain and increase the wildlife biodiversity on Rockefeller State Park Preserve and surrounding Rockefeller family lands. Includes map highlighting areas of significant biodiversity. Ideas presented apply to any North American suburban park containing temperate ecosystems. By Danielle T. LaBruna, Michael W. Klemens, Julian D. Avery and Kevin J. Ryan, MCA 2006. *$10.00*

The Farmington Valley Biodiversity Project: A Model for Intermunicipal Biodiversity Planning in Connecticut. MCA Technical Paper No. 11 The Farmington Valley Biodiversity project presents a model for Connecticut towns to establish intermunicipal collaborations to prioritize and map areas important for the conservation of regional biological diversity. The model integrates biological data sets with land use and habitat maps utilizing GIS applications. Information produced is designed to be incorporated within each town Plan of Conservation and Development. A community outreach component to promote the awareness of regional biodiversity is also included. By Henry J. Gruner, Michael W. Klemens, and Alexander Persons. MCA 2006. *PDF available online.*

From Planning to Action: Biodiversity Conservation in Connecticut Towns, MCA Technical Paper No. 10 To counteract sprawl development and protect biodiversity, local land use decision-makers need three items: the scientific information to identify problems, the technical solutions to those problems, and the legal authority to implement those solutions. This resource provides guidance on all three. The twelve primary challenges facing land use decision-

makers identified in this publication arose out of the authors' collective experience working with municipal officials, and is a practical guide to making ecologically- and legally-informed development decisions. Although this report focuses on towns in Connecticut, the guidance here applies to other "home-rule" states such as New York. By Michael W. Klemens, Marjorie F. Shansky and Henry J. Gruner, MCA 2006. *$10.00*

Biodiversity Planning through Local Land Use Planning: An Assessment of Needs and Opportunities in the New Jersey Townships of Chester, Lebanon, and Washington, MCA Technical Paper No. 9 Biodiversity Planning through Local Land Use Planning is an assessment of needs and opportunities for New Jersey townships (in particular, Chester, Lebanon and Washington). This assessment is intended to serve as a foundation for adopting and adapting the Biotic Corridor approach which employs wildlife surveys as a baseline layer in the planning process and informs policy and land use decision-making. By Nicholas A. Miller, Michael W. Klemens and Jennifer E. Schmitz, MCA 2005. *PDF available online.*

Southern Wallkill Biodiversity Plan: Balancing Development and the Environment in the Hudson River Estuary Watershed, MCA Technical Paper No. 8 The Southern Wallkill Biodiversity Plan emerged from a partnership between MCA, the NYS DEC Hudson River Estuary Program, and the towns of Chester, Goshen and Warwick, including villages and hamlets within these towns. This report provides policy and planning recommendations to support the establishment of a regional, multi-town approach to the conservation of wildlife and habitats. It includes a map highlighting priority areas for conservation efforts across the three towns. By Nicholas A. Miller, Michael W. Klemens and Jennifer E. Schmitz, MCA 2005. *$8.00*

Croton-to-Highland Biodiversity Plan: Somers Addendum. MCA Technical Paper No. 7-A The research conducted for this volume, an addendum to the original Croton-to-Highlands Biodiversity Plan, extends the biotic corridor discovered in the original CHBP towns to the neighboring town of Somers, New York. Map of Somers Biodiversity Areas are included. By Danielle T. LaBruna and Michael W. Klemens. MCA 2007. *PDF available online.*

Croton-to-Highlands Biodiversity Plan: Balancing Development and the Environment in the Hudson River Estuary Catchment, **MCA Technical Paper No. 7** The Croton-to-Highlands Biodiversity Plan was developed out of a partnership between MCA and the four contiguous New York towns of Cortlandt, New Castle, Putnam Valley, and Yorktown. The report provides policy and planning recommendations to support a multi-town approach to conserve wildlife and habitats and includes a map highlighting priority areas for conservation. By Nick Miller and Michael W. Klemens, MCA, 2004. *PDF available online.*

Habitat Management Guidelines for Vernal Pool Wildlife, MCA Technical Paper No. 6 This document provides habitat management guidelines for maintaining vernal pool biodiversity in forested landscapes, especially in the commercially-harvested forests of northern New York and New England. By Aram J. K. Calhoun and Phillip deMaynadier, MCA, 2004. *$8.00*

Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States, MCA Technical Paper No. 5 This paper contains techniques to guide local and state land use decision-makers as they attempt

to conserve vernal pool habitats and wildlife. It provides a pragmatic approach to conservation that encourages communities to attain a more complete understanding of their vernal pool resources, gather information that enables them to designate exemplary pools worthy of protection efforts, and develop strategies to protect them. By Aram J. K. Calhoun and Michael W. Klemens, MCA, 2002. *$10.00*

Eastern Westchester Biotic Corridor: Bedford Addendum, MCA Technical Paper No. 4-A The research conducted for this volume, an addendum to the original Eastern Westchester Biotic Corridor report, extends the biotic corridor discovered in the original EWBC towns to the neighboring town of Bedford, New York. Map of Bedford's extensions to the biotic corridor are included. By Danielle T. LaBruna and Michael W. Klemens, MCA, 2007. *PDF available online.*

Eastern Westchester Biotic Corridor, MCA Technical Paper No. 4 The Eastern Westchester Biotic Corridor (EWBC) is a partnership between MCA and the three contiguous New York towns of North Salem, Lewisboro, and Pound Ridge. This report provides science-based information and tools to support a regional, multi-town approach to conserve wildlife and habitats. By Nick Miller and Michael W. Klemens, MCA, 2002. *PDF available online.*

Conservation Area Overlay District: A Model Local Law, MCA Technical Paper No. 3 This document provides an innovative tool for improved land use planning—a model ordinance that can be adopted by municipalities to delineate a conservation area overlay district. The ordinance seeks to reduce habitat fragmentation, maintain biodiversity, and protect significant natural features across ecologically sensitive areas. It is based upon New York State law, but can be adapted for use in other states that have strong home rule authority. Prepared for MCA by Pace University, 2002. *PDF available online.*

Open Land Acquisition: Local Financing Techniques Under New York State Law, MCA Technical Paper No. 2 This paper describes the authority that local governments have to raise revenues to purchase or otherwise protect open space. It explores the types of programs that have been established using these techniques. It is intended to assist communities interested in PDR (purchase of development rights) and to decide which of several potential funding mechanisms would be most appropriate. Prepared for MCA by Pace University, 2000. *PDF available online.*

A Tri-State Comparative Analysis of Local Land Use Authority: NY, NJ, & CT, MCA Technical Paper No. 1 This paper investigates the local land use authority that towns within the tri-state region have to protect natural landscapes while making land use decisions and to collaborate with one another on an intermunicipal basis. The document lists and describes statutes and cases that empower municipalities to plan and regulate across municipal lines; to adopt floating zones, overlay districts, and natural resource protection ordinances; and to provide incentives to encourage environmentally-sound development patterns. Prepared for MCA by Pace University, 1999. *PDF available online.*

The Metropolitan Conservation Alliance, a program of the Bronx Zoo-based Wildlife Conservation Society, conserves wildlife and habitats in the tri-state New York City metropolitan region. Rare species and healthy ecosystems abound within a mere 50 to 100 miles of Manhattan, but the ever-expanding suburbs radiating outward from the city threaten these resources. MCA has developed a unique approach to conservation in this context of sprawl, one that bridges the gap between science and land use practice. We translate biological data and conservation concepts into planning tools, creating a new land use planning paradigm for local decision-makers that influences the location, extent, and impact of development. Through our Technical Paper Series, we disseminate these planning tools to our partners and the public. Our goal is to help safeguard our region's biodiversity while respecting the rights of the region's communities to prosper.