This appendix provides Dutchess County's 2012 "State of the Environment Report".

Dutchess County
Environmental Management Council (EMC)
State of the Environment Report
February 2012

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Executive Summary and Recommendations

Dutchess County currently has rich and abundant natural resources. Protection of the land and water that make up our beautiful county will preserve its natural beauty, ensuring that we continue to be a destination for people seeking a respite from the stress of everyday life. Perhaps more importantly, protection of our land and water will ensure the continued availability of the resources that are critical for the continued sustainability of human habitation in Dutchess County.

A survey of newspaper articles about the environment as well as forums presented by our local cooperative extension reveal that citizens of Dutchess County are primarily concerned with protection of our water resources, including streams, groundwater, wetlands, lakes and ponds. Second on the list of concerns of Dutchess County residents is land preservation and land management. This report is a summary of the issues and challenges that the County faces now and in the coming years. Several themes are common throughout the report.

Water, one of our most important resources, connects us in ways that cross political boundaries. Groundwater is connected to above ground water (ponds, lakes, wetlands and streams) so preserving the quality of streams, lakes and ponds also ensures protection of our groundwater and vice versa. Knowing how to properly dispose of industrial and residential waste, and improving our recycling rate, will help us protect our groundwater and surface water supplies. Secondly, with regard to water, what happens in upstream communities affects downstream communities. Minimization of impervious surfaces in upstream communities will protect downstream communities from devastating floods, which will increase in frequency as the climate changes in the coming years.

In terms of land management, the report reveals that protection of large tracts of undisturbed forest, our native vegetation, will help maintain a diverse biota, which will serve to reduce the risk of infectious diseases such Lyme disease and West Nile Virus as well as ensure that our plants and animals are ready to withstand the onslaught of invasive, nonnative species and the certain climate change that Dutchess County will face in the coming decades. Land use change has altered the state of our environment in Dutchess County in profound ways. Large sections of the county have been developed in spread-out suburban patterns, affecting the quality of our air and changing the landscape forever. Continued attention to land use planning that ensures protection of our environment will in turn ensure that Dutchess County remains an attractive and safe place to live and prosper.

Recommendations

- **Climate Change**: Regional planners and stakeholders such as farmers should integrate climate change information (e.g., increased floods, increased droughts and increased summertime heat) into their planning to reduce risks and adapt to the changing climate.
- **Air and Precipitation Quality**: Continue to develop and implement plans to reduce ozone by reducing its precursors (VOC and NOx); control the sources of PM2.5, e.g., vehicular travel and smoke; be aware that the effects of acid deposition exacerbate stresses on natural environment such as invasive species or ozone pollution.
- **Water Quality and Quantity**: Protect water quality, especially groundwater, by taking steps to improve the efficiency of road salt, ensure adequate maintenance of septic systems and wastewater treatment and

reduce agricultural runoff. Protect water quantity by protecting floodplains and wetlands, which act as buffers during floods and reduce impervious surfaces, which greatly enhance floods.

- **Municipal Solid Waste and Recycling**: Increase the recycling rate by increasing public education and improving ease of access to recycling facilities.
- **Hazardous Waste Sites:** Remain aware of superfund sites and their status (these sites are under regulation of state and federal agencies); and report any spills or suspected hazardous waste sites to the NYS DEC immediately.
- **Biological Resources, Including Wildlife and Rare and Endangered Species**: Protect key habitats via careful planning; utilize experts at local colleges and research institutions to make informed decisions about preserving biodiversity resources; collaborate with land use planners and conservation groups to improve effectiveness of biodiversity conservation.
- **Land Use Change**: Maintain large tracts of un-fragmented forest to reduce susceptibility to pests, pathogens and invasive species and to ensure biodiversity; reduce impervious surface development using green infrastructure practices. Focus new development in existing or emerging centers to reduce overall run-off and to protect natural and agricultural green spaces.
- **Invasive Species**: Continue to educate the public about the presence and threat of invasive and exotic species and continue diligent efforts such as preventing firewood transport to preventing the spread of invasive species into and throughout the county. Pressure the federal government to reduce the careless movement and introduction of demonstrated and potentially invasive species.
- **Lyme Disease and Other Infectious Diseases**: Maintain large tracts of un-fragmented forests to ensure biodiversity and reduce the prevalence of Lyme disease. Continue education of the public about avoiding ticks and other disease carrying organisms and health care professionals about the symptoms and treatment of Lyme disease and other vector-borne diseases.

Background

The EMC is charged in its enabling legislation (Resolution No. 58 of 1972) with the task of writing a State of the Environment report, which has not been completed since 1982. While conditions have improved since 1982 (better air and water quality, reduced acid rain, increased forest cover, better emissions controls on motor vehicles and smokestacks), some environmental issues remain a concern to the citizens of Dutchess County. This report is a compilation of information gathered by EMC volunteer appointed at-large members, and staff and interns from the Cornell Cooperative Extension Dutchess County (CCEDC) Environment and Energy Program (EMC Ex-Officio Member), with the goal of providing the County Legislature as well as the citizens of Dutchess County with useful information that can inform the decision-making process. We intend for this to be a summary of the environmental issues that the county faces as well as an informative document about, for example, where an individual can recycle or safely dispose of waste. The issues that we chose to address are largely derived from an analysis of Poughkeepsie Journal articles and EMC and CCEDC Environmental Education Forums that have occurred in the last several years. We used this as a metric to determine the environmental issues about which the public is concerned. These issues included: Water quality and quantity; Land preservation; Wildlife management; Waste disposal; Lyme disease and other infectious diseases; Cancer; Superfund sites; Climate Change; Air pollution; and Biodiversity.

A Metric of Important Environmental Issues in Dutchess County[1]

An analysis of archived articles in the Poughkeepsie Journal between 2005 and 2011 revealed that the top environmental concern in Dutchess County is water, including streams and groundwater. Land preservation was the second most covered topic among environmental issues in the county followed by wildlife management, waste disposal, infectious diseases, cancer, superfund sites, global warming, air pollution and biodiversity. Informational forums conducted by the CCEDC, which reflect the public's concerns, roughly followed the pattern revealed by Poughkeepsie Journal articles. The top two categories of forums from 2005-2010 were water and land management, followed by energy and climate, biodiversity, education, wildlife management, air quality, human health, waste management, municipal law, cancer and infectious diseases/ticks.

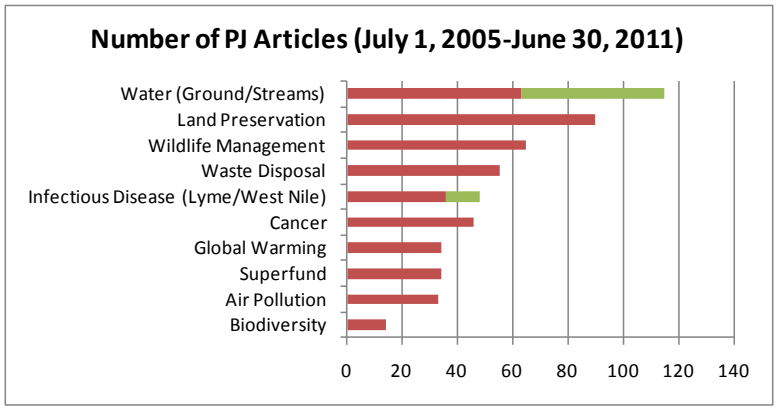

Figure 1. Poughkeepsie Journal Articles on Environmental Topics (2005-2011).

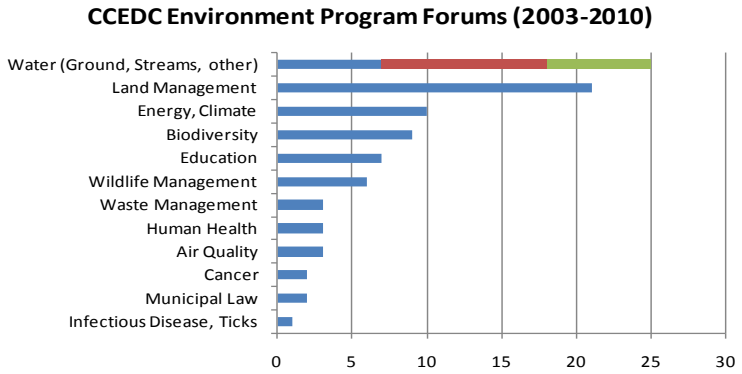

Figure 2. EMC and CCEDC Environmental Education Forums held in Dutchess County (2003-2010).

[1] Section written by Victoria Kelly, Dutchess County EMC.

Climate and Climate Change[2]

Climate refers to the long-term weather patterns of an area, including temperature, precipitation, humidity, atmospheric pressure, and wind, while weather refers to the present condition of these elements over shorter periods. These factors continually shape our lives and the environment in which we live. Dutchess County is located in the northern portion of the temperate climate zone. Dutchess County's climate is humid continental, and is characterized by strong seasonal contrasts and highly variable weather.[3]

Moderate temperatures and sufficient precipitation make Dutchess County an excellent location for farming, while seasonal variations help to attract tourists and recreational users. The county's relatively hot summers and cold winters result in substantial heating and cooling costs for homes and businesses. Temperatures at any one place in Dutchess County normally exceed 90 degrees Fahrenheit between 5 and 15 times during the summer. On average, temperatures fall below zero degrees 5 to 10 times during the winter.

Table 1. Key Climatic Indicators for Dutchess County, NY[4]

Mean Annual Winter Temperature	27.3°F
Mean Annual Summer Temperature	69.5 °F
Range of Mean Annual Precipitation	38-46 inches
Mean Annual Relative Humidity	66 and 75%
Mean Annual Average Wind Velocity	5.4 MPH

During the growing season (May through September), total precipitation averages between 18 and 22 inches, a sufficient amount to support the wide variety of vegetation found in the county. However, there is usually one or more periods of short-term rainfall deficit that occur during most summers. Different areas of the county receive significantly different amounts of precipitation due to the varying topography. For example, eastern Dutchess County receives the most rain due to its higher elevation on the uphill slopes of the Taconic Mountains, while there is lower precipitation in northwestern Dutchess County. The county receives a moderate amount of snowfall, with roughly 30 to 50 inches throughout the county.

Floods occur with relative frequency in Dutchess County, with roughly three floods of varying degrees reported each year in the county. Each major stream in Dutchess County has a significant number of flood prone areas and certain areas are prone to annual flooding. The probability of flooding is greatest from December to April, when the ground is frozen, and runoff from melting snow and ice causes soils to be saturated.

Climate Change

Dutchess County residents may be noticing that trees are budding earlier in the spring, summer heat waves are more common, and when it rains - it pours. These observed changes are part of the global change in the

[2] Section written by Allison Chatrchyan, Environment and Energy Program Leader, Cornell Cooperative Extension Dutchess County, and Ex Officio member of Dutchess County EMC.
[3] This section provides a summary of detailed climate explanations and data from the Dutchess County Natural Resource Inventory, available at: http://www.co.dutchess.ny.us/CountyGov/Departments/Planning/16138.htm.
[4] Much of the County's climate data was provided by the Northeast Regional Climate Center at Cornell University: http://www.nrcc.cornell.edu/.

Earth's climate. Natural factors alone cannot explain the unprecedented rate of change in the Earth's climate, which is being caused by humans emitting greenhouse gases (GHGs) like carbon dioxide into in the atmosphere.[5]

Since the 1800s, the Earth has warmed by more than 1.5°F. In New York, the average summer temperature is already 2°F warmer than in 1970, and winter temperature is 4°F warmer. There is a similar warming trend observed in Dutchess County. We have observed an increase in the number of extremely hot summer days (above 90°F) and a decrease in the number of cold winter days (below 32°F). In the future, New Yorkers can expect an increase in average temperature of 1.5 to 3°F by the 2020s, or 3 to 5.5°F by the 2050s, depending on the amount of GHGs humans emit into the atmosphere.

There has been a gradual increase in annual precipitation in Poughkeepsie, NY to about 43.8 inches of rain per year from 1931 to 2000. In the future, we can expect an increase in average annual precipitation of up to 5% by 2020 or 10% by the 2050s. Patterns of precipitation will change, with increased precipitation in the winter, and decreased precipitation in late summer or fall, which could lead to increased periods of short-term drought during the growing season. In Poughkeepsie, the number of days with at least one inch of snow on the ground has decreased by about 33% over the past 60 years. Winter storms will more likely produce sleet, freezing rain, and rain, with less if any snowfall.

The most striking trend is the observed increase in frequency and intensity of extreme precipitation events. There has been a 67% increase in the number of 2-inch rainfall events occurring over a 48-hour period since the 1950s in New York. In Poughkeepsie, the average number of days per year with at least 2-inches of rain has increased from 1 to 2.5. In 2005, there was a record of six extreme precipitation events during the year. Sea level rise, including the level of the Hudson River, will continue to increase. This may affect shorelines and roads and bridges, and salination of drinking water systems that take water from the Hudson River.

Climate change will continue to have widespread impacts on ecosystems, agriculture, infrastructure and human health. The growing season has increased by over 20 days in Dutchess County over the past 60 years, and is expected to increase by as much as a month by the end of the century. Local and regional planners, government officials, and stakeholders such as farmers will need to integrate climate change information into their planning in order to reduce risks and adapt to the changing climate.

Air and Precipitation Quality[6]

The Climate and Air Quality of Dutchess County Chapter of the Dutchess County Natural Resource Inventory provides a thorough summary of air quality issues including precipitation quality for Dutchess County. The major air pollutants in Dutchess County are ground-level ozone, particulate matter and acid deposition.

Ozone occurs in the upper atmosphere of the earth where it absorbs ultraviolet radiation thus protecting the surface of the earth from their harmful rays. At ground-level, ozone is a harmful pollutant that reduces our ability to absorb oxygen as we breathe, which has serious consequences for individuals with compromised breathing (the elderly, infants, asthmatics, etc.). Ozone is not emitted directly, but is formed through chemical

[5] For more details, see the Cornell Climate Change Fact Sheet Series, at: www.climatechange.cornell.edu.
[6] Section written by Victoria Kelly, Dutchess County EMC.

reactions between precursor emissions of Volatile Organic Compounds (VOC) and Nitrogen Oxides (NOx) in the presence of sunlight. These reactions are stimulated by sunlight and high temperature, which is why peak ozone levels occur during summer and the warmest period of the day. The VOC and NOx precursors to ozone are produced by the combination of pollutants from many sources, including smokestacks, cars, paints and solvents. Standards that have been set by the Environmental Protection Agency (EPA) as required by the federal Clean Air Act are periodically exceeded in the mid-Hudson region. As a result, agencies receiving federal transportation funding are required to develop and implement plans that address this issue. In order to reduce ozone levels, it is necessary to reduce emission of its precursors.

Particulate Matter (PM) includes dust, dirt, soot, smoke and liquid droplets. It can be formed by condensation or transformation of gases. There are two size classifications for particulates: PM10, which is the class of particulates less than 10 microns in size and PM2.5, which is the class of particulates less than 2.5 microns in size. The PM2.5 size class causes decreased lung function that can have serious effects on individuals with asthma, bronchitis or other airway diseases. PM2.5 is most commonly the result of combustion, including fossil fuel burning, and transformation of gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds. PM2.5 is not currently monitored in Dutchess County. The closest monitoring sites are Newburgh and Albany. PM2.5 was monitored in Poughkeepsie between 1999 and 2002 and was compliant within the standards during that time. Although Dutchess County is currently within compliance for PM2.5, it would be prudent to be aware of and control the sources of PM2.5, e.g., vehicular travel and smoke.

Acid precipitation refers to rain, snow or ice that is more acidic than what is normal for a given area. In the northeastern United States, normal precipitation pH is about 5.2. In Millbrook in Dutchess County, the average precipitation pH between 1984 and 2010 was 4.34 and the average pH of precipitation in 2010 was 4.78. Acid precipitation most commonly forms from sulfur dioxide (SO2) and oxides of nitrogen (NOx). Most SO2 is emitted by coal burning power plants while NOx most commonly comes from car exhaust and other industrial processes as well as coal burning. Because the prevailing wind direction for Dutchess County is southwest, we are upwind of the midsection of the country where many coal burning power plants are. Our air and precipitation largely originates in areas with high emissions of the acid deposition precursor SO2. Acid deposition acidifies soils, lakes and streams and enhances the process that makes toxic mercury (another pollutant emitted during the burning of coal) available to organisms. Acid deposition also enhances the mobilization of toxic aluminum from soils to tree roots, increases leaching of sulfate and nitrate to soils and surface waters and promotes the loss of important buffering nutrients from soils. In aquatic systems, aluminum can kill fish and other aquatic organisms, reducing fish species richness. The increased acidity in lakes and other surface waters can reduce ecosystem productivity. While existing acid precipitation regulations are necessary, they are insufficient to conserve natural ecosystems and their valuable services.

Water Quality and Quantity[7]

Water quality and perhaps to a lesser extent water quantity are of great concern to citizens of Dutchess County. Water exists both above ground (surface water) in streams, lakes, ponds and wetlands, and below ground (groundwater). It is important to know that surface and ground water are connected. Water quantity issues include worries about the availability of water for drinking and manufacturing and worries about too much water in periodic flooding. Protecting water so that its availability is consistent, it remains free of

[7] Section written by Victoria Kelly, Dutchess County EMC.

contaminants, is safe for humans and other organisms that require it for survival, and moves safely through our communities requires careful planning. In order to develop adequate plans for water protection, an understanding of how water moves and what it contains is essential. Studies of both water quality and quantity have been done in Dutchess County and provide some understanding of this vital resource.

The Water Resources of Dutchess County, NY chapter of the Dutchess County Natural Resource Inventory provides a thorough description of Dutchess County's water resources. In addition to a summary of how water moves through the water cycle, this document describes each of the county's streams and their drainage basins. It provides a complete description of the current water quality and quantity issues facing the county including groundwater availability and quality. It describes the importance and location of the county's floodplains and wetlands and what to expect in the future as our climate changes and the county develops. It is an invaluable document for policymakers and the public for understanding water in Dutchess County.

Current concerns about water quality in Dutchess County include contamination of drinking water by toxic materials, which has occurred in several locations (see Superfund Sites section of this report), non-point source contamination of drinking water with road salt and agricultural runoff, and contamination of surface water (streams, lakes and ponds) from wastewater, especially where dense development, a high concentration of septic systems, and improper maintenance of septic systems may be factors.

Water quantity concerns center around the possibility that consistent availability of drinking water may be compromised with increasing development in sections of the county where water is provided by public or private wells. Also, the potential for increased flooding is of great concern as development increases the percentage of impervious surfaces in the county, and channelizes stream water, and climate change brings larger and more frequent flood events. The protection of floodplains and wetlands from development is imperative so that they can act as buffers during these inevitable events.

Municipal Solid Waste and Recycling[8]

According to a recent report from Mid Atlantic Solid Waste Consultants commissioned by the Dutchess County Legislature,[9] there is approximately as much as 291,000 tons of municipal solid waste produced in Dutchess County each year. The consultant's estimate of the county's recycling rate is approximately 23%.

In Dutchess County, much of this municipal solid waste is transported by licensed haulers to a Waste-to-Energy Facility that incinerates the waste and generates electricity that is sold to Central Hudson into the electric grid. This facility (one of only ten active municipal waste combustion facilities operating in New York State) is owned by Dutchess County and operated by Covanta Hudson Valley Renewable Energy, LLC for the Dutchess County Resource Recovery Agency. The facility, which is located on 11 acres owned by Dutchess County at 98 Sand Dock Road, in the Town of Poughkeepsie, began operation in 1989, and serves the greater Dutchess County area. According to the latest data available from the NYS Department of Environmental

[8] Section written by Allison Chatrchyan, CCEDC, Robert Cohen, Dutchess County EMC, Victoria Kelly, Dutchess County EMC, and Andrew Lo, CCEDC Summer 2011 intern.

[9] MSW Consultants, 2011. Dutchess County, NY: Independent Review of Solid Waste Management System and LSWMP, Final Report.

Conservation, the Dutchess County facility received and processed the following amounts of waste (in tons) in 2009:

Table 2. 2009 Municipal Waste Combustion Summary Report.[10]

Facility Name	Amount MSW Received (tons)	Amount MSW Processed (tons)	Amount MSW Bypassed (tons)	Amount Residue Produced (tons)	Amount Electricity Generated (megawatt hours)	Amount Electricity Sold (megawatt hours)	Amount Total Metals Recovered (tons)
Dutchess County Resource Recovery Facility	150,682	150,925	126	44,631	60,569	46,934	6,518

The Dutchess County Resource Recovery Agency has a service agreement with a dual stream Material Recovery Facility (MRF) in the town of Poughkeepsie, NY currently operated by the Hudson Baylor Corporation, which sorts, bales, and sells recovered recyclable materials. As of 2011, Hudson Baylor is finalizing construction on a new, 56,000 sq. ft. industrial Material Recovery Facility in Beacon, NY, which will accept residential material from dual stream (two recycling bins), single stream (one recycling bin), and commercial sources. The current MRF facility in Poughkeepsie will become a transfer station.

According to Dutchess County, as of November 2011, there are 16 companies licensed by the County to haul waste in Dutchess County, NY, the largest of these include Royal Carting, Recycle Depot, Taylor Recycling and Waste Management. These companies transport some waste to the Dutchess County waste-to-energy facility, some recyclables to the MRF facility, handle some of the compost and recyclable materials themselves, and transport some municipal solid waste to out-of-county facilities.

Among the key findings of an independent review of solid waste management in Dutchess County commissioned by the County Legislature and completed by the consultant, Mid Atlantic Solid Waste Consultants in July 2011[11] is that the rate of recycling in the county is low and can be improved. Education of county residents is essential to improving recycling rates in the county.

There are also numerous private and municipal transfer stations in Dutchess County, that accept municipal solid waste for the purpose of subsequent transfer to another solid waste management facility for further processing, treatment, transfer or disposal. These include both regulated (permitted) transfer stations and registered transfer stations that receive less than 12,500 tons of household waste per year.

Table 3 was developed by the EMC to provide more information for Dutchess County residents as well as public officials about how to properly dispose of municipal solid waste in each municipality (Town, Village and City) in the county. The matrix is divided into two sections, the first includes a listing of whether the municipality has a transfer station and if residents can bring to their local facility or dispose of via curbside pickup: garbage, plastic bottles, aluminum cans, glass, jars, bottles, newspaper, corrugated cardboard, brush and electronics. The second section of the matrix provides a listing of whether residents can dispose of tires, vehicle batteries, hazardous materials, motor oil, appliances and construction debris. There is extensive variability in what and how each municipality collects refuse and recycling, especially among towns. Individual residents may be required to purchase access to their municipal facility and should contact their town officials

[10] New York State DEC: http://www.dec.ny.gov/chemical/40052.html.

[11] MSW Consultants, 2011. Dutchess County, NY: Independent Review of Solid Waste Management System and LSWMP, Final Report.

to obtain information about fees. The cities of Beacon and Poughkeepsie contract with Royal Carting for curbside collection of residential garbage and recycling.

Table 3. Solid Waste Management and Recycling Options by Dutchess County Municipality.[12]

Town, City and Village	Transfer Station	Garbage	Plastic Bottles	Alum. Cans	Glass, Jars, Bottles	Newspaper	Corrugated Cardboard	Brush	Electronics
Amenia/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Beacon/C	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Beekman/T	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Clinton/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Dover/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
East Fishkill/T	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fishkill/T	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fishkill/V	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hyde Park/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LaGrange/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Milan/T	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Millbrook/V									
Millerton/V									
North East/T	No								
Pawling/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pawling/V	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Pine Plains/T	No								
Pleasant Valley/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Poughkeepsie/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Poughkeepsie/C	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Red Hook/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Red Hook/V	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Rhinebeck/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rhinebeck/V	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stanford/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Tivoli/V	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Union Vale/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Wappingers /V	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wappinger/T	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Washington/T	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

[12] This two-page matrix provides information on the different recycling services provided by each municipality. The matrix can also be used by municipalities to see what services other municipalities are providing to their residents. Residents can use the matrix to see what services their municipality provides. EMC makes no claim as to the full accuracy of the data – contact your local municipality for more detailed information.

Town, City and Village	Tires	Vehicle Battery	Hazard. Material	Motor Oil	Appliances	Constr. Debris	Comments
Amenia/T	No	No	No	No	Yes	No	Transfer Station
Beacon/C	No	No	No	No	No	No	Electronic Equip goes to DCRRA
Beekman/T	Yes	No	No	No	Yes	No	Transfer Station Run by Royal Carting (recycling is free)
Clinton/T	Yes	Yes	No	No	Yes	No	Recycling Center
Dover/T	No	No	No	No	No	No	
East Fishkill/T	Yes	No	No	No	Yes	No	Trash goes to Royal Carting/Tires can go to Highway Dept.
Fishkill/T	Yes	No	No	No	Yes	No	Brush goes to Highway Dept/DCRRA for battery disposal
Fishkill/V	Yes	No	No	No	Yes	No	Contracts with Royal Carting. Haz materials go to DCRRA
Hyde Park/T	Yes	No	No	No	Yes	No	Royal Carting Transfer Station
LaGrange/T	Yes	No	No	No	Yes	No	Royal Carting Transfer Station
Milan/T	Yes	No	No	No	Yes	Yes	
Millbrook/V							Information not available
Millerton/V							Information not available
North East/T							
Pawling/T	Yes	Yes	Yes	Yes	Yes	No	
Pawling/V	Yes	Yes	No	Yes	Yes	No	
Pine Plains/T							
Pleasant Valley/T	Yes	No	No	No	Yes	Yes	Compactor & Recycling Facilities
Poughkeepsie/T	No	No	No	No	Yes	No	Electronic equip goes to DC RRA
Poughkeepsie/C	Yes	No	No	No	Yes	No	Haz materials go to DCRRA
Red Hook/T	No	Yes	No	No	Yes	No	Recycling Center; free drop off 10 times/yr; Haz materials go to DCRRA
Red Hook/V	No	No	No	No	No	No	Curbside Pickup; free drop off 10 times/yr
Rhinebeck/T	Yes	No	No	No	Yes	No	Transfer Station
Rhinebeck/V	No	Yes	Yes	No	Yes	No	Curbside pickup only
Stanford/T	Yes	No	No	Yes	Yes	No	Weds 7:00am-1:00pm; Sat 7:00am-3:00pm
Tivoli/V	No	No	No	No	No	No	Village arranges for bigger items to be taken
Union Vale/T	Yes	Yes	No	No	Yes	No	Recycling Center
Wappingers Falls/V	Yes	No	No	No	Yes	No	Residential Garbage District; Curbside pickup only; Recycling with Royal Carting
Wappinger/T	Yes	Yes	No	No	Yes	Yes	Recycling Center/Royal Carting
Washington/T	Yes	Yes	No	Yes	Yes	Yes	Royal Carting for Recycling

Hazardous Waste Sites[13]

Dutchess County currently has five inactive hazardous sites in the federal Superfund Program that are listed on the National Priorities List (NPL) including, Haviland Complex, Hopewell Precision, Jones Sanitation, Sarney Farm, and Shenandoah Road, and three federal Resource Conservation Recovery Act (RCRA) sites still being monitored and used for private purposes including, Chevron-Texaco, IBM Fishkill, and IBM Poughkeepsie (see Table 4 below). Abandoned hazardous waste sites placed on the federal NPL List include those that the EPA has determined present "a significant risk to human health or the environment," with the sites being eligible for remediation under the Superfund trust fund program. Hazardous Waste Sites listed under the federal RCRA program provides EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste.

Among counties in New York, Dutchess is surpassed in the number of NPL and RCRA sites by Orange (5 and 4), Niagara (8 and 11), Broome (8 and 1), Suffolk (16 and 4) and Nassau (16 and 5) counties. All of the Dutchess County superfund sites involved contamination of groundwater.

Table 4. Federal Superfund and RCRA Sites in Dutchess County, NY.[14]

Site EPA ID#	Site Name	Address	NPL Status	Source of Contamination	What is contaminated / What can be contaminated?	Date of Proposed Clean up	Current Status
NYD9807 85661	Haviland Complex	Route 9G & Haviland Rd, Town of Hyde Park	F	Underground injection	Groundwater, Sediments	10/15/1984	Ongoing monitoring as of 2007
NYD0668 13064	Hopewell Precision	15 Ryan Rd, Hopewell Junction	F	Dumping	Groundwater, Surface Water, Air	3/1/2003	Ongoing assessment
NYD9805 34556	Jones Sanitation	Cardinal Rd, Hyde Park	D	Lagoon disposal & Landfill	Groundwater, Sediment, Soil, Surface Water	1/22/1987	Deleted from NPL in 2005
NYD9805 35165	Sarney Farm	Benson Hill Rd, Amenia	F	Landfill	Groundwater, Soil, Surface Water	10/15/1984	Ongoing until reviewed in 2011
NYSFN020 4269	Shenandoah Road Groundwater Contamination	Seymour Ln, East Fishkill	F	Buried, Septic system	Groundwater	4/13/2000	Ongoing monitoring as of 2011
NYD9805 32907	Texaco	Glenham, Fishkill	RCRA	Dumping, spills	Air, Groundwater, Soil	Spring 2011	Ongoing as of 2011
NYD0007 07901	IBM Corporation-East Fishkill	2070 Route 52, Hopewell Junction	RCRA	Dumping, land filling on site	Groundwater, Soil, Air	9/29/1995	Undergoing renewal as of 2008
NYD0804 80734	IBM Corporation-Poughkeepsie	2455 South Road, Poughkeepsie	RCRA	Dumping	Groundwater, Surface Water, Indoor Air, Soil	1992	Ongoing review since 2007

* Status Codes: P = Proposed for Superfund National Priority List (NPL); F = Currently on the Final NPL; D = Deleted from the Final NPL; RCRA = Resource Conservation and Recovery Act Site.

In addition to the hazardous waste sites being remediated under the USEPA's authority, there are numerous hazardous waste sites in Dutchess County under the jurisdiction of the NYS DEC's State Superfund (SSF) Program. The mission of this DEC program is to identify and characterize suspected inactive hazardous waste disposal sites (sites) and to investigate and remediate those sites that pose a significant threat to public health

[13] Section written by Allison Chatrchyan, CCEDC, Victoria Kelly, Dutchess County EMC, and Andrew Lo, 2011 CCEDC Summer intern.
[14] USEPA, New York Sites in Region 2: http://www.epa.gov/region2/cleanup/sites/nytoc_sitename.htm.

or the environment. Significant threat SSF sites are Class 2 sites on New York's Registry of Inactive Hazardous Waste Disposal Sites (Registry)[15] (see Table 5. below).

Table 5. Current Known Hazardous Waste Sites being Remediated in Dutchess County, NY[16]

#	Site Code	Site Name	Program	Site Class	City/Town	Address
1		CH - Waster St. - Poughkeepsie MGP	BCP	A	Poughkeepsie	North Water St.
2	C314081	Former A.C. Dutton Lumber Yard	BCP	A	Poughkeepsie	1 Dutchess Ave.
3	C314081A	OFF-SITE Former A.C. Dutton Lumber Yard	BCP	A	Poughkeepsie	1 Dutchess Ave.
4	C314083	Chelsea Waterfront Development Site	BCP	A	Fishkill	5-47 Chelsea Industrial Park (Brockway Rd.)
5	C314108	PURA-14 Site	BCP	C	Poughkeepsie	36 Pine St.
6	C314109	Former City of Poughkeepsie Sewage Plant	BCP	C	Poughkeepsie	Rinaldi Boulevard and Hurlihe St.
7	C314111	Former Drive & Park Inc. Site	BCP	C	Poughkeepsie	28 IBM Rd.
8	C314112	Long Dock Beacon	BCP	A	Beacon	8 and 12-25 Long Dock Rd.
9	C314113	Future Love Rd. Guardian Self Storage Facility	BCP	A	Poughkeepsie	2 LOVE Rd.
10	C314114	Nine Mall Plaza	BCP	C	Poughkeepsie	1810 - 1840 Rt. 9
11	C314116	Cornerstone Enterprises Inc.	BCP	A	Pawling	33 East Main St.
12	C314117	Beacon Terminal	BCP	A	Beacon	555 South Ave.
13	B00020	Former Hamilton Reproduction	ERP	C	Poughkeepsie (c)	166-186 North Hamilton St.
14	B00036	Qual Krom Site	ERP	C	Poughkeepsie	28 Orchard Place
15	B00130	Brunetto Cheese	ERP	C	Beacon (c)	33 North Cedar St.
16	B00148	"400 Block" Restoration Area	ERP	C	Poughkeepsie	413-441 Main St
17	B00177	Perx Property Cleanup	ERP	C	Red Hook	68 South BRd.way
18	B00190	Hudson River Waterfront-DeLaval Property	ERP	A	Poughkeepsie (c)	Rinaldi Boulevard and Pine St.
19	E314108	PURA -14 Property	ERP	C	Poughkeepsie	Pine St.
20	314001	IBM - Poughkeepsie	HW	2	Poughkeepsie	South Rd.
21	314002	Pawling Rubber Company	HW	2	Pawling	157 Charles Colman Boulevard
22	314003	Schatz Federal Bearings	HW	4	Poughkeepsie	223-47 Van Wagner Rd.
23	314004	Texaco Research Center	HW	4	East Fishkill	Old Glenham Rd.
24	314006	Amenia Town Landfill	HW	2	AMENIA	Rt. 22

[15] NYS DEC: http://www.dec.ny.gov/about/53234.html.
[16] NYS DEC, Environmental Site Remediation Database, http://www.dec.ny.gov/cfmx/extapps/derexternal/haz/results.cfm?pageid=3.

25	314007	Sarney (a.k.a. Giannattasio)	HW	4	Amenia	Benson Hill Rd.
26	314008	NOW Corporation	HW	4	Clinton	Rt. 9-G
27	314012	Jones Sanitation	HW	4	Hyde Park	Cardinal Rd.
28	314015	Taconic Products	HW	C	Millerton	5979 North Elm Ave.
29	314020	Dutchess Metal Finishers	HW	C	RED HOOK	Rt. 199
30	314038	Page Industrial Park (Tau Industries)	HW	3	POUGHKEEPSIE	Rt. 55
31	314044	Tuck Industries	HW	C	Beacon	Tioronda Ave.
32	314047	Dutchess Sanitation (FICA)	HW	4	Poughkeepsie	275 Van Wagner Rd.
33	314048	North East Town Landfill	HW	2	Northeast	Coleman Station Rd.
34	314052	Former Hopewell Precision Contamination Area	HW	2	Hopewell Junction	Ryan Rd.
35	314054	IBM-East Fishkill	HW	2	East Fishkill	Rt. 52
36	314058	Three Star Anodizing	HW	2	Wappingers Falls	Market St.
37	314059	Haviland Complex and Haviland Rd.	HW	4	Hyde Park	Rt. 9-G & Haviland Rd.
38	314061	Harris Corporation	HW	4	Poughkeepsie	Mid-Hudson Industrial Park & 70A Overocker Rd.
39	314063	Hudson River Psych. Center (HRPC)	HW	C	Poughkeepsie	North Rd.
40	314065	Great Eastern Lithographic Co.	HW	C	POUGHKEEPSIE	46 VIOLET Ave.
41	314067	Fairchild	HW	4	WAPPINGERS FALLS	91 All Angels Hill Rd.
42	314074	Schatz Plant	HW	2	Poughkeepsie	70 Fairview Ave.
43	314076	IBM B952/982	HW	4	Poughkeepsie	Neptune Rd.
44	314077	B906 - Page Industrial Area	HW	2	Poughkeepsie	Rt. 55
45	314078	Dutchess County Airport Hangar Facility	HW	4	WAPPINGER	Rt. 104
46	314082	Fargo Manufacturing	HW	4	Poughkeepsie	130 Salt Point Turnpike
47	314083	Circle M Wood Treating Corp.	HW	2	Fishkill	5-47 Chelsea Industrial Park (Brockway Rd.)
48	314084	Apple Valley Shopping Center	HW	2	LA GRANGE	Rt. 49 & Rt. 55
49	314085	Jorgensen Residence	HW	C	Pleasant Valley	378A Meddaugh Rd.
50	314088	Greer Toyota	HW	4	WAPPINGERS FALLS	1349 Rt. 9

* Site Codes: BCP = Brownfield Cleanup Program Site; ERP = Environmental Restoration Program; HW = State Superfund Program. Site Class: Classification Code A = work is underway and not yet complete. Classification Code C = remediation has been satisfactorily completed under a remedial program.[17]

In addition to maintaining a list of known hazardous waste sites, the DEC also maintains two other databases: the Spill Incident Database and the Bulk Storage Database. Through the Spill Response Program, DEC responds

[17] NYS DEC: http://www.dec.ny.gov/chemical/8663.html.

to reports of petroleum and other hazardous material releases (both large and very minor spills). Spill response staff throughout the State investigate such spill reports and take action based on the type of material spilled, the potential environmental damage, and safety risks to the public. Both immediate response and continued cleanup vary depending on the type of material spilled and the damage caused. Federal and State law require the spiller, or responsible party, to notify government agencies and to contain, clean up, and dispose of any spilled/contaminated material in order to correct any environmental damage. Between January and December 2011, the DEC recorded and responded to more than 375 incidents in the county.[18]

The DEC's Bulk Storage Program Database maintains the registrations of over 60,000 active and inactive bulk storage sites statewide. The Bulk Storage Program includes three types of facilities; Petroleum Bulk Storage (PBS), Major Oil Storage Facilities (MOSF), and Chemical Bulk Storage (CBS). All PBS facilities with a total storage capacity of 1,100 gallons or more are required to register; All CBS underground tanks and all stationary aboveground tanks with a capacity of 185 gallons or more are required to register; and all MOSF Sites storing more than 400,000 gallons of petroleum products must register. As of December 2011, there are 1,107 Sites in the DEC's Bulk Storage Program Database in Dutchess County, NY.[19]

Biological Resources, including Wildlife and Rare and Endangered Species[20]

Dutchess County has diverse, rare and ecologically important biological resources. There is an urgent need to work to preserve these resources. Through protection of key habitats and careful planning, we can maintain and even improve our remaining biotic resources. We are home to species ranging from river otters and black bear to pileated woodpeckers, Blanding's turtles, woodland warblers, and specialized wetland orchids and sedges. The county also supports several federally and state listed threatened species (see Table 6 below).

Table 6. Dutchess County Federal and NYS Listed Endangered & Threatened Animal Species.[21]

Common Name	Scientific Name	Status
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	US = P; NY= NL
Bald eagle	*Haliaeetus leucocephalus*	US = D; NY = T
Blanding's turtle	*Emydoidea blandingii*	US = NL; NY = T
Bog turtle	*Clemmys muhlenbergii*	US = T; NY = E
Dwarf wedgemussel	*Alasmidonta heterdon*	US = E; NY = E
Eastern wormsnake	*Carphophis amoenus*	US = NL; NY = SC
Golden eagle	*Aquila chrysaetos*	US = NL; NY = E
Indiana bat	*Myotis sodalis*	US = E; NY = E
New England cottontail	*Sylvilagus transitionalis*	US = C; NY = SC
Pied-billed grebe	*Podilymbus podiceps*	US = NL; NY = T
Sedge wren	*Cistothorus platensis*	US = NL; NY = T
Shortnose sturgeon	*Acipenser brevirostrum*	US = E; NY = E
Timber rattlesnake	*Crotalus horridus*	US = NL; NY = T

* Status Codes: US = United States; NY = New York; E = Endangered; T = Threatened; P = Proposed; C = Candidate; SC = Species of Special Concern; D = Delisted; NL = Not Listed.

[18] NYS DEC: http://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=2.
[19] NYS DEC: http://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=4.
[20] Section written by Maribel Pregnall and Stephen MacAvery, Dutchess County EMC. Excerpts taken from Chapter 6: Biological Resources and Biodiversity of Dutchess County, NY by Mary Ann Cunningham, Neil Curri, Robert Wills October 2010 and Hudsonia.
[21] Source: www.fws.gov/northeast/nyfo/es/section7.htm and www.dec.gov/animals/7181.html.

In addition to animal species, there are 23 plant species in Dutchess County protected by New York State.[22]

Dutchess residents should work diligently to maintain, learn about and protect the high level of diversity that persists in our county (see Table 7 below, taken from the Dutchess County Natural Resource Inventory).

Table 7. Target habitats with special value for conservation.[23]

Habitat	Examples of species needing this habitat
Shoreline corridors	river otter, wood turtle, cerulean warbler, wading birds, trout, stream salamanders and Hudson River water nymph
Unbroken forests	scarlet tanager, warblers, wide-ranging mammals, hawks, owls, box turtles, and plants like fringed polygala flower
Grasslands and shrublands	northern harrier, bobolink, eastern meadowlark, golden-winged warbler, short-eared owl and uncommon butterflies
Wetlands	American bittern, marsh wren, Blanding's turtle, northern leopard frog and a rich diversity of flora like pitcher plant
Seasonal woodland pools	Northeast including Jefferson, marbled, and spotted salamanders, wood frog, spotted turtle, fairy shrimp and others declining throughout the Northeast
Caves and cliff habitats	bats, peregrine falcon, overwintering snakes, migrating hawks, and rare cliff plants like purple cliffbrake and prickly pear
Unique natural areas	at-risk plants and animals

All of us in the county benefit from these biological resources in multiple ways. We enjoy the clean water and air that forests, wetlands and stream corridors work to protect. We benefit economically from the tourism and vital recreational opportunities that our beautiful open spaces and natural areas and associated wildlife provide. It is in our best interest to minimize the impacts to these biological resources so that we can maintain and improve the quality of life of every Dutchess County resident.

Our town Conservation Advisory Commissions, town boards and planning boards and other municipal agencies play a large role in land use planning, environmental reviews, and issuing regulatory approvals for development projects. The public can play an important role supporting these municipal entities and working together to solve environmental issues and mitigate impacts. In Dutchess County, we have sound scientific resources including several colleges and various research institutions. Their input and expertise should be sought out and used to make informed decisions about smart growth and development so that we can better preserve biodiversity resources and prevent habitat loss, degradation and fragmentation. Existing sources of information like Hudsonia's Biodiversity Assessment Manual is available free of charge to municipal conservation commissions, land trusts, and public libraries throughout the region. Encouragement of biodiversity education in our school systems and continued connection with our youth via outdoor and environmental education will enable a well-informed populace for future protection of our vital biological resources.

[22] Source: www.dec.gov/animals/7181.html.
[23] Strong et al., 2008.

When considering our important biological resources, collaboration with land use planners and conservation groups in our county and in the surrounding counties will be most effective. Replication of successful projects will continue to nurture and protect the remarkable diversity we still have left. For example, the Friends of Peach Hill, Scenic Hudson, the Town of Poughkeepsie, New York State and Dutchess County all worked together providing funds and support to save and protect an old apple orchard from development. Peach Hill is the highest point of elevation in the Town and is home to a large population of diverse birds and other flora and fauna. It is valuable open space and offers a peaceful recreational area. Similarly, the Town of East Fishkill implemented road salt applicators that not only save money, but also reduce hazardous sodium and chloride from getting into our waterways and contaminating drinking water and harming wildlife.

The Hudson River Valley Greenway Act, a bi-partisan bill passed by New York State 20 years ago is a popular and successful collaboration between private sectors and local, county and state government. In 2000, Dutchess County completed the Greenway Connections, which outlines guidelines and principals for maintaining open space. Since then 29 of the 30 municipalities have incorporated Greenway Compact guidelines in their local regulations. The County has allotted funds helping to leverage additional funds from the state for the protection of thousands of acres of open space. This very successful program is worth continuing to support.[24]

In addition, the commendable work of the Dutchess County Executive to convert rails to trails and not to highways has brought more tourists into the county and will work to preserve an open space corridor that wildlife will find more useful than highways. In addition, the wetlands and critical habitat adjacent to these trails will benefit greatly from the rail trails. Expansion of this network of trails will enable commuters in Dutchess County to become less reliant on automobiles. Recruiting citizens to play more active roles in the CAC's of Dutchess County like the LaGrange CAC who received an award recently for their environmental education efforts in their community, will enable citizens to be involved in the protection of the biodiversity in their own backyards. The watershed awareness week that Dutchess Watersheds sponsors is an example of how we can all work together to maintain and even improve upon what we have for biological resources. The momentum created by these and many other organizations is powerful and continued support of them is paramount to protection of biodiversity in our county.

Land Use Change[25]

Historic Land Use Change

Much of Dutchess County was cleared for agricultural land uses from colonial times into the last century. A period of agricultural decline followed in the 1940s with substantial field abandonment and a resurgence of forest cover. Preliminary analysis of historic aerial photographs provided by Dutchess County Office of Computer Information Systems has shown that tree cover in the county has increased by approximately 140 percent from 1936 to 2000. Recent photographs also capture a simultaneous increase in residential and commercial development.

[24] Plan on it, a Dutchess County Planning Federation Newsletter, December 2011/January 2012, Growing in a Green Way: The Past and Future of Greenway, By John Clarke, Development and Design Coordinator.
[25] Section written by Neil Curri, Sr. GIS Resource Educator, Cornell Cooperative Extension Dutchess County.

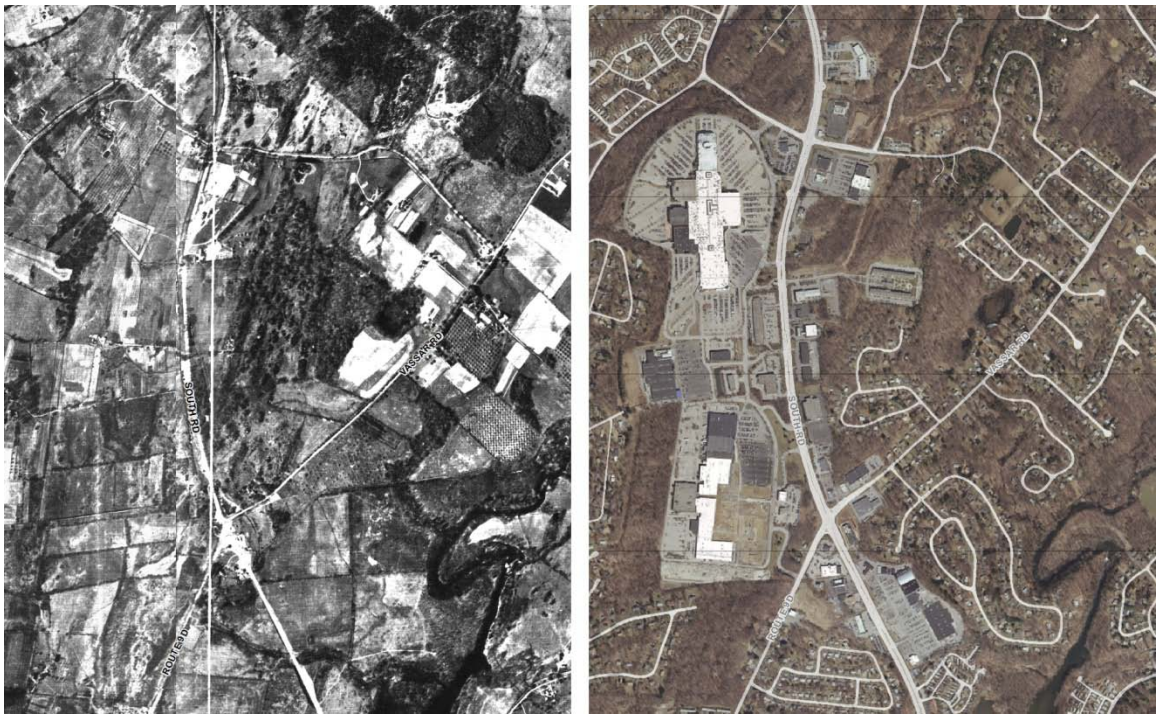

Figure 3: Land use changes in Dutchess County, 1936 and 2009. Route 9 near the Poughkeepsie Galleria Mall and South Hills Mall. Table 8 provides a summary of key changes.[26]

Table 8: Changes in forest cover and orchards, and roads from 1936 to 2000[27]

Land use class	1936	2000	Percentage change
Forest	75,410 ha	116,300 ha	+54%
Orchards	5120 ha	1202 ha	-77%
Roads	2,867 km	4,609 km	+61%

Recent Land Use Change

An important recent trend in land use in the last 60 years has been the expansion of developed areas, in particular housing, commercial, and transportation activities. These land uses increasingly occurred away from urban centers, as residents increasingly wanted and could afford, large lot sizes, larger houses, and longer commutes to work. In the past 10-15 years, roughly one-third of new houses have been built on lots 2 acres or larger – a dramatic transition from the 1960s and 1970s.

[26] Cunningham et al., 2010.
[27] Cunningham et al., 2010.

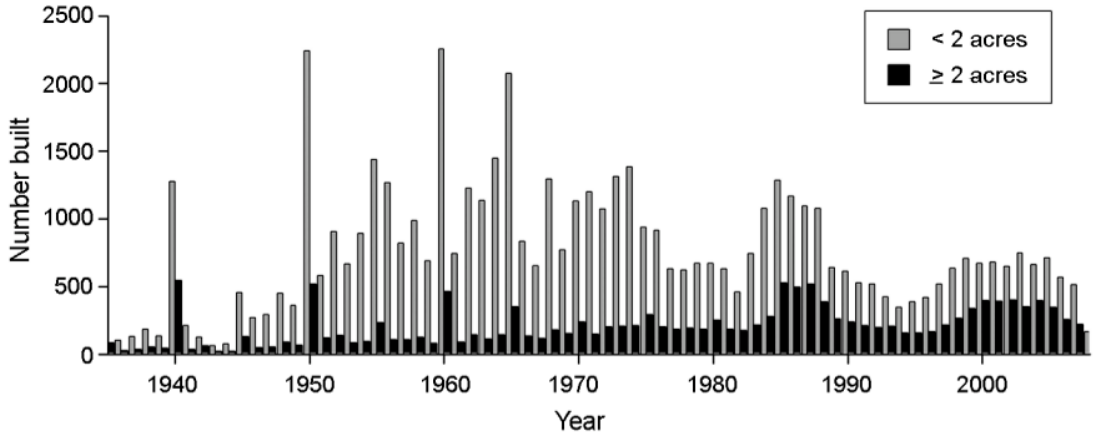

Figure 4: Number of houses built in a year, on small lots and large rural lots, from RPS4 data, 2008. Peaks at decades (e.g. 1940, 1950) include records for which build dates were rounded or estimated. (from Cunningham et al., 2010).

The recent growth of developed area has occurred largely at the expense of forested land. Figure 5 below illustrates the amount of developed area converted from various other land cover types in Dutchess County from 1996 to 2006. Over 1.1 square miles (about 700 acres) of forested areas were developed, compared to about 300 acres converted from all other land cover types combined. The total increase in developed land across the County from 1996 to 2006 was 2.21% (over 1,000 acres) with an increase in impervious surface area of 2.73%.

Impervious surface is composed of any man-made material that impedes or prevents the natural infiltration of water into the soil, and is associated with developed land uses. Examples of impervious surfaces include building roofs, patios, sidewalks, concrete or asphalt streets, parking lots, and gravel roads. As impervious surfaces increase, so do stormwater runoff volumes (increasing flooding), the velocity of stormwater flows (increasing erosion), and pollutant levels in runoff (Schueler, 1994). Impervious surfaces reduce the amount of water available to recharge wells and springs. Some of these effects can be mitigated by Green Infrastructure, a variety of site design techniques and structural practices for managing stormwater. Green Infrastructure practices help control stormwater at its source, remove pollutants, and reduce the amount of runoff and waste that ends up in sewer systems and local water bodies. An EPA Study[28] showed that more compact forms of development reduce runoff rates per house by 74% if constructed at eight units per acre rather than typical one-acre lots. Close-knit, walkable, and transit friendly centers consume far less land, save natural and agricultural green spaces, and produce less overall impervious surfaces and run-off than spread-out suburban sprawl.

[28] EPA: Protecting Water Resources with Higher Density Development, 2006

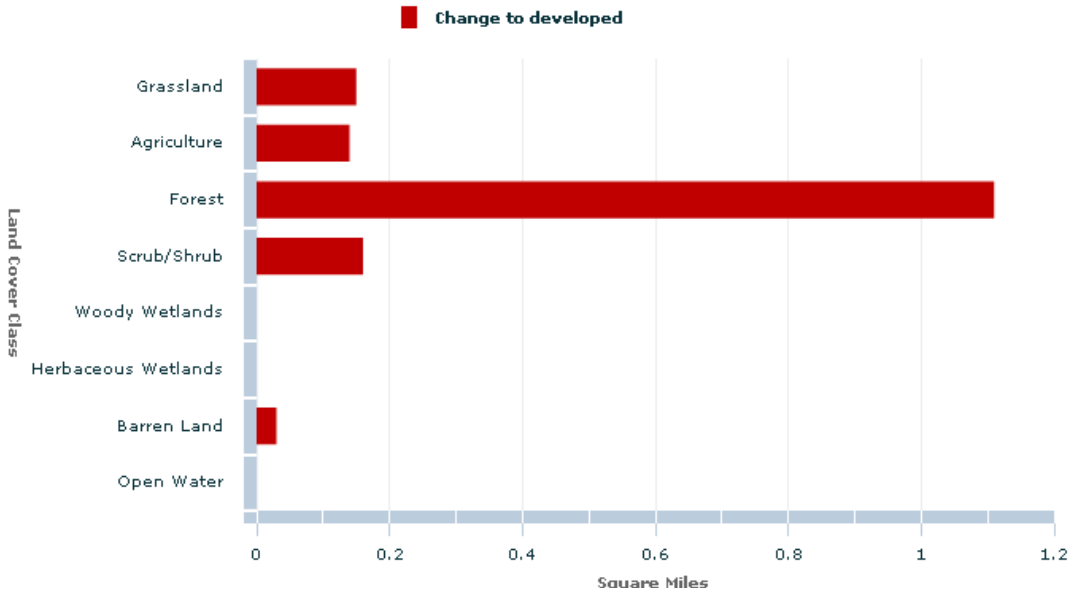

Figure 5: Distribution of areas in Dutchess County converted to development by land cover, 1996-2006[29]

Most land cover types in Dutchess County showed both gains and losses between 1996 and 2006, but developed areas increased with almost no loss (Figure 6). This trend in the growth of developed land shows that once developed and covered with high proportions of impervious surfaces, these areas are rarely converted to other uses. Small net gains in grassland and agriculture may be the result of conversion from forested areas, as well as from scrub/shrub areas.

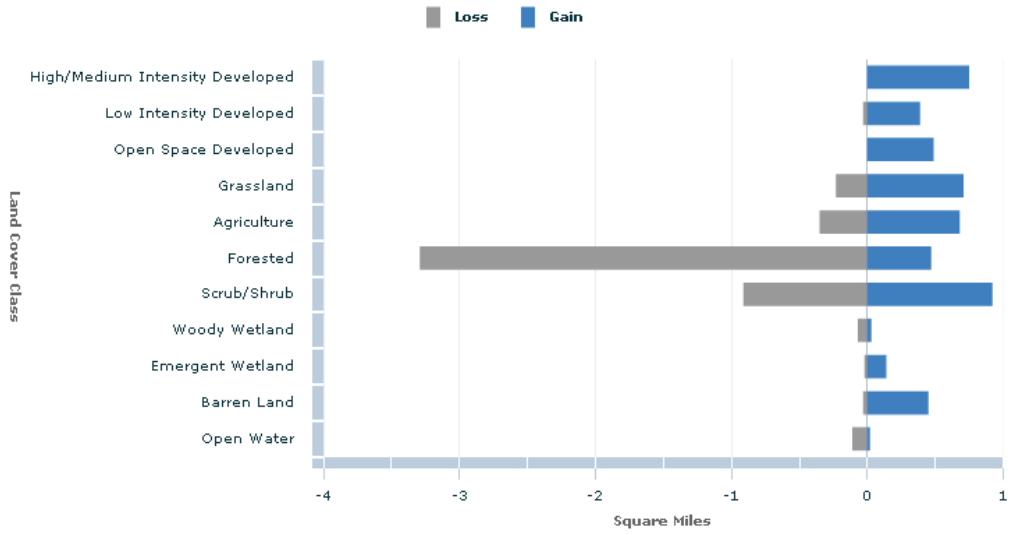

Figure 6: Distribution of change (losses and gains) in Dutchess County by land cover, 1996-2006[30]

Total forest cover in Dutchess County has decreased over half of a percent (0.57%) or about 1,800 acres from 1996 to 2006, while core forest area has decreased nearly 0.8 percent. Non-core forested area has increased 0.19%. Core forests are the interior portions of large forested areas preferred by species that require this type

[28] National Oceanographic and Atmospheric Administration, C-CAP Land Cover Atlas, http://www.csc.noaa.gov/ccapatlas.
[30] National Oceanographic and Atmospheric Administration, C-CAP Land Cover Atlas, http://www.csc.noaa.gov/ccapatlas.

of habitat isolated from other, non-forest areas. Non-core forests are small, isolated forest patches as well as the outer portions of large forested areas, between core forests and other land cover types. Decreasing core forest area and increasing non-core forest are indicators of forest fragmentation.

Forest fragmentation occurs when large, contiguous stands of mature forest are divided into smaller isolated patches. Forest fragmentation is caused by human activities, such as road construction, agricultural clearing, and urbanization, or by processes like fire and climate change.

The degradation of core forest into fragments can cause the loss of native flora and fauna species, alterations to water cycles, and degradation of air and water quality. Forests weakened by fragmentation become more susceptible to damage from insects, diseases, and invasive plants, Recent research conducted in Dutchess County by the Cary Institute of Ecosystem Studies also suggests that Lyme disease risk decreases when vertebrate communities contain many species (high biodiversity) and increases when the habitat is highly fragmented with lower diversity (Ostfeld et al., 2003).

Invasive Species[31]

New York State defines "invasive species" as follows: (a) non-native to the ecosystem under consideration; and (b) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. According to the NYS Department of Environmental Conservation (NYSDEC), invasive species are a threat to our biodiversity and are judged second only to habitat loss. Invasives hail from around the world and the rate of invasion is increasing at an alarming rate with the increase in international trade.

Invasive species have been problematic in the past and are certainly a problem now, since they threaten our ecosystems, including all natural systems, managed forests, our food supply, including not only agriculture, but also harvested wildlife, fish and shellfish. Invasives are a threat to our built environments including landscaping, infrastructure, industry, gardens and pets. Invasives can affect recreational areas and human health.

The NYS Invasive Species Council was charged with developing a recommended four-tier system for invasive species management. The regulatory four-tier system required by statute assigns one of three regulatory categories to all species of non-native plants and animals. The most restrictive category is "Prohibited Species" and bans the commerce, use and purposeful introduction of non-native species that pose clear risks to New York's economic, ecological and/or human health. The second category is "Regulated Species." It restricts, but does not prohibit, the commerce and other use of species that have the potential to cause significant harm and could be effectively contained through practicable and meaningful regulatory programs. The third category is "Unregulated Species." This category identifies those non-native species that are expected to pose no significant threat and therefore can be used freely. Climate change was a factor in creating these assessments of invasive species, since it is likely that invasive species found in more southern states will be able to survive in a warmer New York.

The number of persisting non-native species in New York is 1,405. The number of persisting non-native species assessed as having a High or Very High invasive nature in New York as of January 2010 is 68. Though not an

[31] Section written by Stephanie D. Radin, Agriculture/Horticulture Issue Leader, Cornell Cooperative Extension Dutchess County.

exact figure, Dutchess County probably has at least 75% of all non-native species though only a few are high in density.

Table 9. Top Ten invasive species with an assessment of "Very High" Invasive Nature based on DEC 4-Tier Assessment.[32]

#	Common Name	Scientific Name
1	Eurasian Watermilfoil	*Myriophyllum spicatum*
2	Japanese Knotweed	*Fallopia japonica*
3	Autumn Olive	*Elaeagnus umbellata*
4	Broadleaf Water-Milfoil	*Myriophyllum heterophyllum*
5	Common Reed Grass	*Phragmites australis*
6	Water Thyme	*Hydrilla verticillata*
7	Mile-A-Minute (MaM)	*Persicaria perfoliata*
8	Purple Loosestrife (PL)	*Lythrum salicaria*
9	Japanese Barberry (JB)	*Berberis thunbergii*
10	Black Swallow-wort (BSW)	*Cynanchum louiseae*

There are some additional highly destructive invasive species that are either in Dutchess County or within striking range of Dutchess County that should be mentioned and monitored (Table 10).

Table 10. Significant Invasive Species either in, or within close proximity to Dutchess County, NY.

#	Common Name	Scientific Name
1	Brown Marmorated Stink Bug (BMSB)	*Halyomorpha halys*
2	Emerald Ash Borer (EAB)	*Agrilus planipennis*
3	Hemlock Woolly Adelgid (HWA)	*Adelges tsugae*
4	Japanese Stilt Grass (JSG)	*Microstegium vimineum*
5	Viburnum Leaf Beetle (VLB)	*Pyrrhalta viburni*

Of these species, the Emerald Ash Borer is particular threat. Dutchess County is right in the path of this very destructive pest of native ash trees. This exotic beetle was first discovered in southeastern Michigan in 2002. It has since spread across the Mid-West, the Mid-Atlantic and eastern states as far east as New York. EAB was first discovered in western NY in 2009. In 2010 it was discovered in Ulster County and since spread to other counties in the state. As of November 2011, it has not been confirmed in Dutchess County but it is only a matter of time. Steps are being taken to slow the spread and prepare communities for action steps. There are important quarantines regarding the movement of firewood in NYS, the primary means by which this pest is transported. According to NYSDEC **"**A Regulation is in effect that prohibits the import of firewood into New York unless it has been heat treated to kill pests. The regulation also limits the transportation of untreated firewood to less than 50 miles from its source."

The Hemlock Woolly Adelgid is a destructive introduced pest of forest and ornamental hemlock trees has been in Dutchess County since the mid to late 1980's. Eastern, *Tsuga canadensis* and Carolina, *T. caroliniana* are most susceptible but all species of hemlock may be attacked. Heavy infestations have killed trees in as little as four years. There are concerns due to climate change that its range may spread to the Adirondacks, which has

[32] See NYSDEC website or CCEDC website (www.ccedutchess.org) for more information.

dense natural stands of eastern hemlock. According to NYSERDA "HWA is already well established in New York, in part due to rising winter temperatures that are allowing the insect to survive the winter."

Due to space limitations, several other invasive species commonly found in Dutchess County cannot be described in detail. What follows is a list of other invasive species common to Dutchess County that have increased in population over the past ten years.

Table 11. Invasive Species Common to Dutchess County that have Increased in Population.

Garlic Mustard	*Alliaria petiolata*
Porcelain Berry	*Ampelopsis brevipedunculata*
Oriental Bittersweet	*Celastrus orbiculatus*
Mugwort	*Artemisia vulgaris*
Tree of Heaven	*Ailanthus altissima*
Chinese Water Chestnut	*Eleocharis dulcis*
Zebra Mussels	*Dreissena polymorpha*
Japanese Beetle	*Popillia japonica*
Multi-Colored Asian Lady Beetle	*Harmonia axyridis*

Lyme Disease and Other Infectious Diseases[33]

Lyme disease is an illness caused by an infection of the bacteria *Borrelia burdorferi*. In Dutchess County, the bacteria are transmitted to humans by the bite of black-legged ticks, *Ixodes scapularis* (formerly and mistakenly thought to be *Ixodes damini*, the deer tick). Black-legged ticks have three life stages, larvae, nymphs and adults, each of which needs one blood meal to survive. The tick's life cycle takes two years to complete. Wild animals are important hosts for the ticks. Small mammals such as the white-footed mouse and eastern chipmunk are important hosts for larvae and nymphs, while larger mammals like deer are important hosts for adult ticks. Ticks of all life stages can be found on both large and small mammals. Ticks in the nymphal stage are responsible for transmitting the vast majority of Lyme disease cases largely because they are small and difficult to see.

The symptoms of Lyme disease include joint inflammation, flu-like symptoms, achiness and fever. The site of the tick bite may have a telltale circular rash. Because Lyme disease is caused by bacteria it can be treated with antibiotics. There are some cases that do not respond to antibiotics although this is poorly understood and somewhat controversial. There are advocacy groups that exist to support patients with long-term and difficult to extinguish symptoms.

Lyme disease remains one of the most important environmental issues in Dutchess County. A Community Health Survey done by the Dutchess County Integrated County Assessment Workgroup in March 2009 revealed that Lyme disease (and other insect-related diseases) was the only one of five health issues that a majority of respondents considered a serious health issue in their community. Data about Lyme disease reveal its importance and some of what we understand about the disease:

- 20% of cases in US occur in New York (total 1999-2008)

[33] Section written by Victoria Kelly, Dutchess County EMC.

- Dutchess County has the greatest number of cases in the state (2005-2007), but the incidence of Lyme disease per capita is highest in Columbia County with Dutchess in 2nd place
- Dutchess County is within the region of the US where Lyme disease is most prevalent (northeastern US) see map
- There is a greater rate of increase in US than in NY between 1999 and 2008 (see graphs)

Research done in Dutchess County and elsewhere on Lyme disease has provided us with a better understanding of it now than in 1975 when it was first described. Unfortunately, no silver bullet has been identified as the ultimate means of controlling the disease, and it remains a critical environmental health concern. Continued research is necessary in order to develop control measures to reduce the incidence of the disease. It is important to recognize that it is unlikely that we will ever be able to eradicate Lyme disease from Dutchess County.

A confluence of factors has to be in place to have a prevalence of Lyme disease and Dutchess County happens to lie where those factors come together very well: 1) One has to be within the distribution area of the black-legged tick (*Ixodes scapularis*); 2) One has to be within the distribution area for host species of the tick (all stages); 3) At least one of the host species must transmit, that is, be a reservoir for the bacteria that causes Lyme disease (*Borrelia burgdorferi*); and 4) One has to have the appropriate habitat for the ticks as well as the reservoir species; most commonly those habitats are woodlands and brushy areas. A good understanding of what controls the local distribution and abundance of these organisms is necessary to understand the disease and research is bringing us closer to that understanding.

Ecological food web dynamics are extremely important as determinants of Lyme disease risk from year to year. In Dutchess County, oaks are common trees in our forests. Mast years of acorn production in which large numbers of acorns are produced, result in an abundance of hosts for ticks, including hosts that transmit the disease well. Acorn masts result in increased Lyme disease risk 2 years later. Knowledge of acorn production and food web dynamics can be used to develop preventative measures and to alert the public of a potential increase in Lyme disease risk from year to year.

Several conditions can enhance the presence of the ticks and their host species. Fragmented forests can increase suitable habitat for the tick's host species. This includes fragmentation of forests to fields as well as to urban/suburban development. Fragmentation provides for the host animals escape from predators in woodland lots while also providing ready access to fields and plantings for forage. Fragmentation also reduces the prevalence of predators. Many predators require large tracts of contiguous forest for survival. Lastly, forest fragmentation reduces the diversity of host species. The prevalence of Lyme disease is greater when diversity of hosts is low. This is sometimes called "the dilution effect". Increased diversity of hosts for ticks dilutes the presence of the Lyme disease bacteria because some hosts are poor vectors of the disease and/or poor hosts for ticks. With the assistance of Dr. William Schlesinger and Dr. Michael Klemens of the Cary Institute of Ecosystem Studies, Dutchess County Planning & Development delineated "contiguous biodiversity blocks." These blocks are areas where a rich diversity of flora and fauna are more likely to occur. This information may be useful to communities interested in minimizing fragmentation that can occur during the land development process.

Observed increases in the number of Lyme disease cases may be attributed to increased awareness among medical professionals, thus more diagnoses, as well as an increase in vector contamination. The number of Lyme disease cases in US is increasing at a faster rate than in New York. Reasons for this may include a greater awareness by the public in New York resulting in avoidance of forests and fields as well as proper attire, tick

checks and use of chemical repellants. Additionally saturation of the vectors may be occurring, which will result in plateau of the disease incidence.

Currently, the best defense against Lyme disease is diligence on the part of the public as well has health care professionals. Protection and avoidance of the ticks and awareness of the symptoms of the illness and early treatment if they arise are critical. Continued education by public officials will go a long way toward protecting people from this serious disease.

Lyme disease is not the only illness transmitted by ticks. Ticks carry other organisms that cause illnesses, including Anaplasmosis, Babesiosis and others. We know less about the ecology of these illnesses than Lyme disease and continued research is important to develop control measures for these illnesses. It is also important to continue research on the other vector-borne illnesses such as West Nile Encephalitis and diseases carried by other tick and insect species.

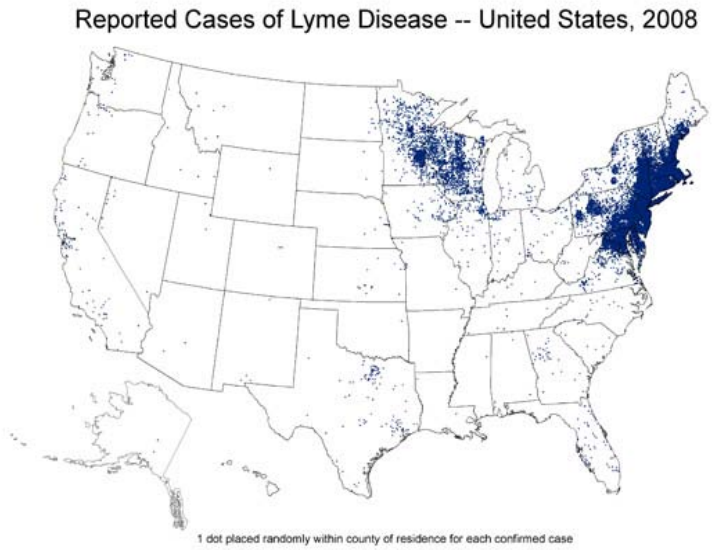

Figure 7. Lyme Disease Occurrence in the United States, 2008.[34]

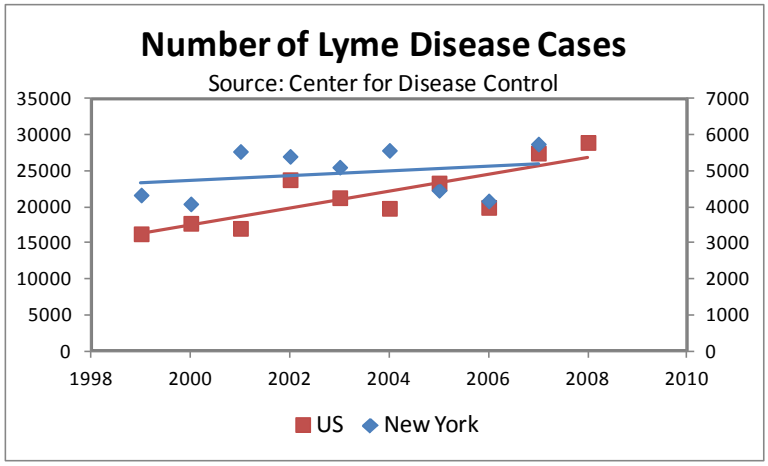

Figure 8. Rise in Lyme Disease Cases from 1998 to 2010 (CDC).

[34] Source: http://www.cdc.gov/ncidod/dvbid/lyme/ld_statistics.htm.

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